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UTILIZING GOOGLE EARTH FOR ENVIRONMENTAL PLANNING: EXTRACTION OF POINT SOURCE LOCATIONS AT THE UPSTREAM OF SUNGAI SKUDAI CATCHMENT, JOHOR MALAYSIA

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Abstract

This study explores the application of geospatial technologies, specifically focusing on Google Earth (GE), to extract and mapping point source pollution in the upstream of Sungai Skudai Catchment (SRC). A thorough analysis of the locations of restaurants, laundrettes, car washes, and workshops was made practical by the combination of Geographic Information Systems (GIS) tools with satellite images, which offers important data for environmental planning and water quality management. The research area, located in Johor, Malaysia, offers an example of the difficulties driven by rapid urban growth. This study provides comprehensive directions for extracting point sources, with a focus on verifying data via field surveys and Google searches. The upstream region was found to have 373 restaurants, 62 laundrettes, 73 car washes, and 80 workshops. The dataset was further improved by the validation process, which determined any inconsistencies and added additional data. This study highlights the importance of field verification for improving point source pollution data accuracy. It also provides a base for comprehensive strategies for pollution management, land-use planning, and preservation efforts in rapidly changing environments, such as the Sungai Skudai Catchment.

Keywords: Point source, pollution, GIS, environmental, water, Google Earth

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INTRODUCTION

The use of advanced geospatial technology has become significant in modern environmental planning to improve the precision and effectiveness of data collection procedures. Accurate mapping, strategic decision-making, and monitoring in environmental planning depend on geospatial technologies. When contaminants are released into the environment from distinct, localized sources—often identified by precise geographic coordinates—it is referred to as point source pollution (Braden & Shortle, 2013). GIS offer a solid foundation for spatial analysis and visualization, making them important for managing and mitigating point source pollution. A comprehensive knowledge of the spatial relationships between pollution sources and their surrounding environments is made possible by the integration of many datasets, including the patterns of land use, pollution source locations, and environmental characteristics (Bateman et al., 2002; Choi et al., 2020). This is often achieved through GIS and plays an important role in effectively managing water pollution.

Google Earth (GE) was first released in 2005 by Google and currently stands as a versatile tool that provides access to high-resolution satellite imagery with an intuitive interface. It has become one of the most popular and successful virtual globe technologies that can be used to effectively analyze environmental issues (Zhao et al., 2021). GE's capability to gather and process extensive quantities of satellite imagery and geospatial data has facilitated the examination of changes in land cover and environmental management, the monitoring of ecological health, disasters, diseases, and food security, alongside the evaluation of climate change's effects on natural resources and human communities (Hoang Tu et al., 2023).

This article explores the utilization of GE in the field of environmental planning, specifically concentrating on the Sungai Skudai Catchment area. GE's capability to identify the exact locations of point sources offers a unique chance to gather accurate data that is important for making accurate choices in environmental management. Given the increasing urbanization and industrial activity in the Sungai Skudai basin, it becomes essential to identify the specific sources of pollution to ensure the sustainable development and preservation of this important ecosystem. The Sungai Skudai Catchment located in Johor, Malaysia shows the complex difficulties encountered by areas undergoing rapid urban growth. Both researchers and planners can utilize GE to collect a vast amount of spatial data for discovering and defining specific sources that contribute to environmental degradation. Additionally, this article aims to clarify the techniques used to extract point source locations from Google Earth, highlighting the importance of such data in developing effective environmental planning strategies. The combination of technology and environmental science in this particular situation offers a potential for promoting a comprehensive

approach to land-use planning, pollution control, and conservation activities within the continually evolving landscape of the Sungai Skudai Catchment.

The following sections of the paper provide with details explanation of the step-by-step techniques used in point source extraction. Additionally, the significance of data validation being discussed, and examples presented to shows the effective use of this methodology in environmental planning activities. The point source pollution extracted includes pollutants from restaurants, laundrettes, car wash service centres, and workshops. Wastewater from restaurants, which comes from activities such as cooking, dishwashing, and housekeeping, usually consists oil and grease (O&G), suspended solids (SS), and detergents (Yau et al., 2021). The presence of detergent-derived chemicals and various contaminants in laundry wastewater presents difficulties in wastewater treatment, which might potentially reduce plant efficiency and microbiological activity, ultimately leading to water pollution. The presence of detergent-derived surfactants and various contaminants in laundry wastewater creates difficulties in treating the wastewater. This might potentially reduce the effectiveness of wastewater treatment plants and prevent microbial activity, ultimately leading to water pollution (Kah et al., 2021). Also, the waste from the car wash produced petroleum hydrocarbons, heavy metals, phosphorus, nitrogen, ammonia, total suspended solids (TSS), and surfactants from car wash soap may cause water pollution issues (Hu et al., 2022).

Furthermore, the exploration of challenges and proposed solutions, alongside the integration of extracted data into Geographic Information Systems (GIS) database, will underscore the comprehensive nature of utilizing Google Earth for point source location extraction. GIS databases store spatial data, including the location of affected areas. This may also optimize the use of spatial data in a specific area, enabling research to inform decision-making and facilitate more precise actions (Ariffin et al., 2023). This studies investigation aims to contribute to the discourse surrounding innovative methodologies in environmental planning and pave the way for informed and effective strategies in mitigating the impact of anthropogenic activities within the Sungai Skudai catchment and beyond. These studies focusing on the capability of GE as tools to locate the point source pollution (restaurant, launderette mart, car wash, and workshop) and how accurate it provides the information.

STUDY AREA

SUNGAI SKUDAI CATCHMENT (UPSTREAM)

This study used ArcGIS 10.8 for analysis, geodatabase, data conversion, and point source pollution mapping. In the first step, the catchment of Sungai Skudai's upstream was generated from the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM). Such step was important to identify the

boundary of this study. SRTM DEM, obtained through radar-based remote sensing with a resolution of 90 m, is a freely accessible topographic dataset and is widely utilized across diverse fields, such as geology, water resources, glaciology, natural hazards assessment, and vegetation survey (Bello & Haniffah Mohd, 2021).

SRC covers an area of approximately 293.3 km² with the main river stretching for 46 km in length. However, this study concerns the quality of water at the Sultan Ismail Water Treatment Plant (SIWTP). Conversely, the study area was confined to the area upstream of SIWTP, which was approximately 136 km² or 46% of the whole SRC. The river flows south-east across several urban areas, including Kulai, Saleng, Skudai, and Tampoi, and ends in the Straits of Johor. The basin is generally undulating with the steepest slope between 25 to 40 degrees covering only a small part in the west of the Sungai Senai sub-basin. Figure 1 shows a map of SRC's upstream and SIWTP's location. It is projected that urban areas will occupy 80% of the catchment area in the future, encompassing approximately 62% of residential areas, 27% of commercial areas, 2.6% of industrial areas, and 8.4% of roads and utilities (IRDA, 2011). River pollution in Peninsular Malaysia is exacerbated by the uncontrolled release of waste into rivers, especially in developing and industrial areas (Mohd Zin et al., 2024).

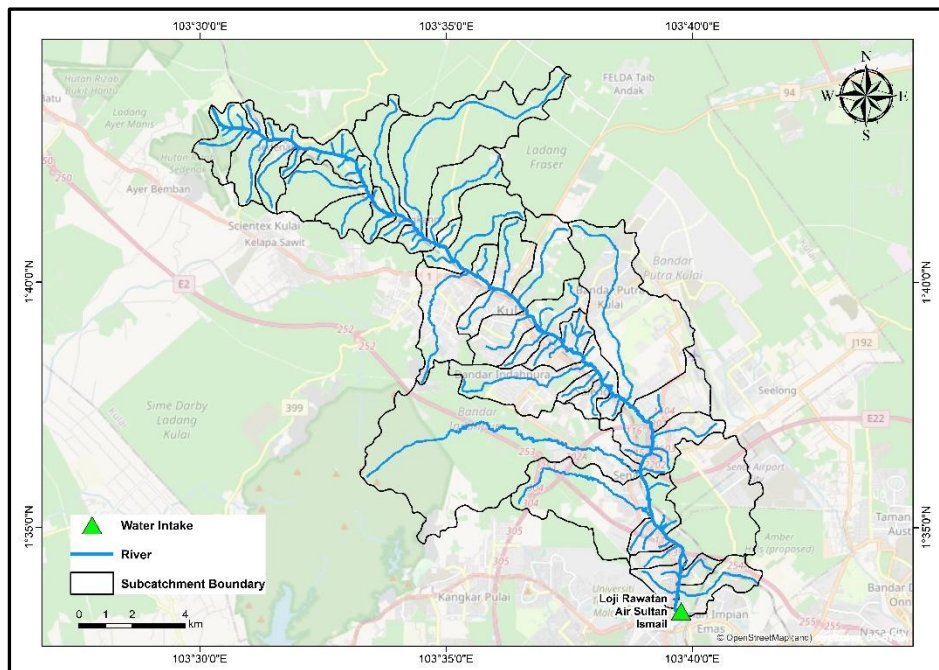


Figure 1: Map for Sungai Skudai Upstream Catchment

RESEARCH METHODOLOGY

This study used ArcGIS 10.8 for analysis, geodatabase, data conversion, and point source pollution mapping. In the first step, the catchment of Sungai Skudai's upstream was generated from the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM). Such step was important to identify the boundary of this study. SRTM DEM, obtained through radar-based remote sensing with a resolution of 90 m, is a freely accessible topographic dataset and is widely utilized across diverse fields, such as geology, water resources, glaciology, natural hazards assessment, and vegetation survey (Zhang et al., 2015). Since this study focused only on the upstream of SRC, the outlet was determined as the location of water intake at SIWTP. Meanwhile, the Watershed tools in ArcGIS 10.8 was used to create the catchment boundary for Sungai Skudai's upstream for catchment delineation purposes. Figure 2 shows the process flow to extract the point source pollution.

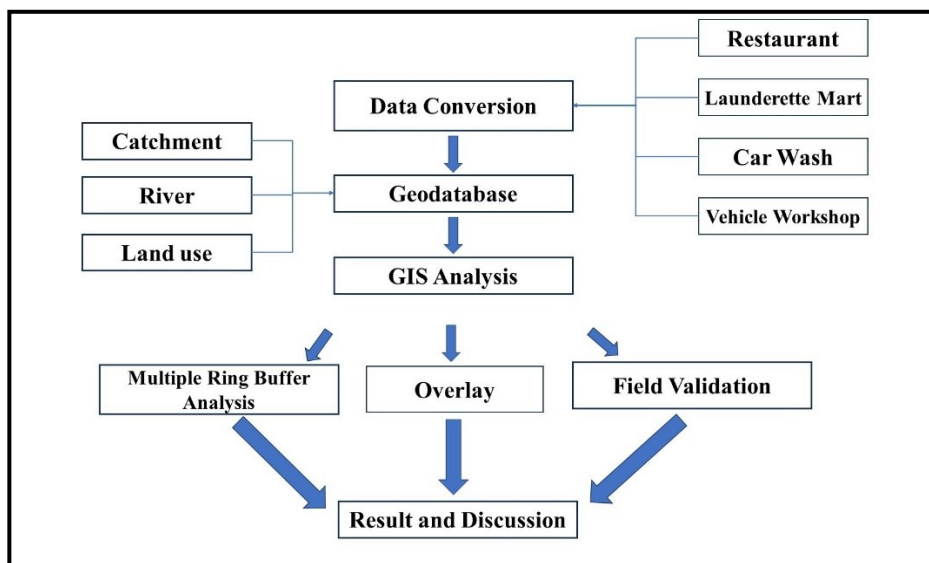


Figure 2: Flow chart for methodology of the study

The next step was to extract the point source pollution (restaurants, launderettes, car washes, and workshops). It began by searching for pollution sources using keywords like 'Restaurant near Skudai and Pulai' in the GE search engines. The results provided the location of all restaurants located near or inside the study area. The next step was to export and save these locations in the Key Markup Language (KML) format. The data was later converted into the shapefile format and overlaid with the Sungai Skudai catchment data. Overlay tools were then used to select restaurant locations that were located inside the study area.

The attribute table for each data was also checked to update the coordinates and names of the restaurants. Similar step was repeated for other types of pollution sources, namely car washes, workshops, and launderettes. All data was checked and updated to eliminate any redundancy.

Finally, the data was checked and validated through two different processes. The first process involved utilizing the Google search engine to obtain information regarding the restaurants, launderettes, car washes, and workshops. Such process was crucial to determine whether these establishments existed, remained in business, and were still situated at the exact locations based on the Google images, reviews, and input from users. This process was also useful to determine other point sources of pollution that could have been overlooked during the previous step. Meanwhile, the second process involved validating 30 samples on the ground, consisting of 15 restaurants, five car washes, five launderettes, and five workshops.

RESULT AND DISCUSSION

This section discusses the results extract from the four types of point source pollution, namely restaurants, launderettes, car washes, and workshops. A total of 776 restaurants were identified by GE along the upstream of SRC, encompassing of food courts, fast food restaurants, and restaurants located inside hypermarkets and petrol stations. A database checking was done to remove any duplications and overlays within the SRC boundary, resulting in 373 restaurants after further validation from the field survey and Google search. Figure 3 shows the presence of restaurants within the study area, particularly focusing on locations where these establishments could potentially impact water quality. The data highlighted the number of restaurants in each designated area, shedding light on areas of concern and the need for environmental management strategies. Most of the restaurants are located in the middle of the upstream catchment location where there is a residential and commercial area. Given its relatively high restaurant density, it is crucial to ensure that proper wastewater management practices are in place to prevent any adverse effects on local water sources. The discharge of highly concentrated restaurant oily wastewater from restaurants and food processing enterprises into the aquatic environment typically leads to environmental contamination and hampers the activity of microorganisms in biological wastewater treatment systems (Gao et al., 2019).

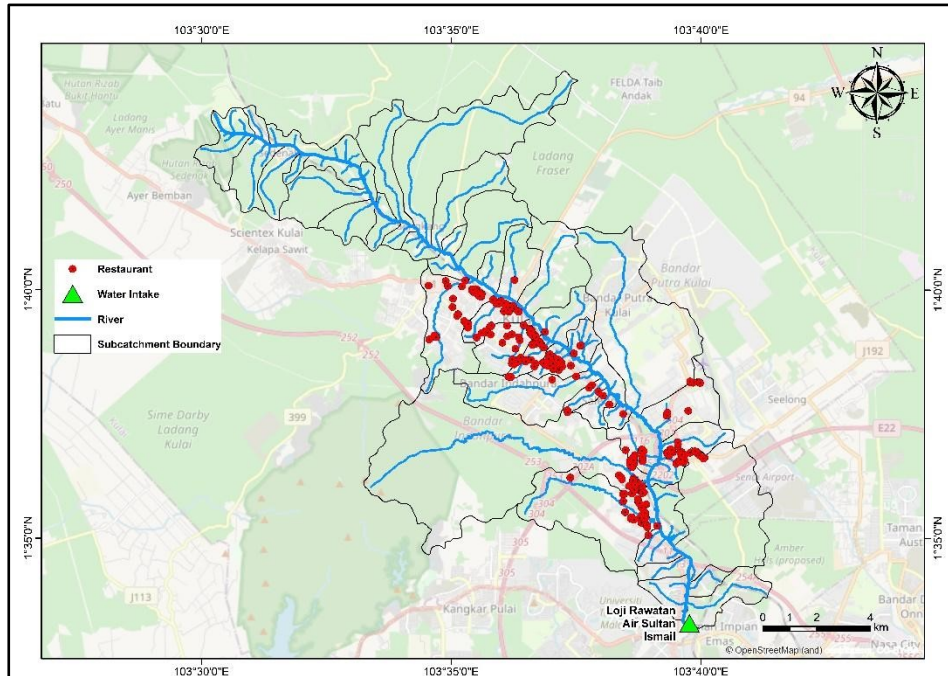


Figure 3: Restaurant location map

Meanwhile, 112 launderettes were found along the upstream of SRC; however, only 62 launderettes existed within the study area. Figure 4 shows the presence of launderettes across various locations in the study area and their potential impact on water quality. Given the high number of launderettes in this area, it is crucial to monitor and regulate their effluent disposal practices to prevent potential pollution. While these businesses play an important role in providing laundry services to the community, their effluent management practices must be closely monitored to prevent negative effects on water quality. The substantial discharge of laundry wastewater has significantly overwhelmed the city's sewage treatment system and caused severe contamination of the surface water (Liu et al., 2014).

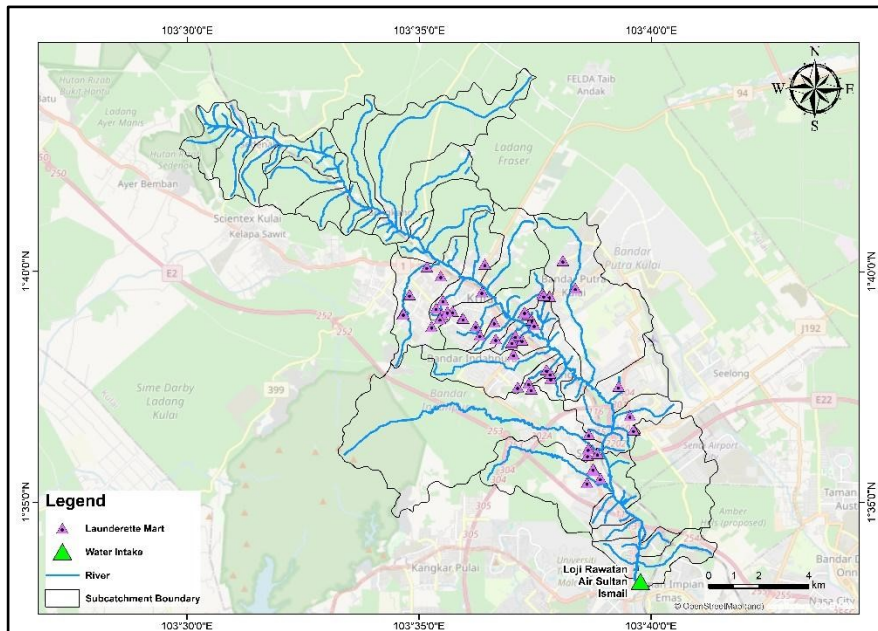


Figure 4: Launderette mart location inside upstream of Sungai Skudai Catchment

The GE imagery also denoted a total of 155 car washes along the upstream of SRC. Subsequent field validation and careful scrutiny revealed 73 car washes within the study area after the removal of duplications. This meticulous process of data verification and elimination of redundancies ensures a more precise understanding of the spatial distribution and density of car wash facilities in the upstream region. The refined dataset serves as a valuable foundation for further analyses related to environmental impact assessments, land-use planning, and water quality management initiatives within the Sungai Skudai Catchment. While the car wash industry is vital for post-sales service in the automobile sector, it consumes substantial water and transforms it into heavily polluted runoff that is often untreatedly discharged into drain or river (Monney et al., 2019). Figure 5 depicts the presence of car washes at various locations within the study area and the potential impact of these facilities on water quality.

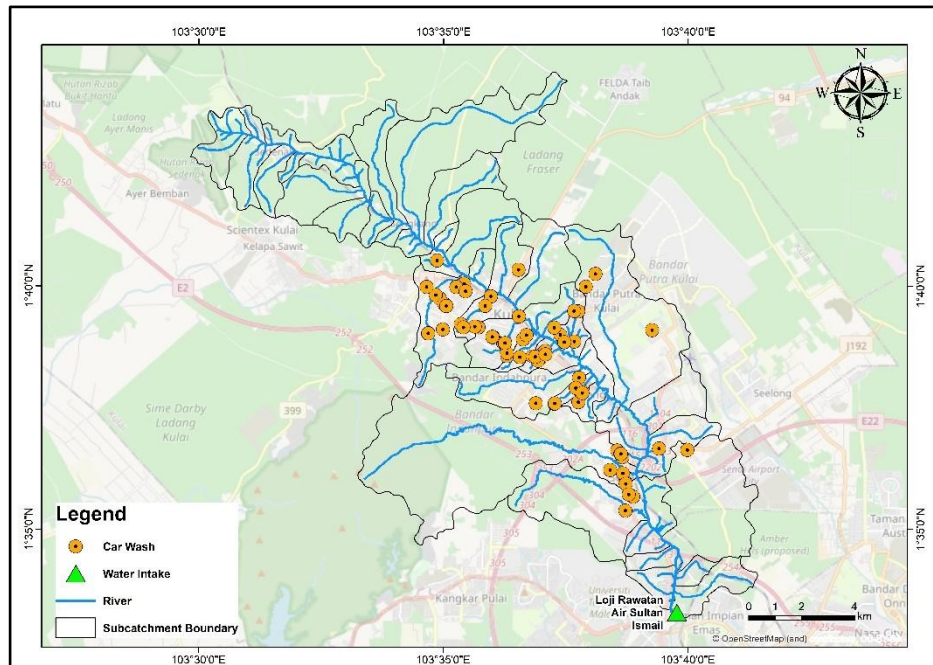


Figure 5: Car wash location map

A comprehensive survey of vehicle workshops was also undertaken via GE imagery and found 167 of such establishments along the upstream of SRC. Rigorous validation procedures, encompassing both remote verification and on-site field inspections, were implemented to ensure data accuracy and the removal of duplicate entries. A final count of 80 vehicle workshops were identified within the study area. This meticulous approach to data refinement provides a reliable foundation for subsequent analyses, including environmental assessments, land-use planning, and considerations of potential impacts on water quality and the broader ecosystem within the Sungai Skudai Catchment. Workshops can have a significant impact on water quality in nearby rivers and water bodies if their waste and pollutants are not properly managed. Past studies reported that improper management of workshop wastes like engine oil and lubricants can cause water pollution in nearby rivers as these substances are difficult to decompose, significantly reducing water quality and hindering self-purification processes (Fikri et al., 2020). Figure 6 displays the various locations of workshops in the study area and their potential impact on water quality.

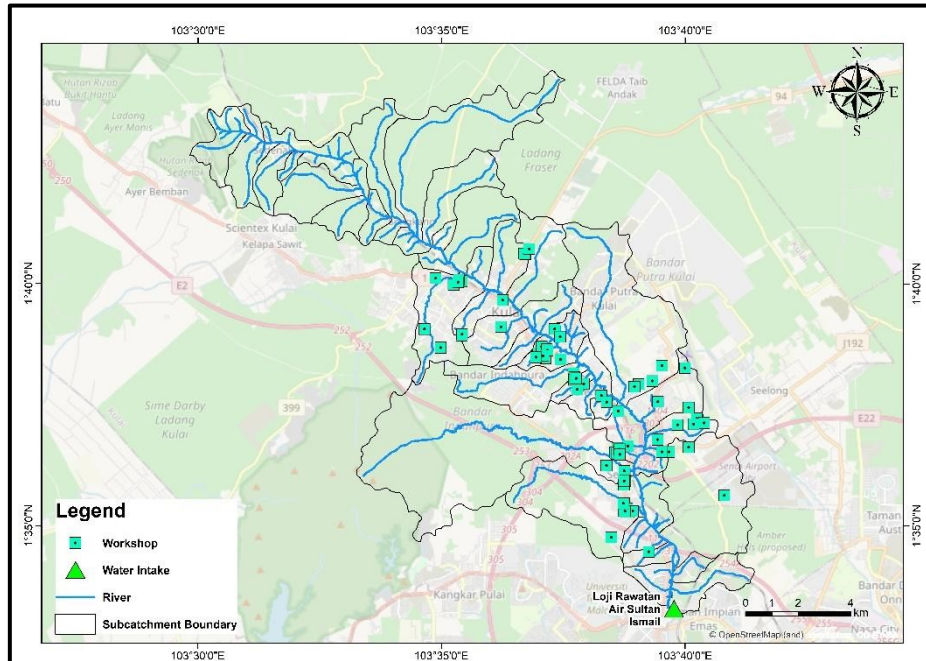


Figure 6: Vehicle location map

During the validation phase of the field survey, 30 selected points (15 restaurants, five launderette marts, five car washes, and 5 workshops) within the study area in SRC underwent rigorous assessment. Several discrepancies between GE data and field-validated information were identified, yielding a total of 6 errors. Specifically, three errors were associated with restaurants, one error with car wash, and two errors with workshops. Notably, field validation revealed new data, including two additional restaurants and one launderette, thereby enriching the dataset. These findings underscore the importance of on-the-ground verification in enhancing the accuracy and reliability of point source pollution data, ultimately contributing to a more comprehensive understanding of the environmental landscape in the upstream of the Sungai Skudai Catchment. Table 1 shows the results from the validation process via Google search and field survey.

Table 1: Validation result

Type of point source pollution	Error		New added from field survey
	Google search	Field validation	
Restaurant	3	0	2
Launderette mart	0	1	1
Car wash	1	1	0
Workshop	2	0	0
Total	6	2	3

CONCLUSION

In conclusion, this study demonstrates the crucial role of advanced geospatial technologies, particularly GE, in extracting and analyzing point source pollution in the upstream of Sungai Skudai Catchment. The integration of GIS tools and satellite imagery allows for a detailed examination of restaurant, launderette, car wash, and workshop locations, thus providing valuable insights for environmental planning and water quality management. The field survey validation process proved to be pivotal in enhancing the accuracy of the extracted data, revealing discrepancies and introducing new information. The spatial distribution maps of point source pollution highlight areas of concern, emphasizing the need for targeted environmental management strategies. With its diverse land uses and increasing urbanization, the Sungai Skudai Catchment, faces environmental challenges that demand for informed decision-making. Moreover, the utilization of GE to extract pollution sources can reduce the cost of collecting data on the ground while serving as a time-effective tool for collecting the pollution source location. Google Earth breaks from traditional GIS by freely sharing vast geospatial data, fostering the "democratization of GIS", and acting as a crowd-sourcing platform for volunteered geographic information from citizens (Liang et al., 2018).

This study contributes to the discourse surrounding innovative methodologies in environmental planning and underscores the importance of accurate, validated data in devising effective strategies for mitigating the impact of anthropogenic activities. By bridging technology and on-the-ground validation, this research sets a foundation for holistic approaches to land-use planning, pollution control, and conservation efforts in dynamic landscapes, such as the Sungai Skudai Catchment. Future research can further explore the collection of additional sources of pollution, including industrial zones or illicit factories, via GE.

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SHORT-TERM RESIDENTIAL ACCOMMODATION IN STRATA PREMISES: A LEGAL AND TECHNICAL PERSPECTIVE

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Abstract

The perception of life changes towards quality living also plays a role in the demand for strata property, namely to live in a modern lifestyle by owning not just a house but a home with extensive housing conveniences and services such as security, privacy, covered parking space, gymnasium, swimming pool, landscaped garden and etc. In respect of short-term residential accommodation demand in strata units high rise buildings, notably, it is the current trend that the growth of high-rise buildings has dominated the real estate market. As a result, it produced rapid development in high-rise residential scheme. However, many residents are concern about privacy of the premise when the premise is overcrowded with STRA guests. The residents are concern that their privilege as residents will be affected with the presence of many STRA guests using the facilities in the apartments, which sometimes lead to nuisance in the premise. i.e. issues of parking, noise pollution and traffic congestion. In order to determine the legality of short-term residential accommodation in strata properties in Malaysia, comparative study with the position in New South Wales is made.

Keywords: short-term residential accommodation, strata properties, by-laws, joint management, body corporate

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INTRODUCTION

The use of 'strata' as a legal term was introduced in Malaysia with the Strata Title Act 1985. It sets out the definition of strata property as a single property within a larger integrated development that shares common facilities. Basically, that is a condo in a larger complex, an apartment in a big development, and even some landed properties where the land is part of a shared development with communal infrastructure. It means that the property itself forms an individual unit within a larger parcel of land that boasts shared areas. In Malaysia, strata properties is now popular with the emerging concept of home sharing where short-term residential accommodation (STRA) is offered to guests. Hence, this article explores the legal perspective on the operation of STRA in strata properties due to the objections raised by other residents in the strata properties. A comparative study with the current legal position of New South Wales (NSW) is made due to its recent advancement in the development of STRA.

LITERATURE REVIEW

The Edge Court Judgments Report on 24 July 2020 reported that the court in the case of *Verve Suites Mont' Kiara Management Corporation v Innab Salil* (Guaman No. WA-22NCVC-461-09/2017) confirmed the fact that the resolution (House Rule 3) at an Extraordinary General Meeting (EGM) where majority of residents' resolution to prohibit the use of residential units in the strata building as short-term accommodation is binding. In this case, the court overruled the judgement of the Strata Title Tribunal which confirmed the non-validity of the prohibition of the short-term accommodation on the grounds that it violated section 70(5) of the SMA 2013 as it restricts the individual proprietor's rights. In a judgment of a court reported case by the Guardian on the October 2016, the court ruled that temporary occupation of an entire property by an Airbnb guest is not consistent with the definition of the property as "a private residence". Foreign writings are also confined to newspaper reports. The New York Times on 18 July 2018 reported that in New York, hosts of the short-term accommodation are required to inform the Office of Special Enforcement every month, whether the rent is for room only or house. In Japan-Guide.com, it is reported that in Japan, under the new legislation, which came into effect on 15 June 2018, anyone wanting to list their property on Airbnb will need to register their accommodation with the local government, who will conduct fire and safety checks. The new regulations will also limit rentals to 180 days per year - with fines of up to ¥1 million (£6,821) for anyone who breaches the rules. In Sweden, it was reported in The Local, on the 8 February 2016 that under the new law, all hosts' income from rentals mediated by an intermediary similar to Airbnb is deemed taxable revenue when amount exceed SEK 50,000 and some of sexual crime occur in listed places.

On 25 October 2023, the Malay Mail reported that Airbnb has recommended that STRA be allowed by default in all strata buildings under the national STRA guidelines. The STRA platform suggested that residents in stratified buildings should be able to collectively decide with a 75 per cent vote via their joint management body (JMB) or management corporation on any conditions or permissions regarding the STRA. The guidelines on STRA in strata buildings is yet to be introduced in Malaysia and the Malay Mail reported that if approved, these guidelines are set to be the first of its kind in South-east Asia, demonstrating Malaysia's dynamism in embracing technology and innovation in tourism. Despite the above literature, there is lack of comprehensive coverage on the legal aspects of STRA and this led to the need for a comprehensive discussion governing the operation of STRA in strata properties in Malaysia, which covers the legality of the business and the way forward (Talha & Leong, 2006).

RESEARCH METHODOLOGY

The article examines the Malaysian Strata Management Act 2013 (Act 757) and makes a comparative study with the current legal position of the New South Wales (NSW) Strata Schemes Management Act 2015 and the NSW STRA Code of Conduct. The leading case in both jurisdictions concerning STRA i.e. the Malaysian case, *Innab Salil & Ors v Verve Suites Mont Kiara Management Corp* [2020] 12 MLJ 16 (Federal Court) and NSW case, *Estens v Owners Corporation SP 11825* [2017] NSWCATCD 52 are analysed. The stand taken by the Malaysian Strata Title Tribunal and NSW Civil and Administrative Tribunal pertaining to the permissibility of STRA operation in strata properties in both countries are compared.

ANALYSIS AND DISCUSSION

Management of Strata Properties

To regulate the upkeep and administration of stratified residential projects, including condominiums, apartments, townhouses, and landed properties in a shared development, Malaysia passed the Act 757 in 2013. In order to guarantee appropriate, effective, and continuous administration of these properties, this legislation seeks to combine the rights and obligations of inhabitants, landowners, and developers. To put it simply, that means enacting laws to make sure everyone does their part to preserve a better place to live (Thean Siew, 2006).

Under the Act 757, management bodies called the Joint Management Body (JMB) or Management Corporation (MC) are in charge of managing buildings.

These organizations, which are mandated by Act 757, are meant to give a centralized entity with the authority and responsibility to plan, direct, and supervise site management. The developer and the people who buy building parcels make up the JMB. The JMC is a committee that consists of three or more

members and oversees managing daily operations and making necessary repairs for progress. The moment the developer successfully completes the building's subdivision and issues individual owners with the appropriate strata titles, the MC is created.

The JMB or MC is responsible for among others:

- (a) Maintain and manage common shared areas
- (b) Determine, bill, and enforce collection of management fees
- (c) Ensure the property is appropriately insured and protected
- (d) Comply with building regulations and notices enforced by local authorities
- (e) Maintain an appropriate register of all owners
- (f) Ensure financial transparency of maintenance accounts
- (g) Enforce relevant by-laws or rules

Restriction of Dealings

Section 150 of the Act 757 states that under the Act, section 70 (5), no additional by-law shall be capable of operating—

- a) to prohibit or restrict the transfer, lease or charge of, or any other dealing with any parcel of a subdivided building or land; and
- b) to destroy or modify any easement expressly or impliedly created by or under the Strata Titles Act 1985.

“by-laws” means the by-laws which are in operation in respect of the building or land intended for subdivision into parcels or the subdivided building or land, and the common property as—

- a) prescribed by the regulations made under section 150 for regulating the control, management, administration, use and enjoyment of the building or land intended for subdivision into parcels or the subdivided building or land, and the common property; or
- b) provided for in any additional by-laws made under section 32, 70 or 71;

Under section 32(3) of the Act 757, a JMB may, by a special resolution, make additional by-laws or make amendments to such additional by-laws, not inconsistent with the by-laws prescribed by regulations made under section 150, for regulating the control, management, administration, use and enjoyment of the building or land intended for subdivision into parcels and the common property, including all or any of the following matters:

- a) safety and security measures,

- b) details of any common property of which the use is restricted;
- c) the keeping of pets;
- d) parking;
- e) floor coverings;
- f) refuse control;
- g) behaviour;
- h) architectural and landscaping guidelines to be observed by all parcel owners; and
- i) imposition of a fine not exceeding two hundred ringgits against any parcel owner, occupant or invitee who is in breach of any of the by-laws.

Similarly in New South Wales (NSW), Section 139 of the Strata Schemes Management Act 2015 provides that by-laws cannot be unjust or 'harsh, unconscionable or oppressive'. Further section 150 provides that any such by-law may be invalidated by the NSW Civil and Administrative Tribunal. Section 2 defines by-laws as the by-laws in force for a strata scheme.

Hence, it appears that under the Act 757 and the New South Wales Strata Schemes Management Act 2015, the Joint Management (Malaysia) or body corporate (New South Wales) must be mindful of the provisions above in deciding on the rules of dealings in the strata building.

In Malaysia, debates on the permissibility of strata buildings used for STRA are raised in the case of *Innab Salil & Ors v Verve Suites Mont Kiara Management Corp* [2020] 12 MLJ 16 (Federal Court). The plaintiff in this case is a Management Corporation (MC), which oversees managing and maintaining the "Verve Suites" residential development in Kuala Lumpur. The first defendant owns and controls a firm (the second defendant) that was incorporated in Malaysia. The first defendant also rents a unit at the Verve Suites. The business is handled by the corporation and runs a short-term rental operation in Verve Suites. The business leased out the units at the Verve Suites for both short- and long-term rentals after renting multiple units from parcel owners.

The MC has notified the residents about the implementation of by-law Rule 3 which provides:

“The unit shall be used only for the purpose of service suites and shall not be used for business or any other purpose (Illegal or otherwise) which may be detrimental to the credibility of Verve Suites Mont Kiara. “

It is not permitted to use any apartment for short-term rentals. Unless demonstrated differently, a short-term rental agreement will be assumed for the purposes of these rules if the following conditions are met:

- (i) Any stay for which a booking was made through services/applications/websites etc such as Airbnb, booking.com, agoda.com, klsuites.com and other similar services;
- (ii) Any stay for which a signed and stamped tenancy agreement has not been filed with the management and tenants registered and issued with access cards;
- (iii) Any unit rented out with a tenancy agreement that permits the tenant from subleasing the property.

Any breach of the above shall attract a penalty of RM 200 for each day the infringement continues.

The Management reserves the rights to deactivate the access cards and barred the unit from facilities booking.”

The motion approved by most parcel owners at the Extraordinary General Meeting is what puts the rule into effect. The plaintiff then fined parcel owners who disregarded the restriction RM 200 per day.

The Defendants, dissatisfied with the ruling, brought the matter before the Strata Management Tribunal on the grounds that the ruling is in violation of section 70(5) of the Act 757.

In the suit between *Innab Salil v. the Verve Suites Mont' Kiara Management* in the Malaysian Strata Title Tribunal, Innab Salil (the owner of a strata lot) in Verve Suites Mont' Kiara sought against the decision of the resolution (House Rule 3) at an Extraordinary General Meeting (EGM) where the majority of residents' resolution to prohibit the use of residential units in the strata building as short-term accommodation. The tribunal ruled that the prohibition of the STRAs on the strata property for the purpose of STRA is void on the grounds that it violated section 70(5) of the Act 757 as it limits the individual proprietor's rights. It means that the tribunal ruled that the STRA owner is entitled to enjoy his proprietary rights over his unit as accorded to other residents.

However, the Court of Appeal in the Malaysian case of *Verve Suites Mont' Kiara Management Corporation v Innab Salil* [2020] 6 MLRA 244 confirmed the fact that the resolution (House Rule 3) at an Extraordinary General Meeting (EGM) where majority of residents' resolution to prohibit the use of residential units in the strata building as short-term accommodation is binding. In this case, the High Court overruled the judgement of the Strata Title Tribunal which confirmed the prohibition of the STRAs on the grounds that it violated section 70(5) of the Act 757 as it limits the individual proprietor's rights. It means that the STRA owner is not entitled to enjoy his proprietary rights over his unit in the providing STRA services.

Like Malaysia, the NSW Civil and Administrative Tribunal has the authority to deem a bylaw illegal if it determines that the Owners Corporation lacked the authority to create the bylaw or if the bylaw is oppressive, harsh, or morally repugnant.

Unlike Malaysia, the NSW body corporates of strata property now find it far more difficult to prevent apartment owners from listing their properties for short-term rentals on Airbnb due to a recent historic court decision, *Estens v Owners Corporation* SP 11825 [2017] NSWCATCD 52. The Owners Corporation's bylaws are subordinate to the strata law principle that they cannot "prohibit or restrict" the functioning of an owner's lot, according to the NSW Civil and Administrative Tribunal.

The NSW case involved Peta Estens, a former rower for Australia, who owned an apartment in a five-apartment block in Woollahra, in Sydney. For 12 months she let the apartment out short-term through Airbnb while she was away on holiday. But the body corporate passed a special by-law against short-term letting after one owner complained about strangers using the common laundry and strange men who she felt were watching her sitting on Ms Estens' deck. Ms Estens argued she was very careful in selecting her Airbnb tenants, they had always left the apartment in immaculate condition, and they did not hold loud parties. She argued that the body corporate did not have the power to ban Airbnb. Ms Estens contended that Airbnb letting is a "lease" within the meaning of section 139 of the Act.

The Tribunal found that under section 150 and section 139 of the Strata Schemes Management Act 2015, the body corporate did not have the power to make the by-law. Section 139 says that by-laws cannot be unjust or "harsh, unconscionable or oppressive". The Tribunal found that Airbnb is a lease within the meaning of the Act, and that the Department of Fair Trading and a parliamentary committee examining short-term letting held a similar view. The Tribunal said it was satisfied that "the manner in which the Airbnb tenancy is devolved by the landlord is sufficient to constitute a tenancy or lease".

In NSW, the new Section 137A of the Strata Schemes Management Act 2015 (NSW) was commenced on 10 April 2020. Section 137A states that:

"By-law made by a special resolution of Owners Corporation may prohibit a lot being used for the purposes of a STRA arrangement if the lot is not the principal place of residence of the person who is the owner or occupier of the lot; and

By-law has no force or effect to the extent to which it purports to prevent a lot being used for the purposes of a STRA arrangement if the lot is the principal place of residence of the person who is the owner or occupier of the lot."

As a result of the new provision, by-laws that currently forbid STRA will no longer be enforceable against owners or tenants who occupy their property for more than 180 days out of the year as of April 10, 2020. Accordingly, property owners and occupants who live there for 180 days a year could:

- (a) rent out a spare room in their property on a short-term letting platform while they are present; or
- (b) rent out their entire property whilst on holiday,

and these arrangements could not be prohibited by an Owners Corporation.

Code of Conduct as Control Tool

The creation of the STRA Code of Conduct is seen in New South Wales as a crucial instrument for guaranteeing that STRA is run in a morally just and rational manner. Such a code of conduct helps to protect other residents' rights and guarantee the comfort of visitors throughout their stay. Restrictions can be outlined in such a code of conduct, such as prohibiting behaviour that violates the bylaws that govern the property. For example, according to the Code of Conduct, guests are not permitted to make noise during the occupancy period that could disturb, harm, or unfairly disturb the peace and comfort of their neighbours, use the property in a way that interferes with their ability to use or enjoy the common areas with their neighbours or other tenants in a stratum or community scheme, or purposefully, carelessly, or negligently damage their neighbours' or other occupants' personal property.

Under the Code of Conduct, a person, who would include an Owners Corporation, could lodge a complaint to the Commissioner if a host or guest contravenes the Draft Code. If the Commissioner is satisfied that the Draft Code has been breached, it can take disciplinary action. Such action could include:

- a) the issuing of a “strike notice”. If a guest or host receives two “strike notices”, then they will be included on an exclusion registrar which will be maintained by the Commissioner; or
- b) the issuing of a written direction requiring the host to stop acting in a particular manner. This direction can include a direction applying to common property or association property, e.g. a direction preventing the host from making a common property facility available to his/her guests.

Although this initially appeared to be a course of action that an Owners Corporation could take in the event that they had a problematic host, the NSW Code of Conduct stipulates that the Strata Commissioner may only accept a complaint based on a by-law violation of a community scheme or stratum scheme if the NSW Civil and Administrative Tribunal (NCAT) has already issued orders for a monetary penalty for the by-law violation.

Hence, this is an example of Code of Conduct that can be adopted in strata properties that have STRA operators.

CONCLUSION

Apart from the issue of legality of STRA in strata properties, there is also insurance consequences on strata property owners who use websites in carrying out STRA business, be it the entire house or giving up bedrooms to guests. The contents within the insurance coverage and policies which is meant for standard home may not cover the STRA business and its *modus operandi*. As a result, the STRA business owners will lose the right to make any claim in any incident related to STRAs which are not covered by the insurance policy.

Under the Malaysian Minor Offences Act 1955 (Revised - 1987) (Act 336), section 13, an action can be taken against an occupier of a premise for extreme noise created in the premise. Upon conviction, he shall be liable to a fine not exceeding RM100. Acting on the complaint of a house holder that the noise for any good and sufficient reason is harmful, any police officer not below the rank of Inspector, may enter upon the premises. After warning to stop the noise, the officer may remove the noise in some other appropriate way. However, this law is already outdated, and the punishments imposed were suitable at the time they were drafted decades ago. (The Star, 17 December 2017)

In addition, any police officer may arrest without warrant any person offending in his sight against any of the provisions of this Act, or reasonably suspected of committing any offence against this Act (section 31 of the Act 336) unless such person cooperates and satisfies such officer that he will act and respond accordingly upon any summons or other proceeding that may be taken against him.

Under the common law, if the STRA service led to the uneasy environment which interrupts other residents' quiet enjoyment and general welfare of the residents, the issue that can be raised is whether the interference was unreasonable for it to constitute a nuisance. From a legal perspective, one must not only prove that the purported unreasonable act had to be more than annoying before it is said to be a nuisance. It must also cause damage or impede with someone's enjoyment of their property.

The source or creator who creates the interference, i.e. the owner of the residence, whether, or not he occupies the premise from which the intrusion derives, will be liable for the nuisance. If the owner of the premise let out the premise to a tenant and the tenant sub-let the premise to STRA customers, the owner will be liable even though it is the tenant or sub-tenant who caused the nuisance. As owner of the premise, it is his duty to ensure that the tenant comply with all the bylaws, rules whatsoever.

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ASSESSING CONSERVATION APPROACHES FOR SUSTAINING HERITAGE BUILDINGS: A CASE STUDY OF IPOH OLD TOWN, PERAK, MALAYSIA

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Abstract

The worldwide emphasis on heritage building conservation has become one of the strategies to effectively conserve the values of heritage buildings and preserve their historic significance. Heritage buildings, acknowledged as vital assets for local development, particularly in the realm of tourism and cultural enrichment, require conservation efforts aligned with urban regeneration initiatives. Despite these international efforts, challenges persist in implementing effective conservation strategies, resulting in continuing deterioration. Therefore, a better understanding of the approach needed to conserve heritage building is important for its long-term sustainability. This qualitative study, involving site observation and semi-structured interviews with the Ipoh City Council and caretakers of selected heritage buildings, focuses on Ipoh Old Town as a case study as it is a historical area abundant in heritage and cultural elements. The findings highlight preservation and rehabilitation as prevalent conservation approaches, while restoration poses notable challenges in sustaining heritage buildings in Ipoh Old Town.

Keywords: Conservation approach; heritage building; preservation; rehabilitation

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INTRODUCTION

In the process of regenerating historical areas, the conservation of heritage buildings is a crucial measure to prevent the deterioration of their historical and cultural significance. These heritage buildings serve as tangible representations of local cultural heritage, as manifestations of the lifestyles shaped by communities across generations. Proper management and maintenance of these heritage buildings are imperative; failure to do so could lead to the gradual loss of the nation's historic townscape (Abdul Latip et al., 2018). The term "townscape" refers to a city area that significantly contributes to the city's distinctive characteristics. Cities with a strong sense of place, identity and image often showcase unique aesthetic features within their townscape, fostering a sense of community (Lazim & Said, 2020).

Within the framework of urban regeneration initiatives, it is crucial to consistently prioritise the conservation and preservation of heritage buildings (Hashim, Dali & Alias, 2023; Bedate, Herrero & Sanz, 2004). Conservation, in this context, refers to the safeguarding of the physical aspects associated with the "profession and knowledge of the restoration". It encompasses a set of measures aimed at mitigating erosive elements and enhancing the physical condition of architectural heritage. These measures include direct interventions, such as modifications to the structure and materials, as well as indirect intervention that involve alterations to the surrounding or important elements of heritage buildings (Feilden, 2007). Heritage buildings are essential to conserving, considering their aesthetic, architectural, functional, historical, cultural, ecological, economic and commercial value. Contemporary efforts emphasise conservation approaches to preserve and enhance the architecture, culture, history and sense of community associated with heritage buildings (Li & Tang, 2024).

Despite these efforts, global conservation activities currently face challenges in implementing effective strategies to prevent continuing of building deterioration. According to ICOMOS (2020), approximately 65% of the world's heritage buildings with artistic and cultural significance lack maintenance and are poorly conserved, leading to a continual loss of cultural, artistic and economic value. Some abandoned or commercial heritage buildings in Malaysia remain improperly rehabilitated due to uncontrolled refurbishment and functional changes, compromising their authenticity value. Practitioners face challenges in identifying decay patterns and deciding on suitable conservation approaches for different cases. Therefore, a better understanding of the necessary conservation approaches is important for long-term sustainability. This is in line with the universal call, where countries have pledged to "make cities and human settlements inclusive, safe, resilient and sustainable" under Sustainable Development Goal (SDG) 11. Within this goal, Target 11.4 aims to "strengthen efforts to protect and safeguard the world's cultural and natural heritage" (UNDP,

2023). Assessing the long-term sustainability of development requires a comprehensive understanding of important aspects contributing to heritage building conservation. Awareness of factors contributing to a building's success should be addressed, evaluating the most significant criteria based on users' perceptions. Policy makers, authorities and other stakeholders can use this information to prioritise criteria during conservation, ensuring sustainable development.

In this case study, Ipoh Old Town, a historic town with numerous heritage buildings, provides insights into the effectiveness of conservation approaches. Some of these buildings, despite conservation efforts, remain abandoned or have undergone modifications, risking the loss of their identity and authenticity over time. The feasibility of conservation approaches plays a critical role in preserving the aesthetic value of heritage buildings.

Therefore, this research study focuses on heritage building conservation efforts to sustain these valuable buildings. The objective of this study is to explore conservation approaches aimed at sustaining heritage buildings. Following sustainability standards, conservation efforts represent a commitment to prolonging the life of heritage buildings. Techniques, methods and materials used in rebuilding and reconstructing these valuable structures are crucial considerations within conservation efforts (Harun, 2011). Conservation approaches comprise a range of actions, including restoration, preservation, rehabilitation, adaptive re-use, reconstruction, or any combination thereof. Given the architectural uniqueness of historic buildings, current decisions regarding conservation approaches for heritage buildings are predominantly influenced by historical and cultural factors.

LITERATURE REVIEW

Heritage and Conservation

In general, conservation represents a technical undertaking towards heritage buildings (Munos & Vinas, 2005), entailing an integrated and enlightened awareness of the historic environment. This endeavour is dedicated to the preservation of cultural property for future generations, encompassing long-term maintenance, regeneration and improvement. Conservation involves physical actions directed at safeguarding the fabric and materials of heritage buildings. Guided by conservation principles, the preservation of the original building structure and fabric is prioritised to maintain the national heritage in its natural condition and authentic significance (Harun, 2011). While conservation is an approach aimed at preventing degradation and extending the life of buildings, it is often linked with renovation, despite the apparent simplicity of conservation principles.

Moreover, public participation plays a pivotal role in educating the public about conservation approaches and the significant value of heritage. Involving the public in the conservation of heritage buildings contributes to fostering a deeper understanding and appreciation of shared heritage. This can be achieved by actively engaging the public in learning about the conservation of heritage buildings, thereby promoting informed and active participation. Heritage values are perceived differently across generations and societies (Ying, et al., 2023), making ongoing education instrumental in improving knowledge and understanding of heritage building conservation. Establishing, retaining and transmitting specialist knowledge and skills is essential in the endeavour to preserve heritage buildings for future generations.

Conservation Approach

Conservation represents a developmental initiative or project designed to prolong the lifespan of heritage buildings through various actions influenced by historical and cultural considerations (Harun, 2011). Jabatan Warisan Negara (2023) classifies conservation approaches into nine categories; (i) Preservation; (ii) Prevention; (iii) Consolidation; (iv) Restoration; (v) Rehabilitation; (vi) Reproduction; (vii) Reconstruction; (viii) Adaptive Reuse; and (ix) Maintenance. However, the specific conservation approaches explored in this study align with those indicated in the Ipoh Old Town Special Area Plan 2020, which are:

a) Preservation

Preservation encompasses the works carried out to maintain the building, structure or monument in its original form, and needs to be implemented where necessary in the effort to prevent damage or deterioration in future (JWN, 2023). This approach involves actions or processes to protect, sustain and stabilise the original materials, form and integrity of heritage buildings, safeguarding their heritage value. Preservation seeks to ensure structural safety, enhance the well-being of heritage buildings, and prevent further deterioration, decay, or dilapidation (Harun, 2011). Using systematic and scientific methods aligned with conservation principles (JWN, 2023), this conservation approach is well-suited for preserving the significance of heritage buildings value where the current fabric or its condition contributes to their cultural value. Monitoring, maintenance and the repair of historic monuments and their surroundings are integral to this approach.

b) Restoration

The restoration of heritage buildings involves a thorough assessment of the structure to reveal its actual condition. This process involves accurately presenting the current condition of a historic building as it existed in the past

and employing various techniques to restore it while preserving its heritage significance (Ali, et al., 2023). Restoration aims to bring the current fabric of a place to a known previous state by removing accretions or reassembling existing components without introducing new materials. Any replacement of missing restoration elements should be substantiated by documentation, references, studies and comprehensive examinations. Therefore, this approach is suitable only when there is sufficient evidence of an earlier state of the fabric.

c) Reconstruction

Reconstruction is a process that aims to return a place to a known earlier state and is distinct from restoration in that it introduces new material into the fabric. This conservation approach can be used to reconstruct a part or the entirety of a building that has been demolished or deteriorated. Recycled materials from other sources may be incorporated into the new material. Reconstruction should be undertaken when documentary and physical evidence allow accurate reconstruction without speculation, representing vanished or non-surviving aspects of a property. The accurate replication of historic features and materials, encompassing materials, style, colour and texture, ensures that the rebuilt property resembles the appearance of the historic building that no longer exists, without detriment to any place of cultural significance.

d) Rehabilitation

Rehabilitation stands as a broad conservation field dedicated to preserving the significant features of heritage buildings, encompassing historical, architectural and cultural values (Kamal, 1970). It goes beyond mere alteration and adaptation, incorporating activities like renovation, extension, improvement, conversion, modernisation and reparation to address deteriorated heritage buildings. The rehabilitation process involves altering and repairing the heritage building, ensuring it becomes efficiently functional while retaining its historical significance.

e) Adaptive Re-use

The adaptive reuse approach involves the transformation of a disused or ineffective building into a new structure with minimal physical alterations while preserving its architectural significance. Adaptive re-use also involves any modification to a building to alter its capacity, function or performance, adapting it to new conditions or requirements (Douglas, 2006). Wilkinson and Reed (2008) and Bullen and Love (2011) state that adaptive reuse approaches enable communities, governments, and developers to reduce the

environmental, social, and economic costs associated with ongoing urban development and expansion. The adaptive re-use of buildings contributes significantly to environmental sustainability. This impact is even more pronounced when applied to historical buildings, as it extends the structure's lifespan by eliminating demolition waste and conserving embodied energy (the energy consumed throughout all processes related to building production) and is widely acknowledged for its ability to reduce low carbon emissions, mitigate climate change and foster sustainable development (Yung & Chan, 2012). Beyond its environmental advantages, this approach transforms heritage buildings into accessible and usable spaces, fostering sustainable regeneration within an area.

Preserving and reusing heritage buildings yield valuable social benefits to communities that appreciate them. Communities will increasingly recognise their own 'historical identities' and local culture through the preservation of heritage significance sites, serving as a lasting benefit for future generations, culminating in cultural continuity within the communities.

RESEARCH METHODOLOGY

The research methodology applied in this study is grounded in a qualitative approach, chosen for its capacity to offer rich descriptions of complex phenomena and track distinctive or unforeseen occurrences (Sofaer, 1999). The data collection techniques utilised in this study include (i) site observation and (ii) semi-structured interviews.

Site Observation

In this research, site observation played a crucial role in understanding how elements in the buildings were preserved and conserved, and the condition of these elements was observed. This method facilitated the analysis of observational data using an inspection checklist. Subsequently, an inspection checklist was developed based on guidelines (**Table 1**) to ensure comprehensive coverage. The site observation was conducted in Ipoh Old Town, Perak, a historical area housing a total of 1,540 heritage buildings comprising categories 1 and 2. The study focuses specifically on institutional and religious facilities, consisting of five (5) units of heritage buildings (Category 1), chosen for their accessibility and openness for interviews data collection.

Table 1: Compliancy of Heritage Building Conservation Works Guidelines Inspection Checklist

Element	Guideline		Compliance
	Design	Explanation	
Walls	Original features should be retained and restored as original.	New additions are not allowed. The original material, original construction technique/method shall be maintained in the process of recovery (if necessary).	Amendments for the purpose of appropriate reuse of a building are allowed if the external appearance conditions of the building are not affected or changed.
Building	Every building is unique in terms of culture and art and it must be nurtured to maintain each of its uniqueness.	The original building materials should be maintained, the repair works should comply with the original composition and the original construction method.	<ul style="list-style-type: none"> The use of concrete material for conservation work is not allowed. Works must be under the supervision of a qualified conservator. HIA
Material	All conservation works should comply to guidelines with original material with correct composition.	Missing and damaged elements should be replaced by the same size, type, design and material.	<ul style="list-style-type: none"> Laboratory tests required. HIA
Modification and Addition	-	Modification and additions are not allowed.	Amendments in the interior may be allowed, subject to the approval of the council.
Internal Space	The original features should be maintained and repaired and rebuilt.	Additional elements are not allowed.	Amendments to a building to appropriately reuse it will be allowed as long as the building's external appearance is not affected or changed.

Table 1 continued

Element	Guideline		Compliance
	Design	Explanation	
Internal Space	The original features should be maintained, repaired, and rebuilt.	Additional elements are not allowed.	Amendments to a building to appropriately reuse it will be allowed as long as the building's external appearance is not affected or changed.
Door	The original decoration and size of the gate and wall should be maintained and rebuilt as the original or with material corresponding to the original material.	Avoid any obstacles in front of the door such as bus stop, parking and others.	<ul style="list-style-type: none"> The decoration should be maintained both on the inside of the lot and on the outside. Conservation works should use the original technique.
Floors	The original material for the floor should be maintained and built with material corresponding to the original material.	The original materials are important to identify the cultural origins of a civilization. Every effort is to be taken to understand the cultural importance.	-
Arrangement of tiles and decorative elements of the roof	Roof decoration elements should use traditional origin material; the details of the roof should be maintained and built as original with the original installation methods.	The original method of tiles installation method and pattern of tiles should be maintained.	The colour, method, material & profile should be consistent with the original.

Source: *Researcher (2023)*

a) St Michael Institution

St. Michael Institution is one of the oldest schools in Perak, with its establishment dating back to 1912. The architect responsible for the design of St Michael Institution was ‘Father Vernier-Auguste’, renowned for his work on other significant structures, including the ‘Chapel of St. Francis’ Institution’ in Melaka and ‘St. John Institution’ in Kuala Lumpur.

b) Masjid India Muslim

Masjid India Muslim, built in 1905, carries a rich history intertwined with the labour of Indian workers brought in by a wealthy Indian Muslim tycoon Shaik Adam Mohammad Ghaus. This mosque, completed in 1908, stands as a testament to architectural influences from the Diwan-i-Khas at the Red Fort in Delhi, which reflects “Chitya Indian” or Moghul-style architecture.

c) Pa Lo Ku Miao

Founded in 1872, Pa Lo Ku Miao stands as the oldest Chinese temple in Ipoh. Located in Kampung Paloh on the west bank of the Kinta River, this temple boasts a rich history. The area in front of the temple, once known as the people’s park, served as a recreational space where individuals gathered for leisure activities.

d) Masjid Panglima Kinta

Constructed in 1898 by Dato’ Panglima Kinta Mohammed Yusof, Masjid Panglima Kinta is a distinctive mosque reflecting architectural influences from the British colonial era, blending Mughal and neo-architectural styles. Recognising its historical significance, this mosque received heritage status under the National Heritage Act 2005 (Act 645) in the year 2000.

e) Masjid Kampung Paloh

Built in 1912 on Jalan Datoh, Masjid Kampung Paloh bears historical significance as it was constructed during the Frank Swettenham administration by Wan Muhammad Saleh, the Penghulus Superintendent and Assistant Land Revenue Collector. The mosque’s construction was facilitated by the contributions of two affluent individuals, including Long Kassim.

Semi-structured Interview

The semi-structured interview method involves posing questions within a predefined framework, targeting local authority officers and caretakers of selected heritage buildings. Structured question aims to delve into their experiences with conservation approaches and their perspectives on heritage



buildings. These interviews, lasting approximately 30 to 45 minutes each, were recorded to aid in analysing responses. A set of structured questions guided the discussions with interviewees, shedding light on conservation approaches and challenges for the selected heritage buildings:

- Conservation approaches being adopted in heritage building (Category 1).
- Challenges in the process of conserving heritage buildings (Category 1) in Ipoh Old Town.
- Regularity of heritage building conservation process carried out.
- Process and procedure to execute conservation work (e.g HIA requirement)

ANALYSIS AND DISCUSSION

This section outlines the conservation approaches undertaken by each heritage building, aligning with the guidelines outlined in the Ipoh Old Town Special Area Plan 2020. The range of actions includes preservation, restoration, reconstruction, rehabilitation, adaptive re-use and their various combinations. These conservation methods are rooted in historical and cultural considerations, aiming to ensure the sustained preservation of the selected heritage buildings, as listed in **Table 2**.




Table 2: The Conservation Approaches Adopted to Sustain the Selected Heritage Buildings

Heritage Building	Conservation Approaches	Justification
 <p style="text-align: center;">St Michael Institution</p>	Rehabilitation	St Michael Institution (SMI) implemented the rehabilitation approach by extending buildings behind the heritage building façade. This extension, introduced in 1970, reflects a new development within the institution area, increasing the capacity of usage.
	Preservation	The preservation of the heritage building façade includes the application of new paint, while the windows have been retained in their original pattern.
 <p style="text-align: center;">Masjid India Muslim</p>	Rehabilitation	Masjid India Muslim underwent an extension in front of the mosque 80 years ago. This extension improved the heritage building, enhancing its capacity to accommodate the needs of the mosque.
	Restoration	The main gate of the mosque has been restored to its original façade, including the wall, without adding any new elements.

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Heritage Building	Conservation Approaches	Justification
	Preservation	The application of new paint was implemented to preserve the walls from peeling paint and dampness.

Table 2 continued

Heritage Building	Conservation Approaches	Justification
Pa Lo Ku Miao 	Rehabilitation	A building extension beside the temple represents a minor development within the temple area to increase capacity usage while maximising the retention of the main architectural building.
	Restoration	The conservation plan of Pa Lo Ku Miao includes protecting wood, roof tiles, and unique structures to safeguard its heritage significance.
	Preservation	The internal structure of the temple is preserved through painting actions and conservation treatments to protect the walls from dampness and peeling paint.
Masjid Panglima Kinta 	Reconstruction	The mosque's right elevation minaret was struck by lightning in 2011, leading to its reconstruction by the Ipoh City Council (MBI). This involved new brickwork and repairs to the crown, facilitated by a crane.
	Rehabilitation	A new building called the Gallery Masjid Panglima Kinta was constructed beside the masjid, serving as a showroom for the history of Masjid Panglima Kinta.
	Preservation	The internal space of the mosque's elements, including the rose window and doors in the prayer hall, has been preserved through painting to prevent paint peeling and retard deterioration.
Masjid Kampung Paloh 	Rehabilitation	The floor material in the mosque was changed from marble tiles to carpet because the original Italian marble tiles could not be replaced.
	Preservation	To maintain the original wood windows, a preservation approach has been implemented through painting to prevent deterioration.

Source: Author (2023)

Preservation and rehabilitation are predominantly used to sustain the heritage buildings, effectively slowing down deterioration and addressing dilapidation. Preservation, focusing on preventing decay over time, proves to be the most effective and essential approach. Meanwhile, rehabilitation involves actions like renovation, extension and improvement on heritage buildings.

Based on site observations, past renovations and extensions aimed at expanding building capacity indicate the effectiveness of preservation and rehabilitation in sustaining heritage buildings. However, the restoration approach adopted in Masjid India Muslim and Pa Lo Ku Miao, while challenging, emphasises acquiring original materials without introducing new ones to ensure authenticity and respect for heritage significance. Over time, the challenge arises as many original materials used in the past have become scarce or non-existent, making it difficult to find them today. The adaptive re-use approach is not applied in any of the selected heritage buildings as this approach involves changing the function of a building to adapt to new needs. The selected heritage buildings have altered facilities and physical components but have not changed their function to accommodate new needs.

Evaluation on the compliance of the building elements namely door, floor, tiles arrangement and decorative elements of the roof, structure of roof, wall, building material and internal space with conservation guideline indicates that some heritage buildings do not comply with the floor element guideline, mainly due to challenges in obtaining the original material for replacement. Nonetheless, the existing guidelines in the Ipoh Old Town Special Area Plan are deemed too general and lack detailed guidance. Consequently, contractors may not refer to or follow the conservation guidelines, as they are not legally binding and lack technical manuals and recommendations for conservation work.

Furthermore, according to semi-structured interviews with the heritage building caretakers, Heritage Impact Assessment Reports (HIA) were not prepared before conservation work. This is attributed to the classification of their conservation work as minor, focusing on preservation and having minimal impact on the building façade. Consequently, HIA exemptions are considered for small conservation or repair works that aim to restore heritage buildings without diminishing their significance, as well as for renovations or the installation of new fabrics. The semi-structured interview with caretakers of the heritage buildings revealed three (3) prominent challenges, which include skilled workers, materials and financial constraints (**Table 3**). Notably, a major challenge is the scarcity of skilled workers in the field of conservation. Caretakers expressed concerns about the contractor lacking expertise in conserving heritage buildings. During the interviews, it became apparent that many contractors rely on their general experience and knowledge in renovation rather than possessing specialised skills in conservation, particularly in approaches like restoration. This

deficiency arises from contractors' unfamiliarity with the original structure, the heritage building's condition and past construction methods. The implications of this skill shortage are detrimental, potentially impacting the quality of conservation work, as unprofessional workers may struggle to address specific conservation issues due to a lack of technical expertise.

Table 3: Conservation Approaches Challenges of St Michael Institution

Heritage Building	Adopted Conservation Approaches	Challenges
St Michael Institution	Rehabilitation	<ul style="list-style-type: none"> • Lack of expertise
	Preservation	<ul style="list-style-type: none"> • Difficulty in obtaining original material for replacement • Financial problem
Masjid India Muslim	Rehabilitation	<ul style="list-style-type: none"> • Lack of expertise
	Restoration	<ul style="list-style-type: none"> • Difficulty in obtaining original material for replacement
Pa Lo Ku Miao	Preservation	<ul style="list-style-type: none"> • Financial problem
	Rehabilitation	<ul style="list-style-type: none"> • Lack of important data
	Restoration	<ul style="list-style-type: none"> • Lack of expertise
Masjid Panglima Kinta	Preservation	<ul style="list-style-type: none"> • Choosing the right materials to match the original building • Financial problem
	Reconstruction	<ul style="list-style-type: none"> • Complication of reconstruction work
Masjid Kampung Paloh	Rehabilitation	<ul style="list-style-type: none"> • Financial problem
	Preservation	<ul style="list-style-type: none"> • Unable to obtain original material required to preserve the building
Masjid Kampung Paloh	Preservation	<ul style="list-style-type: none"> • Limitation of material options
	Rehabilitation	<ul style="list-style-type: none"> • Difficulty in identifying the required material

Source: Author (2023)

The challenge of acquiring original materials for heritage building conservation presents another challenge. Matching new materials with the original ones proves difficult, requiring contractors to ensure compatibility through testing for factors like strength, texture, scale and form. This challenge has implications for the authenticity of heritage buildings, hindering restoration efforts that necessitate original materials. Furthermore, financial constraints emerge as a third challenge in conservation works. Site observations and semi-structured interviews revealed instances where original materials were not replaced due to high costs. Although alternatives from other old building materials might be compatible, the lack of financial support hinders their acquisition. This financial challenge impacts the timely completion of conservation work.

CONCLUSION

In summary, this article highlights the various methods, materials and construction processes used in conservation projects, catering to the unique architecture of heritage buildings. Four (4) out of six (5) conservation approaches – preservation, restoration, reconstruction and rehabilitation – are observed in the selected heritage buildings in Ipoh Old Town. However, the adaptive reuse approach is deemed unsuitable. The assessment of guideline compliance reveals a lack of awareness among building owners regarding the importance and intent of conservation guidelines. The study underscores that all selected heritage buildings in Ipoh Old Town have undergone modifications and additions to expand their capacity, primarily driven by current needs. The identified challenges in implementing conservation approaches include; (i) lack of expertise; (ii) difficulty in obtaining original materials for replacement; and (iii) financial constraints, with financial issues posing the most significant challenge. This research focuses exclusively on conservation approaches in sustaining heritage buildings in Ipoh Old Town. To strengthen this study, future research could benefit from further research in the following subjects:

- 1) Future studies should obtain perspectives from conservation contractors to ensure adherence to guidelines.
- 2) There is a need to suggest recommendations to address conservation challenges.

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STRATEGIES FOR NET ZERO CARBON IN SUSTAINABLE CONSERVATION PRACTICES FOR HISTORICAL BUILDINGS IN MALAYSIA

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Abstract

Heritage buildings have always been essential in improving the quality of the city's life, especially for the communities living in historical settings. They play a vital part in representing historical, architectural, cultural, political, spiritual, and symbolic values that are passed down to generations. Historical buildings are often considered dilapidated, and due to society's neglect of these, the historical buildings positioned within the oldest parts of the city have deteriorated. Heritage buildings in Malaysia are defined as historical buildings that are protected under the National Heritage Act 2005 (Act 645) to preserve tangible cultural heritage. This study intends to identify the Strategies contributing to Net Zero Carbon in Sustainable Conservation Practices for Historical Buildings in Malaysia. The research primarily focused on Conservation Architects and Heritage Professionals, with data being collected through semi-structured interviews and subsequently subjected to Thematic Analysis Matrix. The objective was to propose a set of recommendations for sustainable practices in the conservation of heritage buildings in Malaysia, aimed at achieving net zero carbon emissions. This endeavour was aimed at advancing the discourse on Net Zero Carbon in Historical Buildings and fostering public awareness regarding the significance of these architectural treasures.

Keywords: Net Zero Carbon, Sustainable Conservation Practices, Historical Buildings

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INTRODUCTION

Heritage buildings in Malaysia are defined as historical buildings that are protected under the National Heritage Act 2005 (Act 645) to preserve tangible cultural heritage (Mustafa & Abdullah, 2013). The heritage buildings in Kuala Lumpur are supported by the Kuala Lumpur Structure Plan 2020 (KLSP2020) to support comprehensive management of the city, together with Act 107 and Act 72, which provisions the “proper planning in Federal Territory.” KLSP2020 highlighted policies 186 to 190, which clearly concern the heritage building. Policy 189 ensures that all development shall harmonise with the surrounding area to retain the existing character of the city and to enhance the surrounding area. These are the initiatives developed by the Kuala Lumpur City Hall and aim to convert Kuala Lumpur into a city that conserves most of the environment, architecture, and cultural heritage (Kuala Lumpur City Hall, 2004, p.32). Under these circumstances, a less attractive façade could be retrofitted to create a more attractive environment that reflects the character of adjacent heritage buildings in Kuala Lumpur (Kuala Lumpur City Hall, 2008b, p.127).

United Nations Educational Scientific and Cultural Organization (UNESCO) provided its operational guidelines for the implementation of the World Heritage Convention where Clause 163 to Clause 166 mentioned the modification of cultural heritage, which requires the submission of the proposal to undergo Preliminary Assessment for approval, and these only apply to Penang and Melaka Heritage Site and Buildings. Supported by Preliminary Assessment and Annexes, which are the supportive documents written for the procedure of nomination, they are to be approved by the relevant Advisory Bodies. They are based on the views of the professional bodies towards the modification of cultural heritage (United Nations Educational, 2021).

Sarawak Heritage Society (SHS) has provisions for building conservation in Sarawak with the objectives of assisting in the identification of the styles and features of the historical shophouses and areas and identifying the degree or extent of work allowable in any development (PELITA, 1992), while the regulations not listed in Sarawak conservation initiative shall be protected under Malaysia National Heritage Act 2005.

The guidelines provided often focus on the conservation of building appearance and façade (Mat Nayan, 2017). With the provided guidelines, it could be said that the conservation of the external façade within nominal sight appears to be an essential element in maintaining the outlook of heritage or historical buildings. Under the National Heritage Act 2005, there is also no clear assessment in nominating historical buildings as heritage buildings to be conserved or preserved.

RESEARCH BACKGROUND

Due to the issue of global urbanization, city centres have become the primary target for land acquisition, demolition, and rebuilding to maximise economic returns and profits. (Toong & Utaberta, 2015). Moreover, the heritage buildings are under the threat of destruction due to neglect by the owners and demolition due to the city's development, as well as the lack of community concern to conserve heritage buildings (Hanapi, 2021). National Heritage Act 2005 (Act 645) is the replacement of the previous heritage laws and rehabilitation measures to protect heritage properties together with the Local Government Act 1976 (Act 171) and the Town and Country Planning Act 1976 (Act 172) (Yusoff & Dollah, 2013).

However, conflicts arise in defining historical buildings within the Acts, as they automatically attain heritage status once they reach the age of 100 years. Many historical buildings, integral to the identity of a heritage city, have yet to reach this milestone, or even if they have, they often lack protection and are subjected to neglect, leading to their eventual dilapidation and destruction (refer to Figures 1 and 2). Conservation efforts for these historical buildings pose significant challenges, particularly in sourcing replacement materials due to their construction during earlier eras (Zuraidi & Zainal, 2011).



Figures 1 and 2: Dilapidated buildings in Papan, Perak
Source: TSL Media Group, 2021

HERITAGE BUILDINGS ARE NON-ENVIRONMENTALLY SUSTAINABLE TOWARD NET ZERO CARBON IN MALAYSIA

Historical buildings are often characterised by mediocre performance in terms of green building standards (Okba & Embaby, 2013). Therefore, the concept of sustainability becomes pivotal in the conservation and energy efficiency efforts associated with these structures, aiming to extend their lifespan by integrating new functions (BC, 2021). However, interventions aimed at enhancing energy efficiency, particularly during the operational phase, present significant challenges (Kayan et al., 2018). Moreover, the absence of legal frameworks addressing sustainability issues exacerbates conservation challenges in Malaysia.

For instance, the National Heritage Act 2005 primarily focuses on non-sustainable conservation practices for historical buildings, leading to conflicts within national legislation and hindering the environmental sustainability of heritage buildings in the future (Zuraidi & Zainal, 2011). Heritage conservation efforts have traditionally prioritized preserving the physical structures without sufficient consideration for their cultural significance. Consequently, sustaining cultural heritage becomes challenging not only socially but also environmentally, as conservation practices often fail to address broader environmental concerns (Marçal, 2018).

SUSTAINABLE PRACTICES

Net Zero refers to achieving an overall balance between the production and removal of greenhouse gas emissions from the atmosphere (National Grid, 2023). Net Zero Carbon Heritage Building focuses on reducing carbon emissions to the environment and improving energy performance, while sustainability involves increasing and using renewable energy (BC, 2021). This relates to the green approach to historical building rehabilitation and restoration work, which involves the use of greener materials as well as the adoption of green tactics and technologies (Kayan et al., 2018). It is this consideration that helps heritage buildings last longer and accomplish the Paris Agreement goal of becoming a Net Zero Greenhouse Gas Emission Nation by 2050 (Phang, 2021).

Adaptive reuse and retrofit of existing historical buildings are preferable to demolition and reconstruction of new buildings (Aziz, 2020). In theory, historical building upkeep and restoration have an essential role in reducing carbon dioxide emissions in terms of embodied carbon and energy (Kayan et al., 2018). Low-carbon restoration works must go through a comprehensive procedure to determine the low-carbon material from manufacture to transportation and the amount of energy consumed and carbon dioxide emitted. The sustainable practices in Malaysia to achieve Net Zero Carbon have turned out to be an issue since there are no officially published guidelines for buildings across Malaysia.

SUSTAINABLE CONSERVATION PRACTICES FOR NET ZERO CARBON HERITAGE BUILDING

Referring to the National Heritage Act 2005, heritage buildings are mandated to undergo maximum conservation efforts, wherein restoration typically utilizes the same materials as the original structures. However, flexibility exists wherein materials may be substituted with alternatives possessing similar appearances and characteristics. According to Theory 1, sustainable practices in heritage building maintenance and repair are integral to reducing carbon dioxide emissions, particularly in terms of embodied carbon and energy (Kayan et al., 2018).

Approval for the use of new materials in heritage building maintenance is contingent upon conservators' endorsement as per Act 171.

The second theory, proposed by MDPI, advocates for reducing carbon emissions associated with constant maintenance of heritage buildings, especially those less accessible to the public. Utilizing technologies to enhance public access to these structures can mitigate carbon emissions, preserving their original appearance while preventing deterioration of their heritage value and loss of authenticity.

In accordance with Act 645 and city planning guidelines such as KLSP2020, the development of heritage buildings, including the addition of new functions or elements, may be sanctioned, provided that street-level elevations remain consistent with the original structure. Energy-efficient materials integrated into heritage buildings should harmonize with the original building in terms of colour, texture, shape, and scale, albeit being less conspicuous to preserve the building's historical value.

From the literature review, strategies contributing to achieving Net Zero Carbon in sustainable heritage practices can be categorized into three main approaches:

1. Application of Low Carbon Materials in Heritage Building Preservation.
2. Leveraging Digital Technology and Applications to Enhance Access to Heritage Buildings.
3. Implementation of Energy-Efficiency Interventions within Heritage Buildings to Reduce Energy Consumption.

METHODOLOGY

The qualitative research method was employed to fulfil the aims and objectives of this study, which aimed to develop a set of recommendations for sustainable practices in the conservation of Heritage Buildings in Malaysia toward achieving Net Zero Carbon status. Semi-structured interviews were conducted to engage with selected respondents, seeking to comprehend their perspectives on sustainable conservation practices and their perception of Net Zero Carbon Heritage Buildings.

Respondents of the Study

The respondents selected for this semi-structured interview comprise a total of 6 individuals. Among them are 4 conservation architects recognized as conservators, possessing expertise in conservation practice and documentation, along with substantial experience in related conservation endeavours within heritage buildings. Additionally, 2 heritage professionals distinguished for their expertise in Heritage Conservation were invited to partake in this semi-structured

interview. Their participation aims to garner insights into sustainable conservation practices tailored explicitly for heritage buildings in Malaysia.

The scarcity and unavailability of Conservation Architects and Heritage Professionals in Malaysia has meant that this research is justified by the limited number of respondents. This specialized group is important for determining heritage conservation practices; however, there are not enough experts available. This study emphasizes depth rather than breadth based on rich, high-quality insights from a few experts instead of a large less specialized group. The small number of respondents notwithstanding, they have expertise which makes the findings relevant and useful.

Data Collection

The interview questions were written based on the themes and research objectives of this research. The primary purpose of this interview is to examine the current practices in sustainable conservation practices of heritage buildings in Malaysia and to develop a set of recommendations for sustainable practices of conservation of heritage buildings in Malaysia towards net zero carbon. The structure of the questions is formulated to form different categories based on the theories and themes (see Table 1):

- i. Heritage Conservation Practice in Malaysia
- ii. Sustainable Practices
- iii. Sustainable Conservation Practices for Net Zero Carbon Heritage Building

Table 1: Sample set of Questions for Interviews

Literature Review Themes	Interview Questions	Purpose of the Question
HERITAGE CONSERVATION PRACTICE IN MALAYSIA	Materials: 1. What are the sources of materials for the restoration of heritage works in conservation practice? 2. What is the cost of the materials used for restoration compared to local and imported materials or any of the materials had been replaced with local products? 3. Have you figured out the amount of carbon for materials and compared it before the material decision is made? 4. How do you treat the excessive materials left or unwanted materials produced from restoration works?	To identify the sustainable conservation practices that contribute towards Net Zero
SUSTAINABLE PRACTICE	Digital Technologies: 1. What software is used to reconstruct the documentation and material-construction characteristics of a cultural heritage building?	To examine the current practices in sustainable conservation practices

Literature Review Themes	Interview Questions	Purpose of the Question
	2. How do you use AR and VR as the future software for historical buildings? Passive Design Features: 1. What energy-saving façades or fixtures had been installed in heritage buildings? 2. How do you lower the energy consumption of a heritage building? 3. What is the thermal environment in the building?	of Heritage Buildings in Malaysia
NET ZERO CARBON FOOTPRINT HERITAGE BUILDING	Respondents' Opinions: 1. What can also be suggested for sustainable heritage practices for Heritage Buildings in Malaysia?	To identify the sustainable conservation practices that contribute towards Net Zero

Source: Author

Data Analysis

Thematic analysis is mainly used for theory development, where it is used to transform transcripts or collected data into codes (C). The codes were then further developed and categorised into themes (T) (Figure 3). This eventually helped researchers to build general theoretical concepts for qualitative evidence. Findings were interpreted, and implications were discussed in detail in the conclusion (Khokhar et al., 2020). The purpose of this thematic analysis is to uncover relevant themes and patterns in data concerning a phenomenon and to interpret the underlying meaning, implication, and relevance of the built themes with respect to the current body of knowledge (Braun & Clarke, 2006).

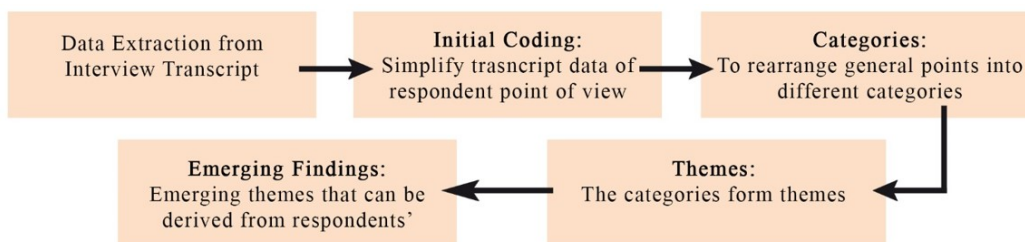


Figure 3: Data Analysis Method

Source: Author

Limitations

Limitations and obstacles encountered during the interview process primarily revolved around the time required to schedule interviews. As a result, the exact number of respondents for data collection through interviews could not be determined. While the aim was to select professionals as respondents to ensure

insightful interviews, the pool of relevant professionals may have been insufficient to provide comprehensive information pertaining to heritage buildings. Additionally, a limitation arose from the fact that respondents' answers might not be entirely accurate, as they were based solely on their experiential knowledge without specific guidelines pertaining to the subject matter. Furthermore, due to the constrained time frame of the interviews, respondents may not have been afforded adequate time to contemplate and justify their responses thoroughly.

DATA ANALYSIS

Replacement of Building Materials

The replacement of building materials involves the utilization of substitute materials that closely resemble the original components, thereby maintaining the visual integrity of the structure. This practice aimed to safeguard the appearance of the building while avoiding the use of materials that deviated significantly from the originals, such as wood or steel. Generally, the adoption of replacement materials resembling the originals, applied or installed in historical and heritage buildings, was viewed positively, especially when the authentic materials for restoration were unavailable or no longer in production. In such scenarios, locally sourced materials bearing a resemblance to the originals, possibly supplemented by imports, were employed to ensure that the restoration process maintained a minimal carbon footprint.

The respondents offered valuable insights into the conservation of heritage and historical buildings, underscoring the significance of preserving their original materials whenever possible. However, in instances where the original materials were untraceable, local substitutes were deemed appropriate alternatives. It remained crucial to uphold the architectural integrity of these buildings to the greatest extent possible, utilizing either authentic materials or suitable replacements that closely mimicked them.

Digital Technology in Sustainable Conservation Practices

Digital technology plays a crucial role in educating and documenting buildings as part of sustainable practices in the conservation of historical or heritage buildings. While traditional methods still prevail in the documentation of historical buildings, experts widely recognize the value of Virtual Reality (VR) and Augmented Reality (AR) in this field. These technologies not only enable access to hardly reachable historical buildings but also allow for the documentation of buildings at various stages, preserving their originality without being susceptible to weather or natural disasters. This approach contributes to sustainable conservation practices by maintaining the overall appearance of

historical or heritage buildings with fixed data, which can serve as educational resources for future generations regarding current building facades.

Energy Efficiency Methods

The elevation and façade of the building must be maintained during conservation works. Experts concur on the installation of passive design features, primarily due to changes in the building's function, which may involve adaptive reuse rather than strictly adhering to sustainable conservation practices. Nevertheless, given prevailing weather conditions, minor passive design features may be incorporated into historical buildings, provided that the original appearance of the building's elevation is preserved to adapt to current weather conditions while maintaining its original function.

Experts recognize that the conservation of cultural heritage involves actions aimed at prolonging the life of cultural heritage while preserving heritage values. Consequently, changes in building functions represent an approach to extending the lifespan of historical buildings.

Summary of Analysis

The semi-structured interview was conducted with experts to support the qualitative research method employed in this dissertation. The interview questions were structured based on the initial theoretical framework developed through a review of relevant literature in the field. Throughout the analysis process, data was initially extracted and categorized using the thematic analysis method. The categories were established based on the initial coding derived from following the steps outlined in the thematic analysis. The final overarching themes were then generated and cross-checked with responses from various experts.

Additionally, sub-themes were identified based on the expert responses. The findings from the interviews yielded 20 categories, which were subsequently grouped into 10 main themes: Renewable materials for historical buildings (T1), Original materials for restoration works (T2), Materials replacement while preserving building aesthetics (T3), Low carbon content building materials (T4), Historical influences on building material selection (T6), Integration of digital technology in conservation efforts (T7), Utilization of digital technology in educational contexts (T8), Manual conservation practices and their limitations (T9), Implementation of mechanical ventilation in historical buildings (T11), and Strategies for carbon reduction in historical buildings (T12). Sub-themes were also identified, including Building function's impact on façade and aesthetics (T5) and Building function's influence on building lifespan (T10) (see Figure 4).

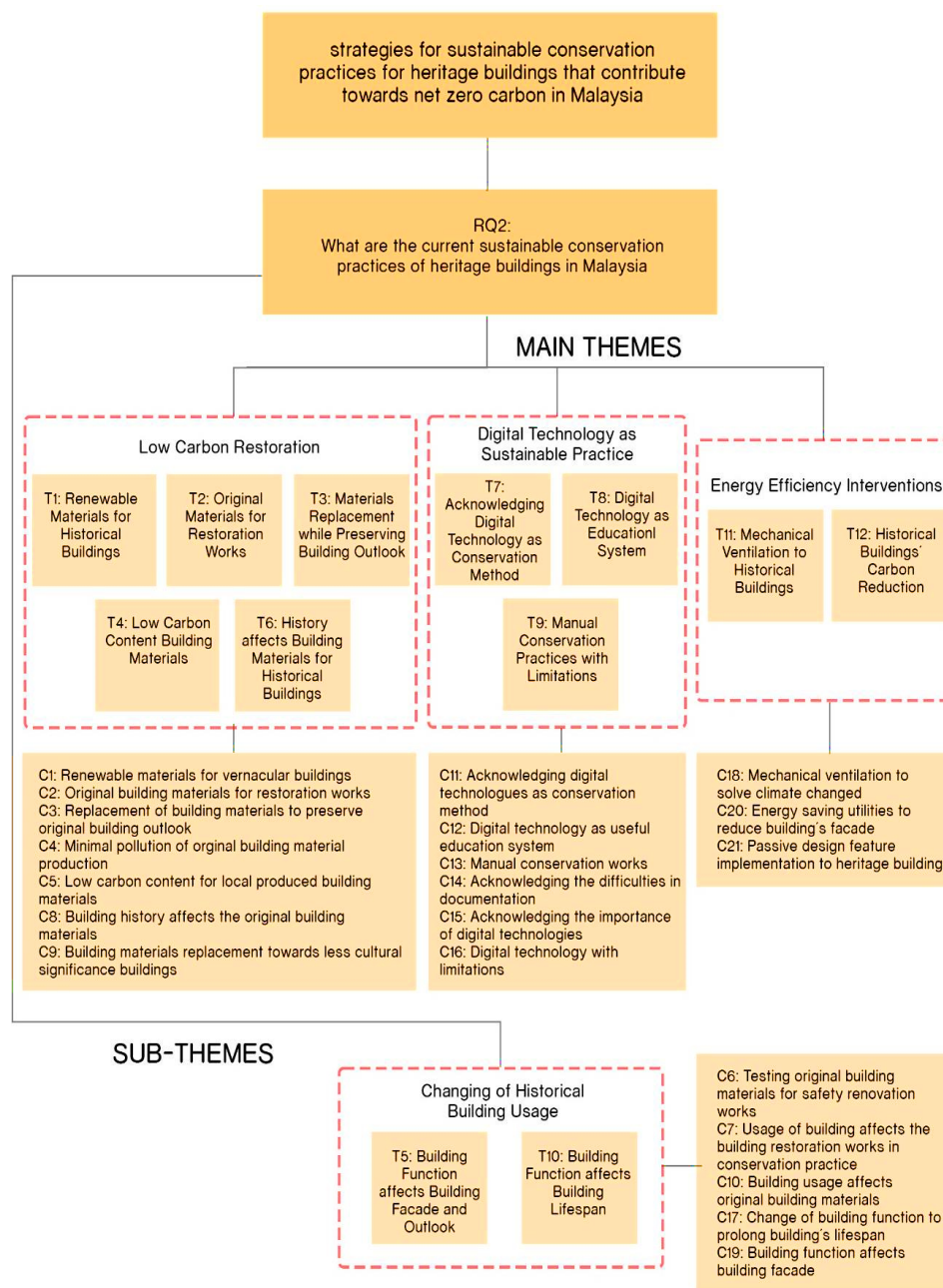


Figure 4: Summary of Analysis
 Source: Author

FINDINGS & DISCUSSIONS

Low Carbon Restoration

Low carbon restoration practices are applicable to various historical and heritage buildings, particularly local vernacular heritage structures, as these buildings typically utilize locally sourced materials whose production can be tracked for availability. Restoration efforts for vernacular architecture inherently involve the use of low-carbon materials, often renewable or locally available materials that negate the need for imports. Colonial buildings, characterized by a fusion of Eastern and Western architectural influences adapted to regional climates (Kuncoro et al., 2022), were historically constructed using imported materials due to their location in port areas.

In conservation practices, the restoration of colonial buildings typically necessitates the use of imported materials to preserve the originality and visual integrity of the structures. However, in cases where imported materials are no longer produced or available in the market, replacement materials may be utilized for restoration, provided that they maintain the building's original appearance and façade. This approach aims to preserve the authenticity of colonial buildings while ensuring the continuity of their historical significance.

Historically, heritage buildings often served as office spaces but may now be repurposed as museums or archival centers for public visitation. Ensuring visitor safety is paramount, and modern conservation practices must address this concern. Changes in building function should be accompanied by adjustments in building materials to enhance user-friendliness while preserving the overall appearance and heritage value of the structure.

Prioritizing the identification of each heritage building's cultural significance is crucial, particularly for Class 1 heritage buildings, where original material restoration takes precedence. For structures with lesser cultural significance, locally sourced materials resembling the original appearance may suffice for restoration purposes. Consequently, low-carbon restoration techniques can be feasibly implemented in certain heritage buildings across Malaysia, facilitating sustainable conservation practices.

Digital Technologies as Sustainable Practices

Digital technologies encompass more than just modern documentation methods; they also encompass Virtual Reality (VR) or Augmented Reality (AR), providing visitors with immersive virtual experiences. Additionally, digital documentation involves utilizing modern tools such as digital measuring devices and computer software to create digital models of heritage sites, which serve as valuable research tools (Koszewski et al., 2021). These technologies have the potential to contribute to sustainable conservation practices for heritage buildings in Malaysia, aiding in the pursuit of Net Zero Carbon emissions.

While experts recognize the availability of digital technologies, their adoption, particularly of digital documentation and visualization tools, remains relatively low among conservators in Malaysia. Manual documentation techniques persist as the preferred method for recording heritage buildings in conservation efforts. However, Virtual Reality offers a promising avenue for providing users with immersive experiences of inaccessible heritage sites, potentially reducing carbon emissions associated with traditional documentation methods.

Despite its advantages, digital technology has limitations, particularly in replicating physical sensations realistically. Nonetheless, it serves as an educational tool, enlightening the public about inaccessible heritage sites and facilitating remote researchers' access to digital representations of these sites.

Energy Efficiency Interventions

The energy performance of heritage buildings is intrinsically linked to the prevailing climate conditions of their respective locations. As climate change leads to gradual temperature increases, the performance of these buildings has suffered, resulting in suboptimal indoor climate conditions and discomfort for prolonged occupancy (Huerto-Cardenas et al., 2021).

According to experts, energy efficiency interventions extend beyond merely enhancing the façades of historical or heritage buildings. They also encompass the installation of Heating, Ventilation, and Air Conditioning (HVAC) systems to improve indoor air quality while bolstering energy performance, with the goal of transforming heritage buildings into Net Zero Carbon structures.

Experts concur that passive design features, serving as energy efficiency interventions, could be integrated into the conservation of historical or heritage buildings. However, such interventions are contingent upon changes in building function; altering the façade may contravene conservation principles. Mechanical ventilation emerges as a crucial intervention to address climate change, as traditional façade designs may not adequately accommodate current climatic conditions.

In instances where heritage buildings undergo significant functional changes to accommodate increased occupancy, retrofitting the building façade and HVAC system becomes essential to align with the new building function while preserving its historical integrity.

Change of Historical Building Usage

This strategy aims to prevent the abandonment of certain historical buildings while simultaneously preserving their intrinsic value and engaging the public. It constitutes a sub-strategy involving the alteration of the usage of historical

buildings, a concept known as adaptive reuse. Adaptive reuse entails repurposing old buildings to serve new functions as a conservation strategy for cultural heritage, allowing these structures to adapt to current climate conditions and urban development (Plevoets & Van-Cleempoel, 2011).

The previously installed building materials in heritage buildings were typically sustainable for their original functions. However, heritage building sustainability extends beyond merely maintaining the physical structure; it also involves ensuring long-term usability for occupants and preserving the cultural value within the urban fabric. One effective strategy to sustain these buildings is to convert their original functions, such as transitioning from office spaces to commercial establishments that generate income to cover restoration expenses in conservation practices.

It can be argued that due to their age and deterioration, historical and heritage buildings may not be sustainable over extended periods for their original purposes. Safety concerns often arise, rendering continued use impractical. According to experts, a viable approach to prolonging the lifespan of such buildings involves adapting their original functions. This adaptation not only allows the building to endure for a more extended period but also prevents its abandonment and eventual removal from the urban landscape.

Recommendation of Sustainable Practices of Conservation of Heritage Buildings in Malaysia towards Net Zero Carbon

There are recommendations concluded from this research based on the theories and current conservation practices that shall be used for sustainable conservation practices of Heritage Buildings in Malaysia towards Net Zero Carbon:

A. Building Materials & Restoration

1. Similar renewable resources should replace renewable building materials,
2. The replacement of building materials is permissible only in cases where the original materials are no longer in production.
3. Replacement of building materials may apply to heritage buildings with less cultural significance value.

B. Digital Technology and Documentation

4. Digital measurement tools in documentation practices,
5. Digital documentation works for sustainable conservation practices and
6. Virtual Reality and Augmented Reality are future assets that will preserve historical or heritage buildings with high cultural significance.

C. Energy Efficiency Interventions and Building Façade

7. Mechanical ventilation to improve indoor air quality,
8. Changing the façade or addition to the building shall depend on the building function for heritage buildings and
9. Energy-saving utilities and passive design interventions could be installed for operating heritage buildings.

D. Building Function and Usage (Optional Sustainable Conservation Practices)

10. Adaptive Reuse of Heritage Buildings to preserve the Heritage Assets and Value.

CONCLUSION

The study of conservation practices for heritage buildings contributing to achieving net zero carbon emissions in Malaysia has yielded a set of strategies for sustainable conservation practices. These practices aim to facilitate the development of net-zero carbon heritage buildings in Malaysia.

Sustainable conservation practices conducive to achieving net-zero carbon emissions were identified through a literature review, which provided theoretical frameworks categorized into three main theories. These theories were translated into research questions, and semi-structured interviews were conducted to investigate current practices in the sustainable conservation of heritage buildings in Malaysia. The purpose of these interviews was to validate the theories derived from the literature, recognizing that theoretical frameworks may not always align with practical applications in the context of Malaysia's heritage building conservation practices.

Through the analysis of findings and discussions, a set of recommendations for sustainable conservation practices in Malaysia aimed at achieving net zero carbon emissions has been developed. These recommendations serve as a simple guideline for architects and conservators involved in future sustainable conservation projects for heritage buildings. The primary implication of this research lies in the preservation of heritage buildings and their cultural significance, along with the necessity of extending their lifespan.

Amidst current climate conditions and urban pressures, heritage buildings may face abandonment due to their perceived lack of relevance compared to contemporary city development. This neglect could ultimately result in their demolition to make way for future construction projects. The significance of this research extends beyond merely safeguarding heritage buildings against climate change; it also aims to ensure their longevity within urban settings while preserving their cultural heritage and intrinsic value.

Whether through adaptive reuse or the alteration of building functions to enhance their appeal, these efforts facilitate public access to and understanding of the significance of historical or heritage buildings as integral assets within the urban fabric. Such initiatives reinforce the importance of these buildings' presence and their cultural value, thereby contributing to the creation of vibrant cities enriched with cultural heritage.

The recommendations outlined provide a framework for conducting more targeted research on sustainable conservation practices and their implications in Malaysia. Further investigation by scholars is essential to promote the adoption of sustainable conservation practices by conservators and architects in Malaysia, ultimately leading to the realization of net-zero carbon heritage buildings.

DISCLOSURE STATEMENT / ETHICAL STATEMENT

This is original research by the authors. It includes the work and complete research on the topic: Strategies Contributing to Net Zero Carbon in Sustainable Conservation Practice for Historical Buildings in Malaysia.

This research was conducted based on references from government bodies and other professionals on heritage buildings and sustainable building studies. This research focuses on the contribution of historical buildings towards net zero carbon in Malaysia, which is partly responsible for the environmental issues arising in the world.

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ASSESSING THE IMPACT OF INEQUALITIES ON RESIDENTS' PERCEPTION AND CRIME INCIDENTS IN URBAN AND PERI-URBAN NEIGHBOURHOODS

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Abstract

The COVID-19 pandemic has brought the issue of inequality to the forefront, exacerbating economic uncertainty and social injustice, which has led to widespread social disorder. This study examines the relationship between inequality and crime in urban and peri-urban neighborhoods in Penang; Moreover, an association between inequality and the incidence of crime will be investigated in two neighborhoods. Having considered the intricate relationship between social inequality and crime in previous studies, a quantitative approach was conducted to investigate how neighborhood locations impact the crime and inequality relationship. A face-to-face survey using a closed-ended questionnaire was conducted with 761 respondents, comprising 329 from Balik Pulau and 432 from Bayan Baru. The findings reveal that economic inequality significantly impacts crime rates in both Bayan Lepas and Balik Pulau, whereas social inequality only shows a negative significant effect in Bayan Lepas. Subsequently, results indicate income does not influence the fear of crime among respondents in Balik Pulau, but residents with higher income levels in Bayan Lepas exhibit a greater fear of crime. However, neighborhood locations do not distinctly affect criminal activity. These insights can help enhance crime prevention strategies, improve security, and foster balanced development in Penang.

Keywords: Inequality, Social disorganization theory, Neighborhood, Peri-Urban community

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INTRODUCTION

Inequality, according to Koh (2020), refers to the unequal and unfair distribution of resources or opportunities within certain communities. Inequality manifests in various dimensions, including political, economic, and social aspects. It encompasses several types, such as income inequality, educational inequality, and gender inequality. Among these, income inequality is particularly impactful as it often leads to reduced opportunities for achieving a better standard of living and hinders financial stability (Kopp, 2021). Income inequality is closely linked to wealth inequality, where wealth distribution across the population is uneven. Many researchers utilize the Gini Index to analyze the level of income inequality within a population. Additionally, social inequality exists where individuals lack equal access to essential resources, services, and societal positions (Doob, 2019). This form of inequality is often more extensive than income inequality as it includes aspects of discrimination and government support.

United Nations (2020) identifies multiple factors driving inequality, noting that income disparities are influenced not only by economic factors but also by gender, ethnicity, age, religion, and sexual orientation. Education and wages determined by the labor market also contribute significantly to income inequality. Unequal resource distribution negatively impacts social life, particularly in terms of access to essential services and opportunities. The relationship between inequality and crime is intricate and often captures the attention of scholars and policymakers. Inequality involves the unequal distribution of resources, opportunities, and wealth within a society, leading to various adverse outcomes such as poor health, lack of social cohesion, and higher crime rates (Goh & Law, 2023). In recent years, the issue of inequality has gained prominence due to widening economic gaps and social injustices, which have sparked widespread political unrest.

A large numbers of studies reveal a well-established link between crime and inequality, with individuals living in poverty and facing economic hardships more likely to engage in criminal behavior (Marzbali et al., 2020; Weaver, 2019). Extensive research consistently shows that higher levels of inequality are associated with higher crime rates (Usai, 2022). Malaysia is no exception, with significant economic and social disparities contributing to elevated crime levels. According to the Malaysian Crime Prevention Foundation report, over 11,000 cases of violent crime, including murder, rape, and assault, were reported in 2022 (DOSM, 2022). Property crimes such as theft and burglary also remain prevalent issues in Malaysia.

The COVID-19 pandemic exacerbated existing economic and social inequalities in Malaysia, leading to a more pronounced divide between different socio-economic groups. Post-pandemic, many low-income families faced significant financial hardships due to job losses and reduced income. The

informal sector, which employs a substantial portion of the population, was particularly affected, leaving many without social safety nets. While government aid programs provided some relief, the support was often insufficient to cover all needs, resulting in increased poverty levels and heightened economic vulnerability among the most disadvantaged groups.

In contrast, prior to the pandemic in 2019, Malaysia had been making steady progress in reducing poverty and narrowing income inequality. Economic growth rates were robust, and the government's targeted social programs were beginning to show results in lifting many out of poverty. However, the benefits of growth were not evenly distributed, with wealth and opportunities concentrated in urban areas and among higher-income groups. Despite these disparities, the pre-pandemic period was marked by optimism and a general trend towards improved socio-economic conditions (Samat et al., 2021).

The pandemic has thus widened the gap between the wealthy and the poor, reversing some of the gains made in the years leading up to 2019. High-income groups and those with secure jobs were better able to adapt to the economic disruptions caused by the pandemic, often benefiting from the shift to digital and remote work environments. Meanwhile, the lower-income population faced increased barriers to economic stability, such as lack of access to technology and healthcare, exacerbating pre-existing inequalities. The post-pandemic recovery phase requires focused policy interventions to address these deepened disparities and ensure more inclusive and equitable economic growth.

Given the intricate relationship between social inequality and crime explored in previous studies, and the lack of empirical research examining the impact of inequality post-COVID-19 on urban and peri-urban communities, this study investigates the relationship between inequality and crime in urban and peri-urban neighborhoods in Penang. Additionally, it addresses how neighborhood locations influence this relationship. The report indicated that the restrictions imposed during the COVID-19 pandemic significantly impacted Penang's tourism industry, leading to numerous business closures and subsequent job losses among the local population. This ban has undoubtedly created a negative atmosphere within society, exacerbating economic and social inequalities (Sundaram JK, 2020). The research was conducted in two distinct locations: Bayan Baru and Balik Pulau. This choice was made because regional comparisons of inequality and crime are seldom performed. Additionally, both Bayan Baru and Balik Pulau experienced high numbers of COVID-19 infection cases (Ministry of Health Malaysia, 2024), making them pertinent areas for studying the pandemic's impact.

Bayan Baru is one of the cities in Penang, with a population of 85,321 people. The median income in Bayan Baru is RM 6,981, and a poverty incidence of 0.500. Conversely, Balik Pulau, another city in Penang, has a population of

approximately 132,344 people. It has a median income of RM 6,485, and a poverty incidence of 0.700.

LITERATURE REVIEW

Inequality and Criminal Behavior

The rise in post-pandemic crime has made the relationship between inequality and crime a key focus for sociologists, criminologists, and economists. Numerous studies have explored this relationship from various perspectives, offering insights into its complex dynamics. At the macro level, research examines the correlation between community-level inequality, such as income or wealth disparity, and crime rates, with mixed results. Some studies indicate a positive association, where higher inequality corresponds to higher crime rates (Clement & Piaser, 2021; Shah et al., 2020; Sugiharti et al., 2023). Conversely, other studies have found no significant relationship or even a negative correlation, suggesting that higher inequality could be linked to lower crime rates (Anser et al., 2020). At the individual level, research often focuses on the relationship between personal experiences of inequality, such as relative deprivation, and individual involvement in criminal activities. These studies typically explore various forms of crime, including property crimes, violent crimes, and white-collar crimes. The findings generally support the idea that individuals who perceive themselves as disadvantaged or unfairly treated are more likely to engage in criminal behavior (Sampson & Wilson, 2013; Wenger, 2019).

Several studies have investigated potential mediating factors that might explain the relationship between inequality and crime. Factors such as social unrest, lack of social cohesion, limited access to resources and opportunities, and strain theory have been explored as possible mediators (Dropplemann & Trajtenberg, 2021). These factors can exacerbate the effects of inequality, leading to increased crime rates in disadvantaged communities. The relationship between inequality and crime can also be influenced by contextual factors, such as cultural norms, neighborhood characteristics, and institutional factors. For instance, Song et al. (2020) found that the effects of inequality on crime vary across different cultural contexts or neighborhood types. Similarly, strong social institutions and effective social control mechanisms can mitigate the impact of inequality on crime rates.

Longitudinal studies, which examine changes in inequality and crime over time, have provided insights into the dynamic nature of this relationship. These studies reveal that changes in inequality, especially sudden shifts in economic conditions or social policies, can significantly impact crime rates. Periods of economic instability, characterized by rising inequality, often coincide with increases in crime rates. Conversely, social policies that address inequality and promote socio-economic mobility tend to reduce crime rates (Zhu & Li,

2017). Comparative studies across countries have also contributed to understanding the inequality-crime relationship. These studies consider differences in economic systems, social policies, cultural factors, and crime measurement methods. They generally find that countries with higher levels of income inequality tend to have higher crime rates, though this relationship can vary depending on other contextual factors (Widyastaman & Hartono, 2022).

In summary, past studies reveal a general consensus that inequality is positively associated with crime rates. Personal experiences of inequality, such as relative deprivation, mediating factors like social disorganization and limited opportunities, and contextual factors all contribute to the complex relationship between inequality and crime.

Inequality in Malaysia

research on the link between inequality and crime in Malaysia is limited, but existing studies indicate a positive correlation between income inequality and property crime rates. Higher-income inequality is associated with increased theft and burglary (Harun et al., 2021). Economic disparities and limited opportunities in disadvantaged communities drive these crimes. Rapid urbanization and socio-economic changes have also been linked to higher crime rates, especially in urban areas with greater inequality and inadequate infrastructure. Concentrated wealth and resources in central cities exacerbate feelings of relative deprivation and frustration, potentially leading to criminal behavior (Banna et al., 2020). Cultural norms and values further influence this relationship (Harun et al., 2021).

Research has also explored the relationship between socioeconomic factors, such as education and unemployment rates, and violent crime in Malaysia. Higher levels of unemployment and lower levels of educational attainment are associated with higher rates of violent crime (Ridzuan et al., 2021). These factors are closely related to inequality and can contribute to social unrest, tension, and limited opportunities that increase the likelihood of violent criminal behavior. Malaysia exhibits regional inequality in terms of development, infrastructure, and economic opportunities. Regions with higher levels of inequality and fewer economic prospects may experience higher crime rates due to uneven resource distribution, varying levels of economic development, and differential access to social services (Abrekov, 2020).

The literature on the relationship between inequality and crime in Malaysia is limited, necessitating further research for a comprehensive understanding. Existing studies indicate that income inequality and urbanization contribute to higher crime rates, particularly property crimes. Socioeconomic factors, cultural norms, and regional disparities also influence this relationship. Ethnicity and religion play significant roles as well (Lee & Khalid, 2020). The COVID-19 pandemic has exacerbated existing inequalities, disproportionately

affecting vulnerable groups like low-income individuals and foreign workers (Al Muzaini, 2022).

Crime profoundly impacts individuals and communities, causing physical and emotional trauma, financial issues, and loss of community trust. Affected areas may face social chaos, declining property values, and reduced quality of life. Addressing crime involves prevention programs, community policing, and criminal justice reform (Hagan & Daigle, 2023). Studies on the pandemic, inequality, and crime suggest that COVID-19 has intensified social and economic disparities, leading to more criminal activity (Estévez-Soto, 2021). However, economic closures have decreased some crime types such as money laundering while increasing domestic violence and cybercrime.

In Malaysia, the pandemic has also affected crime patterns and levels of inequality. For instance, a study by Jamil et al. (2022) found that COVID-19 led to an increase in cybercrime and online fraud, as well as theft of medical supplies and Personal Protective Equipment (PPE). Ridzuan et al. (2021) highlights the disproportionate impact of the pandemic on vulnerable communities in Malaysia, such as foreign workers and the urban poor. To date, there are no comparative regional studies specifically addressing inequality and crime in Malaysia, but existing research generally examines the relationship within the country. The reviewed literature suggests a positive association between inequality and crime, indicating that regions with higher income inequality tend to have higher crime rates. Factors such as relative deprivation, social chaos, limited opportunities, and cultural norms have been identified as mediating and contextual factors shaping this relationship. Moreover, the studies indicate that cultural, socioeconomic, and regional differences between urban and peri-urban areas may interact with inequality to influence crime rates in various ways. Overall, this literature review lays a solid foundation for understanding the link between inequality and crime. The next section explores the theoretical background, presenting elements and variables that elucidate how inequality influences crime in different communities.

Theoretical Background

The social disorganization theory, originating in the early 20th century and notably associated with scholars like Clifford Shaw and Henry McKay, posits that crime and delinquency stem from social disorganization within communities rather than individual pathology. At its core, this theory suggests that certain neighborhoods or communities experience breakdowns in social cohesion, informal social control mechanisms, and access to legitimate opportunities due to factors such as poverty, unemployment, and educational disparities (Bellair, 2017). These conditions foster an environment conducive to criminal behavior.

Central to the theory is the notion of 'concentrated disadvantage,' which describes the clustering of multiple forms of deprivation within specific geographic areas. In these disadvantaged neighborhoods, high crime rates often prevail as residents grapple with limited resources and opportunities, leading to feelings of frustration and alienation.

Economic and educational disparities can further hinder individuals' access to legal avenues for success and social mobility. Especially within disadvantaged communities, individuals may resort to illicit activities as alternative means to achieve their goals or alleviate socioeconomic hardships. The scarcity of legitimate opportunities heightens the likelihood of individuals turning to crime for survival or material gain. Moreover, inequality can cultivate feelings of frustration and tension among individuals who perceive the gap between their aspirations and their actual social and economic status. This tension, stemming from a relative lack of resources, can escalate feelings of resentment and a sense of injustice (Kubrin et al., 2022). In some instances, these negative emotions may prompt individuals to engage in criminal behavior as a coping mechanism or as a means to express their frustration.

Social disorganization theory underscores the significance of community-level factors in comprehending crime and deviance. It underscores the role of structural forces, such as socioeconomic inequality and institutional neglect, in shaping patterns of criminal behavior.

Kornhauser's Social Disorganization theory expands upon traditional social disorganization theories by introducing additional components and factors that influence levels of crime and deviance within a community. As shown in Figure 1, Kornhauser's Social Disorganization theory identifies several factors that contribute to the breakdown of social cohesion and the proliferation of crime and deviance within a community. These factors help to explain why some communities experience higher levels of social disorganization than others. Here are the key factors:

Economic Disadvantage: Economic disadvantage refers to the lack of financial resources and opportunities within a community. Poverty, unemployment, and income inequality are all manifestations of economic disadvantage. Communities with high levels of economic disadvantage often face significant challenges in providing basic necessities and opportunities for residents, leading to increased vulnerability to crime and social disorganization.

Residential Instability: Residential instability refers to the frequent turnover of residents within a community, often due to factors such as eviction, foreclosure, or migration. High rates of residential instability can disrupt social networks, weaken social bonds, and undermine community cohesion. Transient populations may have less investment in the community and fewer opportunities to develop social ties, making them more susceptible to crime and disorder.

Ethnic Heterogeneity: Ethnic heterogeneity refers to the presence of diverse racial and ethnic groups within a community. While diversity can enrich a community's social fabric, it can also pose challenges to social cohesion and collective action. Ethnic tensions, cultural differences, and language barriers may hinder communication and cooperation among residents, leading to social fragmentation and conflict. In some cases, ethnic heterogeneity may exacerbate social disorganization and contribute to higher crime rates.

Institutional Decay: Institutional decay refers to the deterioration of social institutions and community organizations within a neighborhood. This may include the decline of schools, churches, civic associations, and other institutions that traditionally fostered social integration and collective efficacy. When essential institutions fail to fulfill their roles or become ineffective, residents may lack access to vital resources and support networks, leaving them vulnerable to crime and social disorganization.

External Threats: External threats refer to factors outside the community that exert negative influences on its social fabric and stability. These threats may include environmental hazards, economic downturns, political unrest, or criminal enterprises operating in neighboring areas. External threats can undermine community resilience, disrupt social cohesion, and exacerbate existing social problems, contributing to higher levels of crime and disorder.

Overall, Kornhauser's Social Disorganization theory offers a more comprehensive and dynamic framework for understanding the complex relationship between social disorganization and crime. By incorporating collective efficacy, social change, and institutional decay into the analysis, Kornhauser provides a richer understanding of the factors that shape community life and influence crime rates.

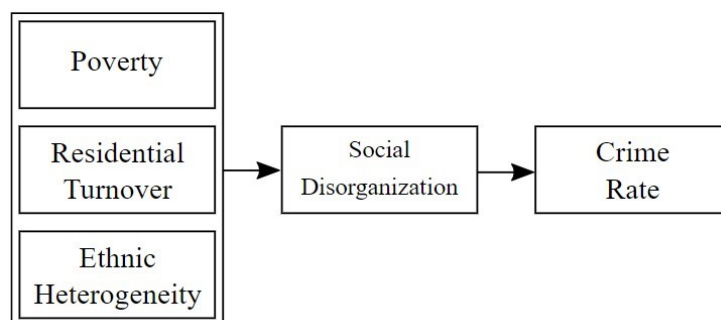


Figure 1: Kornhauser's Social Disorganization Theory
Source: Kornhauser (2017)

RESEARCH METHODOLOGY

The present study is applied research using a survey method. The population comprised adults living in two neighborhoods in Penang, namely Bayan Lepas and Balik Pulau. Primary data were collected through a questionnaire survey, while secondary data were sourced from publications, books, and official reports. The study is quantitative, with households as the sampling units.

Data were gathered using a simple random sampling method of adults aged 18 and over in the study area during the first quarter of 2023. Five teams conducted a face-to-face questionnaire survey, achieving an approximate response rate of 58%. Out of 800 collected questionnaires, 761 were deemed valid after data cleaning. The valid responses included 329 from Balik Pulau and 432 from Bayan Baru.

Through the questionnaire survey, participants provided demographic information and responded to 26 statements reflecting their perceptions of social cohesion and trust, residential instability, family disruption, pedestrian safety, and overall perceived safety. These variables were measured using a seven-point Likert scale to assess respondents' perceptions of crime and disorder in their residential area. Before starting the main survey fieldwork, three academic lecturers specializing in the study area reviewed the questionnaire. They assessed the relevance of the selected items in measuring the underlying variables and evaluated the overall content validity of the survey instruments. Based on their suggestions, several changes were made to improve the clarity of certain statements for the respondents. Consequently, the validity of the questionnaire was established by these three faculty members and experts in the field.

Out of 761 completed questionnaires, 758 respondents were Malaysian, with 432 individuals (43%) from Bayan Lepas and 329 individuals (57%) from Balik Pulau. The ethnic composition showed that the majority were Malays (61.10%), followed by Chinese (29%) and Indians (8.40%). The gender distribution was fairly balanced, with 48.23% male and 51.77% female.

Regarding household income, 18.85% and 29.4% of respondents were in the M40 category, while 63.4% and 54.4% were in the B40 category in Bayan Lepas and Balik Pulau, respectively. The income bracket of RM 1001 to RM 2000 had the highest frequency with 233 respondents, whereas the income bracket of RM 4001 and above had the lowest frequency, with 80 respondents. Additionally, 131 participants did not provide information about their income.

Study Area

Penang, an island situated in the southwestern region of Malaysia, spans approximately 293 km² of land and is nestled in the Straits of Malacca. Connected to the mainland via two bridges, Penang comprises two primary regions: the eastern sector, characterized by urban and industrial areas such as Bayan Lepas,

and the southwestern sector, known for its agricultural and rural landscapes including Balik Pulau. Renowned as a vibrant tourism destination, Penang boasts a rich heritage, diverse culture, delectable cuisine, and picturesque beaches. It is also home to a multicultural populace, blending Chinese, Malay, Indian, and European influences.

Balik Pulau, located in the southwestern region of Penang Island, is renowned for its rural landscapes, agricultural traditions, and rich cultural heritage and has a population of 43,465 people and 10,108 households. This district hosts a diverse population but grapples with significant socio-economic disparities. With a mix of urban and rural areas, Balik Pulau exhibits disparities in infrastructure, service accessibility, and job opportunities. Income inequality is a pressing concern, with pockets of poverty and limited access to essential services like education and healthcare. Recent years have seen a rise in crime rates, including theft, drug-related incidents, and interpersonal violence, prompting this study to delve into the social factors driving these trends.

Meanwhile, Bayan Lepas with a population of 188,603 people and 42,286 households, situated in the southeastern part of Penang Island, serves as a major industrial and residential hub. Known for its electronics manufacturing industry and strategic location near the Penang International Airport, it presents a diverse socio-economic landscape. While it boasts high-tech industrial zones and affluent neighborhoods, it also harbors lower-income communities and informal settlements. Employment opportunities are primarily concentrated in manufacturing, but disparities exist in residents' access to these opportunities. Bayan Lepas faces distinct crime challenges stemming from rapid urbanization and demographic diversity.

ANALYSIS AND DISCUSSION

Fear of Crime

Table 1 presents the results of a correlation analysis conducted to examine the relationship between income and fear of crime in two areas: Bayan Lepas and Balik Pulau. The analysis used Pearson's correlation coefficient (r) to measure the strength and direction of the relationships, and significance was determined by p -values. The analysis revealed distinct differences between the two areas. In Bayan Lepas, there were low but significant positive correlations between income and various aspects of fear of crime, indicating that as income increases, so does the fear of crime in specific scenarios. In contrast, in Balik Pulau, there were no significant relationships between income and fear of crime, suggesting that income does not influence the fear of crime in this area. All relationships shown in the table have positive correlations, regardless of significance.

Inequality and Crime

This study utilized Spearman's correlation analysis to examine the relationship between inequalities (both social and economic) and crime in two areas: Bayan Lepas and Balik Pulau. The analysis aimed to address the primary objective of the study by comparing the correlations in these two distinct regions. Using Spearman's correlation analysis, the correlations between social inequality, economic inequality, and crime rates were tested, and the strength and direction of these relationships were identified in both Bayan Lepas and Balik Pulau. As shown in Table 2, in Bayan Lepas, there is a low but statistically significant negative relationship between social inequality and crime ($r = -0.107$, $p < 0.05$). This suggests that as social inequality increases, the crime rate tends to decrease slightly. Meanwhile, the data shows a low but statistically significant positive relationship between economic inequality and crime ($r = 0.367$, $p < 0.05$) in Bayan Lepas. This indicates that as economic inequality increases, the crime rate also tends to increase.

Figure 2. Study Areas in Penang: (a) Balik Pulau and (b) Bayan Lepas



Source: authors

Table 1: Correlations between Residents’ income and fear of crime in two study areas

Aspect of Fear of Crime	Area	Coefficient (r)	Significance (p)
Burglary (When No One is Home)	Bayan Lepas	0.166	< 0.001
	Balik Pulau	0.031	> 0.05
Theft (Items Left Outside Overnight)	Bayan Lepas	0.243	< 0.001
	Balik Pulau	0.040	> 0.05
Robbery (When Outside the Neighborhood)	Bayan Lepas	0.188	< 0.001
	Balik Pulau	0.095	> 0.05
Vehicle Theft	Bayan Lepas	0.164	< 0.001
	Balik Pulau	0.031	> 0.05
Physical Attack (When Outside the House)	Bayan Lepas	0.185	< 0.001
	Balik Pulau	0.044	> 0.05

Table 2: Correlations between inequality and crime in two study areas

Area	Variable Pair	Spearman's r	Significance (p)
Bayan Lepas	Social Inequality and Crime	-0.107	< 0.05
	Economic Inequality and Crime	0.367	< 0.05
Balik Pulau	Social Inequality and Crime	-0.083	> 0.05
	Economic Inequality and Crime	0.298	< 0.05

In Balik Pulau, the relationship between social inequality and crime is not statistically significant ($r = -0.083$, $p > 0.05$). This suggests that social inequality does not have a significant impact on the crime rate in this area. Similar to Bayan Lepas, there is a statistically significant positive relationship between economic inequality and crime in Balik Pulau ($r = 0.298$, $p < 0.05$). This indicates that as economic inequality increases, the crime rate also tends to increase.

In comparison between the two areas, the relationship between social inequality and crime is significant and negative in Bayan Lepas but not significant in Balik Pulau. This indicates that social inequality may play a role in reducing crime in Bayan Lepas but does not have a significant impact in Balik Pulau. Similarly, both areas show a significant positive relationship between economic inequality and crime, although the correlation is slightly stronger in Bayan Lepas ($r = 0.367$) compared to Balik Pulau ($r = 0.298$). This suggests that economic inequality is a consistent factor in increasing crime rates in both areas.

The study's findings demonstrate that economic inequality significantly influences crime rates in both Bayan Lepas and Balik Pulau, while social inequality has a significant impact only in Bayan Lepas. Consequently, there is a positive significant relationship between inequality and crime for economic inequality in both areas. Given the unusual trend in findings from Bayan Lepas, social inequality is negatively linked to crime rates, contrary to common literature (Hagan & Daigle, 2023; Sampson & Wilson, 2013). This could be due to strong community support and cultural norms that mitigate inequality's impact on crime.

Malaysia's social policies and local dynamics, like effective community programs, may also play a role. Residents in these areas might feel less marginalized due to robust social networks, potentially leading to lower crime rates despite inequality. Interestingly, economic inequality shows a positive relationship with crime, suggesting it's a more significant factor here.

Overall, the unique social dynamics and local policies explain the unexpected relationship between inequality and crime in Bayan Lepas. Moreover, the study conducted by Anser et al. (2020) presents findings that contradict this study. They explain that income inequality and the unemployment rate increase crime rates, while trade openness supports reducing the crime rate. Crime rates significantly increase with income inequality, while health expenditures reduce the poverty rate. Per capita income is affected by the incidence of high poverty, while health expenditure and trade factors both increase per capita income across countries. However, the respondents' income level in this study is still categorized as low, with most belonging to the low-income group (B40). Therefore, there is no significant difference in the relationship between economic inequality and criminal activities in both urban and peri-urban areas.

CONCLUSION

This study investigated the relationship between inequality and crime incidences in urban and peri-urban areas. The findings reveal that Bayan Lepas and Balik Pulau areas are not considered high-risk for crime, but there are notable differences in residents' fear of crime. Interestingly, while income does not influence the fear of crime among respondents in Balik Pulau, residents with higher income levels in Bayan Lepas exhibit a greater fear of crime. Moreover, the results indicate that economic inequality significantly impacts crime rates in both Bayan Lepas and Balik Pulau, whereas social inequality only shows a negative significant effect in Bayan Lepas.

These findings emphasize the importance of addressing economic disparities as a means to reduce crime in both regions. Furthermore, they suggest the need to tackle social inequality specifically in Bayan Lepas to further mitigate crime rates. Future research could delve into why social inequality does not exert a significant impact on crime in Balik Pulau and explore other factors influencing crime rates in this area. By understanding these factors and their interplay, policymakers, practitioners, and community members can develop targeted interventions to address the root causes of social disorganization and promote community well-being.

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THE IMPACT OF COVID-19 ON THE USE OF URBAN PUBLIC FACILITIES: EVIDENCE FROM INDONESIA, JAPAN, AND EGYPT

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Abstract

Since COVID-19 emerged in Asia, the function of urban public facilities has been adapted to adapt to the pandemic conditions. This article discusses the use of public facilities during the COVID-19 pandemic in Indonesia, Japan, and Egypt using responses obtained from a questionnaire. The data retrieved were analyzed using the T-test statistical method and descriptive analysis. The results showed that the intensity of public facilities usage was reduced after community activities were restricted. Moreover, the decision to use the facilities tended to be based on the implementation of health protocols regardless of the distance from their homes. This is evident from the number of visits to modern shopping places rather than traditional markets to fulfill daily needs despite the longer distance and this indicates the focus on security and comfort. Information technology was also considered quite helpful in handling the pandemic as well as the latest information related to the development of the pandemic obtained quite easily from print media, announcements in several public facilities, and easily accessible websites.

Keywords: Use, Public Facilities, Urban Areas, Pandemic, Adaptation

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INTRODUCTION

COVID-19 affected the lives of people in urban areas in several ways including (1) environmental quality, (2) socio-economic impacts, (3) city management and governance, as well as (4) transportation and urban design (Sharifi & Khavarian-Garmsir, 2020). Restrictions imposed on activities in public places during the pandemic led to a reduction in the users of those located in working areas, schools, shops, and others (Howe & Hall, 2020). This indicates the effect of the pandemic on the adaptation of people's behavior (Mendolia, Stavrunova, & Yerokhin, 2020) and also raises public awareness on the importance of space as a shelter from virus transmission. It was, however, discovered to be a place considered to be prone to virus transmission during the pandemic (Devine-Wright et al., 2020).

The public is required to comply with the restrictions and social distancing imposed during the pandemic (Said et al., 2020) in order to prevent crowd formation (Mendolia et al., 2021). The term "social distancing" was used to ensure people stay at a reasonable distance from each other (Arimura, Ha, Okumura, & Asada, 2020) while restrictions were imposed on activities outside the home in order to reduce activities in public places (Li & Mutchler, 2020). However, these measures including restrictions on mobility, social distancing, and self-quarantine at home have the ability to cause mental health disorders in people (Sharmila Thinagar, et al., 2021) and have an impact on their health (Saraiva et al., 2021). The pandemic encourages urban areas to be more responsive to crises through smart, sustainable, and comprehensive planning in order to be able to face future crises (Eltarabily & Elghezanwy, 2020). Therefore, there is a need to study the adaptation of the community to the usage of public facilities during the pandemic based on the perceptions of the people in Indonesia, Japan, and Egypt as an academic contribution. The results are expected to be used by urban planners and policymakers in determining different forms of adaptation to be observed among the people in using public facilities during a pandemic. The third reason for choosing this country is that Japan, Indonesia, and Egypt experienced fluctuating pandemic waves and tended to rise in the second year of the pandemic (years of seeking research). Third countries have also never implemented a lockdown system but have applied the term restriction in various forms of various policies. The Japanese version of COVID-19 lockdown is a little weaker than those enforced elsewhere, where the stay-at-home request was voluntary (Sayeed & Hossain, 2020). In early April 2020, when Indonesia's neighbouring countries entered into lockdowns, the government tightened the work from home (WFH) orders by imposing large-scale social and announced an international travel ban a few weeks later, yet Indonesia did not enter into a full lockdown (Sparrow et al., 2020)

This research aims to study the community's adaptation in the use of public facilities during the pandemic (in three countries). **Research**

Question: How is the community's adaptation to using public facilities during the pandemic? (in three countries). Research Gaps (further developed/priority): various forms of adaptation to the use of public facilities can be implemented according to emergencies and policies of each country.

LITERATURE REVIEW

Health Protocol

The Government of Indonesia through the Ministry of Health issued a decree Number HK.01.07/Menkes/382/2020 concerning Health Protocols requiring public facilities to adapt to the new habits towards achieving a productive and safe society against COVID-19. Similarly, Japan and Egypt generally implemented some policies such as social distancing, wearing masks, and limiting the operating hours of several public facilities such as restaurants required to close before 8:00 PM. Moreover, educational facilities such as Elementary to Middle Schools were forced to limit the face-to-face learning process while universities were made to engage in hybrid learning in early 2021. Hospitals were made to be used only for emergencies with some clinics and hospitals rejecting patients that are not in emergency.

Emergency Declaration

Through the Ministry of Land, Infrastructure, Transport and Tourism, the Japanese Government issued an emergency declaration on 7th April 2020, asking residents in cities with high infections to reduce unnecessary travel. During the COVID-19 pandemic, the Government promoted a 'new way of life' such as using more parks and greenery to promote health, encouraging people to active in outdoor and green spaces while taking care of infection prevention (Ministry of Land, Infrastructure, Transport and Tourism Urban Bureau Town Development Promotion Division, 2020). The terms of working from home is expected to have a positive impact in many areas, such as improving work-life balance, prevents individuals from leaving their jobs due to changing life stages, increasing work productivity, ensuring business continuity in the event of a pandemic and reduce commuter congestion in metropolitan areas (Ministry of Land, Infrastructure, Transport and Tourism City Bureau Park Green Space / Landscape Division Utilization Planning Section, 2021). This is necessary due to the fact that the maintenance of health and social interaction has been discovered to be the only solution to the use of public facilities while maintaining a distance (Eltarabily & Elghezanwy, 2020).

In Japan, people are restricted from going out, and the perception that taking public transportation increases the risk of infection make reduction of the use of public transportation, thus leading to a decline in the city's attractiveness. It is vital to reduce the need to suppress mobility in the context of preventing infection (Kanda, 2021). The emergency declaration had an impact on the

reduction of commuting, less on eating and sightseeing. People were less active in the city centre but more visiting residential parks near their home (Hiroi, 2020). Reduced use of public transportation implies a higher likelihood of using private vehicles, and there is a need to be concerned about the elderly while driving private vehicles (Yamauchi et al., 2021). A higher proportion of the group with increased time spent at home reported increased satisfaction with travelling before and after COVID-19. Greater emphasis is placed on shopping and medical facilities (Otsuyama et al., 2020). In February 2020, as the initial month of the infection, park users increased in 90% compared to the previous year. The number of outdoor plaza users where hold events have decreased. With limited cross-border travel and gatherings, parks with close access to residential area and trees are used more actively than larger busier parks in the city centre (Takeuchi & Hisama, 2021). The expansion of COVID-19 infection is associated with people movement and proper infection control requires the collaboration of multiple sectors, including the transport sector (Hayashi & Zhang, 2021). Several forms of adjustment are needed to make public facilities more flexible to ensure the community adapts to the new normal and makes use of them safely (Cheshmehzangi, 2020). This is necessary due to the changes in the workplace, education, trade, and recreation caused by the restrictions imposed as a response to health issues (Maturana, Salama, & McInney, 2021).

Public Health

Public open space is important to support public health (UN Habitat, 2020) as indicated by the increase in the role of city parks to support the recovery of both mental and physical health of the people during the pandemic (Aiswarya Raj, Angella, & Pooja, 2021). However, the intensity of using these public facilities as a place for social interaction decreased due to restrictions on activities outside the home (Honey-Rosés et al., 2020a). The market which is also one of the important public facilities has the potential for crowd formation, thereby, creating an avenue to spread the virus but there is a need to ensure the continuance of buying and selling activities in order to supply people's daily needs and support the economic sustainability of the poor (Warlika, Putra, Fitri, & Primadella, 2021). Brambilla's research is exploratory, and further long-term research is needed, the findings of which resulted in the development of the OFAT assessment tool, OFAT, to evaluate the extent to which health facilities meet the principles of flexibility (Brambilla, Sun, et al., 2021). The study carried out at the DABC Politecnico, Milano developed a research activity to bring scientific evidence regarding Healthy Urban Planning and Design Strategies identified (Stefano Capolongo, Buffoli, Brambilla, & Rebecchi, 2020). Brambilla made a study to assess the quality of methods and tools, mainly when applied to public facilities such as hospitals. The existing BPE and POE tools are not specific enough. The new version of the instrument presented in his research can bridge

the gap by incorporating informed evidence indicators and a systematic weighting methodology. (Brambilla, Lindahl, Dell'Ovo, & Capolongo, 2021).

The model in size, scalable and replicable, turned out to be highly functional and adaptable during the health emergency period to be rejected in different scenarios for measures and equipment such as exhibitions, supermarkets, logistics poles, and other buildings for tertiary use (Brambilla, Mangili, et al., 2021). Starting from the minimum requirements indicated by the Lombardy Region, a validation checklist has been developed by experts in design, health care layout planning, hygiene, and public health, planning, and compliance, to provide managers of large-scale COVID-19 vaccination centers with a valuable and easy-to-use tool to ensure quality, safety and efficiency of the various activities carried out (S. Capolongo, Brambilla, Girardi, & Signorelli, 2021).

Public Facilities

COVID-19 pandemic showed the importance of planning these public facilities towards ensuring people visit with spreading or contracting the virus (Alizadehtazi et al., 2020). It also indicated the need to make sure the facilities adapt to minimizing the risk of virus transmission (Litman, 2021). This is considered important due to the ability of community activities to ensure people socialize and enjoy civilizations (Jasiński, 2020). Meanwhile, architecture is involved in the urban planning process and the design of public facilities during a pandemic need to consider new values, new habits, and requirements (Ateek, 2020). The lockdown and stay-at-home policies changed people's views on public facilities and this has the ability to reduce their sense of attachment when the restrictions are sustained for a long period (Honey-Rosés et al., 2020b).

The results of an online survey conducted by Snapcart on March 17-28, 2020, show that the Coronavirus pandemic has disrupted lifestyles, work habits, and doing business for Indonesian people, especially people in urban areas. The most disturbing impacts of COVID-19 are: 1) Social life, which ranks highest (48%), 2) Worries about career and work (44%), 3) Changes in vacation and travel plans (39%), 4) Worries about limited religious activities (31%), 5) Disruption of shopping habits (24%) (Dinisari, 2020). In addition, there are also suggested walkways, bike paths, COVID stations, station sinks, and some street furniture that can be adapted in public spaces. It is necessary to look at and review the problems that exist in accordance with the current planning situation (Hamzah & Sinniah, 2022). By identifying and producing a framework of sustainable COVID-19 framework for office building, the building manager or COVID-19 management team in workplace is encouraged to set up a sustainable COVID-19 framework as an advancement for existing COVID-19 guideline by integrating with IEQ. However, this framework is not only resilient to COVID-19, but also resilient to sustainability and can be used as future reference in context of

sustainability (Rahman et al., 2023). (Hamzah & Sinniah, 2022) investigates the scope of public spaces that consist of areas of streets, pedestrian lanes, and bike lanes, as well as an emphasis on several alternatives that can reduce the rate of infection in public space areas. There are several alternatives, such as whole, semi, and limited transit space design. These include the growing emphasis on health and safety, with commuters prioritizing modes that offer lower exposure to potential risks, such as crowded public transport (Lim et al., 2023)

RESEARCH METHODOLOGY

As discussed in the introduction, this research aims to explain the use of public facilities during the COVID-19 pandemic. So, the urgency of using the T-Test is to see the differentiating factors of respondents' preferences in adapting and finding the aspects that respondents pay the most attention to in adaptation. A survey method was used in this research to collect respondents' opinions on the use of public facilities during the COVID-19 pandemic. It is important to note that 1219 people were surveyed and the questionnaire used consisted of questions (Table 1).

Table 1. List of questions and descriptions

Question	Measurements	Description
Intensity of public facilities usage	5-scale Likert (1= never, 5= very often)	Respondents choose one answer according to the intensity of their public facilities usage.
Consideration of public facilities usage	5-scale Likert (1= strongly disagree, 5= very disagree)	Respondents choose one answer according to considerations in using public facilities.
Public facilities measured based on health protocol standards	5-scale Likert (1= very unsuitable, 5= very appropriate)	Respondents choose one answer according to implementations of health protocols in public facilities.
The ease of obtaining information on the use of public facilities during the COVID-19 pandemic	5-scale Likert (1= very not easy, 5= very easy)	Respondents choose one answer on the level of ease of obtaining information on the use of public facilities
Respondents' opinion on the role of Government in determining policies related to health protocols in public facilities	5-scale Likert (1= very unresponsive, 5= extremely responsive)	Respondents choose one answer.

Source: Studio (2022)

A T-test was conducted to test the research hypothesis regarding the effect of each independent variable partially on the dependent variable. In testing the hypothesis, it can be said to be significant when the T-statistics value is greater than 1.96. In contrast, if the T-statistics value is less than 1.96, it is considered insignificant (Ghozali, 2016). Decision-making is done by looking at the

significant value in the Coefficients table. Regression test results were obtained with a significance level of 5% ($\alpha = 0.05$). If the significance value of the T-test > 0.05 , then H_0 is accepted, and H_a is rejected. This means there is no influence between the independent variables on the dependent variable. If the significance value of the T-test < 0.05 , then H_0 is rejected, and H_a is accepted. This means that there is an influence between the independent variables on the dependent variable.

ANALYSIS AND DISCUSSION

The T-test results showed that the public facilities most visited during the COVID-19 pandemic were modern shopping places or supermarkets because they provide daily necessities and are cleaner than traditional markets. The aspect considered to have the most influence on their visitation was the implementation of health protocols and level of cleanliness. This means the respondents preferred clean public facilities with strict health protocols even though they are located far from their homes. Moreover, health protocol implementation, physical distancing, and avoiding crowds were the factors observed to have made the respondents feel safe to visit and use the public facilities as indicated in Table 2.

Table 2. T-test comparing the means of model variables and indicators with the neutral value of 3

Variable (indicator)	T	Significance (2-tailed)	Mean difference: 3
Public Facility			
PF1 (public transportation)	-27.305	0.000	-0.91058
PF2 (health clinic)	-35.607	0.000	-0.89582
PF3 (traditional market)	-18.295	0.000	-0.58783
PF4 (supermarket)	-2.889	0.004	-0.08532
PF5 (tourist spot)	-41.253	0.000	-1.06317
PF6 (city park)	-51.301	0.000	-1.31255
PF7 (place of worship)	-18.488	0.000	-0.65956
PF8 (sports venue)	-50.222	0.000	-1.38310
Considerations in using Public Facility			
CPF1 (distance)	7.164	0.000	0.23216
CPF2 (crowd)	6.577	0.000	0.25677
CPF3 (disinfectant)	38.627	0.000	1.14110
CPF4 (health protocols)	47.698	0.000	1.34126
Opinion on Public Facilities			
OPF1 (condition of public transportation)	3.711	0.000	0.10747
OPF2 (condition of health clinic)	29.108	0.000	0.71452
OPF3 (condition of traditional market)	-11.288	0.000	-0.32814
OPF4 (condition of supermarket)	9.519	0.000	0.26087
OPF5 (condition of tourist spot)	-3.582	0.000	-0.10418
OPF6 (condition of city park)	-2.220	0.027	-0.06317
OPF7 (condition of the place of worship)	20.720	0.000	0.56686
OPF8 (condition of sports venue)	2.018	0.044	0.05578

Variable (indicator)	T	Significance (2-tailed)	Mean difference: 3
Ease of Obtaining Information			
EOI1 (easy to get information)	23.848	0.000	0.68253
EOI2 (ease of use)	10.561	0.000	0.28630
Government Policies			
GP1 (government role)	10.930	0.000	0.34454

Note: n=1219. Shaded rows identify mean values that are not significantly different from the *neutral* value of 3 ($p < 0.05$).

Source: Studio (2022)

Table 2 shows that the public facilities that meet the COVID-19 health protocol standards according to respondents were health clinics and places of worship. The health protocols were implemented in places of worship by limiting the number of visitors, providing handwashing facilities, and checking body temperature. Moreover, the T-test showed the public facilities with values almost equal to the neutral value of 3 were tourist spots and sports venues indicating their health protocols were on the average and were rarely visited with over 50% of respondents stating they did not visit during the COVID-19 pandemic.

Use of Public Facilities During The COVID-19 Pandemic

- (1) public transportation, bus terminal, and train station: During the COVID-19 pandemic, 39.8% of respondents never used public transportation, bus terminals, and train stations, 29.9% used them regularly, 17% sometimes, 8% often, and 5.2% very often. Based on domicile, the majority of the respondents in Indonesia represented by 45.4% have never used public transportation nor visited bus terminals and train stations during the pandemic while 27% in Japan and 33% in Egypt use them sometimes and often, respectively.
- (2) Health clinic: The results showed that 24.3% did not use health clinic facilities, 49.2% used them regularly, 19.7% sometimes, 5.4% often, and 1.4% very often. Based on domicile country, 54.3% of Indonesians and 32% Japanese used them during the pandemic while 40% in Egypt used them very often.
- (3) Traditional market: It was discovered that 19.7% of respondents never shopped at traditional markets, 37.4% shopped regularly, 27.5% sometimes, 12.8% often, and 2.6% very often. Based on domicile, 38.5% in Indonesia shopped at the traditional market during the pandemic while 41% in Japan never visited the market and 40% in Egypt went there occasionally.
- (4) Modern shopping place, supermarket: A total of 6.2% of respondents never purchased from a supermarket, 31.6% shopped regularly, 34.6% sometimes, 19.9% often, and 7.7% very often during the pandemic. Based on domicile, 36.8% in Indonesia shopped while 30% in Japan never visit but 33% in Egypt often shopped at the supermarket.
- (5) Tourist spots: It was indicated that 37.7% never visited tourist attractions, 36.3% visited regularly, 21.5% sometimes, 3.7% often, and 0.8% very often.

Based on the country of domicile, the majority of respondents in Indonesia represented by 38.9%, Japan by 37.9%, and Egypt by 46% have never visited this public facility.

- (6) City Park and playground: The findings showed that 54.9% never used city park facilities and playgrounds, 26.4% used them regularly, 14.4% sometimes, 3.8% often, and 0.6% very often. Based on the country of domicile, the majority of respondents in Indonesia as indicated by 61.4% never used these facilities while the majority of those in Japan represented by 33.7 used them regularly, and 46% in Egypt used them occasionally.
- (7) Place of worship: It was observed that 31.4% never attended a place of worship, 31.2% attended regularly, 16.2% sometimes, 14.4% often, and 6.8% very often during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 33.2% attended a place of worship while 54% in Japan and 46% in Egypt never attended.
- (8) Sports venues: The results showed that 64% of respondents never used sports facilities, 17.7% used them regularly, 12.2% sometimes, 4.8% often, and 1.3% very often. Based on domicile country, the majority of respondents in Indonesia represented by 66.8%, Japan by 52.4%, and Egypt by 73.3% did not go to sports venues during the pandemic.

Considerations in Using Public Facilities During The COVID-19 Pandemic

- (1) Distance from home: The results showed that 10.3% strongly disagreed, 14.5% disagreed, 26.2% less agreed, 39.4% agreed, and 9.5% strongly agreed that distance from home was considered a factor to visit public facilities during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 41.2% and Japan by 34.1% agreed that the distance was considered while 40% in Egypt strongly agreed.
- (2) Crowd level: It was discovered that 15% strongly disagreed, 16.4% disagreed, 18.3% less agreed, 28.5% agreed, and 21.8% strongly agreed that level of the crowd was considered a factor to visit public facilities during the pandemic. Based on domicile, 26.8% of respondents from Indonesia and 36.3% from Japan agreed that the level of the crowd was considered while the majority of respondents in Egypt represented by 66.6% strongly agreed.
- (3) Disinfectant: The results also showed that 4.4% strongly disagreed, 3.9% disagreed, 8.9% less agreed, 38.8% agreed, and 44% strongly agreed that the availability of disinfectant was considered a factor to visit public facilities during the pandemic. Based on domicile country, 26.8% of respondents from Indonesia and 36.3% from Japan agreed that availability of disinfectant was a factor considered while the majority of those from Egypt represented by 66.6% strongly agreed. Implementation of health protocol: The findings showed that 3.9% strongly disagreed, 2.6% disagreed, 5.9% less agreed, 30.7% agreed, and 56.9% strongly agreed that health protocol implementation

was considered a factor to visit public facilities during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 47.3% and Egypt by 40% strongly agreed that the level of cleanliness was considered while 35.7% from Japan also agreed.

Respondent's Opinion on Public Facilities When Measured by Standard Health Protocols

- (1) Public transportation, bus terminals, train stations: The results showed that 8.9% strongly disagreed, 14.3% disagreed, 39.5% less agreed, 31.9% agreed, and 5.5% strongly agreed that public transportation, bus terminals, train stations conditions are in line with the standard health protocols during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 42% and Japan by 31.3% believe the public transportation facilities are not in accordance with health protocol standards while 40% from Egypt showed they are highly not in accordance.
- (2) Health clinic: It was also discovered that 2.5% strongly disagreed, 6.5% disagreed, 20.3% less agreed, 58.3% agreed, and 12.4% strongly agreed that health clinic conditions are in line with the standard health protocols during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 62.2% and Japan by 45.1% stated that health clinic facilities are in accordance with health protocol standards while 33% in Egypt showed they are not.
- (3) Traditional markets: The findings showed that 15.4% strongly disagreed, 24.3% disagreed, 40.7% less agreed, 17% agreed, and 2.7% strongly agreed that traditional markets conditions are in line with the standard health protocols during the pandemic. Based on the country of domicile, the majority of respondents in Indonesia as indicated by 42.7% and Japan by 34.9% believed the market facilities are not in accordance with health protocol standards while 53.3% in Egypt (53.3%) showed they are slightly in accordance.
- (4) Modern shopping places/supermarkets: The results also showed that 6% strongly disagreed, 13.1% disagreed, 34.8% less agreed, 41.1% agreed, and 5% strongly agreed that modern supermarkets' conditions are in line with the standard health protocols during the pandemic. Based on domicile country, 45% of respondents in Indonesia stated that supermarket facilities are in accordance with health protocol standards while 29.6% from Japan and 40% from Egypt stated otherwise.
- (5) Tourist spots: It was observed that 11.3% strongly disagreed, 19.3% disagreed, 42.1% less agreed, 23.2% agreed, and 4.1% strongly agreed that tourist spots conditions are in line with the standard health protocols during the pandemic. Based on domicile country, the majority of respondents in Indonesia as indicated by 44% and Japan by 36.6% stated that tourist spots

public facilities are not in accordance with health protocol standards while 33% from Egypt stated otherwise.

- (6) City parks and playgrounds: The findings showed that 10.1% strongly disagreed, 18.9% disagreed, 41.9% less agreed, 25.7% agreed, and 3.5% strongly agreed that city parks and playgrounds conditions are in line with the standard health protocols during the pandemic. Based on domicile country, the majority of respondents in Indonesia represented by 44% and Japan by 34.5% showed they are slightly in line with the standards while 40% from Egypt showed they were not.
- (7) Places of worship: The results showed that 3.9% strongly disagreed, 8.8% disagreed, 26.6% less agreed, 48% agreed, and 12.7% strongly agreed that the places of worship conditions are in line with the standard health protocols during the pandemic. It was also indicated that the majority of respondents in Indonesia (53.3%) believed they were in accordance with the standards while 39.4% from Japan showed they were not and 33% from Egypt indicated they were highly in accordance with the standards.
- (8) Sports venue: It was also discovered that 8% strongly disagreed, 16% disagreed, 42.5% less agreed, 29.5% agreed, and 4% strongly agreed that sports venues conditions are in line with the standard health protocols during the pandemic. Moreover, the majority of respondents in Indonesia represented by 44.4%, Japan by 34.9%, and Egypt by 46% indicated the sports facilities were less in accordance with the standards.

Respondents' Opinions on The Ease of Obtaining Information Regarding the Use of Public Facilities During the COVID-19 Pandemic

Ease of obtaining the latest information on the implementation of health protocols: A total of 3.5% of respondents stated it is very difficult to obtain the latest information on the implementation of health protocols, 10.7% believed it is difficult, 17.4% slightly difficult, 50.7% easy, and 17.7% very easy. Moreover, the majority of respondents in Indonesia represented by 55.8% and Japan by 32% found it easy to obtain the latest information while 26% from Egypt stated otherwise. Ease of use of public facilities for all people: The results also showed that 4.3% of respondents found it very difficult to use public facilities for all groups, 15.5% stated it was difficult, 33.3% slightly difficult, 40.9% easy, and 6% very easy. Moreover, the majority of respondents in Indonesia represented by 42% and Japan by 36.9% believed it was easy while 26% from Egypt felt it was slightly difficult.

CONCLUSION

The intensity of using public facilities as a place for social interaction in Indonesia, Japan, and Egypt was reduced due to restrictions imposed on activities outside the home during the COVID-19 pandemic. Therefore, several

adjustments were needed to make these facilities more adaptive for safe use by the public to reduce its potential for the transmission of the virus. The implementation of health protocols during the pandemic in the three countries affected the usage of public facilities with some selected to be used by the people due to the safety and comfortability they offered despite their long distance. Modern shopping places or supermarkets had a higher percentage of patronage compared to traditional market facilities due to the implementation of better health protocols and this was the same reason places of worship and health clinics had a large percentage of visits during the period. Places of worship are one of the public facilities with the potential for crowd formation but the number of users was limited during the pandemic but the respondents in Indonesia and Egypt considered these facilities safe to use due to their implementation of good health protocol standards while a contrary report was recorded in Japan. This contradictory finding is thought to be due to the difference in the dominance of the Muslim community in Egypt and Indonesia. They perform praying five times as a daily routine, while the Japanese people perform worship regularly (monthly or annually). The conclusions indicate that the three countries are compatible (Indonesia, Japan, and Egypt). This conclusion confirms the review in section 2. Some of the suggestions made for future planning of public facilities include strict application of health protocols, implementation of visitor restrictions, maintenance of the level of cleanliness and provision of handwashing facilities, usage of masks while in public facilities, regulation of visitor circulation to create a sense of security and comfort, limiting the number of public transportation passengers, paying attention to air circulation, especially in the room (indoor), as well as spraying disinfectants routine.

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EXPLORING INSTITUTIONAL INVESTORS' DETERMINANTS OF INVESTMENT IN AFFORDABLE HOUSING FUND

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Abstract

This study attempts to explore factors that may attract institutional investors to invest in affordable housing funds in Malaysia. Six traits of investments were tested, namely fund structure and mandate, market return, social return, risk mitigation, governance and transparency, and government support for the investment. Based on the six determinants, the study uses a partial least square structural equation modeling (PLS-SEM) technique using data gathered from a survey involving employees of institutional investment firms in Malaysia. The study found three significant factors motivating institutional investors to invest in affordable housing fund, namely social return, government support, and governance and transparency. Overall, it was found that institutional investors do greatly consider social elements in their investment decisions. This will potentially open new avenues in fundraising efforts to build more affordable housing, hence providing an adequate supply of these homes for those in need.

Keywords: Affordable Housing, Institutional Investors, Investment Determinants, Social Investment

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INTRODUCTION

Providing shelter is one fundamental human rights component that Islamic economics and finance must give undivided attention to. However, this is challenging since high house prices have been set by market forces. Consequently, one of the biggest problems facing large cities worldwide, including Malaysia, is having houses that are affordable. People naturally turned to the government for help since housing is a problem that need to be addressed on a social and political level. However, the government's options are constrained due to its limited fiscal capacity. In the same way, private developers will not construct unprofitable homes. Therefore, one potential solution is to get investments from institutional investors, who have large financial resources and could be able to resolve this conundrum.

One of the key initiatives to attract institutional investors to invest in affordable housing projects is to create instrument(s) that suit their risk profile and investment appetite as suggested by (Mohd Daud et al., 2020). This research surveys institutional investors in Malaysia on their preferences towards certain variables that may attract them to invest in affordable housing projects as proposed by (Mohd Daud et al., 2023). Six variables are tested, namely structure and mandate, market return, social return, government support, risk mitigation, and governance and transparency.

This research contributes to knowledge in four ways. First, this study is among the limited research done on trying to understand the motivation of institutional investors in their investment decision-making process. Particularly in the Malaysian context, there is limited research on these institutions, despite their significance influence in the financial market, due to huge amount of funds under management of these institutions. Second, research on institutional investors at the global level is also scarce. This study contributes to understanding institutional investors' decision-making and determinants of interest in their investment. Third, this study identifies crucial property trust funds performance indicators that may entice institutional investors to make investment. The policymakers may benefit by applying the attributes in structuring the investment vehicles. Fourth, although the study's main intention is to investigate what makes institutional investors want to invest in affordable housing funds, these same factors could be relevant to other socially conscious investment projects.

This article's remaining sections discuss the literature on investment determinants, the study methodology, and an interpretation of the findings. We wrap up this research by outlining the main findings and their implication for policymakers.

LITERATURE REVIEW

Since the inception of the global financial crisis, restrictions on public and private institutions have compelled governments in the United Kingdom and Australia to

encourage institutional investors and do research in this field (Milligan, Yates, Wiesel, & Hal, 2013; Milligan, Yates, Wiesel, & Pawson, 2013; Montague, 2012). The impetus behind these initiatives originated from the prosperous experience of the Low-Income Housing Tax Credit (LIHTC) system in the United States, which attracted considerable attention from institutional investors seeking to allocate capital towards social and affordable housing (Lawson et al., 2010). Despite being extensively and formally announced (M Berry et al., 2006; Mike Berry, 2000), the effort to solicit capital from institutional investors was unsuccessful, both in the United Kingdom (Crook & Monk, 2011) and in Australia (via public-private partnerships, equity investments, mortgages, REITs, housing supply bonds, and equity investment) (Milligan, Yates, Wiesel, & Pawson, 2013). Mohd Daud et al., (2020) emphasized the need for increased supply of affordable housing by encouraging institutional investors to invest more in such developments. A progressive affordable housing policy, with the primary objective of addressing prevailing challenges in affordable housing, is an essential requirement for the realization of such scheme (Mohd Daud et al., 2022).

Milligan, Yates, Wiesel, Hal, et al., (2013) & Pawson & Milligan (2013) delineated a multitude of factors that influence allocations towards the provision of affordable rental homes. The factors include resilient demand for rental housing, population and household growth, dynamics of social and economic structures that delay homeownership, major disruptions in traditional financing accessibility brought on by the global financial crisis, shortages of housing supply, and concerns about housing affordability. In addition, they outlined several significant obstacles that prevent institutional investors from investing in affordable housing in Australia. The critical factors include suboptimal returns when compared to infrastructure investments, compliance charges such as stamp duty and land taxes, risks associated with house prices and market information, counterparty and scale constraints, liquidity concerns arising from the lack of a secondary market, and intricate administrative matters. Regarding the concerns, several suggestions were put out, including risk mitigation, effective governance framework, and the imperative for governmental backing, particularly to initiate the undertaking. Their primary recommendation was to reduce the associated risks to attract institutional investors who would be willing to participate despite the potentially low return, provided that a reasonable risk-adjusted rate of return was offered.

Due to the paucity of research on the factors that attract institutional investors to invest in affordable housing, Socially Responsible Investment (SRI) was added to the evaluation. One could characterize an investment in affordable housing as a social investment. Social return, market-based return, risk mitigation, transparency and corporate governance, and government support were the other determinants to be tested.

Social return is the primary determinant. SRI funds, according to Benson & Humphrey (2008) are less return-sensitive than conventional funds. A range of factors, including non-financial rewards or utility (Beal et al., 2005; Bollen, 2007), social relations (Galema et al., 2008), collectivism (a type of social cohesion), religiosity, and environmental attitude, are considered by investors in this regard (Sreekumar Nair & Ladha, 2014).

Market-based return continues to be a significant factor in investment attraction (Bland et al., 2015; Galema et al., 2008). According to a study by Mukherjee & Roy (2011), return on equity for debt instruments had an impact on investment decisions for mutual funds in the India market, but not for equity instruments. As posited by Galema et al., (2008), administration expenses must be minimal to guarantee an adequate market return.

In addition, adequate risk reduction is a crucial factor in attracting investments. Management risk, property risk, and operational risk are among the most significant dangers. Furthermore, because of the investment's distinctive and innovative framework, investors demand a greater risk premium (Lawson et al., 2009, 2010; Milligan, Yates, Wiesel, & Hal, 2013). Bland et al., (2015) identified three significant characteristics that significantly impact depositors' demand for government investment instruments in Texas: default risk, liquidity risk, and market risk. Mutual funds, according to Ferreira & Matos (2008), prioritize liquidity to a larger extent than insurance firms and banks. In addition, they stress the importance of having an adequate-sized fund to mitigate information asymmetry.

The risk premium of the investment may be diminished, or the government may assist in the form of a reduction in the development's associated expenses. Tax incentives, subsidies, reduced compliance obligations, higher density, lenient loan terms, and decreased investment transaction costs comprise the associated costs. Government guarantees comprise the majority of the risk premium (Gurran & Phibbs, 2013; Lawson et al., 2009, 2012; Milligan, Yates, Wiesel, & Hal, 2013).

The behavioral components of investing decisions cannot be ignored, even if the goal of this study is to investigate how institutional investors' motivations influence their choices. The behavioral aspects of human choice, such as attitude and belief, are still significant in this study since it focuses more on the crucial success element influencing institutional investors' investment decisions. Standard items from behavioral theories like the Theory of Reasoned Action and the Theory of Planned Behavior are incorporated and utilized in this research.

Based on the above, this research identified a deficiency in the literature about the financing of the development of affordable housing in Malaysia, particularly regarding institutional investment that is open to the principles of social finance and responsible financing.

RESEARCH METHODOLOGY

This study uses purposive non-probability sampling method, by collecting data from a sample of institutional investors in Malaysia. The respondents are selected based upon the criteria that they must be employees of institutional investment firm and involved with investment activities in their job. These institutional investors might include the Armed Forces Fund Board (LTAT), Permodalan Nasional Berhad (PNB), Tabung Haji, Retirement Fund Incorporated (KWAP), Employee Provident Fund (EPF), and Khazanah Nasional Berhad.

For data analysis, we employed Partial Least Square Structural Equation Modeling (PLS-SEM). SEM can quantitatively evaluate previous theoretical hypotheses in comparison to empirical evidence. Using this method, the properties of the scales employed are measured against the theoretical constructs and relationships among said constructs are hypothesized (Barclay et al., 1995; Chin et al., 2003).

A total of 252 answers were obtained. With an average of six to ten years of work experience in institutional investment, most respondents work in the departments of equities and fixed income investments. Majority held a bachelor's degree, with a significant number also had professional qualifications like CFA and ACCA.

ANALYSIS

There are 46 constructs used to measure the six variables. The evaluation of multi-collinearity among indicators is done to validate the formative measurements. The results in Table 1 show that all indicators for formative constructs satisfy the VIF values and they were consistently below the threshold value of 5 as suggested by (Hair et al., 2017). It can thus be concluded that collinearity was not a problem for the estimation of the PLS path model and did not approach critical levels in any of the formative constructs.

Next, the significance and relevance of the formative constructs' outer weights were then analysed. The results suggest too many non-significant results for the items. As posited by Hair et al., (2017), the non-significant indicator weights should not be automatically excluded as poor measurements. In essence, consideration should be given to the formative indicator's absolute relevance to its construct (i.e. its loading). Apart from items MR01, MR04, SM08, and IN06, which did not meet the minimal requirements of loadings over 0.50 and t-values more than 1.96, the outer loading findings show that all formative indicators were significant. However, prior research supported the inclusion of item MR04 to capture the operational definition of Market Return (Li et al., 2005). Nevertheless, Item SM08 was retained to capture the operational definition of structure and mandate due to the content validity process's strong support. Consequently, the formative construct's elements MR01 and IN06 were removed. Table 1 outlined the final outer loadings for all the constructs.

Table 1: Outer Loadings Result for Constructs

Construct	Items	Loading	VIF	t-value weights	Sig
Structure & Mandate	SM01	0.546	1.299	4.934	0.000
	SM02	0.753	1.537	8.479	0.000
	SM03	0.259	1.340	2.123	0.034
	SM04	0.653	2.135	6.815	0.000
	SM05	0.501	2.017	4.652	0.000
	SM06	0.449	1.489	4.100	0.000
	SM07	0.523	1.570	4.862	0.000
	SM08	0.323	1.359	2.571	0.010
	SM09	0.633	1.303	7.209	0.000
Market Return	MR02	0.624	1.415	4.377	0.000
	MR03	0.669	1.171	4.567	0.000
	MR04	0.149	1.171	0.765	0.444
	MR05	0.734	1.220	5.148	0.000
	MR06	0.369	1.031	2.250	0.024
Social Return	SR01	0.730	2.162	10.777	0.000
	SR02	0.763	3.598	11.496	0.000
	SR03	0.821	3.851	15.359	0.000
	SR04	0.735	1.751	10.787	0.000
	SR05	0.850	2.864	12.643	0.000
	SR06	0.764	1.951	9.098	0.000
	SR07	0.775	1.837	10.646	0.000
Risk Mitigation	RI01	0.822	1.318	10.821	0.000
	RI02	0.495	1.310	3.998	0.000
	RI03	0.599	1.214	5.304	0.000
	RI04	0.418	1.468	2.367	0.018
	RI05	0.639	1.478	5.552	0.000
	RI06	0.382	1.187	2.637	0.008
	RI07	0.462	1.370	3.558	0.000
Governance & Transparency	GT01	0.345	2.555	1.955	0.051
	GT02	0.362	2.886	2.127	0.034
	GT03	0.706	2.223	5.792	0.000
	GT04	0.674	1.202	7.494	0.000
	GT05	0.887	1.795	13.569	0.000
	GT06	0.296	1.532	2.087	0.037
Government Support	GS01	0.654	1.617	6.862	0.000
	GS02	0.741	1.486	7.966	0.000
	GS03	0.666	2.062	5.686	0.000
	GS04	0.534	2.309	5.206	0.000
	GS05	0.471	1.936	3.809	0.000

Construct	Items	Loading	VIF	t-value weights	Sig
	GS06	0.616	1.684	6.056	0.000
	GS07	0.471	1.556	4.748	0.000
	GS08	0.734	1.473	8.956	0.000
	GS09	0.730	1.973	6.672	0.000
Intention to Invest	IN01	0.809	1.897	11.728	0.000
	IN02	0.620	1.347	6.525	0.000
	IN03	0.607	1.213	6.137	0.000
	IN04	0.822	3.068	11.456	0.000
	IN05	0.767	2.646	11.509	0.000
	IN07	0.498	1.250	4.074	0.000

Standardized Root Mean Square Residual (SRMR) was used to quantify the model's goodness of fit after the measurement model was evaluated. The squared difference between the observed and model-implied correlations is known as the SRMR. A value of SRMR less than 0.1 is considered a good fit (Hu & Bentler, 1998). The value of the Standardized Root Mean Square (SRMR) analysis is 0.089. This suggests that for both saturated and approximated models, the model fits data rather well. After that, the structural model is assessed for lateral collinearity issues. Results shows that all the Inner VIF values for the independent variables are less than 5 and 3.3, thus indicating collinearity is not a concern (Hair et al., 2017).

Evaluating the importance and applicability of the structural model connection is the second phase in the structural model evaluation process. It is clear from examining the relative significance of the exogenous variables in predicting the dependent construct (Intention to Finance) that Social Return (0.322), Government Support (0.279), and Governance & Transparency (0.182) are the most significant predictors. At the 95% significance level, these three predictors were significant. The remaining three predictors - Market Return (0.078), Structure & Mandate (0.073), and Risk Mitigation (0.027) were not significant and were considered weak predictors. Additional analysis is performed by evaluating the confidence interval bias adjusted to confirm this. To interpret the analysis's findings, the study examines the figure at 5.0% and 95.0% confidence intervals. If 0 is not straddled in between the confidence interval bias results, this indicates a significant result (Ramayah et al., 2018). The findings for Social Return, Government Support, and Governance & Transparency were significant, but Market Return, Risk Mitigation, and Structure & Mandate were not. Then, value of R^2 is evaluated. The value of R^2 is 0.561, and the value of adjusted R^2 is 0.55. These values are moderately predictive and accurate (Hair et al., 2017).

Assessing the amount of effect size (f^2) is the next stage in the evaluation of the structural model. The f^2 values of 0.35, 0.15, and 0.02 are

considered as large, medium, and small respectively (Cohen, 1988). The outcome shows that R2 (Finance Intention) has a large effect from Government Support (0.111), Social Return (0.099), and Governance and Transparency (0.049). The outcome also suggested that R2 (Finance Intention) has a small effect from Market Return (0.01), Structure and Mandate (0.007), and Risk Mitigation (0.001). The final path coefficient of the model was generated after all the assessments were completed. The result of assessment of structural model using PLS-SEM in Figure 1 suggests that there are significant results for Governance & Transparency, Government Support and Social Return, whilst depicting a non-significant result for Market Return, Risk Mitigation and Structure & Mandate.

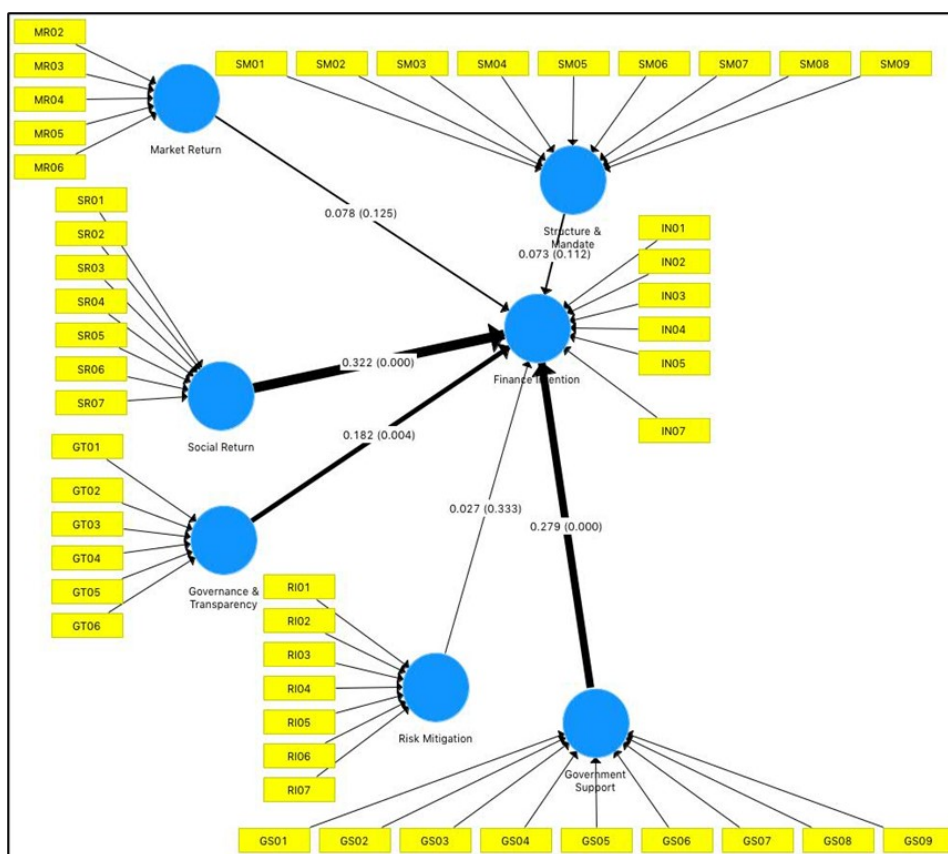


Figure 1: Assessment of structural model

Institutional investors consider social return as the most important predictor. This outcome is consistent with the directive of certain institutional investors, who are only allowed to make investments in conformity with the

United Nations Principle of Responsible Investment (UNPRI), Environmental, Social and Governance (ESG), and Socially Responsible Investment (SRI). Other institutional investors will attempt to follow the Malaysian Code for Institutional Investors if they are not mandated to invest in SRI/ESG/UNPRI compliance. Furthermore, the United Nations Principles for Responsible Investment (UNPRI) are endorsed by one institutional investor, KWAP. The UN Secretary-General called for the creation of UNPRI, which was developed by a global consortium of institutional investors considering the significance of environmental, social, and corporate governance concerns in the investing process. In essence, investments that adhere to SRI/ESG/UNPRI investing guidelines will entice institutional investors. This is consistent with the findings of Pasewark & Riley (2010), who discovered that investors care about social return in addition to monetary gain.

The second most important factor that has been shown to be critical in enticing institutional investors to make investments is government assistance. Since the present housing market is thought to be skewed and needs government intervention to fix the imbalances in the market, help from the government is considered required. Items in the questionnaire addressed to institutional investors focus more on reducing red tape, lowering compliance costs and stamp duty, and offering an investment-friendly legal environment. These will not require monetary backing from the government. The finding is aligned with research by Gurran & Whitehead (2011), who outlines the importance of government support to attract investment, especially for greenfield project which does not have track record.

Institutional investors regard governance and transparency as important predictors as well. The public's constant scrutiny of institutional investors makes strong governance and increased transparency imperative. The result is in line with Schaefer (2003), who indicates that good governance and transparency to be substantial determinants of luring investment. Essentially, number of variables in this theme such as investor protection (Abdioglu et al., 2013; Aggarwal et al., 2005); high information disclosure (Abdioglu et al., 2013); transparent market (Gelos & Wei, 2005); issuance of instrument by strong institution (Cai & Warnock, 2006); separation between ownership and control (Kim et al., 2011); diluted ownership structure (Ferreira & Matos, 2008); and transparent accounting policies (Aggarwal et al., 2005) are key towards achieving good governance and transparency.

It is interesting that market return, commonly perceived as one of the most important factors in deciding investment decisions, is not a main predictor of institutional investors' decision to invest. This negates the finding by Milligan, Yates, Wiesel, Hal, et al., (2013), who expect that the market-based return to play a significant role in attracting investment towards financing affordable housing. Nonetheless, care should be used when interpreting the analysis's findings. The

concept of market return is constructed using three distinct benchmark items for comparative analysis: one that pertains to cost-benefit analysis, another to the fiduciary obligation of investors to maximize returns, and a third that is profitability-related. From these five items, three items are significant at 95% significance level, which are benchmarking against Malaysia House Price Index, benchmarking against Sustainable and Responsible Investment (SRI) sukuk, and institutional investors' fiduciary obligation to provide investors with the maximum possible return. The institutional investors appear to be at odds with the reduced return on investment that may result from funding an affordable housing project; they may think that the effort may be competitive and provide a respectable return without sacrificing affordability. Additionally, the benchmarking exercise will go against the primary motivation for establishing the Fund, as the management of the Fund will want to maximize profit rather than provide housing at a reasonable cost.

Another predictor that is insignificant is structure & mandate. Majority of the respondents support the Fund's designation as SRI fund. This is potentially due to institutional investors in recent times have a mandate of investing only in ESG and SRI compliance investment. Furthermore, those surveyed express a preference for the Fund to be supported by the government or government-affiliated institutions.

Risk Mitigation is another construct that is rated as non-significant. This contradicts with Northern Ireland Assembly (2010), which argue that sufficient risk mitigation strategy employed will encourage investors to contribute to the financing of affordable homes. Like the Market Return, though, one should proceed cautiously when dealing with this predictor's insignificance. Most of the elements on this construct are designed to reduce risk through involvement and guarantees from the government. The findings may indicate that while the respondents did want the government to be involved in the program, they did not want it to go so far as to interfere or offer guarantees.

CONCLUSION

The characteristics of investments that might entice institutional investors to fund affordable housing projects in Malaysia are examined in this study. For policymakers to create investment vehicles that may be used to entice private investment into this project, it is imperative that they identify and outline these characteristics. Rent-capped housing and a new business model for housing supply with regulated profit are necessary for this to be successful. In essence, a comprehensive strategy to housing finance and development with the involvement of institutional investors may be able to achieve the Malaysian government's aim of delivering more affordable housing units. It is thus necessary to establish affordable housing as an asset class to achieve this aim.

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REMOVAL OF VARIOUS METAL IONS IN WATER BY DIFFERENT PRE-TREATMENTS OF FLY ASH

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Abstract

Rapid urbanisation in Malaysia has accelerated water pollution in rivers and other water sources, causing irreversible harm to the ecosystem. In view of that, this study aimed to work on using fly ash to address certain heavy metal components (chromium (Cr), copper (Cu), nickel (Ni), and zinc (Zn)) present in polluted water. The experiment employed three batches of fly ash. Two batches were treated with sodium hydroxide (NaOH-FA) and hydrochloric acid (HCl-FA), whereas one batch was left untreated (UFA). The three batches of adsorbents were examined by using a jar test after solutions containing 100 mg/L of Cr, Cu, Ni, and Zn ions were made. The results of various contact periods demonstrated that the fly ash had variable capacities for metal ion adsorption. The maximum adsorption of UFA was 79.958%(Cr), 80.814%(Cu), 81.580%(Ni), and 82.742%(Zn) while HCl-FA was adsorbing 77.148%(Cr), 82.546%(Cu), 78.896%(Ni), and 78.248%(Zn). NaOH-FA in this study was found to adsorb 80.828%(Cr), 79.230%(Cu), 81.692%(Ni), and 77.394%(Zn). Further to this, it was revealed that the Temkin Isotherm model was best fitted with the highest R^2 values (> 0.98). The negative value of the slope, B indicated that the adsorption is an endothermic process which leans towards physical adsorption. In conclusion, this study demonstrated the successful application of fly ash in water or wastewater treatment of metal ions.

Keywords: fly ash, metal ions, water treatment, adsorption, water pollution

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INTRODUCTION

Water is one of the most precious natural resources on earth. Even though freshwater makes up only less than 3% of the earth's surface, it is nonetheless frequently over-extracted and contaminated by humans due to their activities. As per the World Health Organization (WHO) guidelines, people should receive a minimum of 7.5 litres of treated water daily, with an immediate need for at least 15 litres during the initial post-impact period (WHO, 2023).

Malaysia is not an exception as it is also one of the countries grappling with challenges arising from water pollution (Habibullah et al., 2023). Despite having abundant water resources, we are still facing water disruption from time to time in some areas due to the illegal dumping of wastewater by irresponsible parties to their nearby rivers (Goi, 2020; Salleh et al., 2022). As stated by Othman et al. (2018), the rivers in Malaysia have been contaminated by heavy metals recently due to rapid urbanisation and industrialisation. The common heavy metals that are released by industrial wastes are zinc (Zn), lead (Pb), copper (Cu), iron (Fe), chromium (Cr), cadmium (Cd), manganese (Mn), and nickel (Ni) which are toxic and harmful to the environment and human health (Alsaffar et al., 2019). According to Feary and Cullinan (2019), these toxic heavy metals are commonly produced and discharged from metal refining factories, thermal power plants, petroleum refineries, battery industries, and smelting plants. The accumulation of these heavy metal contaminants in water not only affects human health with various kinds of diseases but also the growth reduction of plants and reduced breeding potential of adult fish. One of the examples, itai-itai disease found in Japan was due to the high concentration of cadmium (Cd) exposure and the symptoms of this disease that include bone pain and renal tubular dysfunction (Nguyen, 2020).

Regrettably, conventional municipal wastewater treatment lacks any designated process for removing heavy metals from the water. The conventional treatment mentioned here involved the primary settling and biological nutrient removal or activated sludge process (Sylwan and Thorin, 2021). In fact, there is a range of drawbacks to these conventional wastewater treatment systems, including high chemical consumption, releases of greenhouse gases, significant power consumption, and high operational and construction costs (Tan et al., 2023). Owing to this condition, various water and wastewater treatment methods are currently available and promoted in the market to remove different types of pollutants. These methods included membrane filtration, ion exchange, and adsorption. Amongst these methods, adsorption has become the most popular technique used due to its simplicity, effectiveness, and low cost. Many researchers are focusing on a variety of materials, particularly those that are natural and inexpensive, to explore their adsorption capabilities due to their inherent physical and chemical properties. These adsorbents often come from the

by-product of agricultural or industrial processes, and thus are readily available and economical. Examples of natural and low-cost adsorbents are ash, wood, clay, corn cob, fruit peel, wheat straw, starch graft, and moss (Ramesh, et al., 2016).

In Malaysia, there are about 43% of electricity is generated from coal-fired power plants (Mardi et al., 2023). During coal combustion, fly ash is one of the waste by-products of coal-fired electric power plants. According to Ghazali et al. (2019), Malaysia generates around 6.8 million tonnes of fly ash annually, while global production reaches approximately 750 million tonnes, and this is still continually increasing every year (Beddu et al., 2018). The main compositions that makeup around 90% of the fly ash are silicon dioxide (SiO₂), aluminium oxide (Al₂O₃), iron oxide (Fe₂O₃), and calcium oxide (CaO). Undoubtedly, fly ash has a strong adsorption capacity due to its porous structure and large surface area. However, only a small amount of fly ash has been widely adopted in the cement component for the concrete to improve its workability and avoid segregation (De Maeijer et al., 2020). Despite that, its utilisation remains marginal as compared to the overall yield. Several researchers used fly ash to remove the pollutants from the contaminated water. Based on the previous study by Nguyen et al., (2020), modified fly ash was tested and successfully removed a maximum of 97% and 90.80% of Cd²⁺ and Hg²⁺ ions respectively. Darmayanti et al. (2017) also claimed that fly ash was able to remove 24.9% to 93.9% of Cu ions by using 1 g/L to 10 g/L of fly ash. Besides, Eteba et al.(2021) observed that observed remarkable removal efficiency, with fly ash removing over 97% of direct blue 78 dye at doses ranging from 3 g/L to 5 g/L. At the same time, Chen et al. (2021) reported that treated fly ash exhibited substantial removal rates, with removal efficiencies of 74.37% for Pb²⁺ and 82.71% for Cd²⁺.

Fly ash is readily available, reusable, low-cost, and environmentally sustainable (Ramesh et al., 2016). By assisting in their recycling, the inexpensive adsorbents also aid in addressing the issue of solid waste products in the environment. As a result, it is worthwhile to investigate further how fly ash can be used in various situations. Our study fills a crucial gap by investigating the impact of various pretreatments on the adsorption performance of fly ash for different heavy metal ions. Surprisingly, there is limited research comparing these aspects. It is discovered that pretreatment doesn't universally ensure superior adsorption, emphasizing the need for tailored approaches. Therefore, this study aimed to (1) investigate the adsorption capacity of fly ash by using untreated and chemical treated (using HCl and NaOH) in removing Cr, Cu, Ni, and Zn ions from aqueous solution, and (2) analyse the adsorption capacity of different pretreatments of fly ash in removing various metal ions from solution by isotherm models.

RESEARCH METHODOLOGY

Materials

In this study, fly ash (FA) was collected from Jimah Power Plant which is located at Port Dickson, Negeri Sembilan. It was washed thoroughly with distilled water to remove the impurities and oven dried at 120 °C for 24 h. After that, the fly ash was allowed to cool at room temperature prior to being sieved to 250 µm. The fly ash was later separated into three batches, the first batch was an untreated sample and the other two batches were treated by using 0.5 mol of sodium hydroxide (NaOH) and 0.5 mol of hydrochloric acid (HCl). In the pretreatment phase, 72 g of fly ash were immersed separately in two distinct beakers containing 0.5 mol of NaOH and 0.5 mol of HCl solutions for 24 h as depicted in Figure 1. Both chemicals treated fly ash were subsequently filtered and rinsed with distilled water to eliminate the excess NaOH and HCl from the surface. The pretreated fly ash was then dried at 105 °C for 24 h for further use.



Figure 1: Fly ash soaked in HCl and NaOH

Preparation of Stock Solution

The stock solution of Cr (VI), Cu (II), Ni, and Zn (II) ions with a concentration of 100 mg/L was prepared separately by using chromium (VI) oxide, copper (II) oxide, nickel (II) chloride, and zinc oxide in accordance with EPA Method 6010 D. The pH value of the stock solution was adjusted by adding 0.1 mol of NaOH and 0.1 mol of HCl (Naiya and Das, 2016).

Adsorption Experiment

This adsorption experiment was conducted by using a jar test apparatus with a maximum of 6 beakers in a batch. A series of jar test experiments were carried out by placing 100 mL of Cr, Cu, Ni, and Zn ions aqueous solution with a fixed concentration of 100 mg/L. Then, 3g of untreated fly ash was added to each beaker. The pH value of the solution was adjusted to the desired value of pH 7 by using 0.1M HCl or 0.1M NaOH. The experiment process involved two stages which were rapid mixing for 3 min at 160 rpm and followed by a slow mixing for

17 min at 40 rpm. Figure 2 demonstrates one of the settings in the Jar test. Next, water sample was collected for 60 min, 90 min, 120 min, 150 min, 180 min, and 210 min for testing and analysing the final concentration for each heavy metal. The aforementioned steps were repeated by using acid-treated and alkaline-treated fly ash.



Figure 2: Jar test apparatus and setting

Analytical Method

In this study, the percentage removal for heavy metal ions and the adsorption capacity of the various pretreated fly ash were first calculated and estimated by using Equation 1 and Equation 2, respectively (Rondón et al., 2013). Then, the adsorption isotherm models, such as Langmuir, Freundlich, Temkin, Brunauer-Emmett-Teller (BET), and Dubinin Radushkevich (D-R) isotherm models were further analysed for the experimental data to describe the adsorptive isotherm performed in the adsorbent to the adsorbate. The suitability of these models to the experimental data was later praised by the regression coefficients (R^2) based on the formation of linear graphs (Ohale et al., 2020). Table 1 shows the various adsorption isotherm models used for the study.

Table 1: The adsorption isotherm models used for this study.

Analytical methods	Equations	
Percentage removal	$\%R = \frac{c_0 - c_e}{c_0} \times 100$	(1)
Adsorption capacity	$q_e = \frac{(c_0 - c_e) \times V}{m}$	(2)
Langmuir	$\frac{C_e}{q_e} = \frac{C_e}{Q_m} + \frac{1}{Q_m K_L}$	(3)
Freundlich	$\text{Log } q_e = \text{Log } K_f + \frac{1}{n} \text{Log } C_e$	(4)
Temkin	$q_e = B \ln K_T + B \ln C_e$ and	(5)

		$B = \frac{RT}{b_T}$	(6)
Brunauer-Emmett-Teller (BET)		$\frac{C_e}{q_e(C_s - C_e)} = \frac{(C_{BET} - 1)}{Q_m C_{BET}} \left(\frac{C_e}{C_s}\right) + \frac{1}{Q_m C_{BET}}$	(7)
	and		
		$C_s = C_0 - C_e$	(8)
Dubinin Radushkevich (D-R)		$\ln \ln q_e = \ln \ln Q_m - K_{DR} \varepsilon^2$	(9)
	and		
		$\varepsilon = RT \ln \ln \left(1 + \frac{1}{C_e}\right)$	(10)
	and		
		$E_{DR} = 1/\sqrt{2K_{DR}}$	(11)
C_0	Initial concentration of adsorbate (mg/L)		
C_e	Concentration of the adsorbate in the solution at equilibrium (mg/L)		
V	Volume of solution (L)		
m	Weight of adsorbent (mg)		
q_e	Amount of metal ions being adsorbed per specific amount of adsorbent (mg/g)		
Q_m	Maximum adsorption capacity of metal ions (mg/g)		
K_L	Langmuir isotherm constant which is related to the adsorption capacity (L/mg)		
K_f	Freundlich isotherm constant		
n	Adsorption intensity of the adsorbate to adsorbent or surface heterogeneity.		
B	Constant related to heat of sorption (J/mol)		
R	Universal gas constant, (J/mol K)		
T	Absolute temperature (K)		
b_T	Factor related to the interaction between the adsorbent and adsorbate		
K_T	Equilibrium binding constant (L/g)		
C_{BET}	Energy interaction with the surface of the adsorbent		
C_s	Saturation concentration (mg/L) $C_0 - C_e$		
K_{DR}	Dubinin Radushkevich model constant or activity coefficient		
E_{DR}	Removal energy of the adsorbate to adsorbent.		
ε	Polanyi potential		

RESULTS AND DISCUSSION

The results and analysis of the study were presented and discussed in the following sections.

Effectiveness of the various pretreated fly ash in various metal ions removal

The effectiveness of pretreated fly ash (UFA, HCl-FA, and NaOH-FA) in adsorbing various metal ions (Cr, Cu, Ni, and Zn ions) were examined. Figure 3 shows the result obtained for UFA, HCl-FA, and NaOH-fly ash in removing the Cr, Cu, Ni, and Zn ions from the aqueous solution, respectively with an initial concentration of 100 mg/L.

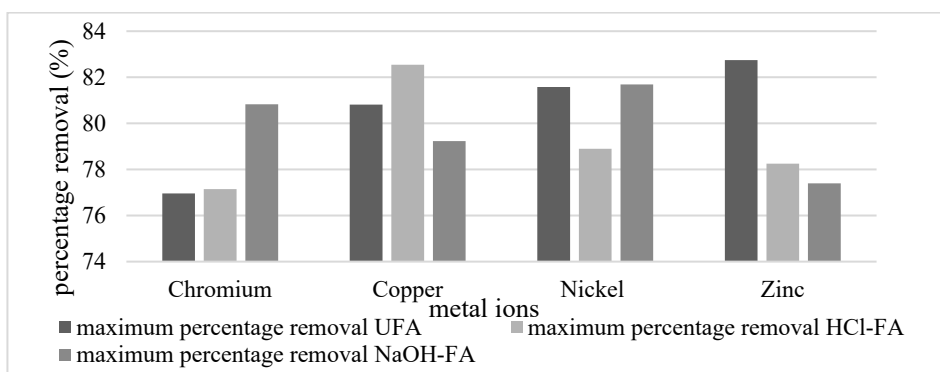


Figure 3: Percentage removal of different pretreated fly ash to Cr, Cu, Ni, and Zn ions solution.

From Figure 3, the maximum percentage removal of Cr ion by UFA was 76.958% on a contact duration of 90 min. HCl-FA achieved a maximum Cr ion removal of 77.148% within a contact duration of 150 min. For alkaline-treated fly ash, the maximum Cr ion removal was 80.828% within 210 min of contact period in an aqueous solution. For the Cu ion solution, UFA was able to adsorb a maximum of 80.814% on contact duration of 120 min. For acid-treated fly ash, the maximum removal percentage for Cu ion was 82.546% at 90 min of contact time, while 79.230% of Cu ion was removed by NaOH-FA within 150 min of contact time. Likewise, for Ni ion, the maximum removal percentage for UFA, HCl-FA, and NaOH-FA were 81.580% at 180 min of contact time, 78.896% at 180 min of contact time, and 81.692% at 150 min of contact time, respectively. For the Zn ion solution, the maximum percentage removal for UFA, HCl-FA, and NaOH-FA were 82.742% at 180 min of contact time, 78.248% at 210 min of contact time, and 77.394% at 180 min of contact time.

The obtained results indicated that the adsorption of metal ions in the aqueous solution exhibited minor fluctuations for each distinct type of fly ash as the contact time varied. This is due to the different surface area of fly ash and led to the amount of free adsorption site. Li et al. (2016) stated that with the continuation of adsorption time, adsorption became more saturated, and solute diffusion to the surfactant concentration was hindered. In addition, there was a slight outperformance of Ni ion removal by NaOH-FA as compared to UFA and HCl-FA, while HCl-FA was slightly better at removing Cu ions from an aqueous solution. Then, the performance in the case of Zn ion by UFA is remarkable as compared to the adsorption performance on other metal ions. This indicated that the functional group of different pretreatments of fly ash have affected the affinity of metal ions onto the fly ash. For instance, the modified FA by NaOH solution increased the surface area and the negative charge of the fly ash (Ranasinghe et al., 2022). According to Alterary and Marei (2021), as pH value increased, the

negatively charged adsorbent was predicted to have a better attraction to the positively charged nickel and chromium ions in the solution. In this scenario, the electrostatic attraction may be the main factor due to the higher pH value in adsorbing metal ions as compared to the lower pH value (Adewoye et al., 2017). To gain a deeper understanding of the adsorption capacity of distinct pre-treated fly ash samples for different metal ions, Figure 4 illustrates the adsorption capacity of these pre-treated fly ash variants in the removal.

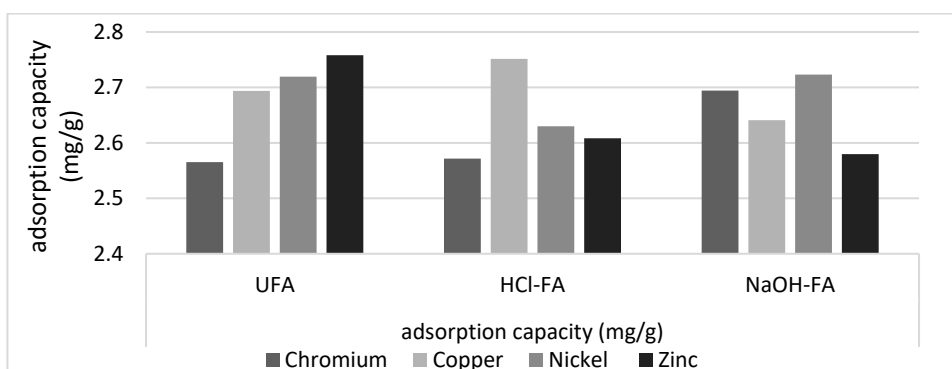


Figure 4: The adsorption capacity of UFA, HCl-FA, and NaOH-FA in various metal ions solutions.

In Figure 4, the results indicate that the adsorption capacities of UFA, HCl-FA, and NaOH-FA are comparable within a similar range of adsorption capacities from 2.5 mg/g to 2.8 mg/g. The maximum adsorption capacity in the order from highest to lowest was 2.7581 mg/g for Zn ion by UFA > 2.7515 mg/g for Cu ion by HCl-FA > 2.7231 mg/g for Ni ion by NaOH-FA > 2.7193 mg/g for Ni ion by UFA > 2.6943 mg/g for Cr ion by NaOH-FA > 2.6938 mg/g for Cu ion by UFA > 2.641 mg/g for Cu ion by NaOH-FA > 2.6299 mg/g for Ni ion by HCl-FA > 2.6083 mg/g for Zn ion by HCl-FA > 2.5798 mg/g for Zn ion by NaOH-FA > 2.5716 mg/g for Cr ion by HCl-FA > 2.5653 mg/g for Cr ion by UFA.

When the fly ash is pretreated with acid or alkali, the chemicals become immobilised at the adsorbent's surface, altering the removal mechanism. It should be emphasised that the removal of metal ions in the solution is induced not only by the adsorbent's porosity but also by the surface attraction or chemical bonding phenomenon caused by the freshly added chemical onto the adsorbent (Qasem, et al., 2021). Table 2 shows the chemical composition of fly ash changes by various pretreatment methods.

Table 2: The chemical composition of fly ash by various pretreatment methods

Constituent	Raw FA	Acid treated FA	Raw FA	Acid treated FA	Raw FA	Alkaline treated FA	Raw FA	Alkaline treated FA
SiO ₂	50.5	60.8	50.96	61.66	60.46	13.74	31.4	10.9
Al ₂ O ₃	26.5	22.2	27.45	24.2	21.50	5.99	28.16	8.6
Fe ₂ O ₃	9.2	6.2	7.02	5.47	4.30	2.79	20.91	4.4
CaO	5.6	2.0	4.22	1.07	7.63	2.69	4.82	1.35
MgO	2.2	0.7	1.28	0.75	0.82	0.23	1.96	0.64
SO ₃	-	-	1.52	0.18	-	-	-	-
TiO ₂	1.6	2.0	1.74	1.92	1.53	0.69	-	-
K ₂ O	1.6	1.7	3.34	3.21	1.25	0.45	0.1	0.12
References	(Go and Yeom, 2019)		(Gjyli et al., 2021)		(Agarwal et al., 2018)		(Santi et al., 2021)	

It was observed that the raw fly ash content was found to be high in aluminosilicate (Si-O-Al). As a result, fly ash is able to perform effectively in adsorbing various metal ions. Increased silica and alumina content through acid pretreatment, as indicated in Table 2, will improve the surface area and sorption characteristics of the fly ash. The stronger the acid, the higher the pH value and surface area of the fly ash and the stronger the interactions of surface functional groups, especially for metal ions such as copper ion, which prefer an alkaline environment (Buema et al., 2021). On the other hand, alkaline treatment increased the soluble Si content while decreasing the alumina and silica content in raw fly ash (Santi et al., 2021). However, the degradation of the mineral surface may be anticipated to enhance the rough surface of the fly ash, resulting in increased porosity of alkaline-treated fly ash capable of metal ion adsorption. Indeed, due to the pH content of the adsorbent to the adsorbate, alkaline treatment exhibited a good performance in removing some of the metal ions as mentioned previously.

Adsorption Isotherms analysis for Cr, Cu, Ni, and Zn ions in solution

Adsorption isotherm models were used in the study to further evaluate the adsorption mechanism of the pollutants into the adsorbent. To investigate the adsorption isotherms, the collected data were analysed by using the Langmuir isotherm, Freundlich, Temkin, BET, and D-R isotherms. Table 3 displays the parameters and correlation coefficients of Langmuir, Freundlich, Temkin, BET, and D-R isotherm models for different heavy metal ions (Cr, Cu, Ni, and Zn) on various fly ash (UFA, HCl-FA, and NaOH-FA), as inferred from the gradient and intercept of the linear graphs.

Table 3: The parameters and correlation coefficients of Langmuir, Freundlich, Temkin, Brunauer-Emmett-Teller (BET), and Dubinin Radushkevich (D-R) isotherm models for different heavy metal ions (Cr, Cu, Ni, and Zn) on various fly ash (UFA, HCl-FA, and NaOH-FA).

	Temkin				Brunauer-Emmett-Teller (BET)		
	K_T (L/g)	B (J/mol)	b_T	R^2	Q_m (mg/g)	C_{BET}	R^2
UFA							
Cr	2.183	-0.859	-2894.604	0.999	1.048	0.846	0.998
Cu	1.948	-0.823	-3019.050	0.994	1.023	0.853	0.985
Ni	1.303	-0.730	-3403.458	0.998	1.264	0.892	0.997
Zn	2.159	-0.848	-2931.469	0.982	0.801	0.810	0.930
HCl-FA							
Cr	2.217	-0.864	-2878.516	0.998	1.029	0.841	0.994
Cu	1.223	-0.717	-3466.099	0.996	1.266	0.893	0.991
Ni	1.529	-0.766	-3243.588	0.999	1.222	0.881	0.999
Zn	1.808	-0.807	-3081.932	0.999	1.138	0.865	0.996
NaOH-FA							
Cr	1.751	-0.797	-3121.012	0.997	1.110	0.866	0.992
Cu	1.629	-0.780	-3186.216	0.999	1.180	0.876	0.997
Ni	0.965	-0.675	-3681.703	0.999	1.397	0.910	0.998
Zn	2.093	-0.847	-2936.664	0.998	1.061	0.849	0.995
Dubinin Radushkevich (D-R)							
	Q_m (mg/g)	EDR	R^2				
UFA							
Cr	2.070	158.114	0.993				
Cu	2.119	158.114	0.942				
Ni	2.251	223.607	0.978				
Zn	2.086	158.114	0.837				
HCl-FA							
Cr	2.068	158.114	0.980				
Cu	2.271	223.607	0.957				
Ni	2.204	223.607	0.992				
Zn	2.145	158.114	0.988				

NaOH-FA			
Cr	2.153	223.607	0.964
Cu	2.178	223.607	0.992
Ni	2.335	235.702	0.986
Zn	2.090	158.114	0.984

The result from Table 3 indicated that all the heavy metal ions adsorption on UFA, HCl-FA, and NaOH-FA were favourable to Temkin isotherm. The accuracy and compatibility of the adsorption system by using the Temkin isotherm can be seen in R^2 value with all the R^2 coefficients of more than 0.99 for all the metal ions and the R^2 coefficient of 0.982 for zinc adsorption. The closer it is to 1, the more compatible it is to the Temkin isotherm model as the assumption of the model coincides with the adsorption system. Table 3 reveals that the regression coefficient value of Temkin isotherm is 0.999 (Cr ions by UFA), 0.994 (Cu ions by UFA), 0.998 (Ni ions by UFA), 0.982 (Zn ions by UFA), 0.998 (Cr ions by HCl-FA), 0.996 (Cu ions by HCL-FA), 0.999 (Ni ions by HCl-FA), 0.999 (Zn ions by HCl-FA), 0.997 (Cr ions by NaOH-FA), 0.999 (Cu ions by NaOH-FA), 0.999 (Ni ions by NaOH-FA), and 0.998 (Zn ions by NaOH-FA). The Temkin isotherm model reflected the interaction between the metal ions in the solution and the fly ash. It is assumed that as more metal ion molecules adhere to the fly ash surface, the heat of adsorption for all molecules in the layer decrease linearly (Elmorsi et al., 2022).

According to the Temkin isotherm model, adsorption is defined by a uniform distribution of binding energies up to a maximum binding energy (Owino et al., 2023). The b_T value in this study ranged from -3681.703 to -2878.516, which was less than 80, indicating that the adsorption process is physical between the metal ions and fly ash (Nandiyanto et al., 2022). Furthermore, the investigation showed the B constant ranging from -0.8636 to -0.6752, implying $B < 8\text{kJ/mol}$, signifying a weak contact between the adsorbate and absorbent, likely due to minimal physical sorption in the initial layer (Elmorsi et al., 2022). Moreover, the negative value of the Temkin constant, B also indicated the endothermic heat adsorption process, as adsorption can be enhanced by increasing temperatures (Potgieter et al., 2021).

The K_T value of the study in the Temkin isotherm model further demonstrated that the adsorption affinity of the metal ions onto the binding sites of fly ash which revealed in the order 2.22L/g (Cr ions by HCl-FA) $>$ 2.18L/g (Cr ions by UFA) $>$ 2.16L/g (Zn ions by UFA) $>$ 2.09L/g (Zn ions by NaOH-FA) $>$ 1.95L/g (Cu ions by UFA) $>$ 1.81L/g (Zn ions by HCl-FA) $>$ 1.75L/g (Cr ions by NaOH-FA) $>$ 1.63L/g (Cu ions by NaOH-FA) $>$ 1.53L/g (Ni ions by HCl-FA) $>$ 1.30L/g (Ni ions by UFA) $>$ 1.22L/g (Cu ions by HCl-FA) $>$ 0.97L/g (Ni ions by NaOH-FA). Principally, numerous factors influence the adsorption affinity

between heavy metal ions and fly ash, such as ionic radii, molecular size, the surface roughness of the fly ash, and the adsorption capacities of the binding groups that react with various metal ions in the solution (Wadhawan et al., 2020). However, the variation of the adsorption affinity of the fly ash is minimal which is less than 1.252 L/g, indicated that both untreated and treated fly ash (acid and alkaline treatments) maintained effective metal ion removal capabilities with only slight impact on the favourability of metal ion adsorption.

CONCLUSION

Based on the study result, both untreated and pretreated fly ash had a significant effect on removing the chromium, copper, nickel and zinc ions from the aqueous solution. The recorded Cr, Cu, Ni, and Zn ions removal rates by UFA were 2.565 mg/g, 2.694 mg/g, 2.719 mg/g, and 2.758 mg/g, respectively. Then, HCl-FA were adsorbed with 2.572 mg/g of Cr ions, 2.752 mg/g of Cu ions, 2.630 mg/g of Ni ions, 2.608 mg/g of Zn ions. While the percentage removal of Cr, Cu, Ni, and Zn ions removal rates by NaOH-FA were 2.694 mg/g, 2.641 mg/g, 2.723 mg/g, 2.580 mg/g, respectively. All the heavy metal ions (Cr, Cu, Ni, and Zn ions) adsorption on UFA, HCl-FA, and NaOH-FA were favourable to Temkin isotherm, with R^2 more than 0.98. Furthermore, the study revealed that all heavy metal ions adsorbed by fly ash were dominated by physical adsorption with an endothermic heat adsorption mechanism. This insight is valuable for water treatment and environmental remediation efforts, providing practical guidance for optimal fly ash utilization based on the target heavy metal ions and water conditions. By bridging the gap between theory and application, this research not only contributes novel findings but also holds the potential to advance current practices in environmental science.

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LANDSCAPE ATTRACTIVENESS AND PLACE IDENTITY: CONSIDERING THE ROLE OF URBAN PARKS

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Abstract

Urban parks, vital public spaces for community health and well-being, also face challenges related to safety and security. Balancing the need for recreational spaces with ensuring safety is paramount for urban stability. However, existing research on the nexus between landscape attractiveness and perceived safety often overlooks the influence of factors such as park usage patterns, place identity, and park typologies. To address this research gap, we conducted a survey among 411 urban park users and employed SmartPLS and SPSS for data analysis. Our findings reveal a robust correlation between landscape attractiveness and perceived safety. Furthermore, we uncover that the combined influence of place identity and time spent in the park can serve as positive mediators in this relationship. Surprisingly, our analysis indicates that time spent in the park alone does not exert a significant mediating effect. Notably, our results highlight nuanced variations: the association between landscape attractiveness and place identity is particularly pronounced in parks with lower landscape attractiveness, while the mediating role of place identity on the relationship between park usage time and perceived safety is more pronounced in parks with higher landscape attractiveness. These findings contribute to our understanding of how urban park landscapes relate to perceived safety and provide new insights for improving the safety of urban parks, offering valuable insights for urban planners and public health policymakers in designing healthier urban environments.

Keywords: Landscape Attractiveness, Perceived safety, Place Identity, Time Spent in the Park, Different Urban Parks

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INTRODUCTION

Urban parks, as essential public recreational spaces, play a critical role in ensuring the well-being of urban residents (Sabri & Ponrahono, 2024). However, urban parks, as primary venues for outdoor recreational activities, not only attract individuals seeking daily leisure and exercise but also potentially attract potential criminal elements (Mak & Jim, 2022). Consequently, studies have investigated factors within parks that contribute to fear of crime (Mak & Jim, 2022; Sreetheran & van den Bosch, 2014). Nonetheless, there remains a significant scope in understanding what factors would help enhance individuals' perceived safety (PS) in terms of crime from the physical environment. For instance, the relationship between the landscape attractiveness of urban parks and PS warrants further exploration.

In environmental psychology, frequent visits to urban parks are associated with greater benefits derived from these spaces (Chen & Marzbali, 2023). Research on crime perception indicates that frequently visiting a particular place can foster a sense of ownership and familiarity, which would benefit people's PS in that place (Barker et al., 2022). However, there is still a lack of clear and specific empirical evidence on how the time spent in the park and place identity influence park users' PS in urban parks. Therefore, unlike previous studies that primarily explored factors evoking fear of crime in urban parks, this research aims to investigate the relationship between urban park landscape attractiveness and PS, considering the influence of time spent in the park, place identity, and different types of urban parks. The goal of the study is to verify that, in addition to increasing park visitation, the attractiveness of urban park landscapes also has a positive impact on PS. The findings will provide important insights for enhancing urban safety and promoting sustainable development through the construction of attractive urban park landscapes.

LITERATURE REVIEW

Landscape Attractiveness and Perceived Safety

Studies that have been conducted exploring the factors influencing fear of crime have found that urban parks' negative aspects (e.g., syringes, drunken persons, hiding spaces) would evoke fear of crime (Mak & Jim, 2018; Sreetheran & van den Bosch, 2014), as well as the high vegetation coverage has been shown to have negative consequences on PS, particularly due to its influence on visibility (Hami & Emami, 2015; Hosseinalizadeh et al., 2022). Such feeling of environmental insecurity also further influences people's visitation to parks (Kiplagat et al., 2022). However, parks with attractive landscapes can promote visitation (Sun et al., 2024). Given the inherent correlations in the aforementioned research findings, it is theoretically plausible that landscape attractiveness is positively correlated with PS, while limited evidence has clearly confirmed this relationship. Additionally, existing research has found that if parks do not create a clear layout

and include hidden places that are difficult to recognize as dangerous when constructing attractive park landscapes, even if the natural value of the park's greenery is high, the park may remain unpopular (Lis et al., 2022), posing a challenge to verifying the relationship. Therefore, this study considers overall attractiveness, rational layout and accessibility of the landscape, and diversity and aesthetics of landscape combinations as the components of landscape attractiveness (Li et al., 2023; Mao et al., 2022; Vannoppen et al., 2021), to test the relationship between landscape attractiveness and PS (Hypothesis 1), aiming to address the aforementioned issues and identify tangible physical factors for enhancing the sense of safety in urban parks.

Hypothesis 1: Landscape attractiveness has a significant positive relationship with perceived safety.

Time Spent in the Park and Place Identity

Relevant research in environmental psychology has established that time spent in the park reinforces the benefits individuals derive from urban parks (Chen & Marzbali, 2023). The impact of landscape attractiveness on park visitation is also well-documented (Ginting et al., 2017; Lin et al., 2023). However, there remains a gap in research regarding whether the time spent in the park strengthens the relationship between landscape attractiveness and PS.

Existing literature suggests that frequent visitors to public spaces feel safer due to enhanced natural surveillance and a sense of ownership and familiarity (Barker et al., 2022; Ceccato & Nalla, 2020; Lomas et al., 2023). However, whether the concept of place identity, defined as recognizing a particular place as a part of who I am, can also be equated with the meanings of ownership and familiarity, thus playing a mediating role in the relationship between landscape attractiveness and PS, remains uncertain. Therefore, to address this gap, Hypothesis 2 is proposed, aiming to provide new insights into the factors influencing PS in urban parks.

Hypothesis 2: The relationship between landscape attractiveness and perceived safety is positively and significantly mediated by time spent at the park and place identity.

Office Workers and Baise Two Urban Parks

Younger individuals express greater concerns about personal crime compared to older adults (Jackson, 2009). However, the urban park usage patterns of younger demographics, particularly young office workers, who are constrained by fixed working hours, spend less time in parks and experience place identity differently than the elderly (Bufquin et al., 2021; Shobri et al., 2021), have received insufficient attention. Even some studies found that urban green space is

recognized mainly by the elderly, the instrumentalization of urban green spaces by young people and not their recreational or naturalistic use (Egea-Cariñanos et al., 2024). These situations highlight the need to focus on young office workers in research, such a focus will also enhance our understanding of how urban park environments influence perceived safety across diverse user groups.

In the existing literature on urban parks in China, research has predominantly concentrated on large cities, with limited attention to young office workers in smaller cities. Baise City serves as a pertinent example of such smaller cities, it has two comprehensive urban parks catering to the daily recreational needs of its residents: Peninsula Park and People Park (**Figure 1**). We observed the different usage of young office workers in two urban parks of Baise, as well as the distinction of landscape environment and found two issues that have not been fully researched.



Figure 1: Map of the study area and its landscape photos

Note: A: People Park; B: Peninsula Park.

Source: Maps from Google Earth, 2022. Landscape photos taken by the first author (2022).

Peninsula Park, a new and modern facility centrally located in a newly developed district, is encircled on three sides by the Youjiang River. Its scenic views and open landscape enhance natural surveillance and PS, attracting many young people to picnicking on weekends. Conversely, People Park, a historic

park in the old city centre, is smaller with outdated facilities and dense vegetation, which can increase the fear of crime (Hosseinalizadeh et al., 2022). Despite its age, People Park holds a special place in the hearts of local residents due to its landscapes that carry locals' childhood memories. It has a distinctive children's playground, and on weekends, many young parents can be seen gathering there with their children. Given the distinct landscape characteristics of these two parks, it is uncertain which park would better enhance place identity and PS among young office workers. Additionally, the literature has not thoroughly investigated the varying mediating role of place identity in the relationship between landscape attractiveness and PS across different urban parks.

This study proposes the following two hypotheses to address the identified research gap, focusing on Baise City's People Park and Peninsula Park as study areas (**Figure 1**). The objective is to provide valuable insights for enhancing urban park safety in Baise and other similar small cities in China. By examining the differences in how various urban parks influence PS, this study aims to contribute to a broader understanding of urban park usage and safety perceptions across diverse urban contexts and different demographic groups. The findings are expected to inform urban planners and landscape architects in designing safer and more inclusive urban green spaces.

Hypothesis 3: Landscape attractiveness, time spent in the park, place identity, and perceived safety vary between Peninsula Park and People Park.

Hypothesis 4: The associations between the study variables differ between Peninsula Park and People Park.

Figure 2 depicts the proposed model based on the hypotheses, which investigates the relationships between urban parks' landscape attractiveness, time spent in the park, place identity, and PS, considering the influence of Peninsula Park and People Park.

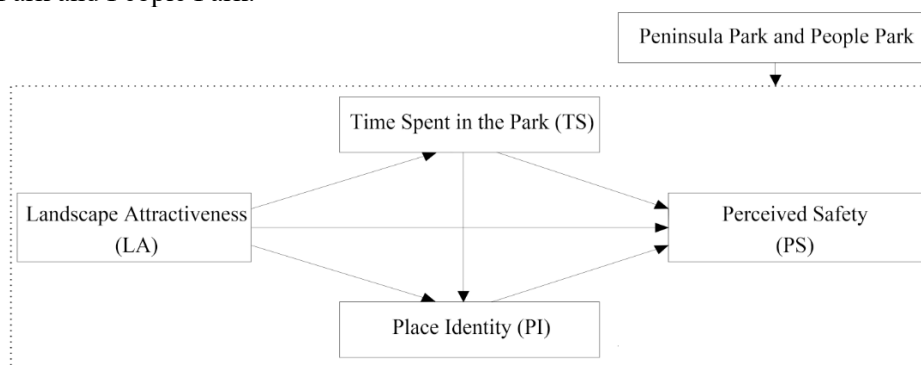


Figure 2: The theoretical model
Source: Authors (2023)

RESEARCH METHODOLOGY

This research utilizes quantitative methods, employing questionnaires, as Table 2 shows to collect data from office workers aged 18 to 40 who have visited People Park or Peninsula Park in Baise City (All-China Youth Federation, 2020). The questionnaire consists of three sections: participants' demographic information, time spent in the park, and the measurement of study variables (landscape attractiveness, place identity, and PS). Time spent in the park is measured by visit frequency and duration. All items related to the study variables are adapted from relevant literature and scored on a 5-point Likert scale ranging from 'strongly disagree (1)' to 'strongly agree (5)'.

Table 1 shows the measurement items for landscape attractiveness, which includes six aspects related to the park's visual attractiveness such as beauty, layout, variety, and aesthetic harmony, contributing to a playful and sequenced landscape experience. Place identity is assessed through five items, focusing on the emotional and psychological bonds individuals form with specific places, reflected in memories, connections, and impacts on well-being. PS is measured by five items, assessing feelings of safety from crime in the park including comfort walking alone, PS at night, and overall fear of crime.

Sampling was conducted using a stratified random sampling method. Data collection took place from May to June 2023, with questionnaires administered both online and face-to-face in urban parks. An a priori analysis was conducted using the G-Power T-Test to determine the minimum number of participants needed for valid results. With an effect size of 0.3, a test power of 0.80, and a significance level of 0.05, a total of 352 participants (176 per park) were considered sufficient for statistical significance (Kang & Huh, 2021). However, to account for factors such as time, financial resources, and investigator involvement, a total of 411 valid responses were collected, with 212 from Peninsula Park and 199 from People Park. Among the participants, 68.37% were female, and 57.18% were married. Additionally, 83.45% of participants had a university/college education. In terms of occupation, 48.9% were public institution personnel, 45.5% were enterprise personnel, and 5.6% were classified as other occupations. In People Park, the proportion of office worker visitors aged 31-40 years old (51.2%) exceeded those aged 18-25 years (48.8%). In Peninsula Park, the proportion of office workers aged 18-30 (57.8%) was higher than that of office workers aged 31-40 (42.2%). This suggests that young office workers are more inclined to visit Peninsula Park than People Park.

After data collection, the study employed the PLS-SEM (partial least squares structural equation modelling) technique using PLS 3.0 to analyze the data to verify hypotheses 1 and 2 (Hair Jr et al., 2021). Furthermore, we employed the multiple group analysis (MGA) method in SmartPLS to explore variations in these relationships between Peninsula Park and People Park (verify hypothesis 4). In SPSS 26, chi-square tests were used to assess the associations between the

two urban parks and the participants' time spent in the park, while t-tests were employed to evaluate differences in landscape attractiveness, place identity, and PS between Peninsula Park and People Park (verify hypothesis 4).

Table 1: The study constructs and measurement items

Variables	Item code	Item	Source
Landscape attractiveness (LA)	LA1	The park landscape is very attractive to me.	(Li et al., 2023; Ma, 2021; Mao et al., 2022; Qi et al., 2017; Wei et al., 2022)
	LA2	The park landscape is beautiful.	
	LA3	Reasonable and easily accessible layout of the park landscape.	
	LA4	The park has various types of landscapes, and each has its characteristics.	
	LA5	Water, terrain, plants, pavement, roads, structures, and landscape features are well combined and aesthetically pleasing in the park.	
	LA6	The park landscape is playful and has a sense of landscape sequence.	
Place identity (PI)	PI1	I have a lot of fond memories of the park.	(Bazrafshan et al., 2023; Dasgupta et al., 2022; Li et al., 2023; Mao et al., 2022; Powers et al., 2022)
	PI2	I miss the park when I am away for a long time.	
	PI3	The park reminds me of some of my loved ones (parents, children, friends, etc.).	
	PI4	This park has a special meaning to me.	
	PI5	The urban park has a lot of impacts on my health and well-being.	
Perceived safety (PS)	PS1	I feel safe in the park in terms of crime.	(Böcker et al., 2023; Cozens & van der Linde, 2015; Luyk, 2022; Morgan et al., 2017)
	PS2	I wouldn't mind walking along this park unaccompanied.	
	PS3	This park is generally safe at night.	
	PS4	I didn't fear crime in this park.	
	PS5	I wouldn't quickly escape from this park due to fear of crime.	

Source: Authors (2023)

RESULTS

Measurement Model

The statistics generated based on the theoretical model in Smart PLS are used to evaluate the reliability and validity of the constructs. All the item factor loadings (ranging from 0.775 to 0.876) exceeded the recommended threshold of 0.7, all Cronbach's alpha coefficients (ranging from 0.903 to 0.909) surpassed the acceptable threshold of 0.70, the composite reliability values (ranging from 0.789 to 0.929) also exceeded the generally accepted benchmark of 0.70, the Average

Variance Extracted (AVE) values (range from 0.652 to 0.721) exceeded the minimum criterion of 0.5, indicating that the constructs demonstrated convergent validity (Hair Jr et al., 2021).

On the other hand, the discriminant validity between constructs was assessed using the Heterotrait-Monotrait Ratio (HTMT), with all HTMT values below the recommended threshold of 0.85, indicating good discriminant validity between constructs. Additionally, according to the Fornell-Larcker criterion, the Average Variance Extracted (AVE) for each construct was higher than its correlations with other constructs, further confirming the construct validity.

In **Table 2**, the R^2 value for the dependent variable, PS, was 0.217, indicating that the model explains 21.7% of the variance in perceived safety. All Q^2 values of study variables were over 0 indicating that the PLS path model has predictive relevance and meaningful predictive accuracy (Hair Jr et al., 2021). Finally, the goodness-of-fit calculation (GoF), was significantly exceeded the threshold of 0.36, indicating that the model performs well in explaining the data structure and is capable of effectively capturing the relationships within the observed data (Hedayati Marzbali et al., 2016).

Table 2: Coefficient of determination and predictive relevance and GoF

Constructs	Q^2	R^2	AVE (≥ 0.5)	GoF
Landscape attractiveness	--	--	0.686	$= \sqrt{(R^2 * AVE)} =$ $\sqrt{(0.263 * 0.695)} = 0.427$
Time spent in the park	0.092	0.145	0.652	
Place identity	0.298	0.428	0.721	
Perceived safety	0.152	0.216	0.72	

Source: Authors (2023)

Hypotheses Testing Results

The study's hypothesis 1 and 2 testing results are displayed in **Table 3**. Landscape attractiveness has a positive and significant relationship with the PS ($\beta = 0.282, p < 0$). Place identity ($\beta = 0.133, p < 0$), or time spent in the park and place identity ($\beta = 0.018, p < 0.01$), can act as positive and significant mediators in strengthening the relationship between landscape attractiveness and perceived safety. Notably, the time spent in the park was found to have no mediating effect on the relationship between landscape attractiveness and PS ($\beta = -0.008, p > 0.1$), as the time spent in the park showed no relationship with PS ($\beta = -0.023, p > 0.1$).

Table 3: Results of Hypothesis

Hs	Relationships	β	p-value	Direct relationships p-value	Total effects p-value	Type of mediation
H1	LA → PS	0.282	0***	--	--	--
H2	LA → TS → PS	-0.008	0.694	0****	0***	Direct-only (no mediation)
	LA → PI → PS	0.133	0***		0***	Complementary mediation
	LA → TS → PI → PS	0.018	0.003***		0***	Complementary mediation

Note: * p < 0.10, ** p < 0.05, *** p < 0.01.

Source: Authors (2023)

Table 4: Comparison of model relationships between People Park and Peninsula Park

Relationships	Peninsula Park		People Park		Path Coefficients-diff	P-Values Permutation	P-Value MGA
	β	95% CI (two-tailed)	β	95% CI (two-tailed)			
LA → PI	0.456	[0.337;0.561]	0.599	[0.494;0.685]	-0.143	0.054*	0.053*
TS → PI → PS	0.079	[0.035;0.143]	0.025	[0;0.072]	0.054	0.081*	0.082*

Note: Peninsula Park (n = 212) and People Park (n = 199). CI, confidence interval. * p < 0.10, ** p < 0.05, *** p < 0.01.

Source: Authors (2023)

Results of Hypothesis 3. Independent-sample t-test results demonstrated that participants at Peninsula Park reported significantly higher levels of landscape attractiveness ($M=0.414$, 95%CI [0.302, 0.526], $t(409)=7.281$, $p<0.001$), place identity ($M=0.372$, 95%CI [0.229, 0.516], $t(409)=5.106$, $p<0.001$), and perceived safety ($M=0.152$, 95%CI [0.012, 0.29], $t(409)=2.133$, $p=0.033$) compared to participants at People Park. Additionally, chi-square analyses revealed a significant relationship between the type of urban park and both visit frequency ($\chi^2(6) = 23.871$, $p<0.001$) and visit duration ($\chi^2(4) = 33.270$, $p<0.001$). Overall, the majority of office workers visited Peninsula Park weekly (34.3%), whereas People Park was primarily frequented 2-5 times annually (27.1%). Furthermore, 59% of visitors stayed at Peninsula Park for over an hour, while only 36.6% did so at People Park.

Results of Hypothesis 4. Our study validated that the measurement invariance, assessed using the Measurement Invariance Assessment (MICOM) in PLS 3.0, met the criteria for multi-group analysis (Barroso et al., 2018; Chin & Dibbern, 2009; Henseler et al., 2009). The MGA p-value and the permutation test p-value for differences in path coefficients were both below 0.1 (two-tailed),

indicating a significant difference at the 1% level between the two groups. **Table 4** shows that the relationship between landscape attractiveness and place identity was stronger in People Park compared to Peninsula Park. Notably, the mediation of place identity in the relationship between time spent in the park and PS was stronger in Peninsula Park than in People Park.

DISCUSSION

Although the public recognizes the significant health benefits provided by urban parks, they also acknowledge certain risks or disservices associated with urban trees (Egea-Cariñanos et al., 2024). Compared to park elements that induce feelings of insecurity related to crime (Mak & Jim, 2018), this study found that attractive, well-designed, beautiful, diverse, and sequential park landscapes can positively influence participants' PS. This finding offers an alternative perspective to previous research indicating that crime risk is a factor deterring public institutions from planting trees in parks and along streets (Gwedla et al., 2024). It suggests that through thoughtful landscape design, the natural environment of parks can be constructed to enhance users' sense of safety.

Contrary to previous studies (Salleh et al., 2022), this study found that frequent visits to urban parks did not enhance participants' sense of safety. Instead, their PS was more influenced by the physical attractiveness of the park's landscape and their place identity. This finding is similar to the study of Zhao et al. (2024), who reported that higher satisfaction with green spaces is linked to greater subjective well-being, independent of the frequency of visits. Our study enhances the understanding that the frequency of urban park use does not directly correlate with some types of benefits, indicating that the factors influencing the benefits derived from public spaces are diverse and cannot be solely dependent on encouraging frequent park visits.

A notable finding is that time spent in the park can influence place identity, and together they serve as multiple mediators to strengthen the relationship between landscape attractiveness and PS. Building on previous studies (Barker et al., 2022; Ceccato & Nalla, 2020), our research further reveals that place identity alone can be an effective mediator, enhancing the link between landscape attractiveness and PS more effectively than time spent in the park. This finding diverges from and expands on Shadi et al. (2024), showing that while environmental diversity does not have a significant indirect link to safety, combining diverse landscapes with well-designed attractions positively impacts safety perception. Additionally, our study builds on the understanding that landscape readability influences safety through sociability and environmental responsiveness, highlighting that place identity can also reinforce the relationship between landscape attractiveness (or time spent in the park) and PS. This finding enriches the understanding of multiple mediating relationships between park landscapes and safety perception.

Evidently, Peninsula Park outperforms People Park in terms of landscape attractiveness, place identity, and PS among study participants. Surprisingly, however, landscape attractiveness had a stronger impact on place identity in People Park, likely due to its historically significant landscapes. This finding supports previous research showing that old parks hold significant identity value for historical residents (Rosenbluth et al., 2024). Interestingly, the positive moderating effect of place identity on the relationship between time spent in the park and PS was stronger in Peninsula Park. This suggests that, despite People Park's historical significance enhancing place identity, Peninsula Park's larger size, higher landscape attractiveness, and more frequent visits by participants made the mediation effect more pronounced. This finding further corroborates that not only do the health effects of urban park use vary with park types (Lin et al., 2023), but also the safety perception derived from park use via place identity varies with different urban parks.

CONCLUSION

This study, conducted in two urban parks in Baise City, explored the relationships among landscape attractiveness, time spent in the park, place identity, and PS based on environmental psychology. Through the analysis of questionnaire data using SmartPLS 3.0 and SPSS 26.0, significant empirical evidence of relationships between landscape attractiveness and PS among young office workers was found, generally supporting the hypotheses. Notably, place identity positively strengthens the relationship between landscape attractiveness and PS, while time spent in the park has no significant mediating effect on this relationship. Although the landscape attractiveness is higher in Peninsula Park, the relationship between landscape attractiveness and place identity is stronger in People Park due to its historical significance. However, the PS derived from park use via place identity is stronger in Peninsula Park than in People Park. Considering the differences in study contexts, future studies could investigate the relationship between landscape attractiveness and perceived safety in various urban settings to ensure the generalizability of the results across different geographical and cultural contexts.

This study provides valuable insights into enhancing the safety perception of urban parks. Conducted in Baise, China, the findings apply to many similar small cities across the country and can inform the safe development of urban parks in these areas. The study findings support the broader goal of building a safer China (The State Council of China, 2021).

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WILLINGNESS OF ISLAND COMMUNITY TO PARTICIPATE IN THE WASTE-TO-WEALTH PROGRAM: A CASE STUDY IN TELUK RENJUNA, TUMPAT, KELANTAN, MALAYSIA

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Abstract

This manuscript explores Teluk Renjuna communities' willingness to participate in the waste-to-wealth program. Waste-to-wealth is an initiative to reduce the environmental impact of waste disposal. The total number of respondents who participated in this study was 118 respondents. Analysis indicated a reasonable waste disposal practice among respondents, with moderate knowledge and high awareness of the waste-to-wealth program. Besides that, this study found no significant sociodemographic impact on the knowledge and awareness of respondents on the waste-to-wealth program, except for age, income, and marital status. A Pearson Correlation test assessed the significance between knowledge, awareness, practices, and willingness. The results indicated a weak relationship between practices and willingness. A moderate relationship was found between knowledge and willingness, and a strong relationship was observed between awareness and willingness. The findings of this study are crucial to help government agencies or NGOs in planning suitable waste-to-wealth programs for the island community.

Keywords: Waste-to-Wealth, Waste Disposal Practices, Knowledge, Awareness

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INTRODUCTION

Unsustainable solid waste management directly threatens the environment, public health, and economic stability (Cayumil et al., 2021). Globally, 33% of the 2.01 billion tons of solid waste generated annually remains uncollected, with predictions of reaching 3.40 billion tons by 2050 (Guo et al., 2021). Efficient solid waste management is essential to alleviate the negative impacts on rural communities' social, economic, and environmental well-being due to population growth (Hoang & Fogarassy, 2020). In rural areas of Kelantan, Malaysia, waste disposal methods involve burial and burning, facing challenges like insufficient collection coverage, inconsistent services, and lack of knowledge, contributing to poor waste management. The success of waste management initiatives like Waste to Wealth relies on community engagement, practices, and public acceptability. Waste to Wealth transforms waste into valuable resources through recycling, upcycling, composting, and the 3R program (Egun, 2012). Composting, for instance, offers an alternative to waste disposal in the baking sector (Govindaraju et al., 2021). Implementing waste-to-wealth programs in Malaysia, such as recycling e-waste, has economic potential, though challenges like low awareness persist (Ismail & Hanafiah, 2021). Similarly, opportunities for generating resources from organic acids in the palm oil industry face challenges due to a lack of awareness and environmental concerns (Mumtaz et al., 2010). Addressing increasing solid waste, like plastic bottles, through recycling activities requires raising awareness, as seen in the Serdang community (Utiti et al., 2021). This study aims to assess the willingness of the Teluk Renjuna Community to participate in the 'Waste to Wealth' program, emphasising the importance of community engagement for environmental, economic, and social well-being.

LITERATURE REVIEW

Community Willingness to Participate in Waste-to-Wealth Program

Socio-demographics, including gender, age, education, and income, are crucial in influencing community participation in Waste-to-Wealth. Knowledge and awareness are linked to daily human activities and are impacted by socio-demographic factors. Research by Wang et al. (2020) suggests that individuals with favourable socio-demographic backgrounds are more likely to participate in household solid waste recycling programs, despite having less knowledge of recycling. Conversely, previous studies indicate that low-income households may not contribute to recycling practices due to financial constraints compared to higher-income households. Issock et al. (2020) found that young females with low to medium income and high knowledge levels are more inclined to engage in environmental programs like household waste separation.

Good practices play a role in fostering willingness to engage in sustainable programs (Yusoh et al., 2023). Waste disposal practices, including recycling, composting, source reduction, landfills, and animal feeding, are gaining attention in the environmental community. Funding from local authorities in Nigeria has been identified as a significant factor contributing to effective waste disposal practices, impacting sustainable waste management (Ogu, 2000). Conversely, a lack of funding results in challenges such as the inability to purchase new waste collection vehicles, inadequate workforce, poor vehicle maintenance, and unsubsidised waste storage containers, leading to increased solid waste generation (Abila & Kantola, 2013). The increased knowledge provides an understanding of the natural and social worlds, impacting attitudes to participate in environmental programs. In a study by Almulhim (2022), communities with high knowledge of e-waste management showed willingness to participate in e-waste recycling programs, while a lack of knowledge was linked to an increase in solid waste. Factors contributing to the lack of knowledge include limited communication channels, such as mass media and posters, leading to low community exposure to waste recycling and disposal methods (Abila & Kantola, 2013). Individuals with a high level of knowledge are more likely to participate in public recycling programs and are willing to fund solid waste collection and management (Babaei et al., 2015). However, a lack of interest in knowledge and responsibility can contribute to low willingness, establishing a culture of non-participation in decision-making processes and little environmental care (McAllister, 2015). Conversely, Bashir et al. (2018) found a high level of community willingness to participate in composting in Kampar district, Malaysia, attributed to knowledge provided by local authorities.

Awareness of solid waste management involves basic knowledge and an understanding of the effects of solid waste (Debrah et al., 2021). However, awareness is distinct from knowledge. Chang and Chou (2018) demonstrated that consumers' willingness to participate in the "Bring Your Shopping Bags" reuse program in Taiwanese supermarkets is highly influenced by their awareness and behaviour. In Malaysia, Omran et al. (2009) found higher participation in recycling campaigns, such as 'recycling days,' when there was public knowledge.

A study of households in Nigeria by Momoh and Oladebeye (2010) revealed that households with low awareness of solid waste disposal practices have a lower willingness to participate in solid waste recycling programs. Similarly, a research study at Universiti Kebangsaan Malaysia found that nearly half of the students (65.9%) had low awareness of solid waste practices, leading to cleanliness and hygiene issues among students (Desa et al., 2011). While students possessed knowledge of solid waste practices, they lacked awareness of the impact of poor solid waste management. Awareness and knowledge are

crucial indicators and tools to gauge willingness to participate in the Waste-to-Wealth program.

METHODOLOGY

Study Area

This research focuses on the rural area of Teluk Renjuna (6°12'06° N, 102°13'34° E), a sub-district in Tumpat, Kelantan. The primary source of community income is fisheries. There is no waste management coverage or services provided by the local authority in this area. Therefore, Teluk Renjuna was chosen for the study due to its strategic location and potential for sustainable solid waste management.

Data Collection

This research determined the sample size of 118 respondents using the Krejcie and Morgan method. This method allowed flexibility in selecting margins of error and confidence levels, providing everyone in Teluk Renjuna an equal chance to be a respondent (Abas et al., 2020). The convenience sampling technique was applied. The questionnaire, consisting of five sections, covered socio-demographics, waste generation, disposal practices, knowledge, awareness, and willingness to participate in the Waste to Wealth program. Data on sociodemographics, waste types, practices on waste disposal, knowledge, awareness, and willingness to participate in waste-to-wealth programs were collected using nominal and ordinal data types, respectively. Experts performed validation to ensure content clarity and comprehensiveness. A pilot study was conducted in Kampung Gemang, Jeli, with 30 participants. The questionnaire's reliability test was measured using Cronbach's Alpha. The results, shown in Table 1, indicated strong reliability for all variables—practices, knowledge, awareness, and willingness—with Cronbach's alpha exceeding 0.7.

Table 1: Cronbach Alpha Reliability Test Result

Variables	Cronbach Alpha
Practices	0.761
Knowledge	0.720
Awareness	0.827
Willingness	0.965

Data Analysis

The normality test (Skewness and Kurtosis) was used to assess whether the collected data followed a normal distribution. The results in Table 2 indicated that the data was normally distributed. Descriptive statistics, including frequency,

percentage, mean, median, standard deviation, and range, were used to analyse the willingness of the local community in Teluk Renjuna to participate in Waste-to-Wealth programs, such as recycling, composting, and upcycling. Awareness was classified into categories of 'very high,' 'high,' 'medium,' 'low,' and 'very low' based on the scores obtained. At the same time, knowledge was categorised as 'high,' 'medium,' or 'low' according to the scores (Reinau et al., 2012).

Table 2: Normality Test Results

Variables	Skewness	Kurtosis
Practices	0.905	0.652
Knowledge	-0.216	-0.994
Awareness	-0.603	0.623
Willingness	-0.245	-0.907

The analysis incorporated independent sample t-tests and ANOVA to assess the significance of differences in willingness based on socio-demographic factors. If the p-value was <0.05, the null hypothesis was rejected, signifying a significant difference. Inferential analysis, specifically Pearson correlation, gauged the relationship between practices, knowledge, awareness, and the willingness of Teluk Renjuna communities to participate in the Waste to Wealth program. Pearson correlation values, ranging from -1 to +1, indicated the strength and direction of linear relationships. The null hypothesis, formulated to test whether study findings show an effect, was assessed based on various parameters, including the p-value. Rejection or acceptance of the null hypothesis depended on the p-value, with values <0.05 leading to rejection.

Null Hypothesis (H₀): Sociodemographics do not influence the willingness of respondents to participate in the waste-to-wealth program.

Null Hypothesis (H₀): Waste disposal practices, Knowledge and awareness do not influence the willingness of respondents to participate in the Waste-to-Wealth program.

FINDINGS AND DISCUSSION

Respondent's Profile

Table 3 displays sociodemographic variables, their frequency, and percentages. Females aged 26 to 35 contribute the most (19.5%). Teluk Renjuna primarily consists of Malay (100%) and Islamic (100%) respondents. Marital status is dominated by marriage (64.7%), followed by single (18.6%) and widowed

(18.6%). Regarding education, secondary school is the highest (45.8%), with higher education levels showing reluctance to join sustainable programs.

Most respondents have 4 to 6 household members (49.2%), and the primary head of household employment is in the self-employed sector (61.9%). Most respondents fall into income group B1 (<RM2500) (90.7%). The study provides insights into the sociodemographic characteristics of the Teluk Renjuna community, indicating potential areas for targeted waste-to-wealth programs.

Table 3: Socio-demographic Profile of Respondents

Sociodemographic	Frequency/ Percentage (%)	Sociodemographic	Frequency/ Percentage (%)
Gender		Education Background	
• Male	36 (30.5%)	• Primary School	31 (26.3%)
• Female	82 (69.5%)	• Secondary School	54 45 (45.8%)
		• Certificate	7 (5.9%)
		• Diploma	6 (5.1%)
		• Degree	20 (16.9%)
Age (Mean: 3.55, SD: 1.69)		Number of Household (Mean:1.92, SD: 0.78)	
• 17year--25year	16 (13.6%)	1--3	37 (31.4%)
• 26year--35year	23 (19.5%)	4--6	58 (49.2%)
• 36year--45year	20 (16.9%)	7—9	19 (16.1%)
• 46year--55year	19 (16.1%)	≥10	4 (3.4%)
• 56year--65year	19 (16.1%)		
• >65year	21 (17.8%)		
Ethnic		Number of Person Working in Household	
• Malay	118 (100%)	• 0	7 (5.9%)
		• 1	55 (46.6%)
		• 2	36 (30.5%)
		• 3	7 (5.9%)
		• 4	5 (4.2%)
		• ≥5	8 (6.8%)
Religion		Head Household Employment	
• Islam	118 (100%)	• Self-employed	73 (61.9%)
		• Government	3 (2.5%)
		• Non-government	15 (12.7%)
		• Not Working/ Housewife	27 (22.9%)
Marital Status		The number of years settled in the present residence.	
• Marriage	74 (62.7%)	• ≤5 years	5 (4.2%)
• Single	22 (18.6%)	• 6 years – 10 years	5 (4.2%)
• Widow/widower	22 (18.6%)	• 11 years –15 years	9 (7.6%)
		• 16 years – 20 years	4 (3.4%)
		• ≥ 21 years	95 (80.5%)

Sociodemographic	Frequency/ Percentage (%)	Sociodemographic	Frequency/ Percentage (%)
Household Income			
• B1 (<RM2500)	107 (90.7%)		
• B2 (RM2501-RM3170)	9 (7.6%)		
• B3 (RM3171-RM3970)	0 (0%)		
• B4 (RM3970-RM4850)	2 (1.7%)		

Waste Disposal Practices

In this study, waste disposal practices in the Teluk Renjuna community were explored. For the statement 'I burn the waste generated,' 90.7% of respondents answered 'Yes,' and only 9.3% answered 'No.' In the statement 'I buried the generated waste,' 76.3% disagreed ('No'), while 23.7% agreed ('Yes'). Statement 'I throw away the waste into the drain,' 61.9% disagreed ('No'), and 38.1% agreed ('Yes'). Additionally, for 'I throw the waste into the river,' 89% answered 'No,' and only 11% answered 'Yes.' Regarding 'I throw the waste into the trash bin provided,' 77.1% answered 'No,' while 22.9% answered 'Yes.' The results indicate moderate waste disposal practices among the Teluk Renjuna community. The total mean score for all questions in this survey is 2.03, reflecting a moderate level across the five waste disposal practices. According to the categorisation from a previous study, 30.5% exhibited poor practices, the majority (64.4%) demonstrated reasonable practices, and the lowest percentage (5.1%) showed good practices. This classification aligns with the reasonable practices level, according to Lietz (2010), who suggests creating an index based on score values to identify variable levels. The Teluk Renjuna community's waste disposal practices are reasonable and influenced by willingness and community dynamics. Previous studies suggested that the perception of good or moderate practices depends on community willingness and external influences like neighbours (Syahid et al., 2023).

Knowledge and Awareness of Waste-to-Wealth Program

The statistics on knowledge of the waste-to-wealth program show that, on average, 55.1% of respondents answered 'Yes' to the statement that composting, recycling, and upcycling are examples of waste-to-wealth initiatives. For the statement 'Coconut waste cannot be reused as handicraft items,' 66.9% of respondents answered 'No,' while 70.3% believed the initiative could lead to profit. Regarding the perception of high costs, 78% answered 'No.' Additionally, 67.8% agreed that garden and food waste could be reused as valuable resources. These responses indicate a moderate knowledge level, with a mean score of 3.38. However, a previous study reported a low level of knowledge affecting participation in waste composting (Suandi et al., 2023).

The statistics indicate that 59.3% of respondents agreed that the initiative can benefit environmental well-being, and 46.6% agreed it can generate income. About 50.8% were either moderately aware or unaware of the challenges involved, while 44.1% agreed that most waste can be used for waste-to-wealth initiatives. Furthermore, 78.8% agreed that the waste-to-wealth practice needs to be improved in Malaysia, especially in Kelantan. The mean score for awareness is 3.59, indicating a high level of awareness among respondents. In a similar study, the urban community in Puchong, Selangor, showed high recycling awareness with a mean value of 4.08 (Sharaai & Yap, 2022).

Willingness of Community to Participate in Waste-to-Wealth Program

Most respondents expressed willingness (29.7%) or a moderate response (26.3%) to implement the waste-to-wealth initiative if given the opportunity and training. For composting-related initiatives, 28.8% responded moderately, while 26.3% agreed. Regarding producing handicrafts from coconut waste, 43.2% expressed willingness, 33.9% disagreed, and 22.9% responded moderately. The Teluk Renjuna community showed a moderate and willing attitude towards participating in the waste-to-wealth program, indicating awareness of its benefits. The mean score for willingness is 3.03. However, a study in Puchong demonstrated a relatively higher willingness to participate in the recycling program, with a mean value of 4.07 (Sharaai & Yap, 2022).

Factors Influence Willingness of Community to Participate in Waste-to-Wealth Program

Table 4 shows no significant difference in willingness mean scores between males and females, accepting the null hypothesis (p -value=0.226). Age (p -value=0.014), marital status (p -value=<0.001), and income (p -value=0.045) significantly influenced willingness, with respondents aged 46 to 55, married individuals, and those in the B4 income group showing higher willingness. However, no significant differences were found based on education background, number of households, employment, number of persons working, or residency duration. The study also revealed that those with a Diploma education level, 7-9 members in the household, two persons working, government employment, and income in the B4 group expressed higher willingness to participate in the waste-to-wealth program.

Table 4: T-test and ANOVA results

Socio-demographic	t-value	p-value	Status
Gender	-1.217	0.226	Not Significant
Socio-demographic	F-value	p-value	Status
Age	2.993	0.014	Significant
Marital Status	7.672	<0.001	Significant
Education Background	1.837	0.127	Not Significant
Number of Household	.203	0.894	Not Significant
Number of people working in Household	0.927	0.466	Not Significant
Head of Household Employment	0.434	0.729	Not Significant
Income of the household	4.698	0.045	Significant
The number of years settled in the present residence	0.548	0.701	Not Significant

Relationship between Waste Disposal Practice, Knowledge, and Awareness with the Willingness of Respondents to Participate in Waste-to-Wealth Program.

The findings revealed a weak positive correlation ($r=0.251$, $n = 118$, $p=0.006$, 2-tailed), indicating that higher practices were associated with greater willingness (Table 5). The result is statistically significant ($p < 0.05$), showing a connection between practices and willingness. However, it is noteworthy that high practices did not consistently translate to high willingness, as indicated by Fadhullah et al.'s (2022) research on waste segregation.

Table 5: Pearson Correlation Results

Pearson Correlation	Waste Disposal Practices			
	Knowledge	Awareness		
Willingness to Participate in Waste-to-Wealth Program	Correlation Coefficient, r	.251**	.472**	.517**
	Sig. (2-tailed)	.006	<.001	<.001
	N	118	118	118

** Correlation is significant at the 0.01 level (2-tailed)

The study found a moderate positive correlation between willingness and knowledge ($r = 0.472$, $n = 118$, $p < 0.001$, two-tailed), indicating that higher knowledge levels are associated with greater willingness. This significant link between knowledge and willingness is consistent with previous research. Additionally, a strong positive correlation ($r = 0.517$, $n = 118$, $p < 0.001$, two-tailed) was observed between willingness and awareness, suggesting that higher awareness is linked to greater willingness. This is evidenced by individuals actively participating in recycling and composting programs. While good waste

disposal practices are significantly associated with willingness, the correlation between practices and willingness is relatively weak and needs improvement. The study highlights a significant association between knowledge, awareness, and the willingness of the Teluk Renjuna community to engage in waste-to-wealth programs, emphasising a strong link between knowledge and awareness in the study area.

CONCLUSION

Waste disposal practices in Teluk Renjuna need improvement through better waste management, including recycling and upcycling, for profit generation and reducing household waste. The study indicates moderate knowledge but higher awareness of waste-to-wealth programs. Although there is a weak relationship between current practices and willingness to participate, there's a moderate to high connection between willingness and actual participation. High-practice respondents may only sometimes be willing to participate, indicating a weak link between practices and willingness. To enhance the waste-to-wealth approach, the government, NGOs, and the public must play crucial roles by promoting recycling, upcycling, and composting for income generation and sustainable living. Specifically, the government should extend the efforts to rural areas like Teluk Renjuna by deploying more recycling bins and initiating community engagement campaigns for waste-to-wealth programs. Both governmental and non-governmental organisations should facilitate more accessible, cost-effective, and streamlined methods for the community.

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CHILDREN’S INDEPENDENT MOBILITY TO SCHOOL IN MALAYSIA

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Abstract

The concept of children’s independent mobility encourages children to participate in physical activity through active transportation. Children’s Independent Mobility (CIM) is defined as the freedom for children to move around their surrounding neighbourhood without supervised by an adult supervision. Currently, there are some concerns about the decline in children’s levels of physical activity. Increased reliance on automobiles for children’s daily transportation can have negative effects on the environment, as well as increase the level of childhood obesity, and reduce their sense of independence. Research suggests that independent mobility to school is an essential component of a balanced childhood, and it has positive impacts on various aspects of children’s lives, such as physical health, social skills, and cognitive development. However, very few practical studies address the association between children’s independent mobility and school specifically. Investigating CIM in the specific context of children’s mobility to school is important because commuting between home and school is a major issue in active school travel. Adopting literature reviews as an approach, this paper will outline some recommendations that can be used by the relevant authorities in implementing pedestrian policies and guidelines for school children based on school accessibility and connectivity to promote CIM. From the literature reviews, this paper establishes a conceptual framework for the promotion of CIM to schools in the Malaysian context. It was found that most residential areas and school surroundings in Malaysia are responsive to children’s needs but parents’ mindsets hinder this concept to be successfully done.

Keywords: Children’s independent mobility, Active transportation, School, Accessibility

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INTRODUCTION

Children's independent mobility (CIM) refers to the ability of children to move around their neighbourhood without adult supervision (Chaudhury et al., 2017; Sharmin et al., 2017; Habsah et al., 2019). This concept encourages children to engage in physical activities such as walking or cycling to school and other destinations as well as outdoor play. Research shows that children with higher levels of independent mobility are more likely to engage in active travel, leading to improved physical activity and reduced reliance on motorized vehicles (Veitch et al., 2017). Independent mobility has positive impacts on various aspects of children's lives, including physical health, social skills, and cognitive development (Chaudhury et al., 2016; Qiu & Zhu, 2017; Riazi & Faulkner, 2018; Masoumi et al., 2020). However, limited studies have specifically addressed the relationship between CIM and school travel.

Physical inactivity among children can have serious consequences on public health. There is, nonetheless, a decline in children's physical activity levels worldwide, with less than 20 percent meeting the physical activity standards recommended by the World Health Organization (Schmidt et al., 2017). Engaging in physical activities such as walking and cycling can greatly improve children's well-being by preventing health issues (Lin et al., 2017; Sharmin, 2017; Veitch et al., 2017; Marzi and Reimers, 2018). However, only 8 percent of children and teenagers in Canada engage in the recommended 60 min of moderate-to-vigorous physical activity (Riazi and Faulkner, 2018). Similarly, in countries such as the United Kingdom, Canada, and Germany, only 20 percent to 45 percent of children and adolescents use active forms of transportation (Pérez, 2020). Additionally, Love et al. (2019) found that only 24.5 percent of Australian students aged 9–12 walked or cycled to school, while the remaining 75.5 percent travelled by motor vehicles with their parents. These statistics highlight the issue of physical inactivity among children, which can have serious consequences on public health. Lack of physical activity can lead to obesity, cardiovascular disease, diabetes, and other health problems in children and adolescents.

An investigation of children's independent mobility (CIM) in the context of traveling to school is crucial for creating environments that support children's freedom to move safely. This paper aims to provide a comprehensive overview of the promotion of CIM in schools in Malaysia. This paper will first discuss the general perspectives on children's independent mobility based on the existing literature to achieve this. Additionally, this paper examines the current state of CIM about school travel in Malaysia. Finally, the paper recommends policies and guidelines to promote CIM for schoolchildren, considering school accessibility and connectivity.

LITERATURE REVIEW

Definition and Indicators of Children Independent Mobility (CIM)

According to Hillman et al. (1990), "independent mobility" is defined as a child's ability to move freely outside of their home, engaging in active travel and outdoor play without the presence of an adult. Active travel, such as walking and cycling, can significantly contribute to a child's overall physical activity (Veitch et al., 2017). Some researchers have described independent mobility as a child's ability to move freely around their neighbourhood or beyond without direct adult supervision (Chaudhury et al., 2017; Lin et al., 2017; Sharmin et al., 2017; Riazi & Faulkner, 2018; Habsah et al., 2019). This includes walking or biking to school, visiting friends, playing in parks or other public spaces, and participating in age-appropriate activities that promote independence and socialization. Previous studies have shown that children who are free to play outdoors and use active modes of transportation without adult supervision are more physically active in their daily lives (Marzi & Reimers, 2018; Marzi et al., 2018; Masoumi et al., 2020). Independent mobility can be measured in various ways. There are four main indicators of CIM that have been mentioned in majority of the literature reviews namely, 1) Destination, 2) Territorial Range, 3) Parental License, and 4) Time Spent Outside.

Table 1: Indicators of children independent mobility from previous studies

Indicators	Descriptions	Citations
Destination	Various local destinations a child could independently travel	Chaudhury et al. (2016); Lin et al. (2017); Qiu and Zhu (2017); Marzi and Reimers (2018); Riazi and Faulkner (2018); Pérez (2020); Sharmin (2020); Hamad et al. (2022)
Territorial Range	Distance from a child's home to the destination during independent movement	Qiu and Zhu (2017); Lopes (2018); Marzi and Reimers (2018); Riazi and Faulkner (2018); Pérez (2020); Sharmin (2020); Hamad et al. (2022)
Parental License	Mobility licenses parents grant their child to move independently	Chaudhury et al. (2016); Qiu and Zhu (2017); Lopes (2018); Marzi and Reimers (2018); Riazi and Faulkner (2018); Pérez (2020); Sharmin (2020);
Time Spent Outside	Time a child stays outside of home without adult supervision	Chaudhury et al. (2016); Lin et al. (2017); Marzi and Reimers (2018); Pérez (2020); Sharmin (2020); Pelletier et al. (2021)

Source: Various literatures

Factors influencing Children's Independent Mobility (CIM)

Children's independent mobility is influenced by individual characteristics, with age and gender being the most influential factors (Riazi & Faulkner, 2018; Love et al., 2019; Hamad et al., 2022). Generally, the level of CIM is correlated with a child's age (Qiu & Zhu, 2017). Hamad et al.'s 2022 study found that age, gender, and socioeconomic background significantly impact children's home range and engagement in CIM-related activities in Egypt, as distance increases. In terms of gender, a study by Pelletier et al. (2021) found that not only does a child's gender influence their movement behaviours, but their parents' gender as well. Parents' decisions regarding CIM can sometimes be biased based on gender (Riazi & Faulkner, 2018; Masoumi et al., 2020).

The social environment includes the perceptions of parents and children regarding the safety of their neighbourhood and traffic. As guardians, parents are concerned about the risks of strangers and traffic accidents when their children are outside the house (Riazi & Faulkner, 2018; Pérez, 2020). Strong relationships with neighbours and a sense of belonging in a safe street network are crucial for parents to grant their children independence. This means that parental permission for their children to be independent and their perception of the neighbourhood environment are crucial concerning CIM (Marzi & Reimers, 2018). A study by Masoumi et al. (2020) found that parents are twice as likely to drive their child to school if they perceive the neighbourhood to be unsafe.

This paper categorizes physical environment into two factors: 1) built environment, and 2) neighbourhood environment. Built environment factors, such as distance, density, land-use mix, and urban design, all influence CIM (Riazi & Faulkner, 2018; Hamad et al., 2022). The neighbourhood is particularly important as it is often the first place where children encounter the outside world (Habsah et al., 2019). Children frequently travel to school from home, often causing parental concerns about their safety. To promote CIM to school, neighbourhood and school administrations should address these concerns and implement measures to ensure child safety. (Qiu & Zhu, 2017; Love et al., 2019).

The policy environment, whether at the national, state, or local level, has always been considered a crucial determining factor in the implementation of CIM (Riazi & Faulkner, 2018; Sharmin, 2020). According to Riazi and Faulkner (2018), countries with the highest rates of children who independently move around have laws that promote active transportation, such as walking and cycling. Therefore, governments must develop pedestrian guidelines and facilities in urban areas that align with the physical environment and the CIM concept to achieve sustainable policies (Sharmin, 2020). The policy environment for CIM is divided into various areas, including public health, education, transportation, public spaces, urban design, and housing, making it challenging to develop an integrated approach (Masoumi et al., 2020).

CIM Concept in Malaysia

The demand for urban transportation in developing countries is increasing, but there is still a need for safe, affordable, accessible, and sustainable systems. The Sustainable Development Goals aim to make cities inclusive, safe, resilient, and sustainable (United Nations, 2021). Therefore, UNICEF has launched the Child Friendly Cities Initiative to ensure children have the right to live in a safe, secure, and clean environment (UNICEF, 2018). In the national context, Malaysian government has taken steps to improve children's rights and well-being, such as establishing an independent Children's Commission and the Child Act 2001, which safeguards children's social and physical rights with parents and guardians are responsible for protecting children's well-being (Mariana et al., 2017).

Malaysia's reliance on motorized vehicles has led to environmental issues like air pollution, prompting a focus on promoting green mobility in urban and rural planning. The Twelfth Malaysia Plan (2021-2025) aims to promote green mobility in Malaysia, addressing environmental issues like air pollution. The plan prioritizes modes of transportation such as public transport, walking, cycling, and environmentally friendly vehicles (Economic Planning Unit, 2021). It also outlines strategies to reduce greenhouse gas emissions and promote active mobility and low-carbon public transport. The plan aims to improve accessibility, connectivity, safety, and reliability of public transportation. Research by Yong Adilah et al. (2022) suggests that more public transportation facilities are more likely to allow children to travel independently. Also, transit stations should be developed with a vibrant mix of activities to ensure effective and efficient service to the public (Nur Aulia et al., 2018). This approach is crucial for promoting green mobility and reducing greenhouse gas emissions in the transportation sector.

Malaysia faces challenges in integrating motorized transportation with walking and cycling, addressing declining independent mobility among school children due to lack of physical activity. According to Malaysian Health Minister, Dr. Zaliha Mustafa, four out of five Malaysian children and teenagers are not physically active (Bernama, 2023). As independent mobility is closely linked to active commuting, this physical inactivity is detrimental as it decreases the level of independent mobility. Malaysian cultural and social norms may discourage children's independent mobility due to safety concerns among parents, limiting their freedom to explore their surroundings. Typically, children in Malaysia do not walk to school, even if the distance between home and school is less than 1 kilometer, due to concerns about traffic risks (Eliani & Brimblecombe, 2022). Therefore, to promote independent mobility, this concept needs to be promoted so that society has a better understanding of its benefits. Unfortunately, research on independent mobility among children in Malaysia is limited, with few studies exploring parental perceptions of neighborhood environments and safety, impacting children's long-term development and well-being.

School Planning and Guidelines for Walking

The Malaysian government has established standards and guidelines for determining the appropriate walking distance to schools. In Malaysia, these standards and guidelines are provided by the Department of Town and Country Planning, also known as PLANMalaysia. These guidelines are used as a reference when planning and locating schools, considering their proximity to housing and other community facilities. The safety of school children, particularly when walking to school, is a top priority for the community. As a result, relevant agencies and stakeholders are working to reduce child pedestrian injuries in school areas. When selecting a school site, one of the main considerations is road access. It is important for the school to not be located near a major road or freeway. Figure 1 shows the walking distance between home and primary school, with the destination within 800 meters or 10 minutes. Children are more likely to commute if home distance is less than 1.6 km. Walking is an excellent way for children to accumulate daily physical activity, so schools should be developed based on population and catchment area.

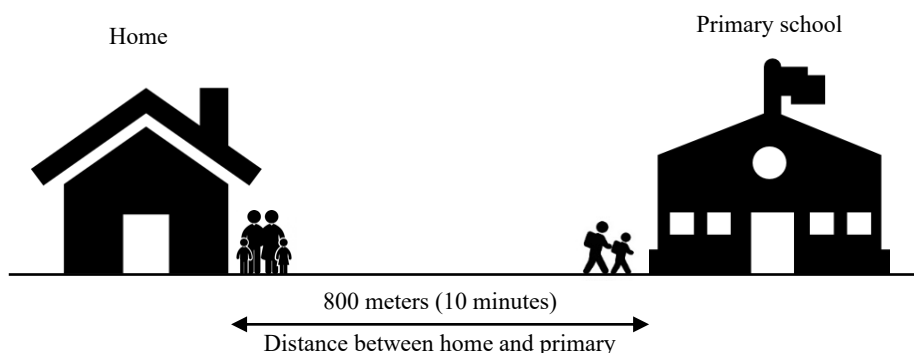


Figure 1: Walking distance between home and school
Source: PLANMalaysia (2022)

Meanwhile, Table 2 shows the specific guidelines on location and road for primary school. Literature suggests that key destinations should be within 400 to 450 meters (approximately 5 minutes of walking) of residential areas and 800 meters of public transportation (Intan Syuhana et al, 2014; Chaudhury et al., 2016). In ensuring the walkability of children, schools should be located near other supporting development components such as open spaces, shops, and recreational areas. According to PLANMalaysia (2013), the location of school is in the centre of the neighbourhood and mixed with other land-used categories such as open spaces, commercial areas, etc. Because a school is an educational facility, its location, design, and physical condition may be one of the most

critical factors in community planning. The location of the school is at the centre of the residential area and serves as the neighbourhood’s focal point (Qiu & Zhu, 2017).

Table 2: Specific guidelines on location and road for primary school

Criteria	Descriptions
Location Placement	<ul style="list-style-type: none"> • Distance from the intersection (minimum 200m) • Direct access to road 20.1m (66') (in residential area) • Close to residential areas and public transport transit (800m or 10 minute-drive)
Road Width (Minimum)	<ul style="list-style-type: none"> • Collector Road: 66' (20.1m) • Local Road: 40' - 50' (12.2m - 15.2m) • Special Lane (pick up and drop off): 50' (15.2m) <ul style="list-style-type: none"> - 3 spaces of bus lay-by (minimum 4m x 12m per space) - Parent/guardian vehicle zone

Source: PLANMalaysia (2022)

On the other hand, PLANMalaysia (2017) provided guidelines for the planning and implementation of a Healthy Walkable City at the city, town, and neighbourhood level or in any new development area. Healthy City was first introduced by the World Health Organization (WHO), where it promotes public health policy and sustainable development at the local level. One of the objectives of this guideline is to promote healthy living practices among urban residents by providing walking and cycling infrastructures to support active transportation. For school compounds, pedestrian footpaths and bicycle lanes must be provided with appropriate widths and must be considered safety factors. These facilities should also be equipped with support facilities, such as a covered bus stop and lay-by area for drop-off and pick-up, speed limit signs, and zebra crossings. Each pedestrian is different according to their age, gender, and physical ability; therefore, the planning and design of pedestrian-friendly cities should consider these factors. Table 3 shows the average walking distance and time of the children.

Table 2: Specific guidelines on location and road for primary school

Category	Age	Average Walking Distance (meter)	Time Estimation (minutes)
Children	3 to 6 years old	100 m	Average time 5 to 10 minutes
	7 to 12 years old	400 m	

Source: PLANMalaysia (2022)

Challenges for CIM in Malaysia

A recent study shows a decline in active transportation in Malaysia, leading to a decrease in green transportation options like walking and cycling (Mariatul Liza and Habizah, 2019). There were 66% of students chose to walk to school when

the distance was less than 1 km, while motorcars were a popular mode of travel for most students (Nurulhuda et al., 2020). In some cases, schools are located too far away from home; hence, children can't walk or cycle to school. In addition, findings from a study done by Tung et al. (2016), mentioned that more than one-third of Malaysian children were physically inactive. However, these studies only focused on active travel to school; whether active travel to other destinations such as shops, parks, and friends' houses increases children's daily physical activity is yet to be determined. Wong et al. (2016) and Tung et al. (2016) found that girls in Malaysia are less active than boys in physical education and outside-of-school activities. Again, these statements are only for physical activity, not specifically for active transportation, such as walking and cycling.

Active mobility among Malaysian schoolchildren is declining due to fear of crime and traffic concerns. Poor road safety, including improper pedestrian infrastructure and reckless driving, has led parents to consider private vehicles for transportation to school, resulting in a decrease in the popularity of walking and cycling (Ahmad Rasdan et al., 2018; Zaharah et al., 2022). Traffic congestion in Malaysia's urban areas is a common issue, with motor vehicles frequently dropping and picking up children. However, pedestrian negligence can also contribute to road accidents. For instance, some students intentionally violated safety regulations by not using pedestrian bridges (Ahmad Rasdan et al., 2018). Despite provisions for improper pedestrian infrastructure, these may not be fully utilized due to imprudent attitudes among pedestrians.

Malaysian parents frequently experience increased anxiety about the safety of neighborhood environments, which can potentially restrict their children's physical activity (Tung et al., 2016; Yong Adilah et al., 2022). Mariana et al.'s 2017 study found that 49% of parents in Klang Valley felt their children should walk within 100 meters of public areas, 31% perceived 400 meters as safe, and 20% felt 1 km was safe. In contrast, Liza and Habizah's 2019 study on urban children in Shah Alam revealed that parents still refuse to let their children walk independently to school, despite the home-school distance being less than one kilometer. On the other hand, children's gender could be a huge reason for influencing parents' decisions to allow children's independent travel to school. Malaysian parents prioritize their daughters' safety over their sons', according to Yong Adilah et al. (2022). Habizah et al. (2018) found that girls prefer parents' companions for safety, despite the minimal risk of stranger danger. Crime rates and cultural factors in Malaysian society, emphasizing traditional values, may also contribute to this concern.

RESEARCH FRAMEWORK

Methodology

This paper provides an overview of CIM from both global and Malaysian perspectives. The methodology used was a narrative literature review, which

covers a wide range of studies related to CIM. The techniques started by defining the topic, conducting a search for relevant literature, organizing structure, providing coverage of the topic, and lastly identifying gaps.

Theoretical Framework

A theoretical framework is fundamental to this research, which examines previous theories to identify relevant factors that determine CIM. Based on previous research, there are five primary factors for CIM: external, physical, social, socio-demographic, and individual (refer Figure 2). To explain children's mobility behaviour, three (3) well-established theories have been adopted in this research, encompassing the Social-ecological Theory, the Theory of Affordances, and the Neighbourhood Planning Theory.

Social-ecological Model

Bronfenbrenner's Theory of Ecological Systems emphasizes the significance of understanding human development within interacting systems. It suggests that children's independent movement can be studied from a social perspective, considering factors like family rules, neighborhood characteristics, and interaction between home and school environments. Therefore, both physical and social environments significantly impact children's mobility.

The Theory of Affordances

Gibson introduced the concept of affordances in 1979, which is linked to CIM, which involves identifying and using environmental means effectively. Affordances can be positive or negative, and their identification depends on an individual's developmental characteristics and the specific features of the space.

The Neighbourhood Planning Theory

Perry's 1929 neighbourhood unit concept emphasizes elementary schools in neighborhood planning and uses distance and population as guidelines for community facilities, transportation, and commercial activities. However, it's criticized for inadequate provision of community facilities and distant locations and lacks an illustration of the relationship between neighbourhood units and town centers.

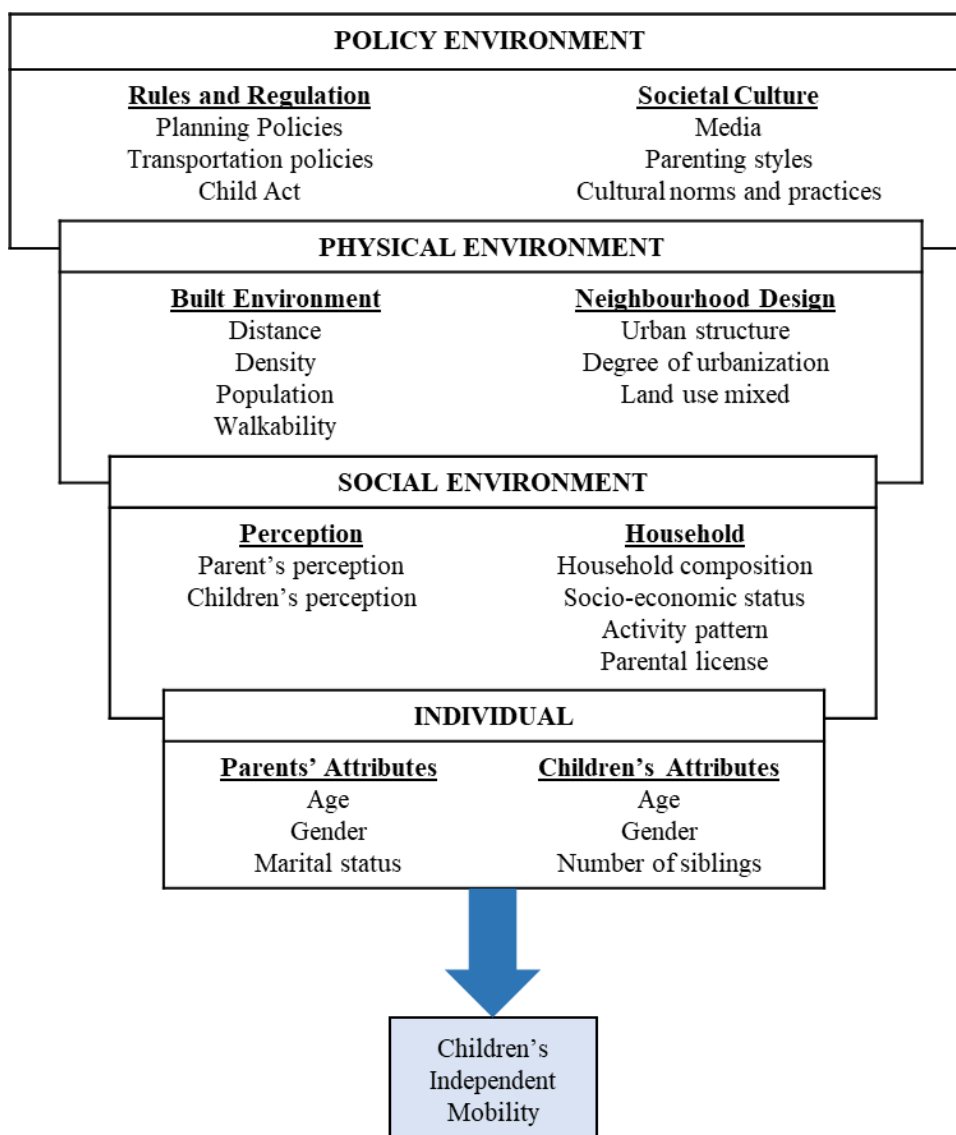


Figure 2: Factors influencing children's independent mobility

Source: Chaudhury et al. (2016), Lin et al. (2017), Qiu and Zhu (2017), Marzi and Reimers (2018), and Riazi & Faulkner (2018).

Conceptual Framework

School is a unique place among all accessible destinations for children. In this paper, CIM will be assessed to school. Active travel to and from school is a common mode of CIM. The conceptual framework in this paper incorporates factors influencing CIM to school. This paper identified policy environment, urban environment, and individual as variables in determining CIM to school. The proposed conceptual framework for this paper is illustrated in Figure 3.

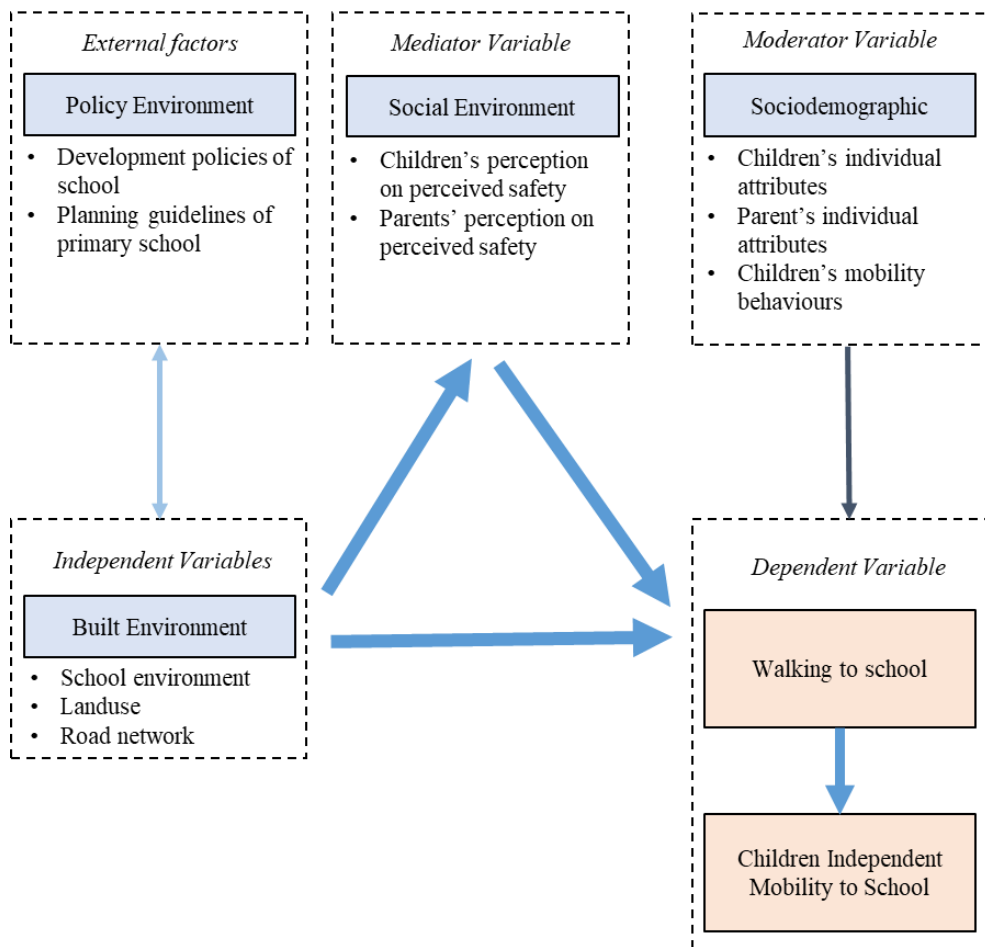


Figure 3: Proposed conceptual framework
Source: Authors (2023)

CONCLUSIONS

This paper provides a conceptual framework for the CIM concept in Malaysia. In a nutshell, the Malaysian government has tried its best to adapt the concept of CIM by implementing legal frameworks in consideration of the establishment of an independent Children's Commission from UNICEF. However, cultural norms in Malaysia prevent the adaptation of the CIM concept. Most parents still have doubts about allowing their children to move independently for safety reasons. Factors such as the built environment, traffic conditions, crime rate, and parental perception can affect children's ability to move independently in Malaysia. In addition, hot and rainy weather conditions in Malaysia also hinder the use of active travel (walking and cycling) among children. The lack of research in the Malaysian setting is not doing any good, which results in a lack of exposure to the benefits of CIM to the public. Therefore, research on CIM is crucial for understanding its challenges and opportunities in urban areas, especially in Kuala Lumpur, the capital city of Malaysia. Such research can help to determine areas for improvement in creating safe and accessible environments for children, particularly during school travel.

In terms of planning designs, it is suggested that school location and school catchment boundaries must be considered as key elements such as location, proximity, and accessibility to encourage active school commuting among children, thus promoting the CIM concept. Although the choice of travel mode varies depending on factors such as distance and local conditions, hence indicates that walking may not be the best choice among children. As previously highlighted, CIM is measured by the parental license, which is rarely granted to their children due to safety concerns regarding stranger danger and traffic risk. On the other hand, there are some strategies to promote CIM to school such as, 1) obtaining parental confidence and trust by exposing the values of active travel to school, 2) protecting children's safety by improving pedestrian infrastructure and road design, and 3) implementing green mobility initiatives, master plans and design guidelines at the local level, state, and federal level. Based on these strategies, the relevant parties need to work together to make the CIM concept successful in achieving sustainable urban living.

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THE IMPLEMENTATION OF DESIGN FOR MANUFACTURING AND ASSEMBLY (DfMA) IN INDONESIAN CONSTRUCTION INDUSTRY: MAJOR BARRIERS AND DRIVING FACTORS

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Abstract

Construction industry is a crucial sector of a country's economy, but faces continuing problems such as low productivity, labor intensity, and fragmented processes. Design for Manufacturing and Assembly (DfMA) has been identified as an important strategy for solving this problem. Despite its potential, the adoption of DfMA in Indonesian construction industry has been slow. Therefore, this study aimed to (1) investigate barriers to the adoption of DfMA and (2) propose effective drivers to promote the adoption of DfMA. To achieve these objectives, a comprehensive literature review and structured interviews were conducted with DfMA experts. A questionnaire survey was then carried out with 100 respondents, and after applying purposive sampling criteria, 71 respondents were considered eligible. Following this discussion, the primary data was analyzed using descriptive and inferential statistics. The collected data was processed using structural equation modelling (SEM) application known as SMARTPLS. The result showed that the main obstacle faced was the organizational mindset, while the most effective strategy was the contribution and support of the government. This study provided a better understanding of the constraints faced and driving factors that could be considered effective by industry practitioners. Additionally, there was an expectation that the results of this exploration would be an important starting point for developing a roadmap to encourage the wider adoption of DfMA in construction industry in Indonesia.

Keywords: design for manufacturing and assembly, DfMA, prefabrication, manufacturing, off-site construction, construction innovation

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INTRODUCTION

Low productivity and efficiency are a major and a critical problem in construction industry. To solve this problem, prefabricated systems was introduced. According to (Assad, El-Adaway, Hastak, & LaScola, 2021), off-site construction can help reduce costs, and time, improve quality, and eventually increase productivity.

The major cause of problem in construction industry is lack of communication and cooperation, as well as inadequate knowledge and experience (Nabi & El-Adaway, 2021) among stakeholders. Construction industry suffers from poor organization, productivity, complicated requirements, low profit margins, inadequate communication, and limited talent development (Tung et al. 2021). However, to overcome these problems, several countries have introduced DfMA and the important role in increasing the productivity of construction industry (Tan et al., 2020). The application of DfMA principles in prefabrication can encourage optimal design, manufacturing, and assembly processes. This processes often lead to cost and time savings, impact product quality, and customer satisfaction (Lu et al., 2021) (Abd Razak, Khoiry, Badaruzzaman, & Hussain, 2022).

Several developed countries such as UK, Singapore, and Hong Kong have recognized the benefits of DfMA in construction. As a result, local government authorities and professional bodies in these countries have introduced guidelines to practitioners in construction industry (Tan et al., 2020). These countries are currently leaders in the application of DfMA principles in construction industry (Langston & Zhang, 2021). Despite the advantages of DfMA, many other countries have been slow to adopt these principles. There is also a lack of study connecting DfMA principles to construction industry (Jiang, Mao, Hou, & Tan, 2018). For instance, the application of DfMA principles in Singaporean industry still encounters resistance from private sector, with only 11.2% of the prefabrication usage being recorded in 2001 (Gao, Low, & Nair, Design for Manufacturing and Assembly (DfMA): A preliminary study of factors influencing its adoption in Singapore, 2018). To address this issue, studies have suggested exploring the factors influencing the adoption of DfMA. Understanding these factors could assist in developing strategies to promote effective private-sector participation.

None of the discussions above are specific to Indonesian construction industry from preliminary studies on DfMA adoption. Knowledge gaps concerning barriers and strategies for implementing DfMA, particularly in the country's construction industry. Therefore, this preliminary study aims to explore the major factors that can hinder and encourage the adoption of DfMA principles in construction in Indonesia. The results of the study are expected to be an important starting point for developing a roadmap to inspire the wider adoption of DfMA, specifically in construction in the country.

LITERATURE REVIEW

Issues of Prefabrication Systems

Construction industry performs an important role in the economy of a country, but still has problems with low productivity (Ma, Chan, Li, Zhang, & Xiong, 2020). To address this issue, innovative methods have been developed, namely, prefabricated construction.

According to Nawi et al. (2019), construction industry cannot fully use the potential of prefabricated construction. Despite its positive effect, the industry still faces issues with project delay and cost overruns. This observation is supported by empirical data from prefabrication projects conducted by contractors in Indonesia, as shown in Table 1. An analysis of data in Table 1 showed that the projects still experience problems with timely completion, even though these projects have implemented prefabricated construction.

Table 1 : List of Projects Performance Using Prefabricated Systems

Project Name	Prefabricated Construction	Project Performance
Living Plaza	Yes	1 month late
South 78 Office	Yes	Completed on time
Apartment Royal Tajur	Yes	Completed on time
Tokyo Riverside Apartment T5	Yes	Completed 2 months earlier
DTP Center	Yes	4 months late
Ecohome Apartments	Yes	3 months late
Aeropolis Residence	Yes	4 months late
Living Plaza 328	Yes	3 months late
Tokyo Riverside Apartment T6	Yes	Completed 2 months earlier
Serpong Garden Apartments	Yes	Completed on time
West Senayan Apartments	Yes	Completed on time
Mall Boxies 123	Yes	2 months late
Midtown Apartments	Yes	2 months late
Vivere Office	Yes	1 month late
Osaka Apartments	Yes	Completed on time

A question arises, when prefabricated construction has been implemented, which is known for its speed of delivery, why are these projects still delayed? The same question is also found in Malaysian construction industry, although implementing industrialized building systems (IBS) is still not able to meet the demands of stakeholders (Abd Razak, Khoiry, Badaruzzaman, & Hussain, 2022).

Structured literature review has revealed that issues relating to time and costs often arise from poor communication and cooperation (Nabi & El-Adaway, 2021), as well as lack of knowledge and experience among major stakeholders

(Hyun, Kim, & Kim, 2022). This finding is further supported by a report from KPMG April 2016), which cautions that off-site manufacturing alone will not solve the challenges facing construction industry. Therefore, process needs to be combined with an incorporated design.

DfMA

Description of DfMA Principles

DfMA originates from manufacturing industry and is hailed as a powerful solution to overcome problems in the Architecture, Engineering, and Construction (AEC) industry, such as cost overruns, project delays, and low productivity (Lu et al., 2021). According to Lu et al. (2021), DfMA is still in its early stages in AEC industry, and practice largely applies guidelines and strategies from manufacturing industry. Similarly, DfMA studies have been initiated in construction industry, as shown in Table 2.

Table 2: Previous Studies

Authors	Years of Publication	Study Objectives
S. Gao, S. P. Low, and K. Nair	2018	Exploring factors influencing the adoption of DfMA to better understand the strategies required to promote effective private sector participation in construction industry in Singapore.
K. Chen and W. Lu	2018	Reports a case study of the successful application of DfMA-oriented design method to CWS in a commercial building in Wuhan, China.
S. Gao, R. Jin, and W. Lu	2020	Critically review the concepts and principles of DfMA, and propose major strategies for better implementation of DfMA in construction industry.
C. Langston and W. Zhang	2021	Identify barriers to implementing DfMA in construction industry in Australia.
W. Lu <i>et al</i>	2021	Review the development of DfMA in manufacturing and the status quo in construction, and clarify its similarities and differences to other concepts.
Abd Razak et al	2022	Identify the main benefits, inhibiting factors, and supporting factors of DfMA in construction industry in Malaysia.

DFMA is a principle for optimizing design (best design concept) and assembly, through the methods of Design for Manufacturing (DfM) and Design for Assembly (DfA). Following the discussion, these methods help designers optimize prefabricated building design and reduce conflicts between different disciplines at construction stage, by incorporating professional knowledge and information from the other phases into design stage. Based on DfMA principles, more detailed and comprehensive project information will be available at the outset because the contribution of major stakeholders such as designers,

engineers, suppliers, and contractors occurs early in design process. Such collaboration can help to identify and address potential risks in manufacturing and construction phases (Bogue, 2012). According to (Langston & Zhang, 2021) DfMA will be a promising strategy for the future of construction industry. This is because DfMA offers several benefits such as fast project delivery, improved quality control, worker safety, and reduced on-site waste.

Barriers to the Adoption of DfMA

DfMA in construction is an innovative concept adopted from manufacturing sector. However, the benefits alone are not sufficient to convince industry to adopt the concept. Several barriers hinder broader application of DfMA, and these challenges need to be addressed. Through a structured literature review, 15 potential barriers to the adoption of DfMA have been identified, as shown in Table 3.

Table 3: Potential barriers to the adoption of DfMA in construction industry

Code	Barriers	Description	References
B01	Resistance to change	The new process brought by DfMA requires stakeholders to change the way from conventional design, production, and construction to be more collaborative following DfMA principles. The process is not always easy for stakeholders to adjust to new processes which can create resistance to major changes and will be barriers to DfMA adoption.	Lu et al. 2021
B02	Higher initial cost	DfMA principles will trigger higher initial costs, for example, to set up factories and warehouses for DfMA components, staff training, technology investment, and others. Therefore, the traditional construction methodology remains the preferred choice as developers or contractors resist the adoption of DfMA due to perceived higher initial costs.	Langston & Zhang. 2021; Gao et al. 2018; Gao et al. 2020
B03	Community mindset	Stakeholders are conservative and lack the mindset to accept new products, technologies, and methodologies.	Langston & Zhang. 2021
B04	Opposition from trade unions	The implementation of DfMA brings increased efficiency and productivity, but it also raises concerns about potential job losses, particularly for on-site laborers. Unions oppose the use of DfMA because of unwillingness to allow job cuts. The resistance from the trade unions could be one of the challenges in DfMA adoption.	Langston & Zhang. 2021

Code	Barriers	Description	References
B05	There is business politics	Contractors and subcontractors usually have long-term agreements with large organizations that dominate the market for traditional construction materials. In this case, contractors and subcontractors are not willing to violate the agreement to adopt DfMA.	Langston & Zhang. 2021
B06	There is no incentive support from the Government	The government has not given attention and support in the form of incentives to support the implementation of DfMA.	Langston & Zhang. 2021
B07	There are no regulations from the Government	The government has not yet issued regulations or policies for the application of DfMA principles to certain building or infrastructure criteria.	Langston & Zhang. 2021
B08	There are no guidelines and standards	The government or related institutions have not created relevant standards and guidelines to encourage and guide the application of DfMA principles in construction industry.	Lu et al. 2021
B09	Technology limitations	The absence of affordable technology will hinder the widespread application of DfMA.	Lu et al. 2021
B10	Low levels of prefabrication in the private sector	The slow progress of DfMA adoption is largely due to resistance and low rates of prefabrication with DfMA principles in the private sector.	Gao et al. 2018
B11	Low demand owner	Project owners are major stakeholders in implementing DfMA because holders have strong control over the decision-making process, low awareness and demand from project owners is an obstacle to implementing DfMA in construction industry.	Gao et al. 2018
B12	Lack of contractor interest	Lack of demand from contractors due to reluctance to invest large amounts at the start to set up factories and procure technology to support the implementation of prefabricated systems with DfMA principles.	Gao et al. 2018
B13	Supply chain management challenges	Difficult to ship large modules from manufacturers which are usually located in big cities and surrounding areas to remote locations (transport challenges).	Langston & Zhang.2021; Gao et al. 2018
B14	Storage location constraints	Limited project location raises challenges for prefabricated module placement, which led to the project team being reluctant to adopt prefabrication.	Gao et al. 2018

Code	Barriers	Description	References
B15	Longer design process	Design process with more complex DfMA principles will cause a longer design process, which can reduce stakeholder interest in implementing DfMA.	Abd Razak et al. 2020

Drivers to the Adoption of DfMA

Construction industry in various countries have recognized the potential of DfMA to improve the delivery of prefabricated projects. Therefore, accelerated efforts to encourage the adoption of DfMA have attracted the attention of several explorers. Through a structured literature review, eight strategies are identified that could encourage the adoption of DfMA, as shown in Table 4.

Table 4: Possible drivers for the adoption of DfMA in construction industry

Code	Drivers	Description	References
D01	Financial incentives	Encouraging the adoption of DfMA in prefabrication processes through financial incentives (such as interest-free financing) etc., could be the right strategy to encourage industry to move towards better adoption.	Gao et al. 2018
D02	There are government regulations	Regulations issued by government agencies urge that the level of prefabrication with DfMA principle in AEC industry be increased.	Gao et al. 2018
D03	Promotion from the government	Promotion from government agencies related to prefabrication technology will generate attention, awareness, knowledge, interest, and action in construction industry.	Gao et al. 2018; Langston & Zhang. 2021
D04	Guidelines and Standards	Guidelines and standards can activate stakeholder attention and interest, hence, it is important for less experienced stakeholders, to regulate DfMA application procedures.	Lu et al. 2021; Gao et al. 2020; Abd Razak et al. 2020
D05	Application of appropriate project delivery	DfMA principles mean that multidisciplinary teams are included from the initial design stage. Only certain procurement methods are possible, e.g. Design-Build or IPD. Moreover, this method is a preferred method which will encourage interest in applying DfMA principles.	Chen et al. 2018; Abd Razak et al. 2020
D06	Increase knowledge	Incorporate DFMA principles in educational curricula, seminar topics etc., to increase knowledge to create awareness and allowing industry players to have an interest in it.	Abd Razak et al. 2020; Lu et al. 2021

Code	Drivers	Description	References
D07	Successful DfMA pilot project	Practitioners are required to be inspired and encouraged by successful examples of DfMA, some stakeholders may wait and observe whether competitors implementing DfMA will receive any real benefits. In addition, a successful DfMA application case will encourage the diffusion of the principle in AEC industry, possibly starting from Government projects first.	Lu et al. 2021
D08	Labor training	Existing workforce training whose capabilities are updated concerning prefabrication systems with DfMA principles can have an impact on opening new job opportunities, which will make major changes in the current structure of construction industry and will activate the interest of AEC industry practitioners.	Langston & Zhang 2021

STUDY METHODOLOGY

The data used in this study were primary data from the respondents' perceptions. To obtain the primary data, a purposive sampling method was used by providing the responders' criteria, including, (1) the respondent had average minimum knowledge of prefabrication and DfMA, (2) the responder had been included in prefabrication project, and (3) the respondent's education was at least a diploma and the people who did not meet these criteria were excluded from the list of respondents. Moreover, the measurement scale referred to Mvududu et al. (2013), using an ordinal measurement scale of 1–5 with a description of the scale which included, 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree. Following this discussion, the type of questionnaire used was a closed direct questionnaire.

The initial data obtained in this study were analyzed using descriptive statistics. Specifically, mean and standard deviation (SD) were calculated to rank the most important variables from respondents' perceptions. Variables with an average score above three were considered important, indicating respondent agreement. This analysis could help in understanding the perception patterns of different stakeholders, acknowledging that each group had different characteristics, interests, and business areas.

Following the initial assessment, inferential statistics, specifically exploratory factor analysis were used to explore the data. The method allowed for the identification of a smaller set of factors that could describe a large number of interrelated variables, enabling interferences about the population based on the sample. The factor analysis process used in this study included, (1) Kaiser–Meyer–Olkin (KMO) and Bartlett Tests, (2) Anti-Image Matrices, (3) Factor

Extraction, and (4) Factor Rotation. In this context, inferential statistics were considered the most appropriate method for generalizing the conclusions of this study.

ANALYSIS AND DISCUSSION

Respondent's profiles

Data were collected using a questionnaire survey with a purposive sampling method to 100 respondents. Subsequently, only 71 responders were considered to meet the criteria for selection. According to Hair, Black, Babin, and Anderson (2013), the minimum limit was 50 samples, as Table 5 showed the 71 profiles of the responders.

Table 5: Respondent's Profiles

Categories	Characteristics	Frequency	Percentage (%)
Organization Type	Clients/developers	7	9.86
	Consultant	11	15.49
	General Contractors	36	50.70
	Supplier	17	23.94
Disciplines of the Organization	Multidisciplinary	20	28.17
	Architecture	9	12.68
	Structure	37	52.11
	Mechanical, electrical, and plumbing	5	7.04
Job role of Respondent	Director	17	23.94
	Team Leader	14	19.72
	Manager	16	22.54
	Engineer	24	33.80
Respondent's years of experience in AEC Industry	<5 years	10	14.08
	5-10 years	20	28.17
	11-15 years	19	26.76
	>15 years	22	30.99
Education of Respondent	Diploma	9	12.68
	Bachelor's Degree	34	47.89
	Master's Degree	20	28.17
	PhD	8	11.27
The level of understanding of pre-fabrication	Excellent	37	52.11
	Good	23	32.39
	Average	11	15.49
The level of understanding of DfMA	Excellent	19	26.76
	Good	27	38.03
	Average	25	35.21

Descriptive Statistic Results

The mean and SD values were used to rank the relevance of the variables based on the perceptions of 71 respondents from various organizations and selected multidisciplinary groups. Based on the respondent's perception of variable B11,

the holder's low request to apply DFMA principle was the main obstacle with a mean value of 4.127. Additionally, Table 6 reviewed the results of the descriptive analysis, which showed the level of relevance of barriers to DFMA adoption.

Table 6: Descriptive Statistics of Barriers

Code	Barriers to DFMA Adoption	Means	SD	Rank
B11	Low demand owner	4.127	0.675	1
B13	Supply chain management challenges	4.113	0.934	2
B03	Community mindset	4.014	0.949	3
B08	There were no guidelines and standards	3.972	0.956	4
B01	Resistance to change	3.901	0.958	5
B07	There were no regulations from the government	3.901	0.913	6
B12	Lack of contractor interest	3.845	1.009	7
B09	Technology limitation	3.775	1.136	8
B02	Higher initial cost	3.746	1.092	9
B06	There was no incentive support from the Government	3.718	0.974	10
B10	Low levels of prefabrication in the private sector	3.662	0.985	11
B05	There was business politics	3.507	1.107	12
B14	Storage location constraints	3.493	1.229	13
B15	Longer design process	3.380	1.074	14
B04	Opposition from trade unions	3.352	1.148	15

The driving variable for DfMA adoption, variable D03, was a promotion from the government to introduce DfMA principles to developers and service providers such as general contractors, subcontractors, and consultants. Moreover, encouraging the adoption of DfMA implementation in Indonesian construction industry was the most effective strategy, with a mean value of 4.366.

Table 7: Descriptive Statistics of Drivers

Code	DFMA Adoption Drivers	Means	SD	Rank
D03	Promotion from the government	4.366	0.681	1
D04	Guidelines and standards	4.310	0.667	2
D07	Successful DfMA pilot project	4.282	0.680	3
D08	Labor training	4.239	0.726	4
D06	Increase knowledge	4.211	0.754	5
D02	There were government regulations	4.197	0.689	6
D01	Financial incentives	4.085	0.671	7
D05	Application of appropriate project delivery	4.042	0.726	8

Factor Analysis Results

From the analysis of factors inhibiting adoption, KMO value was 0.746, with a significance of 0.000, and the anti-image correlation and communality values of all inhibiting variables were above the minimum limit of 0.50. From the best results above, a conclusion could be deduced that the data met the criteria for

factor analysis. In addition, Table 8 showed 5 groups of factors that were formed, namely, organizational mindset, low level of stakeholder awareness, technical constraints, supply chain problems, and lack of interest.

Table 8: Rotated Component Matrix of Barriers

Barriers	Variables	Components				
		1	2	3	4	5
Organizational mindset	Community mindset	0.567	0.364	0.164	0.247	0.107
	Opposition from trade unions	0.663	0.298	0.297	-0.156	-0.040
	There was business politics	0.766	0.089	0.242	-0.091	-0.097
	There was no incentive support from the Government	0.622	0.112	-0.231	0.233	0.228
	There were no regulations from the Government	0.676	-0.018	0.076	0.407	0.371
Low level of stakeholder awareness	There were no guidelines and standards	0.516	0.593	0.037	0.307	0.113
	Technology limitations	0.146	0.788	0.172	0.177	-0.051
	Low levels of prefabrication in the private sectors	0.029	0.771	-0.039	-0.012	0.409
	Low demand owner	0.212	0.272	-0.007	0.726	-0.188
Technical constraints	Lack of contractor interest	0.231	0.745	0.036	0.221	0.114
	Storage location constraints	0.287	0.257	0.788	-0.044	0.072
Supply chain problems	Longer design process	0.076	-0.083	0.754	0.281	0.08
	Supply chain management challenges	-0.046	0.213	0.362	0.653	0.150
Lack of interest	Resistance to change	0.154	0.157	-0.073	-0.071	0.735
	Higher initial cost	-0.006	0.100	0.362	0.068	0.667

The driving variable required two rounds of factor analysis because the results of the first factor analysis obtained the value commonalities from variable D01. The variable included financial incentives that did not meet the minimum threshold with a value of 0.267. Therefore, D01 was removed from the list of variables and factor analysis was repeated in the second round.

The results of the second round of factor analysis obtained satisfactory results with anti-image correlation values and communality values above the minimum threshold, with a KMO value of 0.883 and a significance of 0.000.

Following the discussion, Table 9 showed the rotation of factors where there was only one group of factors formed, called government contribution and support.

Table 9: Rotated Component Matrix of Driver Factors

Driver Factors	Variables	Components
		1
Government Engagement and Support	Financial incentives	0.742
	There were government regulations	0.790
	Promotion from the government	0.846
	Guidelines and standards	0.721
	Application of appropriate project delivery	0.806
	Increase knowledge	0.816
	Successful DfMA pilot project	0.736

Main Barriers Factor: Organizational Mindset

The application of DfMA in construction industry in Indonesia was relatively new. According to factor analysis result, the main obstacle to the adoption of DFMA in construction industry was organizational mindset, with a variance of 32.8%. Observation showed that construction practitioners were comfortable with conventional methods, rather than switching to more efficient methods.

The new process offered by DfMA application required stakeholders to change way of working, which was originally fragmented from the processes of design, production, and construction, to become more collaborative. According to Lu et al. (2021), the changes were difficult to implement, and the design process was more complex and longer. Due to the complexity, stakeholders have been observed to maintain the conventional methods.

Organizational mindsets were also affected by expensive up-front costs to change the way things work and technology investments. According to (Gao, Jin, and Lu, Design for Manufacture and Assembly in Construction: A Review, 2020), cost components arising from DfMA applications increased capital costs such as costs for setting up factories and storage areas for DfMA components, the requirement for tower cranes with higher capacities to lift DfMA modules, module molding, staff training, and others. Giel and Isa (2011) also explained that expensive initial financing and investment uncertainty were important factors affecting organization's mindset and could lead to resistant to change.

Main Driving Factor: Government Engagement and Support

The main driving factor for the adoption of DfMA in Indonesian construction industry was the participation and support of the country’s government agencies, with a variance of 60.981%. Moreover, the government aspect was a stress point in developing countries (Rasoomalinesh et al, 2011)

The transition from conventional, fragmented prefabrication methods to more collaborative with DFMA principles led to higher project capital costs. For

example, setting up factories and storage areas for DfMA components, workforce training, technology investment, etc., could be very expensive (Langston & Zhang, 2021) (Gao, Low, & Nair, Design for manufacturing and assembly (DfMA): a preliminary study of factors influencing its adoption in Singapore, 2018) (Gao, Jin, & Lu, Design for Manufacture and Assembly in Construction: a Review, 2020). Consequently, many companies were reluctant to be the first to adopt DfMA technology considering the expenses and risks of uncertainty.

Indonesian government has a crucial role in encouraging the adoption of DFMA in prefabrication process. This could be achieved through financial incentives such as interest-free financing, making policies to include DfMA principles in educational curricula, seminar topics, etc., in order to increase knowledge, create awareness, and allow industry players to be interested in the adopting DfMA.

Gao et al. (2018) investigated the role of Singapore's government in the adoption of DfMA in construction industry. The results showed that support from Singaporean government through policies increased the level of prefabrication through DfMA from 6% to 50%. Additionally, promoting prefabrication through financial incentives, such as interest-free financing could positively impact the successful adoption of DfMA technology in construction industry.

CONCLUSION

In conclusion, the adoption of precast construction was proposed to solve the problem of low productivity in Indonesia's construction industry. However, in reality, construction industry was unable to exploit the full potential of prefabrication systems. This is because several projects in the country that had implemented prefabrication systems still faced problems with cost, time, and quality. The main problem identified in this context was lack of communication and multidisciplinary participation from the start of the project.

DfMA for Indonesian construction industry was still relatively new, hence, there were not many applications. The results of this study showed that the main factor affecting the adoption of DfMA was organizational mindset. Specifically, this mindset assumed that DfMA caused design process to be more complex and longer, leading to cost overruns and investment uncertainty at the start of the project.

To solve these challenges, government contribution, including government regulations and standards, financial support, training, and seminars to increase stakeholders' knowledge and awareness, could perform an important role in encouraging DfMA adoption in Indonesian construction industry. The results are expected to contribute to knowledge in the field of construction project management and as a proposed strategy for the country's government for the wider adoption of DfMA.

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CONSIDERATION OF PLANNING PERMISSION IN SHORT-TERM RESIDENTIAL ACCOMMODATIONS

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Abstract

Planning permission may be required if the use of the property for short-term residential accommodations (STRA) services constitutes ‘development’ in planning terms. In analysing the possible operational aspects of STRA application in the planning system in Malaysia, the experience of STRA implementation in some selected countries is explored. The article concludes that there are different approaches, which are adopted by different regions concerning the need for planning permission. Most jurisdictions that are “friendly” towards STRAs view that planning permission is not necessary if STRA is managed on a small scale. Hence, it can be concluded that if the scale of the STRA business is big, i.e. ‘commercial’ in nature, planning permission is needed. Alternatively, the local planning authority may consider issuing a provisional or temporary planning permission (TPP), a short-term approval that is only permissible for the transitory nature of the use of land and buildings.

Keywords: short-term residential accommodations, planning permission, local planning authority, material change

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INTRODUCTION

Nowadays, many people are renting out their residences to short-term visitors and operates as short-term residential accommodation (STRAs) operators. One of the debates on permissibility of STRA is whether the nature of use of the building has significantly changed, with the operation of such business in the building. This led to the issue of whether planning permission is needed as this is a requirement in event of material change of use of building. In this article, a summary of the planning system in Malaysia and its connection with the concept of STRA is suggested. This article makes comparative study with selected foreign jurisdictions which have different types of STRAs in recommending the suitable approach in addressing the issue of planning permission in the approval process of STRA operation in Malaysia.

LITERATURE REVIEW

There are very few literatures which discuss on the legal aspects of short-term accommodations (STRA) in Malaysia. Most of the literatures are newspaper reports which give a brief idea on the legal aspects of the short-term accommodation and the STRA online platform for example, the Airbnb (Airbnb considered legal, Penang Property Talk, 29 August 2016). Diane Foo, in the Market News on 19 January 2017, in her article, “Rules on Short-Term Rentals Vary in Malaysia” is the very few literatures on this matter. Currently different states have different treatments on STRA. It was reported that in last July 2017, the Penang Island City Council issued summons to landlords, after receiving complaints that they were leasing their premises for short term residence purposes. The Environment Health and Licensing Department of Penang defines STRA as operating an illegal lodging house without a lodging house licence issued by the local authority. This is again confirmed in the report published in the Penang Property Talk on the 13 August 2019. On 13 April 2024, The Edge Malaysia reported that the Airbnb calls for fair and practical guidelines for STRA. Airbnb is reported to have advocating for a balanced and simple approach to regulate STRA with recommendations, including no cap on booking nights as this severely limits guest travel and undermine ongoing efforts to promote Penang and Malaysia as a digital nomad hub.

Arshad, A. F. in 2012 suggested that the Temporary Planning Permission (TPP) is an option to avoid the complication of the traditional planning permission which is basically a short-range or time-based planning permission. He concluded that the TPP can be expanded or withdrawn by the Local Planning Authority (LPA) at any time. The revocation of the TPP may arise if the LPA thinks necessary for the safety of public interest in the vicinity. Mohammad Yusup, Ahmad Fuzi Arshad, Marlyana Azyyati Marzukhi et.al., in 2018 further emphasised that it is important that provisions regarding TPP in Town and Country Planning Act of 1976 (Act 172) are expanded in detail

especially regarding time frame, type of development, development fees, and so on. The writers also stressed that the provisions related to TPP are also important for the purpose of planning legal system. According to the authors, the process of decision-making, the use of formal and informal instruments and other measures need to be considered and should be uniformly formulated to be implemented by the LPA. In the absence of specific discussion on the need of planning permission in the approval process of STRA business in Malaysia, this article is to fill the gap.

RESEARCH METHODOLOGY

Content analysis of the Malaysian statutes which has relation with approval of planning departments, i.e. the Town and Country Planning Act of 1976 (Act 172) and approval of construction of buildings, i.e. the Street, Drainage and Building Act 1974 (Act 133) and the Sewerage Services Act 1993 (Act 508) are discussed. Comparative study with the statutory provisions of the Irish Planning and Development Act, 2000, which regulates the planning and development of land in Ireland, the Greater London Council (General Powers) Act 1973 and the Deregulation Act 2015 are made. Due reference is also made to the New South Wales (NSW) Guidance on Planning Applications for Short Term Lettings (Circular letter PL 10/2017), issued by the New South Wales Department of Housing, Planning and Local Government.

Case study on Malaysian cases pertaining to public participation in planning permission process i.e. the cases of *Datin Azizah bte Abdul Ghani v Dewan Bandaraya Kuala Lumpur & Ors* (1997) 2MLJU 204 and *Mentari Housing Development Sdn Bhd & Anor v Abdul Ghapor Hussin & Ors* (2011) MLJU 1009 are discussed in this article.

ANALYSIS AND DISCUSSION

STRAs and Planning System in Malaysia

Many countries placed the STRA scheme under planning system as their STRA management tools. For instance, the Parliamentary Committee of the NSW, Australia has recommended to use planning instruments in regulating and managing STRAs, primarily through exempt and complying planning development. In Malaysia, the same rules apply whereby the Kuala Lumpur City Council and Melaka Local Council for example require the property owner to apply for a STRA permit before running the business. However, prior to issuance of the permit, the STRA property owner can be asked to apply for planning permission and be approved by the local planning authority (LPA) (Ahmad et al., 2013). As implemented by most part of the world, in Malaysia, the Town and Country Planning Act 1976 (Act 172) prescribed several criteria that need to be satisfied before the planning permission is granted. Most local councils do not specifically regulate STRAs, and the use is commonly treated as an ancillary

activity to the residential use of a home, where some local councils may require the property owner who decided to run a STRA business to apply for planning permission under Act 172 before the STRA permit is issued. Why is planning permission required in the process of issuance of the STRA permit?

The general rule is that planning permission is only required if “development” is carried out. This can be either a ‘material change of use’ or ‘works’ or both. In considering STRA in the planning perspective, it is assumed that no renovation works is required if the use of the property approved is for residential purpose and if the nature use of STRAs has not changed the nature of the purpose of property. Thus, the only aspect that may cause the STRA services to fall under the designation of “development” is the material change of use. It is about the consideration of whether there is change of use from a private residential property to STRA services which now is commercialised and to a certain extent, represents a material change of use which would require planning permission.

Under the Act 172, if the property owner makes any material change in use on the land and/or building that falls under the definition of “development”, then planning permission is necessary. “Development” has been defined by Section 19(1) of Act 172 as the carrying out of any building, engineering, mining, industrial, or other similar operation in, on, over, or under land, the making of any material change in the use of any land or building or any part thereof. Section 19(1) of Act 172 states that before the commencement of any development, an application for planning permission must be obtained unless it falls under section 19(2) of Act 172. Section 19 (2) elaborates on several circumstances where no planning permission shall be necessary. Among others, the provisions which may relate to the STRAs services are as follows:

1. Section 19(2)(a)(i) provides that planning permission is unnecessary for the carrying out of such works as are necessary for the maintenance, improvement, or other alteration of a building, being works that affect only the interior of the building and do not involve any change in the use of the building or the land to which it is attached;
2. Section 19(2)(f) also provides that if the use of any land or building within the structure of a dwelling-house for any purpose incidental to the enjoyment of the dwelling-house as such; and
3. Section 19(2)(g) for the making of such material change in the use of land or building as the State Authority may prescribe to be a material change for which no planning permission is necessary.

In the context of STRA, the above provision clearly specifies that the property owner who converts the land use from a residential purpose for a STRA business may not be subject to the planning permission obtained from the LPA if

it falls under any one of the above circumstances. If the property owner whose application for STRA permit is subjected to the approval of planning permission, he may challenge the imposition of such requirement. He could challenge it if he can prove that he falls under any one of the circumstances in section 19(2) of Act 172 i.e. if he intends to make alteration to the main structure of the building but do not affect the any change of use of the building, or if the use of any land or building for any purpose is incidental to the enjoyment of the house.

Application for planning permission

In the application for planning permission due to material change of land use, section 21(1) of Act 172 provides that it shall be made to the local planning authority and shall be in such form that contains all relevant particulars, accompanied by such documents, plans, and fees as may be prescribed. If the applicant is not the owner of the land on which the development is to be carried out, section 21(2) provides that a written consent of the owner to the proposed STRA shall be obtained and endorsed on the application.

In obtaining approval for planning permission, one must be aware of the issue whether the proposed STRA building is located within the area with a gazetted local plan or otherwise. This is crucial as the process to get the planning permission differs for both cases. If the proposed STRA building is in an area in respect of which no local plan exists for the time being, then, upon receipt of an application for planning permission, the LPA shall, by notice in writing served on the owners of the neighbouring lands informing them of their right to object to the application. They will need to state their grounds of objection within twenty-one days of the date of service of the notice as specified under Section 21(7) of Act 172. In pursuant to this provision, neighbouring land refers to, inter alia either lands adjoining the land to which an application connects, or lands located within 200 metres from the border of the planned STRA. There is no allowance of time available for any delay to object the application within the said period. Upon receipt of the opposition, the planning authority shall, within thirty days after the end of the objection period, hold a hearing before the planning permission is granted.

Notably, the service of notice to object is obligatory as decided in *Datin Azizah bte Abdul Ghani v Dewan Bandaraya Kuala Lumpur & Ors* (1997) 2MLJU 204. In this case, the plaintiff claimed that she was not given the chance to oppose as she did not receive any notice about the application for planning permission. On appeal, the Supreme Court recognised the significance of the public to take part in the planning permission procedure and ordered to invalidate the questioned development order. In another case, *Mentari Housing Development Sdn Bhd & Anor v Abdul Ghapor Hussin & Ors* (2011) MLJU 1009, the Court of Appeal upheld the right of public participation in the planning permission process whereby any approved planning permission without the

statutory hearing was null and void. The Court of Appeal decided that the law confers on the residents a statutory right to be heard. As such, the requirement that requires the planning authority to consider the residents' objections before planning permission can be granted is vital. Applying to the STRA development, through this approach, the public will have the opportunity to raise their concern if the proposed STRA activities affect their livelihood in the area. If, however, there is a local plan available, the LPA and property owner for the planning permission are obliged to comply with the diagrams, illustrations, and other information described in the gazetted local plan. It is to be noted that section 21(1) of Act 172 requires the LPA to consult other related government agencies and statutory bodies such as Fire and Rescue Department of Malaysia or Ministry of Health Malaysia to obtain their views, technical advice, and recommendations on a proposed development prior to the approval of planning permission.

Thus, it is clearly specified that Act 172 requires the STRA operators not to commence or carry out any development unless planning permission in respect of the development has been granted to him under section 22 or extended under section 24(3). In the planning standpoint, what is meant by "development" in the STRA evolution must first be evidently determined as it concerns considerably not only on the change of use, carrying of renovation work of the structure etc., but also the surrounding impacts of STRA improvement within the neighbourhood, area, and the strata buildings (Abdul Rahman et al., 2012).

Although the material change of land use may cause it to fall under the term development and planning permission becomes compulsory for the property owner to apply, circumstances laid down under section 19 (2)(a)(i), (f) and (g) imply that in the context of change of land use for STRA services, it may not be a material change of land use as one may argue that the current and future use of the land/and or building are for residential purpose and housing accommodation. As discussed earlier, in the context of STRAs, section 19 (2) clearly specify that no planning permission is necessary for any alteration to the main structure of the building but does not affect the house, or if the use of any land or building for any purpose is subsidiary to the enjoyment of the guests of the house, or if the State Authority itself decided that such material change in the use of land does not require any planning permission. Although the material change of land use may cause it to fall under the term development and planning permission becomes compulsory to apply, circumstances laid down under section 19 (2) (a)(i), (f) and (g) imply that in the context of change of land use for STRA services, the LPA may consider to invoke section 19(2)(g) that the change of land use for STRA is not that material as its current and future use are similar, i.e. for residential purpose and short-term accommodation especially when the STRA is used as a supplementary function of the property, i.e. not used as the sole purpose of the property.

Hence, how any material changes in the use of the STRA services or any part thereof that fall under “development” need to be analysed. In doing so, the operation of STRA in the planning system of some selected countries were explored. In planning and development, the LPA plays a major role in deciding the physical development of its area. For every physical development that took place on land and/or buildings, development control is an essential tool, used by the LPA in monitoring and controlling the development within its administrative area. Thus, about the STRA and development control, any material changes of use from residential to STRA if falls under the definition of development, it is necessary to determine whether the use of the property from a private residential to be let for STRA would amount to “a material change” and thus fall under the definition “development” which requires planning permission from the LPA. In Malaysia, what is meant by “material change of land use” must first be clearly verified as it concerns greatly not only on the physical or massive changes to the land and/or building but also matters such as fire safety, health, service levels and amenity caused by its use.

Enforcement of Non-Compliance STRA

If planning permission is required for the operation of STRAs, any operator who fails to comply with the requirement can be penalized whereby the LPA has the power to impose a penalty for unlawful development of a fine not exceeding RM500,000 or to an imprisonment not exceeding two years or to both and a further fine not exceeding RM5,000 per day for each day such offence is exercised after the first conviction of the offence. It is also an offence under the Street, Drainage and Building Act 1974 (Act 133) to carry out any construction of a building for STRA enhancement without approval from the LPA. In dealing with the request for planning permission, the LPA needs to take note of any matters which in its opinion expedient or essential for proper planning particularly the provisions of the development plan, if any. Further conditions that must also be considered are the direction given by the State Planning Committee, the objections, if any, made under section 21, any development plan under preparation or to be prepared by the LPA, or the proposals relating to those provisions; the provisions of the Sewerage Services Act 1993 (Act 508) and the development proposal report.

Tests for Material Change of Use

In the New South Wales, Australia (NSW), the local authority defines what constitutes “material change to land use”. In planning terms, a material change of use entails tests to be considered, i.e. a change of use may deem material if the planning authority would take into account various matters in evaluating a planning application for the proposed use as compared with the original use.

In considering the continuous use for STRAs in NSW, matters that may be considered in assessment of the planning application process as provided under the NSW Guidance on Planning Applications for Short Term Lettings (Circular letter PL 10/2017), issued by the Department of Housing, Planning and Local Government are as follows:

1. For a standard domestic or residential application, the local authority may compel certain development specifications to be applied. Examples of such standards relate to car parking and facility including public and private open space. If the standard of use of these facilities increases for STRA guests, it is determined that a material change of use has occurred.
2. Another aspect that needs to be addressed is if the house is occupied for residential use and the STRA is ancillary to this use, it can be reasoned that no material change of use arises. This means, the conventional residential development standards are still relevant and applicable.
3. If a house or apartment is owned by a landlord and occupied by a tenant under a tenancy agreement, the occasional use of that apartment for a STRA might also not constitute a material change of use because the main use is for normal residential occupation.

With reference to STRA scheme, which is related to apartments, NSW government has also issued some guidelines setting out the qualitative and quantitative criteria to determine whether planning permission should be granted, as follows:

Qualitative criteria:

1. Location or site of the apartment;
2. Quality and condition of the accommodation;
3. Need to make efficient use of housing supply; and
4. Potential impact on residential amenities and conveniences of existing local communities.

The guidelines also state that where planning permission for the use of an apartment for STRA is applied for, a permission is to be approved by the planning authority. The approval may subject to several limitations relating to the intensity or number of the use. There are four limitations known as quantitative criteria to be imposed upon approval of the application as far as the intensity of the use for apartments is concerned. They are as follows:

Quantitative criteria:

1. The STRA is available for less than 60 nights in any one year;
2. No more than five consecutive night in any stay;
3. Max of two rooms per apartment;
4. Max of four guests per apartment.

In addition to the limitations relating to the apartment unit itself, there are also conditions imposed on the apartment blocks whereby a maximum of 20% of apartments are available for STRA services on any floor of the whole building. In Ireland, the Irish Planning Board in 2016 elaborated on the issue of whether the use of an entire residential apartment on a year-round basis for a series of STRA, constitutes a change of use. This matter was raised by Temple Bar Residents concerning an apartment in Dublin, which was being sold on the basis that it generated €79,000 in 2015 from short-term lettings via the Airbnb platform. Section 5 of the Planning and Development Act 2000 was referred to and applied by the residents when raising the matter to the Dublin City Council. The provision spells out as to whether such use constitutes ‘development’, and whether such development is exempted development. Dublin City Council determined that the use was a material change of use. Disappointed with the decision, the apartment proprietor referred the case to the Irish Planning Board for review. Such change of use creates planning considerations that are materially different from the planning considerations relating to the regular use of a residential apartment. The change of use is a material change of use, and hence amounts to a ‘development’ under the Planning and Development Act 2000. Accordingly, the apartment owner was required to apply for planning permission from the Dublin City Council.

In another instance, the STRA lettings in Greater London are subject to a further planning restriction under Section 25 of the Greater London Council (General Powers) Act 1973. It provides that the use of residential buildings as transient accommodation for less than 90 successive nights, amounts to a material change of use that requires planning permission. The objective behind the provision is to protect London’s perpetual housing supply. Having said that, the Government introduced an exemption to this restriction in the Deregulation Act 2015 whereby STRA in the municipal areas is no longer deemed a material change of use if:

1. the accumulative number of nights used as temporary lodging does not exceed 90 nights in any one go (or any calendar year); and
2. the STRA owners or operators are liable to pay council tax.

It is further noted that under Building Regulations, such accommodation may nevertheless, be classified as a material change of use which accordingly, enhancement works may still be required to abide by relevant specifications that fit with the STRA scheme.

In Ireland, the Irish Planning Board in 2016 has recognized three issues to be addressed in deciding whether the use of the premises for STRA constituted ‘development’, and whether such development was exempted development or otherwise:

- (a) has a change of use occurred?
- (b) if so, has a material change of use arose such as would amount to ‘development’?
- (c) if development has arisen, is it exempted development?

The Board described that the change of use was a material change of use, mainly due to the distinct planning concerns created by the new use, inter alia:

- (a) the extent and rate of recurrence of usage of the apartment by STRA guests and servicing staff,
- (b) associated considerations for other residents in respect of security and general disturbance and
- (c) the entirely commercial nature of the activity.

It can be established that there are different approaches, which are adopted by different regions in relation to the need for planning permission. Majority of jurisdictions which are “friendly” towards STRAs views that planning permission is not necessary if STRA is managed in small scale. Hence, it can be concluded that if the scale of the STRA business is big, i.e. ‘commercial’ in nature, planning permission is needed.

The Option of Temporary Planning Permission under Act 172

As the nature of STRA implementation mainly for investment purpose, it indicates that the use of land and/or buildings is for a temporary basis. In other words, the property owner may one day decide to terminate the STRA business and reconvert the use of STRA back to a residential purpose. Hence, the LPA may consider issuing a provisional or temporary planning permission (TPP), which is a short-term approval and is only permissible for this transitory nature of use of land and buildings.

The TPP is a short-range or time-based planning permission, which can be expanded or withdrawn by the LPA at any time. The revocation of the TPP may arise if the LPA thinks necessary for the safety of public interest in the

vicinity (Arshad, 2012). Usually, the TPP period can be up to a maximum limit of five years. The endorsement for this type of planning permission is granted by the LPA for a fixed time and will expire depending on the specified planning requirements. The LPA may approve the TPP because the proposed structure or the use of land and/or buildings is transient. Further, the LPA could also remove the structure or halt the use of land and/or buildings when it is no more needed. In addition, the LPA can also grant the TPP if they are doubtful on the impact of the use of land and/or building and aimed to give the proposed development a 'trial basis'. For instance, the impact of a coastline reclamation can be considered as a 'new land'. As the so-called reclaimed land is still new and the structure is unstable, the entire area should not immediately be developed with permanent development.

As far as Act 172 is concerned, there is no such option as TPP apart from Section 22(5), i.e. on the use of planning conditions. This provision provides that planning permission is granted to the applicant for the use of land or buildings within a limited time. Upon expiry of such period, the use of such land and building will be reverted to its original. This is to ensure that the development of such land will follow the approved layout plan. With this approach, the LPA seems to exercise its controlled method in prohibiting any development that may destroy lands and other negative impacts associated with the environment in terms of physical, natural topography, and landscape. It is to be noted that section 22(6) requires a copy of the TPP to be served to the persons who make oppositions to the proposed development according to Section 21(6) of Act 172.

Applying this option to the STRA arrangement, during the insecure period, the LPA can propose or grant temporary planning permission if so, required on the land on a 'trial basis'. Consequently, after the expiry of the trial period the LPA may discover the strengths, weaknesses, opportunities, and threats of the area to plan for an appropriate term for the STRA's future development.

CONCLUSION

In terms of the different characters and interests that exist in various cities, it is the responsibility of the authorities to ensure that the STRA development within the vicinities is preserved. The roles of town planners to attend and manage the cities require effective collaboration between all sectors in the associated fields such as landscape architecture, civil engineering, and public administration. The tasks of other sub-fields such as land-use planning, zoning, economic development, environmental planning, as well as transportation planning are also very much emphasized. In the context of STRA administration and practice, in the event applications for STRA licences and relevant planning permission are required, then the relevant authorities need to provide special attention at the

approval stage especially if it involves negative impacts to the land use, environment and transportation planning.

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SOCIAL IMPACT ASSESSMENT: A COMPARISON OF THE LEGAL FRAMEWORKS IN MALAYSIA AND NEW ZEALAND

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Abstract

Social Impact Assessment (SIA) has been implemented since the early 1990s, and it is a decision-making tool and methodology for determining the benefits or suffering that affect communities through the social outcomes data. This assessment is crucial in the planning phase as well as the development phase to monitor the impact of proposed development projects. Many countries, including Malaysia and New Zealand, have started implementing SIA within their legal framework to respond to the development cycle proactively. Thus, this paper seeks to compare and analyse the legal frameworks of SIA in Malaysia and New Zealand through qualitative methodologies: library research, content analysis, as well as comparative analysis. The findings show that both countries have legislation relating to SIA; however, the method of implementation is not the same, as SIA in New Zealand has emerged with the Environmental Impact Assessment (EIA) while SIA in Malaysia is implemented on a stand-alone basis.

Keywords: SIA, Legal Framework, Comparative, Malaysia, New Zealand

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INTRODUCTION

Becker (2001) defined Social Impact Assessment (SIA) as a process of identifying the potential impacts caused by current or future actions that affect people, organisations, or the social macro system. It does not merely stop at the analysis of potential impacts; rather, SIA is used to determine strategies to overcome the negative impacts that may arise during proposed development and to enhance more positive impacts (Dale et al., 1997).

Many SIA specialists opine that it is impossible to describe all the social impacts. Nonetheless, Vanclay (2002) has identified several variables that could be considered when assessing the social impact of a proposed development. This is due to different situations and various factors, depending on the weight of the development project. Previously, Audrey Armour derived the classification of variables, which consisted of way of life, culture, and community. Vanclay expanded the boundaries of the classification to include the political system, environment, health and well-being, property rights, and aspirations. Figure 1 illustrates the classification of social impact by Audrey Armour and Vanclay.

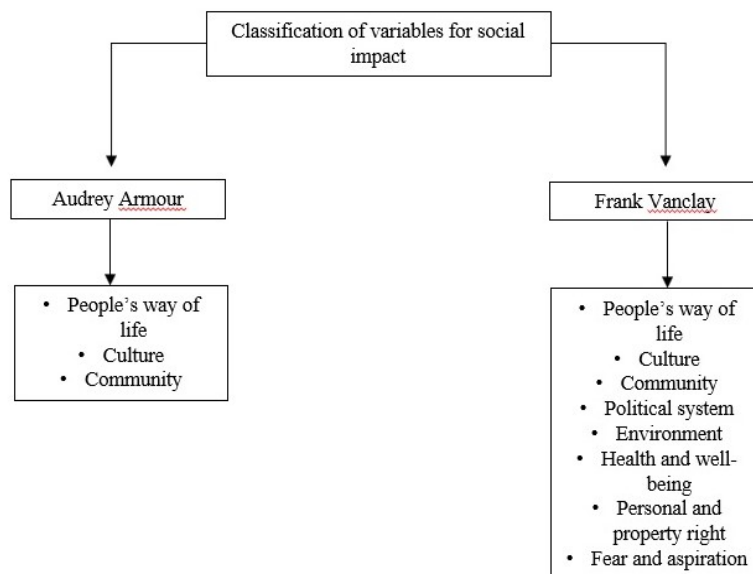


Figure 1: Classification of variables for social impact

Several academics have updated numerous generic lists of societal impacts over time, including Juslen, Taylor, Branch, Gramling, and Freudenburg.

Additionally, international committees like the Inter Organisational Committee on Guidelines and Principles for Social Impact Assessment have

produced lists of social impact variables (Vanclay, 2002). The implementation of SIA has evolved and has been integrated into the legal framework, as SIA is a process of assessing or estimating, in advance, the social consequences likely to follow from specific policy actions or project development, particularly within the context of appropriate national, state, or provincial environmental policy legislation (Burdge, 1994). The inclusion of SIA within legislation not only legalises the implementation of the assessment but also provides guidance and a clear picture to consultants, project proponents, and relevant stakeholders. The affected community may refer to the legal framework in order to assert their personal and property rights as measured by the variables of social impact (Esteves et al., 2012).

DISCUSSION

Legal Framework of SIA in Malaysia Post 2018

SIA was incorporated into Malaysian national policy during the National Social Council meeting in September 2015, where the outcome was the decision to implement SIA for relevant development projects (Othman et al., 2023). A department under the Ministry of Housing and Local Government, namely the Town and Country Planning Department (PLANMalaysia), has been responsible for implementing SIA. A significant step was taken through the amendment of the Town and Country Planning Act 1976 (Act 172) in 2017, where the statutory requirement for SIA was inserted via the Town and Country Planning (Amendment) Act 2017 (Act A1522) (Suaree et al., 2022).

Previously, SIA had been categorised into three categories: SIA Category 1, SIA Category 2, and SIA Category 3 (Suaree et al., 2023). However, the current classification of development types has been simplified into two categories: SIA Category A and SIA Category B (SIA Manual, 2023). Development projects falling under Category A are under the jurisdiction of PLANMalaysia Federal, while those falling under Category B are determined by PLANMalaysia State (Othman et al., 2023). SIA Category A consists of development projects as expressly stated under section 20B of Act A1522 and section 22(2A) of Act 172. It requires the project proponent or SIA consultant to obtain advice from the National Physical Planning Council (NPPC) during the submission of the SIA report for any large-scale project that crosses the border of two states. Meanwhile, SIA Category B involves any project determined by the state authority (PLANMalaysia State). It is insufficient to submit only the development proposal report, as stated under section 21A (1) (ea) of Act A1522. It also requires the submission of an SIA report. During this stage, the submission does not need to be made to the NPPC.

Table 1 shows the latest categories of SIA under Act 172, Act A1522 and SIA Manual.

Table 1: Categories of SIA

Category	Development	Source
A	Coastal reclamation, infrastructure, new township, major utilities, hillslopes, and other infrastructure of nationally important	section 20B (2), Act A1522, section 22(2A), Act A172
B	Prescribed in Manual and determined by State Authority	SIA Manual 2023

Source: Act 172, Act A1522 & Manual SIA

Other than the amendment in 2017 through Act A1522, guidelines and manuals also play a significant role in guiding project proponents and stakeholders in preparing the SIA report. Over time, many complaints have been made by them, leading to further amendments and improvements through production of the third manual, namely 'Guidance for the Implementation of SIA for Development Projects,' in 2023 (Othman et al., 2023). Among the issues addressed are the term 'qualified person' and enhancement of the SIA process.

A qualified person is an individual competent to prepare the SIA report. This individual must meet several criteria, such as having relevant academic qualifications and attending competency courses conducted by PLANMalaysia. Section 58(1A) of Act 172 empowers the NPPC to make rules for matters under the Act. Section 2B(1)(d) also supports this provision by enabling the Director-General of PLANMalaysia to advise the NPPC on the matters referred to him. Applying this situation, a competent person for preparing SIA must meet the criteria stated by PLANMalaysia, as it is one of the rules made by the NPPC. PLANMalaysia has prepared two types of modules: Comprehensive Module and Assessment Module (SIA Manual, 2023). The Comprehensive Module is organised for relevant stakeholders and SIA practitioners, while the Assessment Module is focused more on the evaluator.

There is a distinction between a qualified person for SIA practitioners and evaluators. For evaluators, this qualification is limited to SIA consultants who are registered with the Board of Town Planners Malaysia and/or Malaysian Association of Social Impact Assessment (MSIA). These individuals must have more than ten years of experience in impact analysis and at least five years of experience in preparing SIA reports (Othman et al., 2023). The Comprehensive Module courses held are listed in Table 2 below.

Table 2: Comprehensive Module for SIA practitioner/stakeholder

Modul	Title
1	Introduction to SIA
2	Screening and physical planning and land use
3	Social impact components on methodology, public participation and SIMP

Source: Social Impact Assessment Practices and Applications in Malaysia, 2023

Furthermore, the guidance of the SIA implementation process has been improved in the third manual (Othman et al., 2023). Previously, SIA steps consisted of three stages: preparation of the SIA report, monitoring, and the last step, evaluation and audit (SIA Manual, 2018). Currently, these processes have been simplified into two main stages: the project planning stage and the project implementation stage (SIA Manual, 2023). The project planning stage begins with screening, scoping, data collection and analysis, impact prediction and assessment, refining project designs and options, mitigation measures, and a social impact management plan (SIMP). Meanwhile, the project implementation stage comprises the monitoring and auditing phases. An additional process added into the project planning stage is refining project designs and options, which is now considered as the fifth step. This step should be initiated in the first stage to indicate the best options and modify the necessary designs to maximise the positive impact and minimise the negative impact as much as possible from the findings of the impact analysis.

Other than that, other processes like SIMP, monitoring, and audit have also been improved in the latest manual. For example, the manual provides a more detailed explanation of the implementation process for the SIMP compared to the previous version. Currently, it consists of six important components, namely, implementation mechanism, implementation organisation, monitoring framework, grievance management mechanism, emergency response plan, and reporting and audit framework. Figure 2 illustrates the SIA process in Malaysia.

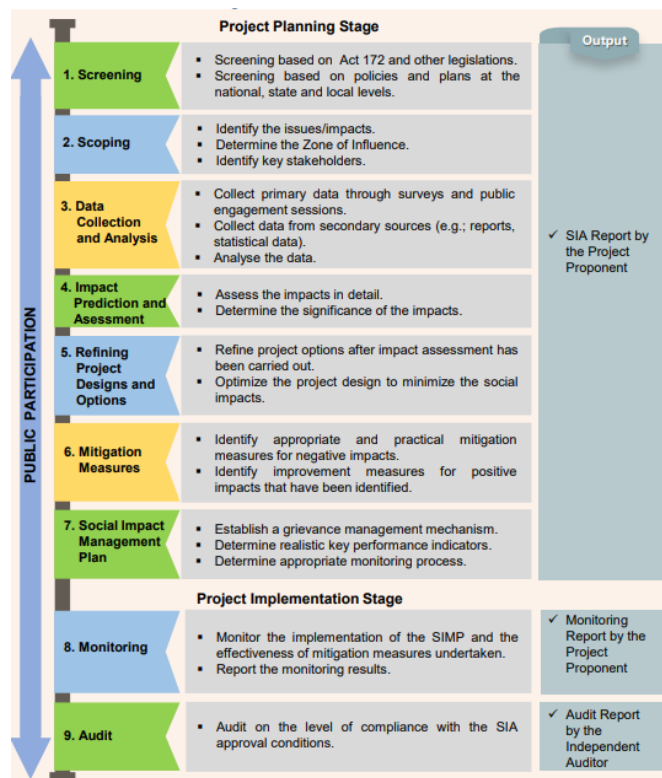


Figure 2: SIA process in Malaysia

Source: Social Impact Assessment Practices and Applications in Malaysia, 2023

The other guidelines, such as 'Panduan Pelaksanaan Akta 13' (Implementation Guidelines for the Act 13) and 'Panduan Pelaksanaan Akta 14,' (Implementation of the Act 14) which assist project proponents, SIA consultants, and stakeholders in applying for permission for development projects under SIA Category A, can still be referred to. Additionally, PLANMalaysia at state level like Selangor, Negeri Sembilan, Malacca, and Kedah have their own state guidelines for implementing SIA (Suaree et al., 2022). They are still practising all these guidelines, and the only significant changes have been made through the third manual of SIA, as stated above.

Legal Framework of SIA in New Zealand

According to the United Nations Department of Economic and Social Affairs, New Zealand's population reached 5,253,903 as of February 12, 2024 (UN, 2024). This represents 0.06% of the current world population, with approximately 82.4% of the population residing in urban areas. This population growth indicates a significant need for development to accommodate the people's needs. Social

impact initiatives should be adopted. These initiatives are crucial for addressing the sustainability of society's social, economic, and overall well-being (Buchan et al., 1990).

New Zealand has incorporated SIA into major energy projects since the late 1970s (Taylor, 2016). In 1994, a health professional body in New Zealand planned to develop the healthcare system in the Maori community. They utilised SIA as an alternative approach to facilitate the process of social change (Burdge et al., 1995). Despite lacking experience and formal practice in SIA, they insisted on its implementation, understanding its importance in guiding development decisions.

Over time, SIA was developed through a Social Impact Unit established by the State Services Commission between 1986 and 2003. In the 1990s, the government called for implementing social assessment as part of government policy. Land-use planning in New Zealand is governed by the Resource Management Act 1991 (RMA 1991). This legislation is intended to provide for good resource management, enabling the avoidance, remedy, or mitigation of any adverse effects of activities on the environment (James Baines et al., 2012). One of the most significant developments incorporating SIA into land-use planning procedures is the Resource Management Bill that led to the RMA 1991, introduced in Parliament in December 1989. This bill aimed to integrate land use planning, water management, subdivision, and mining into one procedure while also providing greater public input, accountability from decision-makers, and a clear separation between decision-makers and resource users (Buchan et al., 1990). On 1 October 1991, the social element was considered and incorporated into the provisions of the RMA 1991. According to Taylor (2016), this provision mandates SIA implementation. However, James Baines and others (2012) claim that SIA implementation is still not mandatory for all.

Section 2 of the RMA 1991 defines the term 'environment' as not only covering the ecosystem, natural and physical resources, and amenity values but also extending to include social conditions (people and community) (Strogen, 2022). Section 5 expresses the purpose of the Act, which is to promote the sustainable management of natural and physical resources. Sustainable management here means the need to protect resources to enable the community to provide for their social, economic, and cultural well-being, as well as ensure their health and safety. Schedule 4 (Clause 7(1)) of the RMA 1991 also states that the effects on neighbourhoods and communities must be considered when preparing an assessment of environmental effects, including in SIA.

Louise Strogen, one of the SIA practitioners in New Zealand (2022), also explained that SIA has been primarily used as a tool in development projects. It is a part of the environmental assessment package and is widely utilised in the regulatory decision-making process for new development projects. However, a separate assessment of environmental impact, which is a distinct document, is

necessary and is included in the planning process. Despite the statutory requirement of SIA being stated in the RMA 1991 (Taylor, 2016), its necessity is still inconsistent across jurisdictions and organisations (Strogen, 2022). Healy (2022) states that the government has produced the Auckland Plan 2050 as high-level guidance to address population growth and transport issues, aiming to deliver a better standard of living for all people in the region.

The leading organisation for implementing impact assessments, including SIA, is the New Zealand Association for Impact Assessment (NZAIA) (Taylor et al., 2022). This organisation encourages the implementation of impact assessments to protect the values of social, cultural, and environmental aspects. The SIA process in this country starts from the scoping stage and continues through to the update and monitoring stages. Figure 3 illustrates the flow of the SIA process in New Zealand.

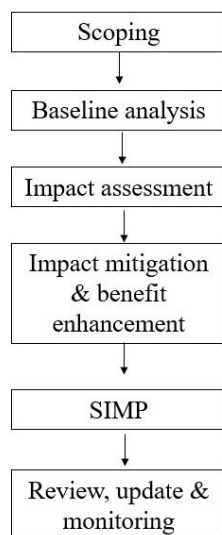


Figure 3: SIA process in New Zealand

Source: Current Principles & Practices of SIA: New Zealand's Perspective

Before submission and approval of the SIA report, an organisation must first apply for and obtain a development permit and an environmental impact assessment (EIA) must be submitted. If the project requires a SIA, it will be included in the application package. The application is then submitted to the responsible authorities. The planning officer of the authorities processes the application and provides recommendations for the project. Part of the recommendation process involves a hearing typically chaired by councillors. If the councillors require technical advice, an expert panel considers the application.

There is an opportunity to appeal to the environmental court if there is a disagreement regarding the application's outcome (Strogen, 2022).

In September 2016, a guideline, namely, the 'Guide to Assessing Social Impacts for State Highway Projects,' was published to provide guidance to all relevant project proponents and agencies in preparing SIAs for state highway projects (Guideline, 2016). Strogen states that the only organisation implementing the SIA guidance is Waka Kotahi NZ Transport Agency (2022). This organisation also refers to the Environmental and Social Responsibility Standard and Environmental and Social Responsibility Screen.

METHODOLOGY

This paper utilizes the qualitative method, employing library research, content analysis, and comparative analysis. According to Fidishun (2002), a library research approach provides an opportunity to explore data in depth and expand further. George (2008) supports the idea that data can be collected through library research, where researchers analyze factual or personal information, as well as expert opinions, related to the paper's objectives from books, journals, articles, online sources, and documents. Books such as "Social Impact Assessment: Practices and Applications in Malaysia" have been analyzed to determine the latest implementation of SIA in Malaysia. Additionally, numerous literature and articles from various high-indexed journals have been analyzed to gather updated information on SIA.

Additionally, content analysis is an important methodology within qualitative research. Hardwood and others (2003) state that content analysis involves analyzing various types of data, including visual and verbal data, to categorize phenomena or events into specific groups, facilitating their analysis and interpretation. Kleinheksel and others (2020) state that this approach can provide valuable insights and can be useful to researchers due to its application in the investigation of a wide variety of data sources, including textual, visual, and audio files. The present paper not only analyzes the content from books or articles but also extends to the interpretation of legislations, manuals, guidelines, and case studies.

Furthermore, the paper employs the comparative analysis methodology in analyzing the basic legal framework of SIA in Malaysia as well as New Zealand. A long time ago, Collier (1993) stated that comparison is a fundamental tool for analysis and strengthens the central role in concept formation by bringing the focus on similarities and contrasts of certain matters.

ANALYSIS AND CONCLUSION

The finding indicates that there are similarities and connections between the implementation of SIA in Malaysia and New Zealand. It has been observed that the implementation processes of SIA in these countries are quite similar. Both

countries have a basic legal framework for implementing the SIA process. In Malaysia, this framework includes Act 172, Act A 1522, and several manuals and guidelines to assist in SIA implementation. In New Zealand, the consideration of social assessment is mentioned under the RMA 1991 and certain guidelines. However, unlike in Malaysia, the requirement to conduct SIA is forms a component of the EIA in New Zealand.

To provide a comparative analysis, Table 2 presents the basic legal frameworks of SIA in Malaysia and New Zealand. This table includes the Acts, manuals, and guidelines that have been analysed in this research.

Table 2: Basic legal framework under SIA in Malaysia and New Zealand

Legislation	Malaysia	New Zealand
Act	Act 172, Act A1522	RMA 1991
Manual & Guidelines	Guidance for the Implementation of SIA for Development Projects (2023), ‘ <i>Panduan Pelaksanaan Akta 13 and 14</i> ’, state guidelines and manuals	Guide to Assessing Social Impacts for State Highway Projects, Environmental and Social Responsibility Standard and Environmental and Social Responsibility Screen

Source: Policies and Frameworks in Malaysia and New Zealand

Both countries have SIA statutory requirements, but they are limited to certain aspects. Act 172 and Act A1522 in Malaysia require the preparation of the SIA report for SIA Category A only, while the RMA 1991 in New Zealand requires the consideration of social assessment in large-scale projects. The core idea of the SIA preparation process remains similar. For instance, both countries have scoping, baseline analysis, mitigation measures, social impact management plans, and monitoring mechanisms. Public rights in the development planning process have also been addressed in the assessments in both countries. All these processes are vital for achieving the objective of SIA. However, Strogon states that not all these processes are being implemented accordingly (2022). For example, there is no responsible agency to review and monitor the progress of the submitted SIA reports. Although the public is given the right, effective feedback has not been obtained from them. These issues are among the challenges the authority in New Zealand faces in the SIA process.

Other than that, the criteria for a qualified person to prepare and evaluate SIA have been clearly explained within the legal framework of SIA in Malaysia, as mentioned above, and this information has also been included in the Manual (2023). The Manual allows registered town planners and professional members from MSIA, including those with backgrounds in social science, town

planning, engineering, and architecture. In New Zealand, the opportunity to prepare the SIA is quite lenient. Stroger has already emphasised that no qualifications are required to prepare the SIA in New Zealand.

The approval of the SIA report by PLANMalaysia is necessary in Malaysia, as mentioned in the Manual. In contrast, in New Zealand, the SIA framework is appended to the EIA application during the approval process. The planning authorities will assess the application and make any relevant recommendations regarding the proposed projects. Furthermore, the main leading organisation that implements SIA in Malaysia is the Malaysian Association of Social Impact Assessment (MSIA). Other organisations, such as the Malaysian Institute of Planners (MIP), are also involved in SIA implementation related to the planning process. In New Zealand, NZAIA is mostly responsible for SIA implementation.

Table 3 presents a summary of a comparison pertaining to the differences in the implementation of SIA in Malaysia and New Zealand based on their respective Acts and guidelines.

Table 3: Distinctive features of SIA according to the respective legislations in Malaysia and New Zealand

Element	Malaysia	New Zealand	Significance
Requirement of SIA	Yes, for SIA Category A only (section 20B, section 22(2A))	Yes (section 2: Interpretation of 'environment', section 5 and Schedule 4, Clause 7(1))	Ensure the accountability of the project proponent, relevant stakeholders and consultant in preparing the report
SIA process	Screening, scoping, data collection and analysis, impact prediction and assessment, refining project designs and options, mitigation measures, SIMP, monitoring and audit	Scoping, baseline analysis, impact assessment, impact mitigation and benefit enhancement, SIMP, review and update and monitoring	To ensure the important element of social impact is considered in implementing SIA
Qualified Person for consultant and evaluator	Pass competency courses, registered town planner, professional member of MSIA, relevant academic qualification	NA	To ensure a high-quality report, only qualified individuals should prepare it

Element	Malaysia	New Zealand	Significance
SIA Approval	Yes, for SIA Category A (Section 20B)	Yes	Approval of report by the Director-General/ relevant authority
Public Participation	Yes (SIA Manual 2023)	Yes	Public interest
Association related	MSIA	NZAIA	Leading organisation for SIA implementation

Source: Policies and Frameworks in Malaysia and New Zealand

It is observed that Malaysia has developed a strong foundational framework for SIA implementation over the years since the insertion of its statutory requirement in 2017 through Act A1522. The other core elements of SIA, such as the qualified person, implementation process, SIA approval, and elements of public participation, have been addressed accordingly in the latest manual in 2023. However, the enforcement and monitoring phases still require substantial attention from all groups, especially PLANMalaysia, to ensure that the entire implementation process is effective. Thus, this will contribute to sustainable development in the country.

In New Zealand, there is a fortunate existence of a basic legal framework that legitimises the implementation of SIA. Large-scale projects are beginning to take SIA seriously, and several guidelines have been utilised in these projects. However, there is still a significant need for improvement, whether from the legal framework or other practices, to ensure the contribution to good development there. Further analysis and improvement proposals are needed to strengthen the SIA implementation in the future.

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EMPOWERING B40 WOMEN IN MALAYSIA: A SOCIOECONOMIC IMPACT ASSESSMENT OF THE ECER-SURI@HOME PROGRAM

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Abstract

Women can be categorised as one of the marginalised and disadvantaged groups in Malaysia. With the COVID-19 pandemic that has hit Malaysia over the past three years, the vulnerability of Malaysian women in aspects of mental health and limited or inflexible occupations has increased. ECER-Suri@Home is a socioeconomic development program designed for women in ECER, especially housewives and single mothers with mobility constraints, to engage in home-based businesses, such as tenun and songket weaving, as a means to help them earn regular additional income. This study aims to assess the socioeconomic impact of the ECER-Suri@Home program on the participants and explore how the monitoring practice used can influence the sustainability of the program in empowering the wellbeing of B40 women in Terengganu. This study employed quantitative and qualitative approaches in data collection by distributing questionnaires to the program's participants and in-depth interviews with several key informants from ECERDC and Yayasan Pembangunan Keluarga Terengganu. The outcome of this study revealed that this program has had a high impact on the economic status of the participants. The monthly monitoring visit has increased the productivity and quality of the tenun songket produced by the participants; however, this program would not be sustainable for the next cohort due to the difficulty in finding suitable participants.

Keywords: Assessment, B40 group, empowering, Suri@Home Program, wellbeing, women

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INTRODUCTION

Women are among the marginalised and disadvantaged groups in Malaysia. The COVID-19 pandemic that has hit Malaysia over the past three years has increased the vulnerability of Malaysian women and girls in aspects of mental health, limited or inflexible occupational arrangements, domestic violence, period poverty and socioeconomic empowerment. According to Yeo (2022), the lower rate of women's participation in the labour force in Malaysia, which was 55.3% in 2020 compared to higher rates in countries like Singapore and Thailand, can be attributed to the problem of poverty among women. This lower participation rate suggests a lack of access to opportunities among a significant number of women in Malaysia, putting them at risk of poverty. When women have limited involvement in the workforce, their ability to earn income is restricted, making them more susceptible to difficulties and poverty. In relation to this, it has become more challenging to achieve the Sustainable Development Goal (SDG) 5 related to Gender Equality (GE) and SDG 8 of decent work and economic growth. Among all, poverty is still a global issue that ranks first in the SDGs and it should be addressed accordingly (Muta'ali et al., 2024).

Women and poor households are often less resilient compared to other groups in society mainly because they have lower levels of education and limited economic resources, which can be attributed to gender-based inequalities in work distribution and ingrained cultural norms. This emphasises the importance of incorporating gender and poverty issues when developing initiatives to enhance resilience (Tran et al., 2023). As an initiative to improve this situation, women's involvement in entrepreneurship activities can be heightened, which would contribute to their socioeconomic development. Ge et al. (2022) in their study highlighted the positive and significant role of women entrepreneurs in improving household income in rural areas. Adapting the entrepreneurial culture among women would increase the socioeconomic status of a poor family. In addition, innovative and active women in entrepreneurship activities will create more job opportunities, generate new ideas and improve their skills. Women's empowerment significantly impacts the economic development of a country (Faiza Arshad & Shahnawaz Malik, 2022).

In regard to this, the East Coast Economic Region Development Council (ECERDC), in collaboration with Yayasan Pembangunan Keluarga Terengganu, has come out with a program called Suri@Home, a social development project specially targeted for the women of ECER. This program would allow them to earn regular income through home-based and other income-generating activities aiming at increasing the average monthly income of families within the region. Apart from reducing the level of unemployment among the women of ECER, this program can also aid them in playing a more active role in the region's economic growth. Furthermore, Suri@Home would help elevate

women's income and contribute towards eradicating hardcore poverty in ECER (ECERDC, 2010).

As its name suggests, Suri@Home involves a host of home-based primary activities that require minimal technical skill and low start-up costs. The program includes a guaranteed buy-back scheme by the participating Anchor Company for every project approved. Through this, each participant is expected to bring home a monthly income of between RM 500 and RM 1,000. Some of the activities carried out under Suri@home are the making of handicrafts (mengkuang and bamboo craft), sewing services, agriculture-related activities such as mushroom farming and vermicompost, as well as processing activities related to food preparation. Several Suri@Home quick-win projects have already been implemented since July 2009, one of which is Songket Weaving in Terengganu, which has been commenced since 2010.

Recent studies in Malaysia found that poverty eradication programs implemented towards marginalised communities, particularly single mothers living in poverty-stricken areas in Kuala Lumpur, have effectively empowered and improved their wellbeing (Dass et al., 2022). Apart from that, Arshad and Malik (2022) discovered a significant relationship between women's empowerment and economic development. The findings of their study revealed that the women dared to decide for their own sake of interest, better health care facilities for them and their children, as well as increased participation and involvement in job performance. Another study involved 433 members of women smallholder groups that joined economic development activities, which showed that these activities managed to economically empower women by giving attention to four important aspects comprising the level of participation, personal psychology, leadership and social capital (Ani, 2021). Hence, this study aims to investigate (1) the socioeconomic impact of the Suri@home Program towards the participants, (2) evaluate the monitoring practice used in the program and (3) identify the sustainability of the program in empowering the B40 women of Terengganu.

LITERATURE REVIEW

According to Shah et al. (2023), women empowerment can be defined as women with economic stability, social acceptability, educational achievement and harmony family. The concept of women's empowerment has changed in the last decades, whereby nowadays, women are actively participating in the process of decision making in society in every aspect of society and possess powerful internal qualities, such as self-confidence and self-awareness. As a consequence, empowerment among women has become an important element for the socioeconomic development transformation of any community (Rekha & Swain, 2023).

Past studies demonstrated that the involvement of women in economic activities can empower their lives and improve the socioeconomic status of their families. As explored in a study by Rekha and Swain (2023), positive impacts were observed on the Self-Help Group (SHG) towards rural women in India. This group has empowered women socially and economically. By joining this group, the women became more self-assured, more self-confident and more likely to take part in family and community decisions. The majority of the women in this group managed to increase their monthly income, with most of them learning new skills. Moreover, a study that assessed poverty eradication among fishermen in Indonesia discovered that the most suitable model for eradicating poverty in fishermen was through the women's empowerment concept, which can be achieved by introducing cooperatives for female fishermen. By managing the cooperative, the female fishermen can be aided to improve their families' economy.

A qualitative study conducted on 30 women who joined the training and received loan assistance from the Rural Poverty Reduction Program in Indonesia revealed that the impact of public policy on women's empowerment seemed positive, particularly in increasing family income (Yusran et al., 2023). The finding is supported by the study from Latip, Othman and Yusoff (2021), which found improvement in women's occupational involvement and their income after participating in human capital development programs implemented in the east coast region of Peninsular Malaysia. The rural women in the studies were naturally empowered by the program. Yusoff et al. (2024) in their studies found income generation and job opportunity were among the main factors affected the wellbeing of rural communities.

Conversely, Raphael et al. (2023) study discussed the impact of ONG's intervention in reducing poverty among women in the Vakinankaratra region in Madagascar. The results of the survey confirmed that ONG empowered women in need as they are holding the role of intervener among the women. Additionally, a study measuring the impact of women's empowerment on eradicating poverty in Egypt found a positive relationship between women's empowerment and poverty. Literally, the program has empowered them economically, socially and politically. However, the rise in the poverty rate in Egypt weakened women's empowerment (Saied Ahmed, 2022).

Meanwhile, Brahma and Mushahary (2022) in their study assessed the effect of women's empowerment on their livelihoods. As the de facto heads of households, enhancing women's access to land is important as agriculture is the main source of income in the Bodoland Region. In consequence, it has impacted poverty reduction and added to improved household food security. On the other hand, Tsawe and Susuman (2022), in their study on inequalities in maternal healthcare use in Sierra Leone, pinpointed the efforts to empower the use of maternal healthcare services among lower socioeconomic status women;

however, the use of maternal health services remained favourable to higher socioeconomic status women. Therefore, this study recommends that policy initiatives should prioritise women with lower socioeconomic status via empowering women's educational level.

The impact between women's empowerment and poverty reduction also can be found in the study by Wei et al. (2021), where the findings showed that women's empowerment has increased their access to asset possession, education, medical facilities and decision-making influence on children's health and education, besides causing a substantial decline in income poverty and multifaceted poverty. Another study investigated the relationship between empowerment and growth among women in India. The findings revealed that economic growth reduced poverty, which led to improvement in two aspects: wellbeing and declining in gender inequality. However, the study identified that economic development was not enough to attain full equality between men and women (Samineni, 2021).

A study by Gani (2021) described the poverty among women in Indonesia during the COVID-19 pandemic, which has caused restrictions in social activities where women experienced limitations and were unable to properly fulfil the basic needs of their families, thus resulting in the decline of income and consequently increasing women's poverty. Without adequate facilities and skills to master information technology, women in Indonesia faced difficulties in being involved in the creative economy. Empowering women with suitable skills and training could help them survive and improve their wellbeing. In contrast, another study revealed that the poverty eradication program among women in Anambra State was not enough to reduce poverty among them. Results showed that most of the women still experience hardship, have no access to a good healthcare system and infrastructure, as well as have low socioeconomic status (Ozoh et al., 2020).

Recently, a project related to the economic empowerment of rural women in Ghana found that the Rural Enterprise Program involving 217 beneficiary women produced positive intermediate and long-term outcomes on the income of participants, implying an improvement in the socioeconomic status of the rural women. In the project, the participants were empowered with education and training in which they were equipped with literacy skills to increase their roles in the entrepreneurial and labour market (Gloria & Charles, 2022). In a way, involvement in entrepreneurship activities has proven to be an effective initiative in reducing the poverty rate, particularly in rural areas. By identifying the skills and strengths of the women in a geographical area, governments can tailor a suitable program to improve their involvement in economic development.

RESEARCH METHODOLOGY

This study utilised quantitative and qualitative approaches in answering the research objectives, which involved the participants of the Suri@Home Program in Terengganu. For the quantitative method, an on-site self-administered questionnaire was distributed to all participants of the Suri@Home Program. The purposive sampling strategy was utilised to select the respondents as this study was looking the targeting participants with specific characteristics relevant to the research questions. The respondents were chosen on purpose to provide rich information and answer the questions related to the socioeconomic impact of the program in empowering their wellbeing and quality of life. The participants of the program consisted of women from the bottom 40% of income earners (B40) group.

The impact of the program was measured by their perception of how the Suri@Home Program affects their life in aspects of social, economic, environment and overall. The questionnaire was designed on a positive scaling rate, in which 1 represents the lowest rate and 5 represents the highest. The questionnaire also comprised a few open-ended questions to obtain their view on their experience upon joining these programs and any problems or issues that occurred during their implementation. In analysing the data, Statistical Package for Social Science (SPSS) software was utilised. Meanwhile, descriptive analysis was used to present the data in a suitable diagram.

This study also involved a qualitative approach, which included in-depth interviews with several key informants who initiated and implemented the program. It comprised the General Manager of the ECER Human Capital Development Division, General Manager of the East Coast Economic Region Development Council of Terengganu Regional office and two officers from Yayasan Pembangunan Keluarga Terengganu. The questions asked related to the monitoring practised during the implementation of the program and its sustainability in empowering the B40 women participants. Each interview session took between 45 minutes to one hour. The researcher obtained the informants' permission before recording the conversation. In this study, thematic analysis was used to systematically organise the qualitative data by coding and coordinating the data into themes. The coding process in this study did not only concentrate on the transcribed data but also triangulate the data from official reports, article journals and field notes from observation. In the end, the themes produced were capable of responding to the main objectives of this study.

RESULTS

Socioeconomic impact of the Suri@home Program

The following Figure 1 illustrates the socioeconomic impact of the Suri@Home program on the B40 women in Terengganu. The respondents were housewives and single mothers with mobility constraints, which explains why home-based

business effective means for them is to earn additional income. The majority of the participants (64.0%) agreed that the program has had a high impact on their economic status, as it has provided them with the required equipment to produce *tenun songket*. The human capital development program has also allowed more job opportunities and increased the income of local people, especially housewives and single mothers.

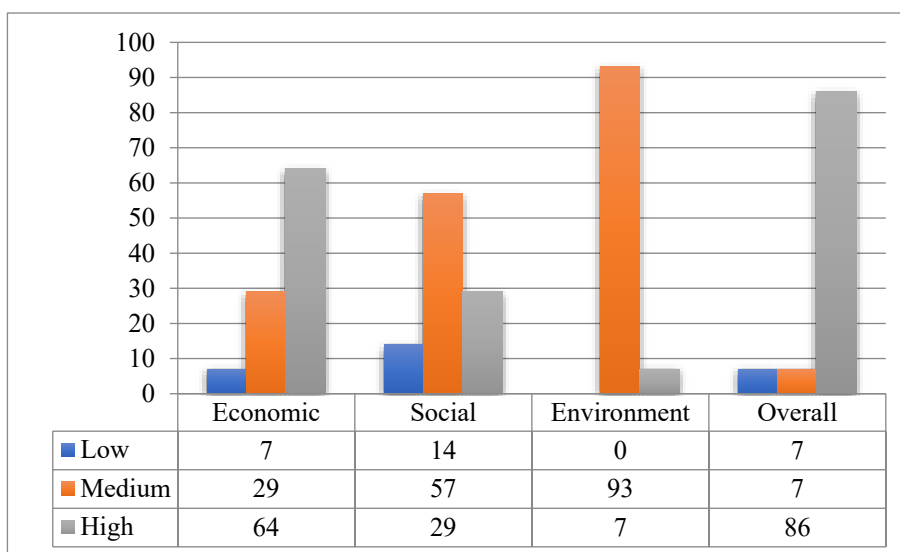


Figure 1: Socioeconomic Impact of Suri@home Programme

As for the social aspect, most of the respondents (57.0%) believed that the program left a medium impact in reducing poverty and improving the standard of living of the local people. Their lifestyle has also improved upon the completion of the program. Overall, 86.0% of the total number of respondents admitted that the program has generally changed their lives; initially, they were doing nothing at home, but now they are able to earn additional income for their family. These findings are in line with the studies of Latip, Othman and Yusoff (2021) that found improvement in women’s occupational involvement and their income after participating in human capital development programs. Additionally, the program addresses the needs of the B40 group, particularly housewives and single mothers.

Participants of the program revealed that they actively produce songket with a similar modus; they work from home to weave songket, while taking care of their children. Some of them even managed to earn up to RM 4,000 per month. The participants were grateful that ECER initiated this program as it became a platform to assist and guide them in becoming entrepreneurs; some of them have even become successful entrepreneurs. This finding is consistent with the study

of Rekha and Swain, who found that woman empowerment has become an important element for the socioeconomic development transformation of any community. In regards to this program, its high impact in improving the economic status has empowered rural women and provided them an equal chance to be involved in economic development.

...Through the assistance and guidance given by this program, I managed to earn about RM 3500 to RM 4000 a month. As a housewife, this figure of income is huge for me. I am not expecting that my life will get much better than today. I received many bookings for Tenun Songket, and now, my customers are not only from around Terengganu, but all over Malaysia. Sometimes, if I receive too many bookings, I will get help from other participants and hire them to finish the booking so indirectly, I can help them to increase their income...

(Informant No. 6, Terengganu)

As for single mothers, this program has provided them with the knowledge and skills to make a living. In other words, it empowered single mothers to be more confident and seek better opportunities to improve their standard of living. Through this program, the women participants can continue to do their hobbies at home while being assisted in earning additional income at home. The General Manager of ECER Human Capital Development Division revealed the following insights on this matter:

...This project is targeted at unemployed housewives. We train them, and we sell their product to the anchor company. They can earn additional income by doing something that they love to do. They are just working from home. As we mentioned before, they wanted to change for a better life, but because of time and family constraints, they cannot actively work. For instance, the participants of the Suri@Home program in Terengganu were involved in tenun songket weaving. At first, we gave them training, and then we attached them with an anchor company. The anchor company will give all the materials needed, and they just get it done. It is like they are hiring them and paying for their work...

(Informant No. 1, Kuala Lumpur)

Apart from that, the service provider of this program revealed that the original goal of Suri@Home was to turn the participants into entrepreneurs. The program only acted as a platform for them to enhance their weaving skills and widen their network with the anchor company. Hence, they should use this opportunity not only to sell their songket products within the program duration but also to sustain their business in the long term by having continuous support

from the anchor company. After the program ended, they are free to sell their products direct to the customers without having to rely on the anchor company. If they can maintain the quality of the tenun songket, they will remain in this industry for a long time.

That was our original goal as well, to see the participants become entrepreneurs. We don't want them to continue relying on the anchor company forever. With their skills and courage, they can become successful entrepreneurs. I think there are a few of them who graduated from this programme and became entrepreneurs. Basically, we wanted all of them to become entrepreneurs, but not everyone can become an entrepreneur. If we can turn them into entrepreneurs, that's a bonus.

(Informant No. 3, Terengganu)

Monitoring Practices Used in the Program

Monitoring is a vital element to ensure the effectiveness of a program. For the Suri@Home Program, a monthly monitoring practice has been used by the service provider during its implementation. As described by the officer from the Yayasan Pembangunan Keluarga Terengganu, every time they visit the participant's workshop located just beside their house, they will monitor their progress, like the amount of songket they can produce in a month. Usually, it takes about two weeks to a month to complete a songket. This job requires high skills and techniques as it is hand-woven and high in quality. As for the service provider, they are expecting the participants can produce a better quality songket as this program has assisted them by providing all the equipment and tools needed for sewing.

...every month, we will go to monitor for a period of one year. During the visit, we expect them to be able to produce more than what they have produced before because we have helped fill the necessary equipment...

(Informant No. 4, Terengganu)

Based on the monitoring visit conducted by the service provider, some of the participants managed to increase productivity and improve the quality of their songket. There were positive changes in their behaviour whereby the participants became more disciplined and adhered to the established deadline for the completion of their songket after joining this program, which can also become external influences that serve as motivators to encourage them to prioritise quality for the songket weaving. This finding supported the recent study of Gloria and Charles (2022), in which the participants were empowered with education and training to increase their roles in the entrepreneurial and labour market. In this

program, the participants received grant assistance from the service provider, with the anchor company helping them to market their songket products.

...Yes, there are indeed among the participants whose results are very positive, and they make the best use of the equipment to increase the total productivity. Before this, people would book directly with them, so they don't need to prepare quickly. When there is an anchor company, they need to prepare according to the set time, so there is a push factor for them to focus more and produce good quality for the songket weaving...

(Informant No. 5, Terengganu)

In aspects of following the outlined instructions during the implementation of the program, most of the participants adhered to the standards of a quality tenun songket and were literally very happy when their products could be sold at a reasonable price. Some participants did not achieve the target and could not produce the tenun songket within the stipulated time given. In this case, the officers did not take any action towards them. Instead of giving negative feedback, the officers would try to motivate them and encourage them to keep doing songket weaving as it is a valuable heritage of Terengganu, and they should be proud of it.

...Basically, they can follow the instructions given and enjoy being able to sell their products at a reasonable price. For those who are not very active, even though they have been given help, we do not take any action to the participants. We come to monitor, ask their progress and give them advice to continue weaving because this is a very valuable heritage...

(Informant No. 5, Terengganu)

Sustainability of the Program in Empowering B40 Women in Terengganu

Although this program demonstrably yielded positive outcomes for participants, particularly in improving their economic status, this valuable program cannot be sustained for the next cohort due to the difficulty in finding suitable participants. The nature of the housewives restricted them from actively participating in songket weaving activities. Undeniably, some of the participants succeeded in becoming entrepreneurs, but the overall rate of sustained profitability remained relatively low.

...Generally, this program has a positive impact on the participants, but it cannot be continued for the next batch. I think it is due to the constraints of finding participants...

...This housewife has many other responsibilities that she has to do besides weaving. Want to take care of children, drop off and pick up children from

school, cook, clean the house. So when they have free time, they can weave. There are those who succeed in becoming entrepreneurs, but not many...
(Informant No. 5, Terengganu)

There are some recommendations specified by the implementer of this program to ensure its sustainability in future, as songket weaving is a prominent heritage associated with Terengganu. Initially, the selection of the participants should be among those who already have the weaving skills besides their determination and sense of belonging to the songket industry. The current selection criteria for participation require individuals listed in the e-Kasih poverty database. e-Kasih contains data on individuals and families identified as living in poverty or hardcore poverty. This data will usually be utilised by various Malaysian government agencies to deliver targeted assistance initiatives or programs; however, the outcomes of this program showed that not all the participants were serious about doing songket weaving.

...This kind of program is important to be continued. We must support Terengganu's songket weavers, who are decreasing now, but I suggest that some things should be improved. First, the selection of participants must be those who have weaving skills and are determined to continue to keep support this industry. If you want to choose participants who are on the e-kasih list only, not everyone has the seriousness to do this...
(Informant No. 4, Terengganu)

As for the monitoring and evaluation practices, there should be a suitable agency responsible for not solely monitoring them but can foresee the potential of the participants. According to the former service provider of this program, the perfect agency for this matter is the anchor company itself, as they demonstrated the potential for more effective monitoring of participant needs and progress. Furthermore, the rapport established between the anchor company and participants may offer participants access to the anchor company's marketing expertise, thereby tackling the identified challenge of limited marketing ability among a significant portion of the Suri@Home participants.

...There has to be an agency responsible for monitoring these participants. I recommend the anchor company because he knows the participants better and he can better monitor the needs and progress of the participants. In addition, he will help the participants to market the woven products of the participants because many participants do not know how to market their products...

(Informant No.5, Terengganu)

CONCLUSION

This study has highlighted the high impact of the ECER-Suri@Home Program on the economic status of the participants, particularly by providing job opportunities and increasing the income of housewives and single mothers. Other than that, this study has revealed that the monthly visit was an effective monitoring tool to encourage productivity and improve the quality of the songket produced by the participants. Nevertheless, this program cannot be sustained for a long time due to the difficulty in finding suitable participants.

The findings from this study can be used by the government and policymakers to redesign future empowerment programs that emphasise gender and poverty issues in achieving Sustainable Development Goal (SDG) 5 related to Gender Equality (GE) and SDG 8 of decent work and economic growth. In addition, related agencies can offer childcare services or subsidies to program participants to overcome the potential obstacle of managing childcare while participating in the training and production of the songket. Apart from that, the government could also provide future participants with training and support in marketing and branding to penetrate local and national markets for their woven products, as songket is a cultural heritage of Terengganu.

In a nutshell, women's empowerment through involvement in entrepreneurship activities economically and socially has a positive impact on alleviating poverty in Terengganu. With regard to the impacts on marginalised communities within the B40 group, more studies should be conducted on aspects, such as funding models, to ensure the program's long-term viability and cost-effectiveness compared to other economic empowerment initiatives targeting B40 women.

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METEOROLOGICAL DROUGHT RISK ASSESSMENT USING SPI NUMERICAL MODEL: A CASE STUDY OF HELMAND RIVER BASIN, AFGHANISTAN

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Abstract

Meteorological droughts, which result from insufficient precipitation, can cause significant economic damage. While preventing meteorological droughts is impossible, their harmful effects can be reduced through close monitoring. This study aims to evaluate the meteorological drought in the Helmand River Basin using the Standardized Precipitation Index (SPI) model. The hydrometeorological data used for this analysis were collected from the Ministry of Energy and Water (MEW) in Afghanistan. The precipitation data collected from MEW covers a 40-year period from 1979 to 2021. The SPI analysis of precipitation shows that 1990, 1991, and 1992 were moderately wet, while 1982, 1983, 1995-1998, 2005, 2014, and 2015 were nearly normal. However, moderately dry conditions were observed in 2000, 2001, 2018, and 2021. Among the sampled stations, Waras and Gardez consistently had low drought levels, while Tarnak, Shila-i-charkha, and Khwabgah stations experienced moderate-level drought. Meanwhile, Lashkargah and Adraskan stations exhibited relatively high levels of drought. In conclusion, this research on the HRB, using the SPI method, has provided valuable knowledge for understanding drought dynamics in the region. The findings underscore the importance of conducting region-specific analyses, the necessity of implementing sustainable water management strategies, and the global significance of addressing drought as a pressing environmental challenge.

Keywords: Meteorological Drought, Standardized Precipitation Index, Risk Assessment, Precipitation, Helmand River Basin

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INTRODUCTION

Drought, which is a consequence of climate change (Said et al., 2024), presents a significant threat. It leads to a long-lasting water deficit, loss of biodiversity, and disruptions to community livelihoods (Rahman & Lateh, 2016). It also increases the frequency of climatic hazards (Mishra & Singh, 2010). Global warming as an amplifier increases the global risk of drought (Tabari & Willems, 2023; Vicente-Serrano, Quiring, Peña-Gallardo, Yuan, & Domínguez-Castro, 2020). This disruption affects agricultural activities, water resources, and ecosystems (Cao et al., 2022; Geng et al., 2015; Lu et al., 2017; Potop & Türkott, 2010). Meteorological drought, a substantial outcome, arises from recurrent and transient natural adversities coupled with inadequate precipitation and possesses the potential to impose extensive economic ramifications. While the complete prevention of meteorological droughts remains unattainable, vigilant monitoring and the implementation of mitigative measures can improve their adverse impacts (Dash et al., 2012). Therefore, assessing drought is crucial for effectively managing water resources and for both short-term and long-term economic and social planning (Keskin et al., 2011). According to Hua et al. (2022), future projections for Central Asia suggest that there will be a rise in the frequency of droughts. This can be attributed to unsustainable land use practices and inadequate water management, which contribute to the risks associated with droughts (Abdullah & Rahman, 2015; Gleick, 2014; Lei et al., 2016; Wilhite, 2002).

Afghanistan faces the persistent threat of drought owing to its arid climate and minimal annual precipitation (Aliyar et al., 2022; Jiang & Gharabaghi, 2021; The World Bank, 2017). From 1980 to 2014, the country received a mere 217 mm of rainfall annually (Jiang & Gharabaghi, 2021). The primary contributors to the risk of drought include low average rainfall and poor water management practices (Christian et al., 2021; Mann & Gleick, 2015; Shahzaman et al., 2021). Additionally, insufficient progress in the energy industry has heightened the susceptibility to drought in the country (Shah et al., 2019). The severe impacts of drought in Afghanistan are reflected in the annual agricultural damage amounting to USD 280 million (The World Bank, 2017). With 80% of the population relying on the agriculture and livestock sectors for their daily needs (Jawid & Khadjavi, 2019; Rasooli et al., 2020; Samim et al., 2021). As of September 2018, over 50% Afghans faced severe water and food insecurity, with approximately 20 million people still grappling with these challenges. Moreover, 371,000 individuals have been internally displaced due to the drought-induced conditions in the country (*Lessons from drought response in Afghanistan*, 2022).

Afghanistan is highly susceptible to the impacts of climate change, including droughts, floods, intense heatwaves, and other weather-related

disasters. According to projections from the Food and Agriculture Organization (FAO), it is estimated that around 90% of Afghanistan will experience drought conditions by 2050, with a water shortage anticipated as early as 2040 (Mayar, 2021). Climate change is contributing to the decline in vegetation cover in the country as well. According to Nabizada et al. (2022), the droughts in 2001 and 2008 resulted in the lowest levels of vegetation coverage, reaching 6.2% and 5.5% respectively (Rousta et al., 2020). The Helmand River Basin (HRB), which is the largest among the five basins in Afghanistan (Goes et al., 2015; Nabizada et al., 2022), is located in the southern region of the country and has a semi-arid climate. It also extends into Iran and Pakistan (Goes et al., 2015). From 2007 to 2017, the Helmand River Basin experienced a temperature rise ranging from 0.9 °C to 2.5 °C in winter and 0.5 °C to 1.2 °C in summer (Nasimi et al., 2020). The mean annual precipitation varies from about 50 mm in the southwest to almost 300 mm in the northeast of the basin (Goes et al., 2016). Regarding precipitation in Afghanistan, the National Environmental Protection Agency (NEPA) anticipates a minor rise in the short term and a decline in the long term, with a projected decrease of 10–40 mm by 2090 (Goes et al., 2015). Over 50% of wheat, barley, and orchards in the HRB have been impacted by recent droughts (Qureshi & Akhtar, 2004).

Since the entire country is vulnerable to drought hazards, therefore, early warning systems can play a vital role in disaster risk reduction (Baudoin et al., 2016; Glade & Nadim, 2014; Hermans et al., 2022; Rogers & Tsirkunov, 2010). Drought risk assessment is required to assess drought hazards, risks, and impacts in specific regions (Belal et al., 2014; Nam et al., 2012; Vogt et al., 2018). The Standardized Precipitation Index (SPI) is an effective method widely used for drought assessment (Alahacoon & Edirisinghe, 2022; Karavitis et al., 2011; Liu et al., 2021). SPI analyzes rainfall trends, highlighting duration and severity over different periods (Augusto et al., 2021; Gadiwala, 2013; Khalili et al., 2011). It allows for calculations across various timescales, from one month to 72 months (Wu et al., 2005). The Standardized Precipitation Index (SPI), recognized by the World Meteorological Organization (WMO), serves as a suitable indicator for monitoring and assessing meteorological droughts. (Bera et al., 2021; Ekundayo et al., 2021). It has been widely utilized in studies conducted in Ethiopia (Wossenyeleh et al., 2022), the UK, (Rahmani & Fattahi, 2021), and Iran, (Fahimirad & Shahkarami, 2021).

A study conducted in the Punpun watershed, a tributary of the Ganga river basin, utilized the SPI method to assess meteorological drought hazards. The findings revealed drought periods from 2004 to 2006 and 2009 to 2010, with increasing intensity and duration after 2004 (Ojha et al., 2021). Another study conducted in West Bengal, India, also employed the SPI method and analyzed 117 years of rainfall data. The study identified frequent drought events with

negative SPI values, indicating a rise in dry events and a decline in wet and normal events in the region (Bhunja et al., 2020). Similarly, a study conducted in the Yellow River Basin, Henan Province, China, using the SPI method, identified both meteorological and hydrological droughts occurring at a 2–4-year timescale (Wang et al., 2020). Conversely, a study conducted in the Bundelkhand region of Central India, utilizing the SPI method, identified seven major drought events from 1981 to 2016 (Pandey et al., 2022). Likewise, in Raya, Northern Ethiopia, meteorological drought results based on the SPI-3 evaluation showed mild-to-severe drought phenomena occurring once every 2-3 years (Gidey et al., 2018). In contrast, a meteorological drought assessment conducted in the Sakae Krang River basin of Thailand using the SPI method found moderate and mild drought events from 1970 to 2014 in different sub-basins (Wichitarapongsakun et al., 2016). The São Francisco River Basin in Brazil was evaluated for drought based on the SPI-12. The study identified a severe and prolonged drought episode between 2012 and 2020, with a duration of 103 months in the upper portion of the basin (Santos et al., 2017).

In this particular study, we have chosen the Standardized Precipitation Index (SPI) as one of the methods to evaluate drought hazards in the Helmand River Basin (HRB). This choice is based on the significance and widespread use of the SPI method in drought assessment. The main objective of our study is to assess meteorological drought in HRB, considering the region's vulnerability to drought hazards.

MATERIALS AND METHOD

STUDY AREA

Afghanistan, a landlocked country in South Asia, has an arid to semi-arid climate with cold winters and hot summers (Sabory et al., 2020). The country is divided into five major river basins: the Amu Darya River Basin, Northern River Basin, Harirud-Murghab River Basin, Kabul River Basin, and Helmand River Basin (Dost & Kasiviswanathan, 2023; Nagheeb & Warner, 2018). It can also be classified into five distinct climatic regions: the Hindukush Region, Northern Plains, Central Highlands, Eastern Slopes, and Southern Plateau (Jawid & Khadjavi, 2019). The Helmand River Basin (HRB), the largest among the five basins in Afghanistan, is located between latitudes 29° 18' to 34° 48' and longitudes 60° 18' and 69° 36' (Akbari & Torabi Haghighi, 2022; Sabory et al., 2020). It is a closed river basin situated in the semi-arid climate of southern Afghanistan, extending into Iran and Pakistan. The Helmand River, approximately 1300 Km in length, serves as a vital water resource shared by Iran and Afghanistan. The basin covers an area of about 400,000 km², with 81.4% in Afghanistan, 15% in Iran, and 3.6% in Pakistan. Originating from the Hindu Kush

mountains, the river flows through the Sistan plain and reaches Hamoun Helmand (Goes et al., 2016).

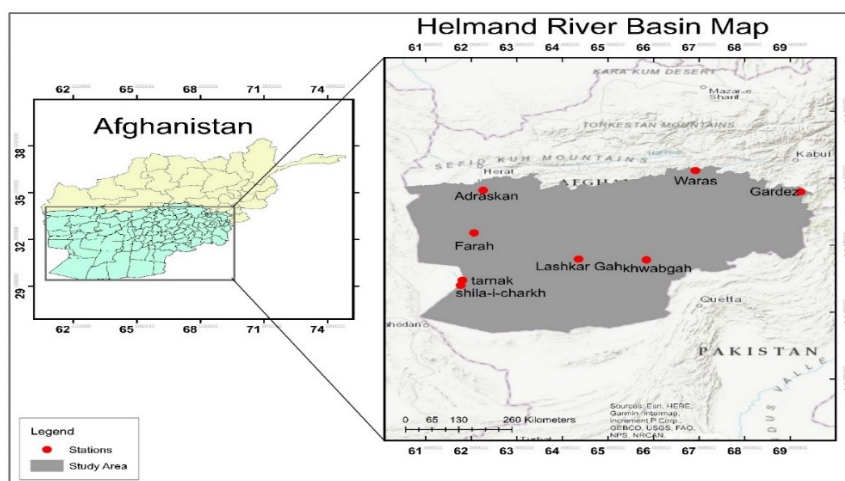


Figure 1: Study Area Map

DATA COLLECTION

The research used qualitative methods to evaluate drought risk in the Helmand River Basin (HRB) based on the Standardized Precipitation Index (SPI). Data on precipitation from the Ministry of Energy and Water, collected over a period of 40 years, were used. The Ministry provided data from seven stations: Farah, Khwabgah, Lashkargah, Shila-i-Charkh, Adraskan, Tranak, and Waras. The annual average rainfall was calculated from the monthly, quarterly, and half-year data. The study relied on SPI time scales of 1, 3, 6, 9, and 12, chosen based on relevant literature. After completing the SPI analysis, the severity of the drought was assessed and highlighted. Geostatistical analysis and interpolation techniques, implemented using ArcGIS, were used to map and evaluate drought hazards in the HRB. This approach allowed for a comprehensive understanding of the spatial distribution and intensity of drought conditions in the study area.

RESULTS AND DISCUSSION

PRECIPITATION

Table 1 presents data on annual rainfall in the Helmand River Basin from various stations including Farah, Khwabgah, Lashkargah, Shila-i-Charkh, Adraskan, Tarnak, and Waras. Among these stations, Khwabgah received the least amount of rainfall, with an average of 72.4 mm, a minimum of 4.32 mm, and a maximum of 196.7 mm. Lashkargah and Shila-i-Charkh experienced moderate levels of

rainfall, averaging 96.4 mm (with a range of 27.0 mm to 204 mm) and 61.47 mm (with a range of 5.17 mm to 141 mm), respectively. In contrast, Adraskan had the highest average rainfall at 210 mm, with a minimum of 36 mm and a maximum of 367 mm. For a more detailed overview of the rainfall characteristics at each location, please refer to Table 1.

Table 1: Annual Rainfall Characteristics of HRB

Station	Mean (mm)	Minimum (mm)	Maximum (mm)
Adraskan	210	36	367
Farah	117	17.8	293
Gardiz	207	49	432
Khwabgah	72.4	4.32	196.7
Lashkargah	96.4	27.0	204
Shila-i-Charkh	61.47	5.17	141
Tarnak	173	46	412
Waras	211	69	389

Table (2) presents the categorization of Standardized Precipitation Index (SPI) values, which are utilized for assessing wetness or dryness. The SPI is a well-established tool for monitoring drought conditions. The categorization classifies SPI values into seven distinct categories, ranging from extremely wet (SPI > 2.0) to extremely dry (SPI < -2.0). SPI values between -1.0 and 1.0 indicate near-normal conditions. These criteria are helpful in determining the severity of drought and can offer valuable insights for decision-making processes related to water resource management, agriculture, and disaster response planning.

Table 2: Categorization of SPI values

State	Criteria
Extremely wet	SPI > 2.0
Very wet	1.5 < SPI < 2.0
Moderately wet	1.0 < SPI < 1.5
Near Normal	-1.0 < SPI < 1.0
Moderately dry	-1.5 < SPI < -1.0
Severely dry	<2.0 < SPI < -1.5
Extremely dry	SPI < -2.0

METEOROLOGICAL DROUGHT ANALYSIS

The research findings on the Helmand River Basin (HRB) using the SPI indicate varying levels of wetness and dryness for specific years. The SPI classification system, widely used in meteorology, categorizes drought conditions into different categories, including Extremely Wet, Very Wet, Moderately Wet, Near Normal, Moderately Dry, Severely Dry, and Extremely Dry. Based on the SPI

calculations, several years in the HRB were identified as near-normal conditions ($SPI < 1.0$). For example, the years 1984, 1986, 2009, 2013, and 2018 were classified as near-normal based on SPI-1, and the years 1981, 1982, 1997, 2005, and 2014 were categorized as near-normal based on SPI-12. Comparatively, based on the SPI different indices, seven major drought events were identified in the Bundelkhand region of Central India between 1981 and 2016 (Pandey et al., 2022). Additionally, SPI-12 identified 1990, 1991, 2014, 2019, and 2020 as moderately wet years ($1.0 < SPI < 1.5$), and SPI-9 identified 1991, 1992, and 1993 as moderately wet years.

Conversely, the analysis revealed some years characterized as moderately dry (SPI values between -1.5 and -1.0) and severely dry (SPI values below -1.5). Specifically, SPI-12 identified 2000, 2001, 2018, and 2021 as moderately dry years, and SPI-9 classified 2017, 2018, and 2021 as severely dry years (See Figure 2). The analysis of multiple SPI indices (SPI-1, SPI-3, SPI-6, SPI-9, and SPI-12) provided insights into the wetness and dryness patterns in the HRB (see Figure 2). Several years exhibited normal wet conditions across different SPI indices, such as 1982, 1983, 1996, 1997, 1998, and 2015. Additionally, the years 1991, 1992, 2005, and 2019 were consistently categorized as moderately wet based on SPI-12.

The study conducted in Southeast Australia utilized SPI methods and found severe drought from 2013 to 2019 (Yildirim and Rahman et al., 2022). This finding is similar to the HRB, which identified severe drought periods from 2018 to 2021. In contrast, the study done in the Sakae Krang River basin of Thailand found moderate and mild drought levels in different sub-basins (Wichitarapongsakun et al., 2016). This differs from the HRB research, which did not specifically mention the presence of moderate or mild drought levels.

Furthermore, based on the São Francisco River Basin study, findings showed severe and prolonged drought between 2012 and 2020 (Freitas et al., 2022). This finding aligns with the HRB research, which found severe drought in 2018.

Overall, the comparison of the HRB research findings with studies conducted in other regions reveals both similarities and differences in terms of identified drought occurrences, severity, and duration. These comparisons emphasize the need for region-specific analysis and highlight the importance of understanding local climate and hydrological conditions when assessing drought hazards and implementing effective water management strategies.

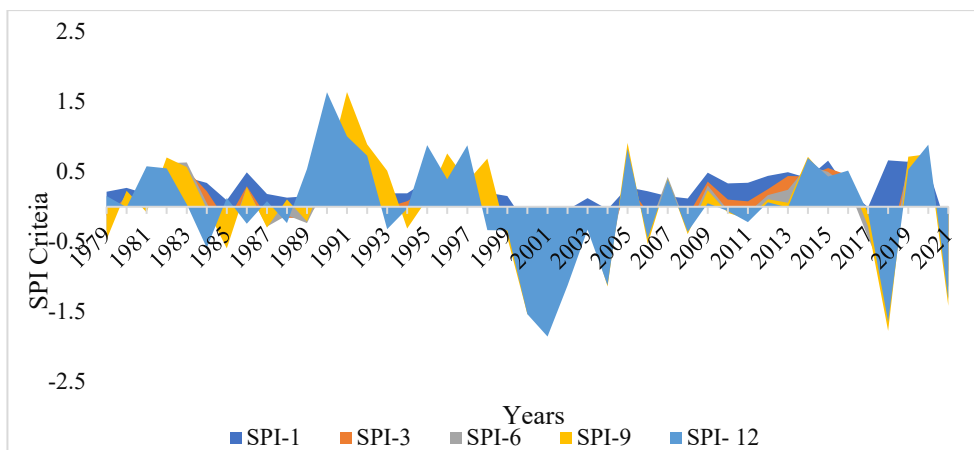


Figure 2: Various SPI indices of HRB between 1979 and 2021

According to SPI values of 1, 3, 6, 9, and 12, the years 1990, 1991, and 1992 were moderately wet. Additionally, the years 1982, 1983, 1995, 1996, 1997, 1998, 2005, 2014, and 2015 experienced drought conditions that were close to normal, with SPI values between -1.0 and 1.0. On the other hand, the years 2000, 2001, 2018, and 2021 were moderately dry, with SPI values between -1.5 and -1.0 (Figure 3).

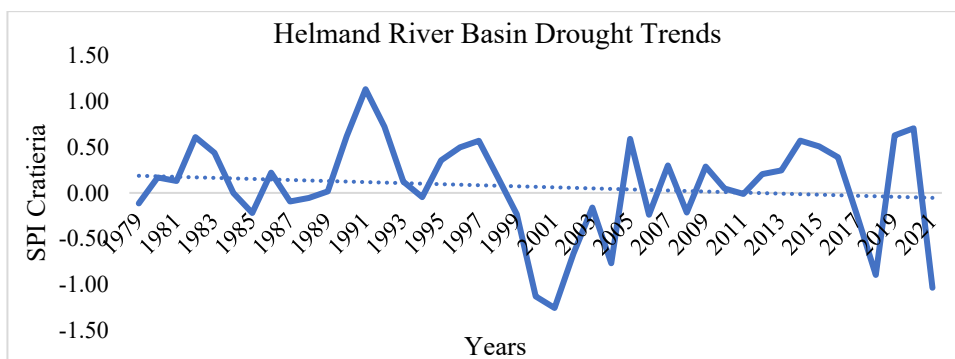


Figure 3: Drought Trends in HRB between 1979 and 2021

Using ArcGIS, we analyzed SPI data from 1979 to 2021. SPI measures precipitation deviation from the long-term average and helps assess drought severity. We examined SPI values at different time scales (SPI-1, SPI-3, SPI-6, SPI-9, and SPI-12) using ArcGIS for analysis and visualization. As we interpreted the SPI values on the map, we found that the Waras and Gardez stations in the Helmand River Basin consistently experienced low levels of

drought throughout the analyzed period. On the other hand, the Tarank, Shila-i-charkh, and Khwabgah stations showed a moderate level of drought, indicating relatively better precipitation conditions compared to Waras and Gardez. Lashkargah and Adraskan stations had a relatively high level of drought, suggesting relatively favorable precipitation conditions in those areas (Figure 4).

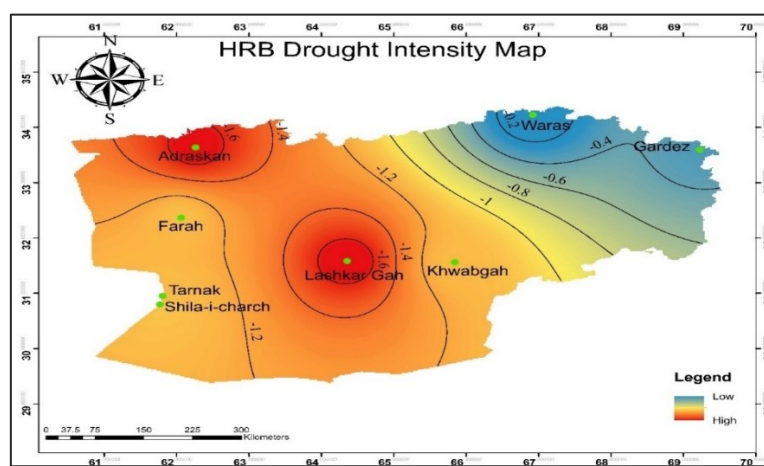


Figure 4: Drought Intensity in Helmand River Basin

CONCLUSION

The research conducted in the Helmand River basin (HRB) using SPI has provided valuable insights into the patterns of wetness and dryness in the region. The SPI has enabled the identification of specific years characterized by varying levels of wetness or dryness by classifying drought conditions into different categories. The analysis revealed near-normal conditions, moderately wet years, and severely dry years in the Helmand River Basin. These findings highlight the dynamic nature of climate patterns in the region and their significant impact on water availability and agricultural productivity. Interestingly, when comparing the results from the HRB with studies conducted in other regions, both similarities and differences emerged. Some regions experienced severe and prolonged drought periods, while others witnessed moderate or mild drought levels. These variations underscore the importance of understanding local climate and hydrological conditions when assessing drought hazards and implementing water management strategies.

The comparison also emphasizes the need for region-specific analysis. While there are similarities in terms of drought occurrences, severity, and duration, each region has unique characteristics that influence its vulnerability to drought. Therefore, it is crucial to consider these local variations in order to

develop effective strategies for mitigating the impacts of drought and ensuring sustainable water management. Moreover, the findings from the HRB research align with studies conducted in different parts of the world, demonstrating the global nature of the drought challenge. Similar patterns of drought occurrences and their impacts on local communities and ecosystems were observed from Southeast Australia to Raya in Northern Ethiopia, the Punpun watershed in India to the São Francisco River Basin in Brazil. These similarities highlight the interconnectedness of our planet's climate systems and the urgent need for coordinated efforts to address the increasing frequency and severity of drought events worldwide.

In conclusion, the research on the HRB using the SPI method has contributed valuable knowledge to our understanding of drought dynamics in the region. The findings emphasize the importance of region-specific analysis, the need for sustainable water management strategies, and the global significance of addressing drought as a pressing environmental challenge. As the physical and psychological comfort of humans is based on the availability of water (Ying et al., 2023), integrating scientific research, local knowledge, and international cooperation can help us work towards building resilience, adapting to changing climate patterns, and securing a sustainable future for all.

CONFLICTS OF INTEREST

The authors state that they do not have any known financial interests or personal relationships that could have potentially influenced the work presented in this paper.

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EVALUATING PEDESTRIAN CROSSING ATTRIBUTES AT INTERSECTIONS IN KABUL CITY, AFGHANISTAN: A COMPUTER VISION APPROACH

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Abstract

This study aims to evaluate pedestrian crossing attributes in heterogeneous traffic environments using computer vision. For this purpose, YoloV8 models were optimised to detect pedestrian crossing attributes. Moreover, an OpenCV-based Python programme was developed to track pedestrian trajectories manually. For accuracy, the inverse perspective mapping method is applied to obtain a bird's eye view. Finally, a heatmap of pedestrian trajectories was provided to visualise the pedestrian crossing attributes. The results show that more than three-quarters of pedestrians are engaging in noncompliance crossing behaviours at major intersections in Kabul City, Afghanistan. In addition, pedestrians tend to walk longer, more frequent routes at corners and outside of crosswalks. Furthermore, statistical analysis reveals that pedestrian crossing speed decreased by 5.8% when disobeying crossing rules, indicating the significant effect of pedestrian attributes on crossing speed. In conclusion, this study contributes to a better understanding of pedestrian behaviour in heterogeneous traffic environments using computer vision. The results would provide insightful information to traffic engineers and planners for traffic management.

Keywords: Pedestrian Crossing Attributes, Computer Vision, Intersection, Heterogeneous Traffic Environment, Crossing Speed

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INTRODUCTION

The traffic environment becomes more complex when pedestrians violated the rules, particularly at intersections on urban arterial streets with heterogeneous traffic. Noncompliance crossing is a prevalent behaviour among pedestrians at intersections in developed countries. This phenomenon exposes pedestrians to consecutive conflicts and creates a high-risk environment for road users.

The heterogeneous traffic environment is defined as a traffic flow which is composed of different types of road users, including vehicles, bicycles, and pedestrians (Board et al., 2022). Heterogeneity of traffic flow is the main characteristic that differentiates traffic conditions in a developing country from those of a developed country (Pandey et al., 2022). It brings unique challenges to traffic management and safety in a developing country. Many studies have recognized that speed variation, longitudinal and lateral lane changing, distance keeping, traffic safety and other aspects of vehicular behaviour are more observable characteristics of heterogeneous traffic environments (Civil & Practice, 2020; Siregar et al., 2021; Ma et al., 2023). Furthermore, the traffic environment in Kabul City is characterised by a lack of lane discipline and weak traffic law enforcement, which causes pedestrians to resort to noncompliance crossing attributes.

Providing a safe and walkable environment for pedestrians is an important aspect of a vibrant urban environment. A lack of control over pedestrian crossing attributes results in a significant reduction in traffic operation efficiency. Pedestrian crossing attributes are affected by several factors such as waiting time on the curb side, traffic volume, walking speed, pedestrian distraction, pedestrian amenities, and nearby land use (Ghomi & Hussein, 2022). However, the impact of pedestrian noncompliance attributes on crossing speeds remains unclear in a heterogeneous traffic environment. Pedestrian crossing speed is a critical parameter to determine the efficiency of traffic operations and safety at intersections (Zafri et al., 2019). It is hypothesised that pedestrians' non-compliance crossing significantly reduce pedestrians crossing speed. On the other hand, computer vision has great potential for growth in evaluating pedestrian behaviour and safety in complex traffic environments. Its recent advances provide a promising outcome for evaluating pedestrian behaviour.

Therefore, understanding the effect of pedestrian crossing attributes on walking speed is one of important aspects of enhancing traffic operation and safety, particularly in complex traffic environment. Furthermore, research on pedestrian crossing attributes will be useful to enforce traffic regulations and control traffic operation (Kadali & Vedagiri, 2020). With this background, the current study aims to evaluate pedestrian crossing attributes in heterogeneous traffic environments using computer vision. To accomplish this, the following objectives should be achieved: (i) to determine the effectiveness of current advances of computer vision technique for evaluating pedestrian behaviour; (ii) to

examine the effect of pedestrian attributes on their crossing speeds; (iii) to provide a framework to identify the location and density of pedestrian noncompliance behaviour in a heterogeneous traffic environment. The outcome will shed light on the pedestrian attributes in a complex traffic environment of a low-income city. It will provide insightful information to policy makers, traffic engineers, and planners to make evidence-based decisions.

LITERATURE REVIEW

Background of Pedestrian Crossing Behaviour Study

Walkability is an essential aspect of a transportation network for healthy and sustainable cities (Ghadzlie et al., 2024). Numerous studies have demonstrated that pedestrian crossing attribute is a crucial aspect of traffic management and explored it from various perspectives, including safety, health, and sustainable urban design (Karwand et al., 2023; Khalid et al., 2023; Read et al., 2018).

Previous studies identified that higher vehicular speeds, pedestrian and vehicle volumes, distraction, land use characteristics, and built environment factors are associated with increasing pedestrian collision rates (Hussain et al., 2019; Leh et al., 2013). A comparison of intersections and mid-block crash records shows that the collision rate is higher in the intersections located on urban arterial streets of non-residential areas than on residential roads (Quistberg et al., 2015). Most of these studies used recorded crash data to evaluate pedestrian safety. However, the availability of reliable historical crash data is limited for developing countries, particularly in low-income cities. Therefore, previous studies also attempt to conduct alternative approaches for evaluating pedestrian safety (de, Ceunynck, 2017). These alternative approaches are basically reliant to road users behavioural characteristics and built environment factors (Arun et al., 2021). A considerable number of studies have focused on evaluating pedestrians crossing behaviour in different types of traffic facilities using a variety of non-crash related approach. Thompson et al. (2013) conducted a field observation to determine pedestrian crossing time with distraction behaviour at intersections. They found that pedestrians take an additional amount of time to cross intersections compared to undistracted behaviour. Zafri et al. (2019) performed a screenshot taken from videographic methods to analyse pedestrian waiting time and crossing speed at three intersections in Dhaka City, Bangladesh. The results of their study show that pedestrians who do not want to wait more than 20-30 seconds to cross the road and pedestrian crossing speed bear reasons which are associated with intersection time, compliance behaviour, gender, age, and crossing location. A field observation of pedestrian illegal crossing was conducted by Shaaban et al. (2018) in mid-block of six lane streets of Doha City, Qatar. The results show that pedestrians used the shortest path to cross when crossing the streets without complying to rules. According to Goh et al. (2012), the types of crosswalks and gender significantly affect pedestrian crossing

speeds. They carried out a manual time recoding in the City of Kuala Lumpur, Malaysia. According to Aceves-González et al. (2020) who conducted a physical audit and questionnaire survey in Mexico City, they highlight built environment factor and its effect on pedestrian safety perception. Pedestrian yield compliance depends on the speed of approaching vehicles and it varies in different locations and types of traffic facilities, which indicates the effect of environmental and demographic factor on pedestrian crossing behaviour (Chaudhari et al., 2021).

Most studies on pedestrian crossing behaviour tend to focus on certain types of traffic facilities and environmental context. However, almost all have not considered pedestrian noncompliance crossing at intersections on urban arterial streets, more specifically in the heterogeneous traffic environment of low-income cities. Although Kadali and Vedagiri (2020) have investigated the effect of various demographic and built environment factors on pedestrian crossing speed, less attention is still paid to the effect of pedestrian attributes on pedestrian crossing speeds. On the other hand, these studies conducted physical audits, field observations, manual time recording, and others which provided information on pedestrian behaviour at the beginning and end of their crossing trips. However, a robust and reliable understanding of pedestrian crossing attributes is required to obtain information on each time interval of the pedestrian crossing journey. This will be achievable using computer vision techniques.

Utilise Computer Vision Techniques

Computer vision refers to the technology that enables computers to extract meaningful information from visual data (Rosenfeld, 1988). Researchers have focused on its growing application in various domains, including transportation. In recent years, computer vision techniques have emerged as a promising method for evaluating pedestrian behaviour.

Several studies have utilized computer vision to study the movement characteristics of pedestrians (Ismail, 2010; Zangenehpour et al., 2015; Xia et al., 2022). They have focused on utilising two main aspects of computer vision: detection and tracking. Automated detection and tracking are challenging issues in the analysis of pedestrian movement patterns, particularly in heavy pedestrian traffic (Zaki & Sayed, 2013). In previous studies, image background subtraction, feature tracking, and optical flow techniques were found to be more commonly used for pedestrian detection and tracking (Fu, 2018; Hussein et al., 2015; Saunier et al., 2010). However, almost all these techniques inherit occlusion and error due to the constant change in the orientation and appearance of pedestrians. The field of computer vision is rapidly advancing and being developed day by day to overcome these challenges. For instance, there is You Only Look Once (YOLO) which is a deep learning-based object detection algorithm that can considerably overcome the challenges of occlusion due to its custom-trained feature. It can be trained to detect multiple objects in an image or video frame in real-time. YOLO

was first introduced by Redmon et al. (2016) and has undergone several iterations. Its latest YOLOV8 version, developed by the Ultralytics team in 2023, has been highly improved in terms of accuracy and efficiency in object detection.

Among the reviewed literature, most studies have not utilized the YOLO model to evaluate pedestrian crossing attributes in a heterogeneous traffic environment. Furthermore, the challenges of full or partial occlusion were addressed in limited studies (Rezaei et al., 2022). To evaluate pedestrian crossing attributes in complex traffic environments, it is of great importance to accurately extract information on pedestrian crossing behaviour using computer vision. In this paper, researcher will discuss the potential of YOLOV8 model, to address the challenge of pedestrian crossing attributes at the intersections in Kabul City.

RESEARCH METHODOLOGY

The aim of this study is to evaluate the pedestrian crossing attributes in heterogeneous traffic environments using computer vision. To accomplish this, there are research material and method which consist of three main steps: (a) study site and data collection, (b) computer vision process, and (c) statistical analysis and data visualisation. The research design flow chart is shown in **Figure 1**. It provides a framework for evaluating pedestrian behaviour in two visual views: perspective view and bird's eye view.

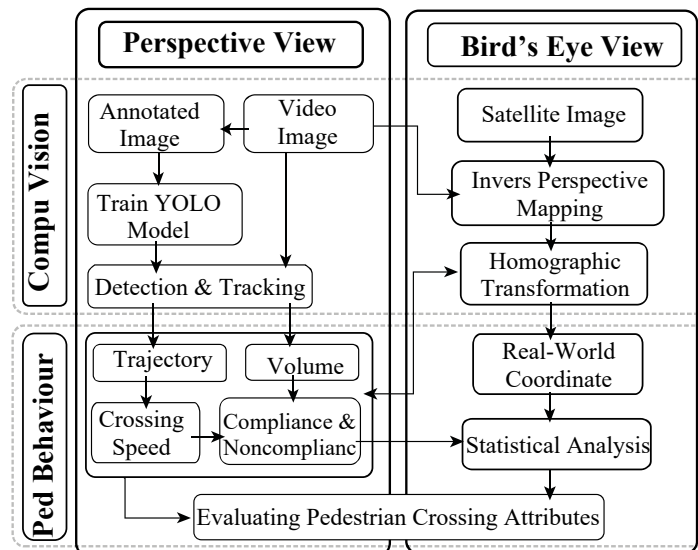


Figure 1: Research design flowchart

Study Site and Data Collection

The data collection process was conducted at the major intersections in the city of Kabul, Afghanistan. Intersections were selected based on traffic heterogeneity,

location in the urban transportation network, and pedestrian activity criteria. Five major intersections were chosen as study sites, which are located on urban arterial streets (Baraki, Kart-e-Momureen, Deh Mazang, Chaman Hozori, and Chare Dan Bagh). Two types of data were collected: video data to evaluate pedestrian crossing attributes and images for annotation and training of the YOLO model.

Video data collection is prohibited at important intersections in Kabul City due to security concerns. Therefore, the research was only able to collect video data from the Baraki intersection. This intersection is in a strategic location that connects the north and south, as well as the east and west of the city. Data collection was carried out using a camera mounted on a building overlooking the intersection. The camera was set to record video with a resolution of 1280x720 pixels at 25 frames per second in MP4 format. The video data was collected for three days on June 13–15, 2021. A total of 26 hours of video footage was collected during these times. In total, 678 images were collected from five intersections with different views and angles. Images were annotated using LabImg, a Python-based image annotation software (Table 1 and Figure 3a).

Table 1: Pedestrian image annotation dataset

Intersection	Images	Pedestrian Instances	Percentage
Baraki	225	6911	39.8%
Kart e Momureen	176	4096	23.6%
Deh Mazang	108	3912	22.5%
Chaman Hozori	72	1593	9.2%
Chare Dan Bagh	97	867	5.0%
Total	678	17378	100%

Computer Vision Process

Computer vision process is a crucial step that involves detecting and tracking pedestrians from a perspective and transforming their position into a bird's eye view. A perspective view refers to the camera's viewpoint at ground level, and a bird's eye view provides a top view. The following techniques were used:

YOLOV8 Detection Model

YOLOV8 is the latest version of the YOLO series detection model. The YOLOV8 structure builds on the previous YOLO algorithm and has shown a great improvement in object detection performance (Jocher et al., 2023).

The YOLOV8 algorithm has a customised feature that allows it to be trained and optimised for a specific task. Considering this, the researcher trained three different models of YOLOV8 (YOLOV8n, YOLOV8s, and YOLOV8m) on the image annotation dataset collected from Kabul City intersections. Then, the performance of the models is compared based on common evaluation metrics: precision (P), recall (R), F1-score, average precision (AP), and mean average precision (mAP). Based on the outcomes, the optimal model is ultimately chosen.

Trajectory Extraction Technique

Evaluating pedestrian crossing attributes is a challenging task in an irregular traffic situation. It is required to accurately extract the entire crossing trajectory.

This study used video footage to extract the crossing trajectory. For this purpose, a Python manuscript is developed using the OpenCV library. It is designed to extract pixel coordinates and timestamps of pedestrian positions from video footage. Homographic transformation is applied to transform image pixels into real-world coordinates (cartesian coordinate system). The pedestrian trajectory extraction process is shown in **Figure 2**. It involves extracting pedestrian positions, homographic transformation, speed and its change estimation, and storing trajectories in a database for further analysis.

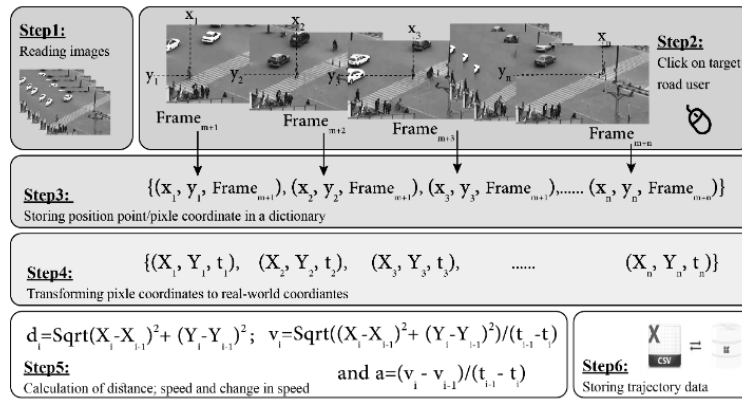


Figure 2: Pedestrian trajectory extraction process.

Perspective Transformation

Perspective view, such as object position in video footage, is not showing real position. It is associated with distortions and calibration is required. For calibration purposes, the researcher has applied IPM to align the perspective viewpoints on the satellite image of the same location. Then, transformation matrix is created to convert image pixel to cartesian coordinates system. The transformation can be carried out using the following equations:

$$X_c = \frac{g_{11} \times x + g_{12} \times y + g_{13}}{g_{31} \times x + g_{32} \times y + g_{33}} \quad \dots [1]$$

$$Y_c = \frac{g_{21} \times x + g_{22} \times y + g_{23}}{g_{31} \times x + g_{32} \times y + g_{33}} \quad \dots [2]$$

Where:

X_c, Y_c = cartesian coordinates system in meters [m]

x, y = image pixel coordinates

g_{ij} = transformation matrix values

Statistical Analysis and Data Visualisation

The computer vision technique is used to obtain pedestrian volume, crossing speed, compliance and noncompliance crossing attributes, and pedestrian density or the number of pedestrians occupying a certain area. The obtained data were analysed in two forms: statistical analysis and pattern visualisation.

First, descriptive analyses were carried out. In addition, comparative statistical analysis, which uses ANOVA and student t-tests, was conducted to determine the effect of pedestrian attributes on crossing speeds. Then, the kernel density estimate (KDE) was applied to pedestrian crossing trajectory data to visualize the pattern of pedestrian crossing attributes at intersections.

RESULTS AND DISCUSSION

The results of this study are discussed from two perspectives: computer vision effectiveness in data acquisition of pedestrian crossing attributes and evaluation of pedestrian crossing attributes. The results show that computer vision techniques are extremely effective in pedestrian crossing attributes detection and analyses of their whole crossing trajectories. Through data analysis, it was observed that noncompliance crossing is a prevalent behaviour among pedestrians at the intersections studied.

Results of Using Computer Vision

Results from computer vision process are presented with regard to the three sections included in the research methodology: YOLOV8 detection model, pedestrian trajectory extraction, and perspective transformation.

Optimising YOLOV8 Detection Model

The results of YOLOV8 detection model involves creating pedestrian image annotations dataset, training three different YOLOV8 models (YOLOV8n, YOLOV8s, and YOLOV8m), and test the performance of trained models.

To begin with, overall, 17378 instances of pedestrians were annotated on 678 images collected from five intersections. The result of the pedestrian annotation is provided in **Table 1**. Labellmg software was used to manually annotate images, as shown in **Figure 3a**. Then, YOLOV8 models were trained in Google Colab with a GPU accelerator using a Roboflow notebook. For each model, 640×640 image size, 150 epochs, and a 0.001 learning rate were arranged in 16 batch runs. The performance results of the models are shown in **Table 2**. The performance of three models was also tested on the same images (**Figure 3**). All three models show acceptable inference speeds. The results indicated that YOLOV8n has a faster inference speed (1.4 milliseconds) with a lower successful detection rate (3 wrong deductions and 8 missed deductions, as shown in **Figure 3d**). In conclusion, YOLOV8m was found to be an optimal model with an acceptable inference speed (9.8 milliseconds) and a higher mAP50-95%.

Table 2: Performance evaluation of YOLOV8 models

Model	R%	P%	mAP50%	mAP50-95%	F1-score	Inference
YOLOV8n	0.922	0.921	0.926	0.706	0.921	1.4 m.sec
YOLOV8s	0.959	0.953	0.955	0.813	0.956	3.7 m.sec
YOLOV8m	0.970	0.968	0.969	0.761	0.968	9.9 m.sec

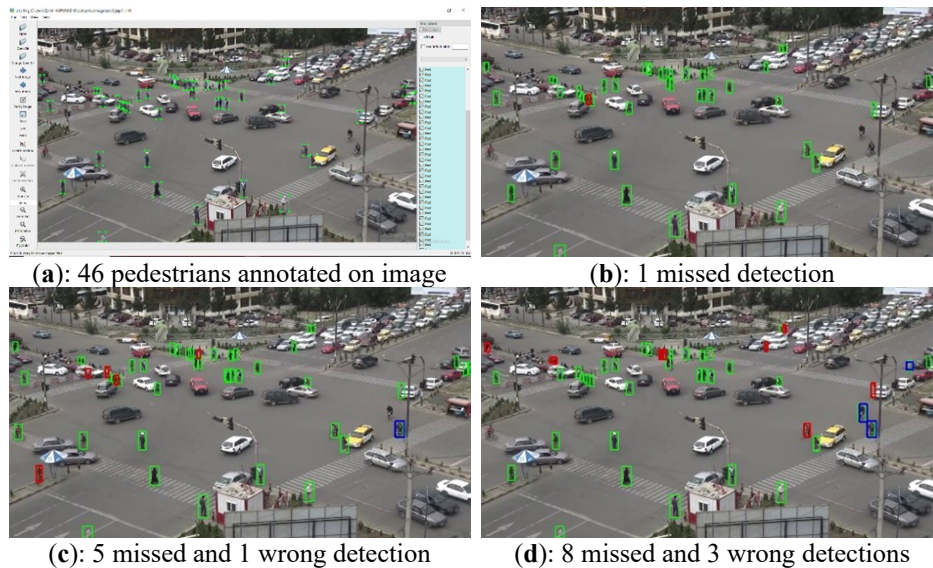


Figure 3: Models test (green box, red box, and blue box are shown successful, missed, and wrong detection respectively). (a) annotated image using LabelImg software, (b) YOLOV8m, (c) YOLOV8s, and (d) YOLOV8n.

Results of Pedestrian Trajectory Extraction

The trajectory extraction technique was used to obtain pedestrian crossing trajectories for interested regions of crosswalks. A total of 1264 crossing trajectories were extracted, and almost 23% of the pedestrians is obeyed traffic rules. **Figure 4** shows the two-hour pedestrian crossing trajectories of the 9:15 to 11:15 a.m. segment of video data on June 15, 2021.

Transforming Pedestrian Trajectory to Bird's Eye View

The results of pedestrian crossing trajectories that transformed to a bird's eye view, namely the ground plane, are shown in **Figure 5b**. Results of the trajectory data, originally from video footage pixels, are unreliable. To address this issue, the inverse perspective mapping was applied to overlay the corresponding point of video footage and satellite image of the same location (**Figure 5a**). A transformation matrix was found between two planes using OpenCV library.

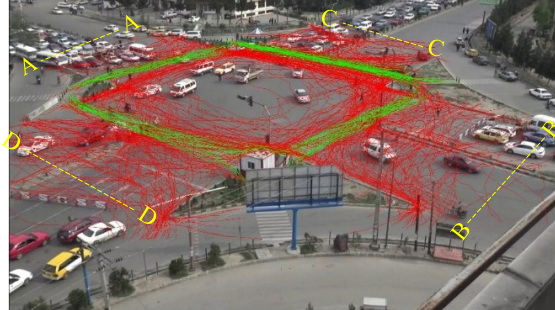


Figure 4: Pedestrian crossing trajectories (red and green shows noncompliance and compliance crossings respectively)



Figure 5: Inverse perspective mapping. (a) Overlaying video footage on satellite image, (b) Transforming pedestrian trajectories to bird's eye view

Evaluation of Pedestrian Crossing Attributes

A statistical analysis and data visualisation method were used to evaluate pedestrian crossings by pedestrian volume count, compliance and noncompliance pedestrian crossings, pedestrian crossing speeds, and pedestrian density. A summary of the data description is presented in **Table 3**.

First, the YOLOV8m detection model was used to automatically count pedestrian crossings in every 50 frames (2 sec). The results of the pedestrian volume count during 12,000 frames for four crosswalks are shown in **Figure 6**. Additionally, the hourly pedestrian crossing on each crosswalk, with compliance and noncompliance attributes, is provided in **Table 3**. The results show that overall, 717 pedestrians per hour cross the Baraki intersection. The crosswalk C-C, with 221 pedestrians per hour, is the most crowded spot among others. It was observed that almost 87% of the pedestrians crossed in a noncompliance manner. Furthermore, based on the KDE, the pedestrian crossing density was visualised using video footage and a satellite image. As shown in **Figure 7b**, it is obvious that pedestrians created several prohibited routes in the vicinity and corners of

each crosswalk, indicating a negative impact on traffic operations. However, major intersections on urban arterial streets must provide higher traffic mobility.

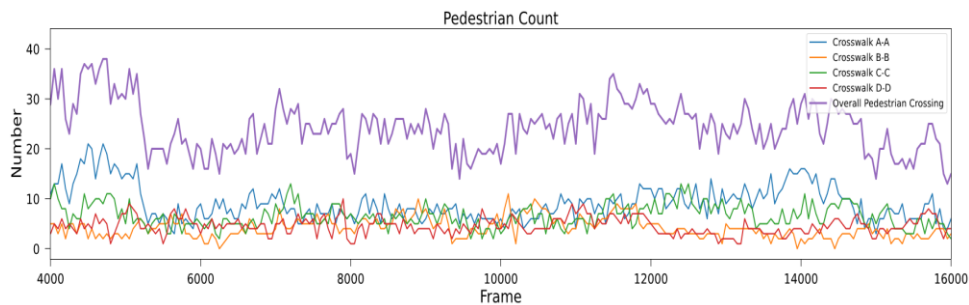


Figure 6: Pedestrian volume count

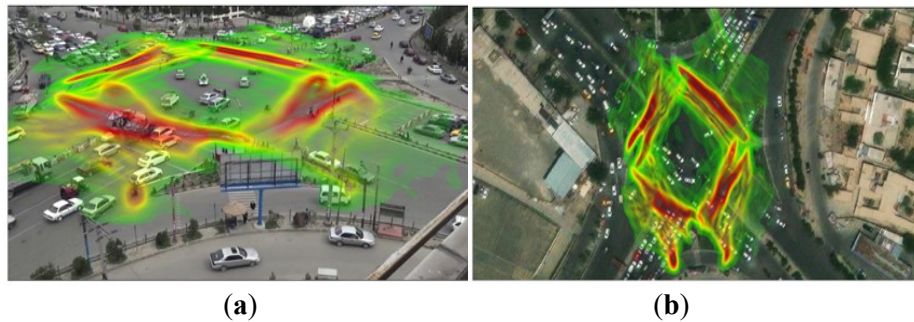


Figure 7: Pedestrian crossing density visualisation. (a) perspective view, (b) bird's eye view –satellite image

From the results, it was found that the mean pedestrian crossing speed was 1.282 m/s for noncompliance and 1.212 m/s for compliance manner, respectively. For comparison purposes, the distribution and variation of crossing speed data are visualised in **Figure 8**. The data are approximately normally distributed; the outer quartile and whisker lengths are symmetrical. However, noncompliance data have shown a wider range of variability than compliance, indicating the stopping and going of pedestrians. As shown in **Table 3**, statistical analysis reveals that pedestrian crossing speeds with noncompliance are significantly faster than compliance (equal variances assumed: $t(14864) = 5.966$, $p < 0.001$). This difference is also consistent and significant at all crosswalks.

Welch ANOVA was performed to determine the effect of factors on pedestrian crossing speeds. In addition, the pedestrian crossing attribute's effect on pedestrian crossing speed was explored. The results showed that pedestrian crossing speed was significantly affected by pedestrian attributes ($F(1, 14858) = 35.594$, $p < 0.001$; Welch: $F(1, 2663.857) = 41.045$, $p < 0.001$). In addition to that,

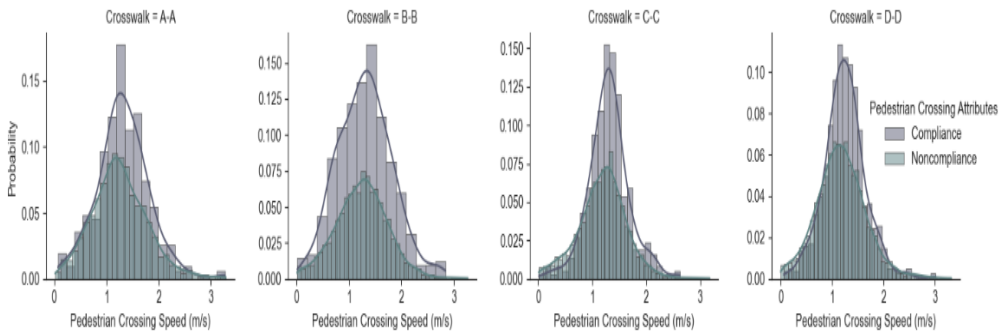
the ANOVA results revealed a significant effect of crosswalks on pedestrian crossing speed ($F(3, 14862) = 19.960, p < 0.001$; Welch: $F(3, 6723.137) = 19.027, p < 0.001$). In summary, analysis indicated that pedestrian attributes and crosswalks have a significant impact on pedestrian crossing speed. However, other factors also need to be explored.

Table 3: Summary of pedestrian crossing attributes

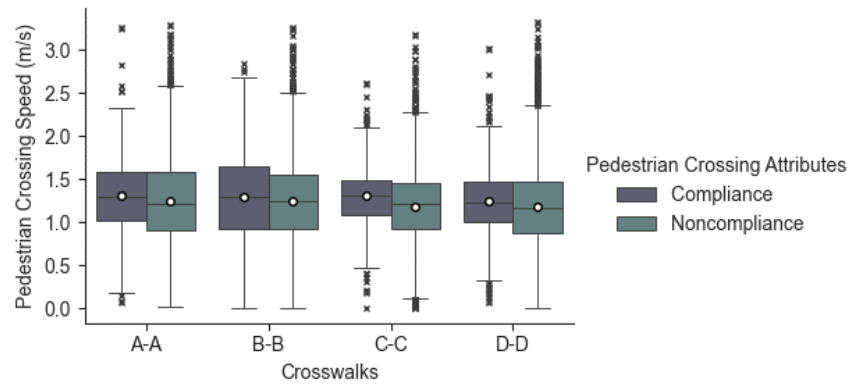
Crosswalks	Crossing Attributes	PCPH ¹ (percentage)	Pedestrian Crossing Speed (m/s)			
			Sample Size (N)	Mean (μ)	Std. Deviation (S)	Sig. (p-value)
A-A	Noncompliance	87(0.12)	1755	1.255	0.5244	0.0469 ^a
	Compliance	16(0.02)	310	1.319	0.4993	
B-B	Noncompliance	183(0.26)	3647	1.247	0.4956	0.0312 ^a
	Compliance	24(0.03)	418	1.302	0.5141	
C-C	Noncompliance	188(0.26)	3183	1.1921	0.4503	0.0000 ^a
	Compliance	33(0.05)	374	1.3064	0.3801	
D-D	Noncompliance	166(0.23)	4358	1.180	0.483	0.0002 ^a
	Compliance	20(0.03)	821	1.247	0.3998	
Overall	Noncompliance	624(0.87)	12943	1.212	0.4857	0.0000 ^a
	Compliance	93(0.13)	1923	1.282	0.4411	

¹ Pedestrian crossing per hour

^a p-value < 0.05 was considered statistically significant.



(a)



(b)

Figure 8: Pedestrian crossing speed distribution. (a) Normal distribution, (b) measure of variation (boxplot visualisation)

CONCLUSION

This study attempted to address the issue of pedestrian crossing attributes in the heterogeneous traffic environment of a low-income city. To accomplish this, the advantages of recent advances in computer vision techniques were successfully utilised with the help of the Python-based OpenCV library.

Computer vision techniques have been found to be extremely effective in extracting pedestrian crossing-related information. It provides a trajectory-based analysis of pedestrian crossing attributes, resulting in an instantaneous analysis of pedestrian behaviour. In addition, it has proven to be highly useful to analyse pedestrian movement characteristics in multiple planes, which allows for the analyse of the exact positions of movement objects.

The results show that noncompliance crossing is a prevalent behaviour at major intersections in Kabul City. Trajectory data revealed that pedestrians tend to create prohibited routes at corners and outside of crosswalks, indicating higher traffic irregularities. In contrast to Shaaban et al. (2018), pedestrians take a longer path when they do not obey crossing rules. Pedestrians have substantially lower crossing speeds when crossing in a noncompliance manner. In fact, Zafri et al. (2019) found a similar result. Furthermore, results from the ANOVA show that pedestrian crossing speed is significantly affected by pedestrian attributes and crosswalks. However, other factors need to be further investigated. In conclusion, this study provides valuable information to better understand the challenges of urban traffic management and planning in heterogeneous traffic environments.

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AIDS SOCIAL EXPENDITURES, POVERTY AND INEQUALITY IN TIME OF COVID-19 PANDEMIC IN INDONESIA

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Abstract

The research investigates the correlation between social aid expenditure and poverty, and inequality across 34 Indonesian provinces from 2004 to 2022. Utilizing the two-step Generalized Method of Moments (GMM) estimate, it examines the impact of social aid expenditure on poverty rates and the Gini coefficient during the COVID-19 pandemic. Results show a significant decrease in the proportion of the impoverished population due to social aid expenditure, with minimal effects on inequality. The study highlights a substantial increase in both poverty and inequality during the pandemic, particularly in rural and urban areas. Analyzing the relationship between social welfare spending and COVID-19 impact reveals a positive influence on disadvantaged populations and inequality in Indonesian provinces. This underscores the need for a comprehensive review of social aid programs, especially amidst COVID-19 challenges.

Keywords: COVID-19; Aids Social Expenditures; Poverty; Inequality

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INTRODUCTION

During the COVID-19 pandemic, it is essential to comprehend the extensive ramifications of this health crisis on the social assistance system, the poverty rate, and economic disparities in both urban and rural areas. A key focal point here is Aids Social Expenditures, as these funds are designed to aid vulnerable groups, and the impoverished often experience reductions or resource reallocations during crises. This can exacerbate their socio-economic conditions, particularly in communities with limited access to resources and healthcare services. In-depth studies on social assistance spending can offer insights into aid effectiveness and its distribution among the needy population. Additionally, it provides an overview of policies that can be enhanced to ensure adequate assistance availability for those in need.

The poverty rate is projected to increase from 9.2 percent in September 2019 to 9.7 percent by the end of 2020, with the least amount of economic growth being impacted by COVID-19 (Suryahadi et al., 2020) including on the island of Java (Muta'ali et al., 2024). This implies that 1.3 million individuals will become impoverished. In accordance with the most pessimistic estimate, 12.4 percent of people will live in poverty, or 8.5 million more people. This implies that Indonesia will lose all of the progress it has made in the last ten years to reduce poverty. Drawing from data provided by the Central Statistics Agency of Indonesia (BPS), we observe that the COVID-19 pandemic has significantly impacted poverty rates. September of 2020, A discernible escalation of 2.76 million individuals resided in poverty, bringing the cumulative count to 27.55 million. It is worth noting that the rate of increase in urban poverty has been more rapid in comparison to that of rural poverty. Specifically, the percentage of individuals living in poverty in urban areas has risen by 1.32 percent, whereas in rural regions, the increase has been 0.60 percent since September 2019.

Furthermore, a focus on poverty is of paramount importance as the COVID-19 pandemic has led to increased unemployment rates and income reductions for many families in both urban and rural areas. In urban areas, the closure of non-essential businesses and industries has caused a surge in unemployment, while in rural areas, difficulties in accessing markets and economic resources can exacerbate the conditions of impoverished communities. Therefore, a comprehensive understanding of poverty levels and shifts in economic dynamics during the pandemic can lay the groundwork for developing targeted economic recovery strategies. Moreover, economic inequality has become an increasingly urgent issue, especially in the midst of the COVID-19 pandemic. In urban areas, the gap between the middle-to-upper socioeconomic groups and the less fortunate has widened due to various economic impacts caused by the pandemic. In rural areas, disparities in access to healthcare services and economic resources can further worsen the conditions of marginalized communities. A comprehensive analysis of economic disparities can offer

profound insights into how the pandemic has deepened inequalities and provide policy guidance to reduce social and economic disparities during times of crisis.

The constitution, laws, and expenditure on social aid in Indonesia have played a pivotal role in advancing social equity and welfare, particularly amid the COVID-19 pandemic. In accordance with the 1945 Constitution of Indonesia, specifically Articles 33 and 34, the government is mandated to protect the populace and promote the ideals of social fairness for all citizens. Moreover, Act number 11 in 2009 delineates the allocation of social assistance as a state strategy to tackle social welfare issues. As outlined in Finance Minister Regulation (181) in 2012, social aid refers to the provision of financial resources, goods, or services by either the central or regional government to the general public, aimed at shielding them from social vulnerabilities, enhancing their economic capabilities, and nurturing social well-being. Legal and constitutional regulations emphasize the significance of focused social assistance in alleviating poverty, particularly amid the ongoing pandemic. These actions reflect Indonesia's commitment to maintaining principles of social justice and welfare while reinforcing the socio-economic structure during an unparalleled crisis.

This research investigates the influence of social assistance expenditure on poverty and inequality in both rural and urban regions of Indonesian provinces. The study specifically concentrates on the governance of 34 province governments during the timeframe spanning from 2004 to 2022. This study examines the influence of the COVID-19 pandemic on poverty and inequality in both rural and urban areas. By focusing on these critical aspects in both urban and rural contexts, we can gain a comprehensive understanding of how the COVID-19 pandemic has exacerbated the socio-economic conditions of vulnerable communities. This understanding forms the foundation for more targeted and effective policies to provide assistance and promote inclusive economic recovery, ensuring that no group is left behind during the process of recovery from this unprecedented global health crisis.

This research contributes significantly to the existing body of literature in various ways. First, this study complements prior research on the influence of social aid spending on poverty and inequality. Second, by specifically focusing on the influence during a health crisis (COVID-19). Furthermore, it underscores the necessity of implementing nuanced policy measures that are specifically designed to address the unique circumstances and characteristics of various contexts and regions, with a particular focus on rural and urban areas.

LITERATURE REVIEW

Theoretical evidence suggests a crucial link between public infrastructure investment, particularly in education and healthcare, and poverty and inequality levels. Suboptimal health can hinder productivity and well-being, while sound health enhances human capital and productivity. The COVID-19 pandemic has

exacerbated global health issues, impacting household welfare and highlighting the inverse correlation between poverty and health infrastructure investment. According to (Castro-Leal et al., 2000), this occurrence can be attributed to the intrinsic relationship between household welfare and health status. Consequently, there exists an inverse correlation between the poverty level and advancements in workforce health and infrastructure investment. Studies by Gupta et al., (2002) highlight the positive impact of increased public spending on healthcare and education, leading to improved academic performance, better access to schooling, and reduced infant mortality rates.

Between 1981 and 1997, the Netherlands witnessed a significant uptick in income inequality due to primary income distribution disparities and reduced social assistance payouts following a social security reform, as noted by (Caminada, 2001). Lustig et al., (2014) found that while direct taxes tend to be progressive, their redistributive impact is limited due to their small share of GDP, with cash transfers showing a generally progressive trend across nations except in Bolivia, where targeting for the poor is lacking. Mahler & Jesuit (2004) highlight that social security programs contribute to a 15 percent reduction in the Gini coefficient across Latin American countries, yet targeted education and health transfers are deemed more effective in curbing inequality. Additionally, (He & Sato, 2013) lower the Gini coefficient by 74.6% while highlighting the important role social security programs play in developed nations.

Research across various countries highlights the multifaceted impacts of social security programs on poverty reduction. In India, initiatives such as food subsidies and employment guarantees significantly enhance individual welfare (Drèze & Khera, 2017), while in Aceh Province, Indonesia, the Special Autonomy Fund (SAF) notably improves school enrollment and reduces poverty Yusri (2022). Similarly, social security programs in Vietnam uplift farmers' expenses and alleviate destitution (Cuong, 2013). In southern Africa, retirement schemes in Namibia, financial assistance in Mozambique, and employment aid in Zambia show positive effects on poverty prevalence (Devereux, 2002). In China, urban and rural social security expenditure weakly correlates with income gaps, significantly reducing rural poverty (Yu & Li, 2021). Moreover, rural American communities with higher social capital demonstrate better resilience to disasters, aiding in community food security (Ren-fu et al., 2020). Amidst the COVID-19 pandemic, poverty rates surged initially but partially mitigated by September across various nations, with Italy experiencing the most significant impact and France the least (Ha, 2023; Menta, 2021), accentuating the pandemic's role in exacerbating global poverty and regional disparities.

In Indonesia, projections indicate a potential increase in poverty rates, with estimates ranging from 9.7% to 16.6% by the end of 2020, potentially reversing previous poverty reduction efforts and impacting millions (Suryahadi et al., 2020). Strengthening social protection programs is imperative to support

those newly impoverished and those already struggling. This underscores the critical role of social safety nets in addressing the pandemic's impact on inequality and poverty. Anderson et al., (2018) highlight the nuanced relationship between government spending and poverty reduction, noting variations across regions and contexts. Kiendrebeogo et al., (2017) emphasize the exacerbating effect of financial crises on poverty rates, mitigated by higher social spending levels, underscoring the importance of social protection during crises. De Matteis, (2013) advocates for poverty-focused aid as more effective in poverty reduction and economic growth promotion. These insights underscore the need for targeted and adaptive policies to address the multifaceted challenges of poverty and inequality in Indonesia and beyond.

Mosley et al., (2004) discuss the fungibility of aid and emphasize that the effectiveness of aid in improving welfare depends on its capacity to increase pro-poor spending. Arndt et al., (2015) explore the ways in which aid boosts physical accumulation and human capital while also contributing to economic growth. The study conducted by Zwane et al., (2022) presents empirical findings that support the notion that social grants significantly improve the well-being of households in South Africa, particularly among women. Turning our attention to Indonesia, Firmansyah & Solikin, (2019) show how social assistance can significantly reduce poverty and inequality, with Rastra being the most successful program. However, in order to guarantee effective aid delivery, improvements are required due to distribution challenges. Furthermore, in Central Java, Handayani et al., (2022) show the complex relationship that exists between regional spending and poverty rates. Specifically, health, spending on social protection, and education has a negative impact on poverty rates, while spending in the economic sector has a positive but significant effect.

A number of studies (Achmad et al., 2023; Ahmad et al., 2023; Lestari et al., 2021; Maria et al., 2022; Riadi, Hadjaat, et al., 2022; Riadi, Heksarini, et al., 2022; Yudaruddin, 2023b, 2023a; Zulkarnain et al., 2023; Wahyuni et al., 2024; Hidayah et al., 2024; Irwansyah et al., 2024; Langi, et al., 2024; Lesmana & Yudaruddin et al., 2024; Achmad et al., 2024) demonstrated the detrimental effects of COVID-19. In particular, studies on the effect of COVID-19 on poverty have been carried out by a large number of researchers in various locations, offering insightful information about the complex problems the pandemic has brought about. Research has been carried out, for example, (Ren-fu et al., 2020) in China, (Langi et al., 2023; Suryahadi et al., 2020) in Indonesia, (Rönkkö et al., 2022) in Bangladesh, (Bassegy et al., 2022) South America, (da Rosa et al., 2021; Nazareno & de Castro Galvao, 2023) in Brazil, (Meehan & Shanks, 2023; Topcu, 2022) in the United States, (Gungor, 2021; Ha, 2023; Menta, 2021) in Europe, (Bargain & Aminjonov, 2021) in Africa, and internationally (Valensisi, 2020). Together, these studies provide insightful information about the intricate and dynamic relationship between the dynamics of poverty and the pandemic.

Nazareno & de Castro Galvao, (2023) highlighted emergency aid's (EA) crucial role in pandemic relief, serving as income replacement, but noted a correlation between EA and reduced family labor force participation, leading to higher unemployment rates. Likewise, da Rosa et al., (2021) found EA allocation in Brazil favored states with larger populations and lower socioeconomic status initially, but final distribution favored more developed regions. Kochaniak et al., (2023) observed ongoing revenue fluctuations for micro-entities in Poland despite government support, necessitating more targeted assistance to address their specific needs, including prolonged earnings reductions, liquidity challenges, limited market access, and job losses.

H1: *As social aid expenditure increases, both rural and urban poverty and inequality will decrease.*

H2: *The COVID-19 pandemic has further intensified disparities in income and destitution between urban and rural regions.*

H3: *Social aid expenditure reduces poverty and inequality in rural and urban areas during of the COVID-19 Pandemic.*

RESEARCH METHODOLOGY

This paper examines the effect of social aid expenditures on poverty and inequality in rural and urban areas of Indonesian provinces, with a particular focus on 34 province governments. Additionally, the effects of the COVID-19 pandemic on urban and rural inequality and poverty are examined in this study. Furthermore, this research investigates the interplay between social aid expenditure and pandemic COVID-19 in order to assess the effect of social aid spending on inequality and poverty and in both urban and rural regions throughout the COVID-19 pandemic. The financial data of provincial administrations covering the years 2004 to 2022, sourced the Central Bureau of Statistics of Indonesia, serve as the dataset for this research.

The association between social aids expenditure and poverty and inequality in rural and urban areas in provinces in Indonesia was evaluated using a regression analysis. The regression equation is as follows:

$$POP_{i,t} = \alpha_{i,t} + \beta_1 SAE_{i,t} + \beta_2 COVID_t + \beta_3 HDI_{i,t} + \beta_4 GRDP_{i,t} + \beta_5 UNE_{i,t} + \beta_6 JAVA_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$POP_{i,t} = \alpha_{i,t} + \beta_1 SAE_{i,t} + \beta_2 COVID_t + \beta_3 SAE * COVID_{i,t} + \beta_4 HDI_{i,t} + \beta_5 GRDP_{i,t} + \beta_6 UNE_{i,t} + \beta_7 JAVA_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$GINI_{i,t} = \alpha_{i,t} + \beta_1 SAE_{i,t} + \beta_2 COVID_t + \beta_3 HDI_{i,t} + \beta_4 GRDP_{i,t} + \beta_5 UNE_{i,t} + \beta_6 JAVA_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$GINI_{i,t} = \alpha_{i,t} + \beta_1 SAE_{i,t} + \beta_2 COVID_t + \beta_3 SAE * COVID_{i,t} + \beta_4 HDI_{i,t} + \beta_5 GRDP_{i,t} + \beta_6 UNE_{i,t} + \beta_7 JAVA_{i,t} + \varepsilon_{i,t} \quad (4)$$

Regression analysis was used to assess the relationship between Social Aids Expenditure, inequality and poverty, and COVID-19, in Indonesian provinces' urban and rural areas. Gross Regional Domestic Product (GRDP), The and Java and Bali Islands (JAVA) Unemployment (UNE), Human Development Index (HDI), were among the control variables used in this study (Defung, F., Hadjaat, M., and Yударuddin, 2023; Deviyanti et al., 2023; Firmansyah & Solikin, 2019; Hilmawan, Aprianti, Vo, et al., 2023; Hilmawan, Aprianti, Yударuddin, et al., 2023; Kheir, 2018; Musviyanti et al., 2022; Nurlia et al., 2023; Paminto et al., 2023; Pham & Riedel, 2019)

The analysis employed in this investigation was the two-step GMM estimator, which stands for Generalized Methods of Moments. A frequently utilized econometric technique in panel data analysis is the two-step application of the GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998). The process encompasses two essential diagnostic instruments, specifically the Hansen-J test and the AR(2) test, both of which are critical in guaranteeing the precision and dependability of the estimation procedure. During the initial stage, the GMM estimator generates initial parameter estimates by employing moment conditions, which are frequently derived from instruments. Subsequently, autocorrelation in the error terms is evaluated using the AR(2) test, which aids in the identification of possible model misspecification and biased estimates of coefficients. Following that, the Hansen-J test is employed to assess the soundness of the moment conditions and the over-identifying limitations in the model. This verification process guarantees that the instruments selected are suitable and that the model has been accurately specified.

ANALYSIS AND DISCUSSION

This study employs a two-step generalized estimating equation (GMM). The findings show that social aid spending has a negative and significant influence on the proportion of Indonesians living below the poverty line (Columns 1 & 3). This finding supports hypothesis 1 (H1), demonstrating that an increase in social aid expenditure correlates with a decrease in the proportion of the impoverished population in Indonesia. Consistent with earlier research conducted by (Anderson et al., 2018; De Matteis, 2013; Firmansyah & Solikin, 2019; Handayani et al., 2022; Kiendrebeogo et al., 2017; Mosley et al., 2004; Zwane et al., 2022) the results suggest that these initiatives directly benefit the underprivileged by providing financial aid and access to essential services.

The implications of this study are significant for poverty reduction strategies in Indonesia. It highlights the importance of strategically increasing financial resources for social assistance programs, encompassing measures such as food subsidies, cash transfers, and other forms of support, which can elevate the standard of living and help individuals escape poverty. Furthermore, the research emphasizes the critical role of precise and effective execution of social

assistance policies, advocating for a targeted approach to resource allocation. Prioritizing the most marginalized and disadvantaged groups is crucial to optimize the impact of social assistance spending. These findings provide empirical support for the effectiveness of social assistance interventions in combating poverty in Indonesia. They also underscore the role of social aid expenditures in mitigating the social disparities between rural and urban communities. However, the study yields different results regarding the impact of social aid expenditure and the COVID-19 pandemic on inequality in rural and urban areas, highlighting an insignificant influence on the dependent variable inequality.

Table 1. The influence of social aid expenditure on poverty and inequality: a comparison between rural and urban areas.

Exp. Var.	Dependen Variables: POV			
	RURAL		URBAN	
	(1)	(2)	(3)	(4)
Dep. Var(-1)	0.9217*** (0.0065)	0.9215*** (0.0066)	0.9498*** (0.0068)	0.9509*** (0.0069)
SAE	-0.00009*** (0.00001)	-0.0824*** (0.0424)	-0.0026* (0.0013)	-0.4926 (0.3210)
COV	0.5197*** (0.0428)	0.5042*** (0.0469)	0.4481*** (0.0745)	0.4172*** (0.0053)
SAE*COV		8.23e-11* (4.24e-11)		4.90e-10 (3.21e-10)
HDI	-0.0133 (0.0099)	-0.01207 (0.0103)	-0.0480** (0.0001)	-0.0476** (0.0193)
GRDP	6.47e-08*** (7.37e-08)	9.87e-08*** (8.59e-08)	2.67e-07** (1.05e-07)	2.42e-07** (1.10e-07)
UNE	-0.0199 (0.0119)	-0.0202 (0.0120)	-0.0367* (0.0211)	-0.0333 (0.0212)
JAVA	0.1189 (0.1063)	0.1144 (0.1053)	-0.1149 (0.1188)	-0.0873 (0.1132)
CONS.	1.2465* (0.6909)	1.1616 (0.7150)	3.7625** (1.4017)	3.7310** (1.3792)
AR(2)	0.214	0.494	0.893	0.886
Hansen Test	0.305	0.646	0.205	0.206
Obs.	453	453	438	438
Exp. Var.	Dependen Variables: GINI			
	RURAL		URBAN	
	(5)	(6)	(7)	(8)
Dep. Var(-1)	0.7424*** (0.0292)	0.7394*** (0.0294)	0.8073*** (0.0311)	0.8058*** (0.0316)
SAE	2.54e-07 (7.61e-07)	-0.0055*** (0.0021)	-0.00001 (0.00006)	-0.0043 (0.0033)
COV	0.0046** (0.0018)	0.0057*** (0.0065)	-0.0014 (0.0014)	-0.0017 (0.0014)
SAE*COV		5.51e-12**		4.32e-12

		(2.19e-12)		(3.36e-12)
HDI	-0.0013**	0.0014**	-0.0007*	-0.0007*
	(0.0005)	(0.0005)	(0.0004)	(0.0004)
GRDP	-2.18e-09	1.64e-10	-3.95e-09	-4.19e-09
	(3.20e-09)	(3.25e-10)	(3.20e-09)	(3.19e-09)
UNE	-0.0016**	-0.0016**	-0.0005	-0.0005
	(0.0006)	(0.0006)	(0.0005)	(0.0005)
JAVA	0.0098**	0.0096**	0.0046*	0.0049*
	(0.0040)	(0.0040)	(0.0027)	(0.0027)
CONS.	0.0061	0.0012	0.1154***	0.1169
	(0.0372)	(0.0382)	(0.0294)	(0.0296)
AR(2)	0.427	0.422	0.370	0.372
Hansen Test	0.521	0.524	0.497	0.497
Obs.	453	453	438	438

Note: ***, **, and * are significant at 1%, 5%, and 10% confidence levels, respectively.
Source: Authors' calculation.

Furthermore, the results of the analysis show that the impact of COVID-19 on poverty and inequality in rural and urban areas of Indonesian provinces is significantly positive (Columns 1, 3 & 5). Thus, it supports hypothesis 2 (H2). This result is consistent with (Bargain & Aminjonov, 2021; da Rosa et al., 2021; Gungor, 2021; Ha, 2023; Meehan & Shanks, 2023; Menta, 2021; Nazareno & de Castro Galvao, 2023a; Ren-fu et al., 2020; Rönkkö et al., 2022; Suryahadi et al., 2020; Topcu, 2022; Valensisi, 2020). Although, specifically for urban areas, the impact of COVID-19 is not significant. The analysis indicates that the impact of the COVID-19 pandemic in urban areas is not significant. This may be attributed to the diverse job market and more readily available economic resources in urban areas, which have helped communities to adapt more easily to the economic changes brought about by the pandemic. Furthermore, these results highlight that the pandemic's impact has been more pronounced in rural areas, leading to an increase in the number of poor people and income inequality. Limited access to healthcare services and restricted economic opportunities in rural areas may have rendered the population more vulnerable to sudden socioeconomic changes. These results indicate that the number of poor people in rural and urban areas and income inequality in rural areas are higher during the COVID-19 period. Therefore, these analysis results underscore the importance of focusing on policy interventions and government programs specifically tailored to alleviate the impact of the COVID-19 pandemic in rural areas.

Table 1 also exhibits the outcomes of the interactional analysis between social welfare disbursement and COVID-19 on poverty and disparity in rural and urban regions of Indonesian provinces. The primary objective is to scrutinize the influence of social welfare disbursement on the percentage of the impoverished populace and Gini coefficient amid the COVID-19 crisis. The study's findings reveal a statistically significant and favorable effect of the interactional variable involving social welfare expenditure and COVID-19 on the proportion of the

indigent population and disparity in rural and urban zones of Indonesian provinces. This outcome contrasts with the conclusions drawn by (da Rosa et al., 2021; Kochaniak et al., 2023). Consequently, Hypothesis 3 (H3) is not upheld. These findings suggest that social welfare expenditure fails to mitigate the adverse repercussions stemming from the COVID-19 pandemic. Consequently, poverty and disparity in rural and urban regions persist at elevated levels during the COVID-19 era.

The research reveals that social aid expenditure has failed to mitigate the negative consequences of the COVID-19 epidemic, resulting in prolonged poverty and inequality in rural and urban regions. This suggests that present social aid tactics and funding may not be addressing the pandemic's complex socio-economic stability and welfare issues. The findings suggest that present social aid programs must be critically assessed to face COVID-19 pandemic issues. This evaluation should identify barriers to social aid resource optimisation. It also emphasizes the need for comprehensive and adaptive social aid programs that can address the particular crisis issues encountered by diverse areas and groups, providing a more fair and inclusive recovery process.

CONCLUSIONS

The investigation examines the correlation between social aid spending and poverty, as well as inequality in rural and urban Indonesian provinces from 2004 to 2022, focusing on 34 province governments. Utilizing the two-step GMM estimator, the study analyzes how social aid expenditure affects the percentage of the population living below the poverty line and the Gini coefficient during the COVID-19 pandemic. Findings indicate that social assistance spending significantly reduces poverty rates but shows varied effects on inequality. The COVID-19 pandemic exacerbates poverty and inequality in both rural and urban areas. Interaction analysis reveals a significant positive impact of the pandemic and social aid expenditure interaction on poverty and inequality across regions.

The research emphasizes the urgent need for a thorough reassessment of social aid programs in Indonesia, particularly amidst the challenges posed by the COVID-19 pandemic. Targeted and adaptable strategies are crucial for addressing poverty and inequality dynamics in both rural and urban areas. Policymakers should prioritize resource allocation to vulnerable populations and foster inclusive frameworks for sustainable socio-economic development, ensuring equitable access to essential services. Strengthening social protection systems is imperative for better crisis response. However, the study's focus on Indonesia limits generalizability, and reliance on quantitative analysis overlooks qualitative nuances. Future research should incorporate qualitative methods, examine long-term effects of aid policies, and explore mechanisms impacting different socio-economic groups to inform more effective interventions.

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ESTIMATION OF NITROGEN OXIDE (NO_x) EMISSIONS FROM MOTOR VEHICLES BASED ON FUEL CONSUMPTION IN KUALA LUMPUR METROPOLITAN CITY, MALAYSIA

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Abstract

One of the major sources of urban air pollution in Kuala Lumpur is attributed to more than 17 million units of motor vehicles that have an impact on human health. This study focused on nitrogen oxide (NO_x) emissions from four classes of motor vehicles such as private cars, motorcycles, and goods vehicle from 2010 to 2014 using fuel consumption analysis. The study revealed that private cars were responsible for the majority of NO_x emissions, with 3,854 kg in 2010 increasing to 5,726 kg in 2014. During the same period, motorcycles emitted 1,200 kg in 2010 and 1,750 kg in 2014, while goods vehicles emitted 199 kg in 2010 and 219 kg in 2014. The results of this study are important to policymakers and stakeholders. In particular, for the planning of various strategies to reduce and control the impact of air pollution from motor vehicles, especially on human health, in Kuala Lumpur.

Keywords: Urban Air Pollution, Motor Vehicles, NO_x Emissions, Kuala Lumpur

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INTRODUCTION

The primary cause of urban air pollution in Malaysia is attributed to mobile sources, as stated by the Department of Environment (DOE, 2017). Motor vehicles emit harmful substances, including carbon monoxide (CO), hydrocarbons (HC), nitrogen dioxide (NO₂), nitrogen oxides (NO_x), sulphur dioxide (SO₂), and suspended particulate matter which is less than 10 microns in diameter (PM₁₀). These substances are released during the combustion process in vehicle engines, which is necessary for movement (Ong et al., 2011; Mohd Shafie & Mahmud, 2015a; Mohd Shafie & Mahmud, 2015b; Abdullah et al., 2024).

The direct discharge of pollutants has a detrimental effect on several areas, including public health, specifically causing respiratory issues in Malaysia (Mabahwi et al., 2015; Ling et al., 2010; Ling et al., 2012; Hoon Leh et al., 2011). In 2016, air pollution was responsible for 7.6 per cent of global mortality, as reported by the World Health Organisation (WHO, 2016). This disease is affected by the individual's level of exposure to pollutants and the length of that exposure, which may occur over both short and extended periods of time. NO_x induces pulmonary inflammation and impairs pulmonary immunity, leading to various respiratory problems such as wheezing, coughing, colds, and bronchitis.

NO_x is a component of air pollutants that are generated by cars and the combustion of fossil fuels. The presence of this substance in the air contributes to the creation and alteration of other kinds of air pollution, such as ozone and suspended particles. It also leads to the development of acid rain and smog when it reacts with sulphur oxide. Acid rain, airborne particulates, and even low-level ozone pose an urgent threat to human health. NO_x is a greenhouse gas (GHG) that contributes to the production of ozone through photochemical reactions in the atmosphere. NO_x also impacts the greenhouse gas budget by influencing hydroxyl radicals. Hence, the emission of NO_x by motor vehicles directly influences the quantity of GHG that will eventually impact climate change. The function of GHG, which capture solar radiation, is to trap and retain heat in the atmosphere, leading to a substantial increase in the Earth's temperature.

LITERATURE REVIEW

Vehicle Pollutant Emissions in Malaysia

The high number of motor vehicles was identified as the main reason for the deterioration of air quality in the urban areas. The proliferation of motor vehicles was pinpointed as the primary cause for the degradation of air quality in metropolitan regions. DOE Malaysia has published statistics indicating a consistent upward trend in motor vehicle registrations. The total number of registered vehicles increased from 4,335,863 units in 2003 to 28,224,407 units in 2017, representing a growth rate of 8.16 per cent. The occurrence of this circumstance may be attributed to the quick economic forces in Malaysia,

namely, the consistent expansion of the Gross Domestic Product (GDP) in conjunction with the increasing number of motor vehicles. The number of motor vehicles and GDP per capita had a simultaneous upward trend, with 11,302,545 units and RM 14,672 in 2001, rising to 25,044,872 units and RM 38,887 in 2015, respectively (WDI, 2017). This condition immediately enhances the buying power and spending capacity of people, enabling them to satisfy their demands more effectively and expediting the process of mobilising products and services. The road infrastructure bore the increased strain due to a lack of space, resulting in a significant traffic congestion issue in the city centre. This was caused by the maximum density of motor vehicles.

The rising number of motor vehicles has a direct impact on the quantity of gasoline that is used by an engine during the vehicle's propulsion. The Malaysia Energy Statistics Handbook study in 2017 documented a consistent rise in diesel consumption from 2,368 ktoe to 9,167 ktoe between 1980 and 2008. Similarly, petrol consumption in Malaysia grew from 10,843 ktoe to 12,804 ktoe between 2012 and 2015. In contrast, petrol had a significant increase in volume from 8,634 ktoe in 2009 to 12,804 ktoe in 2015, surpassing diesel. The fuel consumption in the transport sector witnessed a steady rise, growing from 16,395 ktoe in 2008 to 23,435 ktoe in 2015, as reported in the Energy Emission of Malaysia (2017) compared to the industrial sector. Consequently, the annual rise in motor vehicle numbers in Malaysia results in the direct emission of significant amounts of pollutants. Statistics released by the DOE prove that the production of pollutant emissions from motor vehicles is the highest and dominates compared to other sources, which are fixed sources represented by industry, power, and other sources from 1998 to 2014 (Table 1).

Table 1: Pollutant emissions ('000 metric tons) by type and source in Malaysia from 1998-2014

Year	Point Source		Motor Vehicles	Others ¹	Total
	Industry	Power Plant			
1998	706.5	-	2402.8	146.5	3255.8
1999	461.4	-	2563.1	114.2	3138.7
2000	566.7	-	2642.6	29.2	3238.5
2001	308.0	-	2561.7	8.6	2878.3
2002	702.1	-	2939.9	14.6	3656.6
2003	125.1	127.4	1649.1	163.2	2064.8
2004	372.4	359.0	1478.6	38.7	2248.7
2005	157.3	148.8	1538.0	23.1	1867.2
2006	158.7	150.7	1631.4	44.9	1985.7
2007	132.9	178.2	2172.8	49.4	2533.4
2008	148.7	221.4	1630.8	54.4	2055.3
2009	166.3	595.9	1762.8	60.3	2585.3
2010	113.9	619.2	1829.7	60.4	2623.2
2011	116.4	633.5	1905.6	90.6	2746.1

Year	Point Source		Motor Vehicles	Others ¹	Total
	Industry	Power Plant			
2012	86.4	693.2	2024.6	151.5	2955.8
2013	86.0	701.8	2025.6	142.4	2955.8
2014	101.9	742.9	2092.0	88.1	3024.9

Source: Department of Environment, Malaysia 2015

Note:

¹Data 1998-2002 refers to industrial waste incineration from 2003, including hotels, commercial centres, institutions, and night markets.

The overall emissions of pollutants from motor vehicles in 2017 were CO (1,996,256 metric tonnes), HC (449,895 metric tonnes), NO₂ (224,096 metric tonnes), SO₂ (14,514 metric tonnes), and PM₁₀ with 4,121 metric tonnes (DOE, 2015). Md. Zubir et al. (2017) conducted an estimation of NO_x inventory emissions for passenger cars using petrol and diesel fuel in Peninsular Malaysia from 2008 to 2014. They also made comparisons across the states. The research revealed a consistent rise in yearly NO_x emissions from gasoline-powered passenger cars, with an increase from 1,130 metric tonnes in 2008 to 1,670 metric tonnes in 2014. Nevertheless, there were several years that saw a decline in comparison to the preceding year. Specifically, in 2011, there was a reduction of 1,100 metric tonnes from the 1,320 metric tonnes recorded in 2010. Additionally, there was a dip from 1,700 metric tonnes in 2013 to 1,670 metric tonnes in 2014.

Private cars powered by diesel faced a similar trend, with the emission of NO_x increasing from 827 metric tonnes in 2008 to 1,370 metric tonnes in 2014. However, in 2010, the NO_x emissions from diesel passenger cars decreased compared to the previous year. Specifically, the emissions decreased from 858 metric tonnes in 2009 to 792 metric tonnes in 2010. In summary, the data demonstrates that petrol fuel is the primary source of NO_x emissions from passenger cars in Peninsular Malaysia between 2008 and 2014, surpassing diesel fuel. Kuala Lumpur had the greatest levels of NO_x emissions from passenger cars using petrol and diesel, with 7,320 metric tonnes and 11,400 metric tonnes respectively, between 2008 and 2014 (Md. Zubir et al., 2017).

Consequently, the air quality will worsen and pose a direct threat to human health. The air quality status is assessed using the Air Pollutant Index (API), which is calculated based on five criterion pollutants which is CO, NO₂, SO₂, PM₁₀ and O₃. The pollutant index measurements indicate the air quality classification of a region, as shown in Table 2.

Table 2: Air Pollutant Index (API) of Malaysia

API Index	Status
0 - 50	Good
51 - 100	Moderate
101 - 200	Unhealthy
201 - 300	Very Unhealthy
Above 300	Hazardous

Source: Environment of Department, Malaysia 2014

The API index in Kuala Lumpur, as detected at the Cheras station by the DOE, indicates that the air quality is now at an unhealthy status. This surpasses the index range of 100 to 200 that was recorded from 1998 to 2014. The API index, which measures the effect of transboundary haze caused by land and forest burning in Central Sumatra and West Kalimantan, Indonesia, reached a level of 390 in 2005, indicating the severity of the problem. The haze event on March 14, 2014, also registered an API of over 300 in two regions, including Port Klang and Banting, Selangor, indicating a hazardous level of air pollution. The identification of this scenario was attributed to the occurrence of arid and scorching seasons, as well as the burning of biomass (DOE, 2010-2014). From 1998 to 2014, the API index in Kuala Lumpur was consistently above the index of 100.

This research specifically examines the projected NOx emissions from three categories of officially registered motor vehicles in Kuala Lumpur between 2010 and 2014. These categories include petrol-powered automobiles and motorcycles, as well as diesel-powered cargo trucks. The estimation of emissions is based on fuel consumption data. The choice of the Kuala Lumpur research region was determined by the significant levels of fast urbanisation and building saturation, as well as the substantial number of motor vehicles that has been documented by the Road Transport Department, Malaysia (RTD) throughout the study period. Furthermore, the research only considers motor vehicles that are registered by the RTD Headquarters in Wangsa Maju district, Kuala Lumpur, as the major data source for determining the total number of private cars in the city.

MATERIALS AND METHODS

Study Area: Kuala Lumpur Metropolitan City

Kuala Lumpur (3.1080° N; 101.1440° E) is a sub-region within the Klang Valley. It is governed by Kuala Lumpur City Hall (KLCH) and includes the districts of Petaling, Gombak, Hulu Langat, the Federal Territory of Putrajaya, and Sepang. Kuala Lumpur covered an area of 243 square kilometres or 24,221 hectares and was divided into six key strategic zones based on urban land use planning: Sentul-Manjalara, Wangsa Maju-Maluri, Bandar Tun Razak-Sungai Besi, Damansara-

Penchala, and Kuala Lumpur City Centre (KLCH, 2004) (Figure 1). Notably, Kuala Lumpur's geography consists of a valley that extends from the eastern boundary of the Titiwangsa range to the western Malacca Strait, with other short mountains in the north and south.

The density and size of fully developed urban districts in Kuala Lumpur were concentrated in the city centre. The area increased significantly from 456.99 square km in 1989 to 1,663.23 square km in 2014, representing a rise of 46.67 per cent. The urbanisation and population density of Kuala Lumpur has seen a four-fold rise over a span of three decades, increasing from 51.81 per cent in 1989 to 60.22 per cent in 2001, and ultimately reaching 64.36 per cent in 2014. Regarding the proximity of urban density to the city centre, the data from 2014 indicates that the urban density in the city core exceeded 95 per cent. According to Boori et al. (2015), within a range of 1 to 3 km from the city centre, the city's area and population density have declined by up to 75 per cent. However, beyond a distance of 3 to 6 km, both the area and density have grown. Finally, at a distance of 50 km from the city centre, the area and density have fallen to 0 per cent.

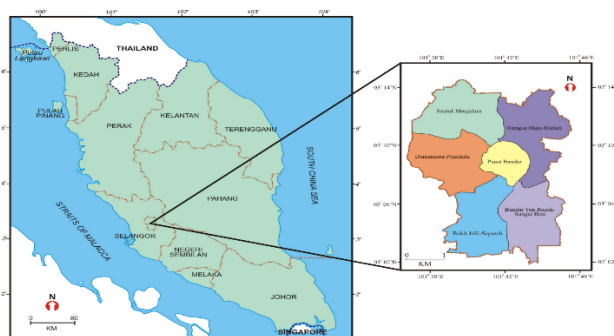


Figure 1: Map of Peninsular Malaysia and Kuala Lumpur
Source: Modified from RSGIS Laboratory, Faculty of Social Sciences and Humanities, UKM 2019

Data and Methods: Registered Motor Vehicle Data

The primary data utilised to estimate the emission of NO_x pollutants in Kuala Lumpur comprises the total count of registered motor vehicles, including private cars, motorcycles, and goods vehicles. These statistics are obtained from the RTD Headquarters in Wangsa Maju district, Kuala Lumpur, covering the period from 2010 to 2014.

Calculation of NO_x Emissions

The estimation of NO_x petrol emission is conducted using a fuel-based analysis for each vehicle class, using equation 1 (Kakouei et al., 2012). The calculation of

NO_x pollutant emission is then determined by utilising fuel, as described in equation 2 (Masjuki et al., 2004).

$$F_c = A_c \times V \times R_d \quad (1)$$

Where:

F_c = daily fuel consumption (diesel or petrol) (litres)

A_c = average fuel consumption for each class per kilometre (litres/ km).

V = number of vehicles by class

R_d = total vehicle travel per day (km).

The "R_d value" refers to the distance that is travelled by a vehicle, and is measured in kilometres. The data collected from a survey of 200 people in Kuala Lumpur indicates that the sample size is quite modest and has been calculated (Mohd Shafie, 2019). The acquired figure is diminutive because of its correlation with the mean distance covered by the inhabitants of Kuala Lumpur. The mean daily travel distance is 14 km.

$$T M_i = C F \times (F E_{1p} + F E_{2p} + F E_{3p} + \dots + F E_{np}) \quad (2)$$

Where:

T_{M_i} = pollutant emissions (year i) (kg)

E_S = energy consumption by fuel (year i)

C_F = conversion factor (default)

F_{E_{n/p}} = emissions per energy unit year per fuel n (kg/GJ)

*The value of the conversion factor (C_F) used in this study is 1 toe = 41.86 GJ (EIA, 2004; IEA, 2002; UN, 1991).

The E_S value in ktoe is derived by combining the total number of motor vehicles that are registered annually with the energy consumption data available from the Malaysia Energy Statistics Handbook report from 2010 to 2014 (Energy Commission, Malaysia, 2014). The emission factor for petrol and diesel fuel is determined based on the contaminants listed in Table 3.

Table 3: Emissions per unit of petrol and diesel energy (FE) (kg/GJ)

Fossil Fuel	Emission	
	CO	NO _x
Petrol	3.490	1.368
Diesel	0.102	0.284

Source: Masjuki et al., 2004

RESULTS AND DISCUSSION

Vehicle Statistics in Kuala Lumpur

According to RTD Headquarters in the Wangsa Maju area of Kuala Lumpur, the total number of registered motor vehicles between 2010 and 2014 was 1,748,367 units. These vehicles included private cars, motorcycles and goods vehicles. The upward trajectory continues annually with the number of private cars, which amounted to 3,161,406 units in 2010, showing consistent growth, reaching 3,812,124 units in 2014, reflecting a rise of 3.72 per cent.

Private vehicles, namely cars and motorcycles, accounted for the largest proportion of motor vehicle registrations from 2010 to 2014. There were 10,906,065 units of private cars, representing 62.37% of the total registrations, and 6,030,752 units of motorcycles, accounting for 34.49%. The heavy vehicle class, including goods vehicles, had a minimum registration of 498,837 units, accounting for 2.85 per cent of the overall registration of motor vehicles.

The registration data for motor vehicles, categorised by class and year, indicates a consistent upward trend from 2010 to 2014. Private cars dominated the vehicle category, with a total of 1,960,081 units in 2010, which rose to 2,382,526 units in 2014, reflecting a growth rate of 2.41%. Motorcycles saw a similar upward trajectory, with their numbers rising from 1,094,113 units to 1,317,578 units (1.27%) between 2010 and 2014. In 2010, the number of good vehicles was 97,611 units. By 2014, these numbers had increased to 102,364 units, with a percentage rise of 0.0003% and 0.02%, respectively. Hence, private vehicles, namely, cars and motorcycles, are the primary sources and factors responsible for urban air pollution in Kuala Lumpur (Figure 2).

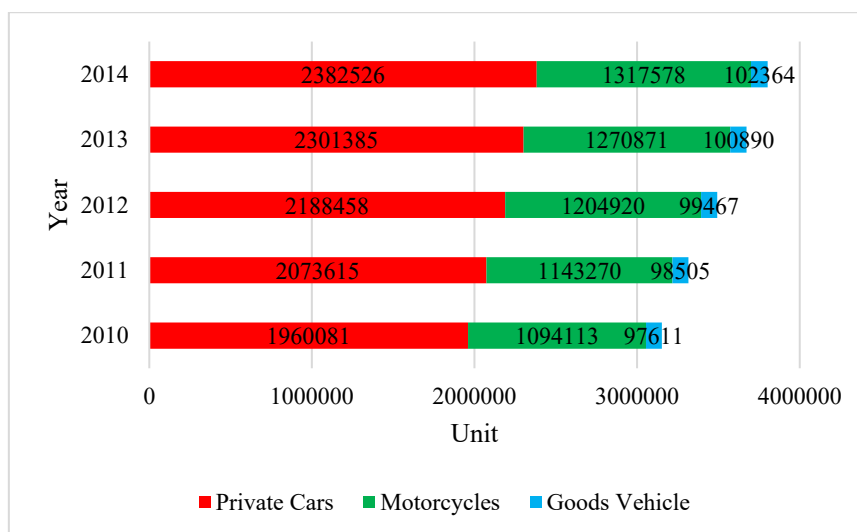


Figure 2: Motor vehicles by class in Kuala Lumpur (2010-2014)

NOx Emissions from Motor Vehicles

In 2010, private cars emitted 3,854 kg of NOx, which grew to 5,726 kg in 2014. This makes private cars the dominant vehicle type in Kuala Lumpur in terms of NOx emissions. Furthermore, motorcycles exhibited a rise in NOx emissions from 1,200 kg in 2010 to 1,750 kg in 2014. Heavy vehicles, such as goods vehicles, had a distinct pattern. In 2010, they emitted the lowest levels of NOx at 199 kg and 193 kg, respectively. However, by 2014, these emissions had climbed to 219 kg and 195 kg, as seen in Figure 3.

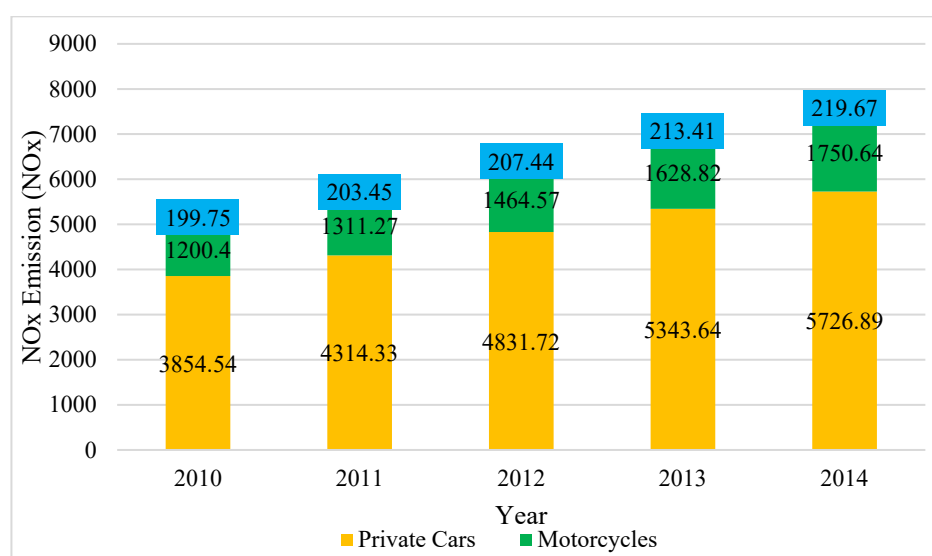


Figure 3: NOx emissions from motor vehicles in Kuala Lumpur (2010-2014)

The elevated levels of pollutants were identified due to the rise in the maximum vehicle count in Kuala Lumpur. The data from RTD regarding the number of motor vehicle registrations by vehicle class is a crucial factor contributing to the rise in emissions. This is evident in the land transport sector, which comprises three vehicle classes- private cars, motorcycles, and goods vehicles. Between 2010 and 2014, more than 17 million units were recorded (RTD, 2016). The primary driver behind the rise in motor vehicle numbers, particularly in urban areas, is the consistent expansion of household income, which directly impacts individuals' capacity to own a motor vehicle. Consequently, significant traffic congestion issues arise, particularly at road junctions and signalised crossings, as well as on roads that are flanked by high-rise structures. Thus, significant emission levels of pollution from motor vehicles and traffic were observed, particularly on weekdays in downtown Kuala Lumpur, in contrast to the weekends. Conspicuously, the position and topography of Kuala

Lumpur city centre, with its proximity to office spaces, industrial premises, residential areas, and major shopping centres in Malaysia, contribute to higher levels of pollutant emissions from traffic activities and motor vehicles. The morning NO_x concentration consistently exhibits a higher daily average compared to the evening, with a minimum average of 0.04 ppm and a maximum of 0.18 ppm, as shown by Sulaiman et al. (2010). Traffic is the primary source of pollution that causes the urban air quality to decline due to elevated levels of pollutants, particularly in the city centre. This is primarily due to the congested and dense traffic network, as well as the high concentration of urban space with various service activities.

IMPACT OF URBAN AIR ON ENVIRONMENT AND CLIMATE CHANGE

Researchers are currently investigating the potential impact of severe climate change on public health. This includes studying the direct consequences of warmer weather events and intense heat waves, the potential decrease in food security, the indirect effects on the prevalence of infectious diseases, and the impact of air pollution. The World Health Organisation (WHO) has affirmed that robust scientific evidence indicates that global warming would significantly impact fundamental human necessities, including food insecurity, air pollution, and lack of access to clean water (Jacob & Winner, 2009). The presence of greenhouse gases, such as carbon dioxide (CO₂) and nitrogen oxides (NO_x), in the air will have a direct or indirect impact on the weather patterns in the affected region due to climate change. Subsequently, urban regions are more likely to have a higher prevalence of health complaints, such as asthma (Zanolin et al., 2004). Each year in China, over 1 million individuals experience early deaths as a result of air pollution. This is compounded by the anticipated rise in severe events and unfavourable weather conditions due to climate change (Schellnhuber, 2019).

Hence, the issue of urban air pollution that is caused by motor vehicles necessitates the attention of stakeholders' and government agencies in order to regulate the emission of pollutants and greenhouse gases, thereby mitigating the consequences of climate change. The influence of greenhouse gas emissions on human health manifests through several means, such as elevated ozone levels, alterations in allergen distribution, and shifts in infectious disease vectors. Consequently, the emission of air pollutants in the city not only affects the air quality but also significantly impacts the health of individuals, especially those with respiratory and other ailments (D'Amato et al., 2010).

STRATEGIES TO TACKLE MOTOR VEHICLES EMISSIONS IN MALAYSIA

To tackle this significant environmental concern, the Malaysian government must enforce more stringent emission regulations for newly manufactured automobiles, to diminish the release of NO_x. The standards should align with internationally recognised best practices and include the most recent technology breakthroughs in the automobile sector. The government needs to promote the use of low-emission vehicles, such as electric and hybrid automobiles, by offering tax incentives, subsidies, and other financial inducements. This will not only decrease NO_x emissions but also encourage the use of cleaner and more sustainable methods of transportation. Correspondingly, the authorities have to enforce a vehicle inspection and maintenance initiative to guarantee that current automobiles are in optimal operational state and adhering to emission regulations. This will aid in mitigating the emission of excessive NO_x into the environment. The government must provide funds towards the advancement of alternative fuels, such as compressed natural gas (CNG) and liquefied petroleum gas (LPG), since they generate lower levels of NO_x emissions compared to conventional petrol and diesel fuels. This will provide customers with a wider range of options and promote the adoption of more environmentally friendly technology.

The government should actively and proactively promote the use of public transit, such as buses and trains, in order to reduce the quantity of private automobiles on the road. This would decrease NO_x emissions and mitigate traffic congestion, which consequently enhance the air quality in metropolitan areas. Malaysia also needs to enforce a congestion fee or road pricing scheme in order to deter the use of private vehicles during periods of high traffic volume. By promoting the use of public transportation or carpooling, the outcome will be a reduction in NO_x emissions. The government should also allocate resources towards the advancement of eco-friendly infrastructures, such as green roofs and walls, with the purpose of mitigating NO_x emissions and enhancing the air quality in metropolitan regions. Implementing this measure would decrease the emission of NO_x, and will also provide other ecological and societal advantages such as mitigating the urban heat island phenomenon and enhancing the overall well-being of urban residents.

Furthermore, Malaysia must actively engage in cooperation with adjacent nations to formulate a regional approach that is aimed at mitigating NO_x emissions originating from motor vehicles. This measure will effectively tackle the problem of transboundary air pollution and enhance the overall air quality in the area. Regular air quality monitoring and evaluation should be conducted by the government to track NO_x emissions and pinpoint locations for intervention. This would empower the authorities to implement precise and efficient strategies to mitigate NO_x emissions and enhance air quality. The government need to

engage many stakeholders, including the automobile sector, consumers, and environmental organisations, in the formulation and execution of programmes that are aimed at reducing NO_x emissions. This will guarantee that the strategies are feasible, efficient, and agreeable to all parties concerned.

CONCLUSION

The cause of air pollution in Kuala Lumpur was attributed to a significant surge in the number of registered motor vehicles, reaching a total of 1,748,367 units including private cars, motorcycles and good vehicles between 2010 and 2014. The emission of NO_x emissions from private cars was the primary contributor, reaching a peak of 3,854 kg in 2010 and rising to 5,726 kg in 2014. Therefore, it is imperative for the government, interest groups, and urban community to establish and implement a range of policies, measures, and control strategies to effectively address, manage, and mitigate the adverse effects of air pollution. This will help to ensure a more sustainable and safer environment for the local community. These are suggestions and enhancements for managing and mitigating air pollution in Kuala Lumpur. The focus is on fostering collaboration and synergy between the government, the economic sector, and the community to effectively regulate and minimise the impact of air pollution. Regulating the release of harmful gases from automobiles and greenhouse gases will have a positive influence on the well-being of the city's residents, and to a certain degree aid in mitigating environmental pollution and the global effects of climate change.

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CONFLICTS OF INTERESTS

The authors declared no conflict of interest.

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SATISFACTION OF INTERNATIONAL AND DOMESTIC TOURISTS IN MALAYSIA’S OLDEST NATIONAL PARK: TAMAN NEGARA PAHANG

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Abstract

This study evaluates the satisfaction of both international and domestic tourists within Malaysia’s oldest national park, Taman Negara Pahang, employing a quantitative methodology through a survey comprising eight distinct dimensions: amenities, service quality, natural allure, accommodation, food services, transport, recreational offerings, and expense. The researchers garnered a sample of 387 respondents via convenience sampling and analysed using frequency distribution and independent sample t-tests. Findings indicate a general satisfaction among tourists with their park visitation experience. However, the researchers identified that service quality, transport, and cost require substantial enhancements to elevate the tourist experience. While both tourist groups displayed similar satisfaction levels, international tourists reported marginally higher satisfaction across most dimensions except for recreational activities. Varying motivations, influenced by geographical origins, attribute this discrepancy to the criteria for satisfaction evaluation. The study underscores the importance of continual tourism demand for sustaining national park conservation efforts through revenue generation. The researchers anticipate that the insights derived from this research will guide enhancements in the performance of tourism products and services through diversified feedback. Marketing strategies tailored to cater to the distinct preferences of domestic and international tourists are recommended, especially for Taman Negara Pahang, which enjoys popularity among both visitor segments.

Keywords: Tourist Satisfaction, International tourists and domestic tourists, National Park

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INTRODUCTION

Many income sources for national park management were tourism-related, for example, recreation activity fees, accommodation charges, entrance fees, merchandise sales, equipment rental, etc. (Eagles, 2014). National Park Service of the United States reported that visitor spending contributes to park management and supports jobs, labour income, value-added and economic output in local gateway economies surrounding the national parks (Thomas et al., 2022). Likewise, tourism contributed significantly to the gateway communities at South Luangwa National Park, Zambia, by providing income and business opportunities (Chidakel et al., 2021). Undoubtedly, economic benefits continued to expand with tourism or ecotourism development in national parks, creating jobs and business sales for local communities (Chidakel et al., 2021; Thomas et al., 2022).

Hence, it is crucial to create continuous tourism demand that sustains tourism revenues as one of the critical financial resources to support park operations and conservation and the livelihood of the local communities. Satisfied tourists may revisit or recommend the tourist destinations to others (Zeng & Li, 2021; Seebunruang et al., 2022; Otsuka et al., 2023), which would generate sustainable income for the national parks. Although substantial research has been conducted on biodiversity and ecosystems, ecotourism and sustainable tourism, and other tourism-related research, much less has been done to assess the effect of different geographical locations on tourists' satisfaction with national parks in Malaysia. As a result, the research was conducted to measure the tourist satisfaction level and whether there is any difference in satisfaction between international and domestic tourists who visit Taman Negara Pahang. Eventually, these findings will help governments and tourism operators ensure that the park's performance, tourism products and services meet all international and domestic tourist's expectations. These satisfied tourists would create demand and help sustain revenue for the national park conservation.

LITERATURE REVIEW

Satisfaction results from the interaction between expectation and experience (Kozak, 2001). In tourism, tourist satisfaction compares a tourist's pre-travel expectations and post-travel experience. Eagles and McCool (2000) indicated that tourist satisfaction with a destination was influenced by the interaction between tourists' overall experience with the tourism services and products and their expectations. They are satisfied when their experience exceeds expectations and vice versa. According to Arabatzis and Grigoroudis (2010) and Lee et al. (2022), tourists' satisfaction with Dadia-Lefkimi-Souflion National Park and Taman Negara National Park was affected by personnel, natural characteristics, recreation facilities, infrastructure, and information communication. In contrast, Sangpikul (2018) discovered that attractions, people, valued destinations,

services and facilities, safety, and cleanliness affected tourist satisfaction at the beach. Oviedo-García et al. (2019) found that informational services, accessibility, directional signs, information, food, and facilities in protected areas were equally important.

In addition to the tourism products and services, tourist satisfaction was also affected by other factors, such as tourism marketing or information sources (Carlos Castro et al., 2017; Nurbasari et al., 2022; Shahrivar, 2012), tourist profiles or demographics (Carlos Castro et al., 2017; Shahrivar, 2012), travel behaviour (Shahrivar, 2012) and cultural characteristics (Park et al., 2015; Shahrivar, 2012). Based on tourist demographics, previous studies reported that tourists of different nationalities had different behaviours in activities (Farahani & Mohamed, 2013; Park et al., 2015), interaction, destination knowledge, commercial transaction or expenditure, time management, respectfulness, facilities (Farahani & Mohamed, 2013), motivation (Barkhordari et al., 2014; Park et al., 2015), overall satisfaction and post-trip behaviour (Park et al., 2015).

Tourist satisfaction may vary depending on the origin of the tourists. Choi and Chu (2000) concluded that Asian tourists emphasised the value factor while Western tourists valued the room quality factor. Similarly, Bowie and Chang (2005) discovered that different cultural backgrounds may have caused Asian tourists to be concerned with more personalised and customer-oriented service in a mixed international guided tour package than other international tourists. Kozak (2001) found that German tourists were likely to have higher expectations than British tourists with destination attributes in Mallorca and Turkey. Later, Campo and Garau (2008) discovered that satisfaction levels differ with destination attributes and hospitality among tourists visiting the Balearic Islands, Spain, due to the different nationalities.

Other research also discovered that satisfaction levels might differ between international and domestic tourists. McDowall and Ma (2010) found that international and domestic Thai tourists differed in their demographic characteristics, evaluation of Bangkok's performance, satisfaction, and destination loyalty. Years later, Bui and Le (2016) noted that domestic tourists were more satisfied than international tourists with service attributes at Ha Long Bay, Vietnam, as domestic tourists were likely to have lower expectations. As research continues to evolve, it becomes clear that understanding tourist satisfaction requires a multifaceted approach that considers the diversity of tourist expectations, experiences, and cultural contexts. Given these, in the context of a national park in Malaysia, the following hypotheses are proposed:

H1: There is a significant difference in tourist satisfaction with destination attributes between domestic and international tourists.

H2: There is a significant difference in overall tourist satisfaction between domestic and international tourists.

METHODOLOGY

Study Area

Taman Negara is Malaysia's largest protected area and the oldest national park (UNESCO World Heritage Centre [WHC], 2015). It covers the borders of 3 states and forms Taman Negara Pahang, Taman Negara Kelantan, and Taman Negara Terengganu. Taman Negara Pahang is also known as Taman Negara Kuala Tahan due to its location in Kuala Tahan, Jerantut district. This park offers tourists better access to tourism facilities and more recreational activities. It houses various rare and endangered species of flora and fauna in the country. It is a famous travel destination among domestic and international tourists for its biological and geological attractions. Gunung Tahan was the highlight and was found to be the most crucial attraction in the park, in addition to adventure activities (Aziz et al., 2018). Other iconic features are the canopy walkway, Orang Asli settlements, where tourists are exposed to the aboriginal culture and lifestyle, rapid shooting, jungle trekking, cave exploration, wildlife observation, and birdwatching as the latest attraction in the national park.

Method and Analysis

This descriptive research employed a four-page questionnaire to collect the socio-demographic profiles, travel characteristics, and tourist satisfaction attributes. The first part includes socio-demographic information, the second section focuses on various aspects of the tourists' travel experience, and the following section assesses tourist satisfaction. Researchers adapted the attributes for measuring tourist satisfaction from the studies of Arabatzis and Grigoroudis (2010) and Sukiman et al. (2013).

A 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) with "0" for not applicable is employed. The "0" selection is available to tourists who did not stay and dine there. Data collection was conducted within the park and the opposite village, Kampung Kuala Tahan, as these were the areas where tourists carried out most of the activities. Respondents were selected through convenience sampling at the bus stop, the park's main entrance, eatery outlets, and other rest areas. Descriptive analysis (frequency and mean) was used to analyse demographic data and respondents' satisfaction. An inferential analysis (independent sample t-test) was also deployed to test the hypothesis.

Forty responses were selected as pilot study samples before the data collection phase to assess the reliability of the research instrument. Overall, Cronbach's alphas for all attributes range from 0.709 to 0.905, which is considered adequate for the internal consistency of the research instrument

(Nunnally & Bernstein, 1994). The reliability of .660 resulted in overall tourist satisfaction because of the item "I shall revisit this park." The return intention remained as it seems to be a critical element in measuring overall tourist satisfaction in some past research (Alegre & Cladera, 2009; Chi & Qu, 2008). Lastly, only eight items remained to calculate the cost. "Long-boat service" was removed because there may be an overlap between items. A total of 387 responses were collected from the fieldwork.

RESULTS AND DISCUSSION

Social-Demographic Characteristics and Travel Purpose

Cross-tabulations were performed to show the tourist socio-demographic profile as listed in Table 1. Almost two-thirds of respondents were international tourists (64.6%), most were female (54.3%), and the majority were between 19-34 years old (71.6%). These active and energetic young people favoured the setting and natural features of Taman Negara Pahang. Perhaps it was perceived as a wilderness area more suitable for them to carry out challenging outdoor activities. However, the park also offers recreational activities like fishing, picnics, and swimming, which are ideal for all age groups. It can be observed that there were still a few elderly foreign tourists (1.6%) visiting the park for birdwatching.

Almost one-third of the respondents earned less than RM10,001 yearly. This demographic diversity suggests that visiting Taman Negara Pahang is affordable across income groups, aided by a low entrance permit fee of RM1 per person. Samdin (2008) indicated that raising this fee could sustain the park better. At the same time, tourists can choose to stay at a hostel, hotel room, guest house, or chalet. Besides, the national park is accessible by private or public transport. Thus, a trip to the national park can be economical or luxurious depending on one's travel budget. A strong economy and favourable exchange rates contribute to higher incomes among a quarter of international respondents.

The tourists visited the national park mainly because of the wildlife or flora and fauna (32.3%), scenery or landscape (21.7%), and spending time with friends and family (21.2%). Wildlife and the natural beauty of the national park were the focus of tourist visits. In addition, natural-based tourism destinations that offer a peaceful retreat from the hustle and bustle of the city are the best choice for tourists to spend quality time with family and friends. According to Barkhordari et al. (2014), domestic tourists were more friendly, active, and intended to relieve stress than international tourists when travelling to Taman Negara. However, the findings of the current study were slightly varied. The result shows that the park's natural beauty attracted international tourists, while domestic tourists wanted to spend their holidays with family and friends. Although domestic tourists still showed the travel purpose of socialising or perhaps relieving stress, international tourists would be more active in engaging

with nature this time. The allure of destination attributes may appeal more to international tourists, influenced by travel distance, over-social interaction, and family togetherness. Hence, the purpose of travel may be different for both tourist groups.

Table 1: Demographic profile and travel purpose of domestic and international tourists

Variables	Nationality				Total (n=387) 100%	
	Domestic (n=137) 35.4%		International (n=250) 64.6%			
Gender						
Male	46	11.9	131	33.9	177	45.7
Female	91	23.5	119	30.7	210	54.3
Age						
18 and below	15	3.9	4	1.0	19	4.9
19-34	89	23.0	188	48.6	277	71.6
35-60	33	8.5	52	13.4	85	22.0
Above 60	0	0.0	6	1.6	6	1.6
Annual income (RM)						
Below 10,001	58	15	64	16.5	122	31.6
10,001 – 30,000	23	5.9	13	3.4	36	9.3
30,001 – 60,000	36	9.3	33	8.5	69	17.8
60,001 – 100,000	15	3.9	46	11.9	61	15.8
Above 100,000	5	1.3	94	24.3	99	25.6
Purpose						
Workshop/seminar/ training	11	2.8	0	0	11	2.8
Spend time with friends/family	50	12.9	32	8.3	82	21.2
Education/research and monitoring	10	2.6	1	0.3	11	2.8
Teambuilding/camping/ campaign	28	7.2	10	2.6	38	9.8
Scenery / Landscape	21	5.4	63	16.3	84	21.7
Wildlife/flora & fauna	14	3.6	111	28.7	125	32.3
Experience the culture of Indigenous people	3	0.8	15	3.9	18	4.7
Bird watching	0	0	6	1.2	6	1.2
Others	0	0	12	3.1	12	3.1

Tourists' satisfaction with tourism attributes

The descriptive analysis of tourist satisfaction is shown in Table 2. The natural attractions were the most satisfactory tourism product (M=5.60); relatively, the cost had the lowest mean (M=4.21) because the price of tourism products and services was considered high. Besides transportation (M=4.48) and service and

hospitality (M=4.63), the performance of other tourism products was above average. However, the overall satisfaction was still satisfactory (M=5.66). The park performance was still above average based on the results shown by the park facilities, natural attractions, and recreational activities. Tourists may not have high expectations for their visit, as maintaining a wilderness area is difficult.

Table 2: Descriptive analysis of tourist satisfaction

Dimensions	Mean	SD	Skewness	Kurtosis
Park facilities	5.11	0.980	-0.376	-0.111
Natural attractions	5.60	1.128	-0.781	0.514
Accommodation	5.15	1.650	-1.578	2.618
Food	5.32	1.464	-1.431	2.787
Transportation	4.48	1.587	-0.322	-0.850
Services and hospitality	4.63	1.322	-0.520	0.125
Recreational activities	5.22	1.452	-1.361	2.562
Cost	4.21	1.465	-0.920	1.320
Overall satisfaction	5.66	1.092	-1.203	2.109

Cheng et al. (2022) include price reasonableness as one of the factors for tourist' satisfaction. According to Abdul Latip et al. (2020), park management plays a vital role in planning and implementing ecosystem protection and conservation strategies, which leads to tourist satisfaction. Abdul Latip et al. (2021) also found similar findings. Hence, the park manager and the Department of Wildlife and National Parks (DWNP) have managed Taman Negara Pahang well, meeting the expectations of tourists. Nevertheless, the park manager needs to ensure that directional and information signages function well and that the pathway is safe to use so that tourists can carry out activities in the park easily without a guide. Simultaneously, this will ensure their safety. Besides, the park manager also needs to limit tourist numbers. This measure may improve the quality of the tourist experience and reduce environmental damage. Most importantly, immediate actions are essential to address complaints or any feedback from tourists.

The national park houses various rare and endangered species of flora and fauna. As the first and oldest protected area in the country, it was secured by the Taman Negara Pahang management plan besides the Taman Negara Master Plan, National Ecotourism Plans (NEPs), and Wildlife Conservation Act 2010 [Act 716] and guidelines provided by NGOs such as United Nations Development Programme (UNDP) and Global Environment Facility (GEF). However, tourism activities in the park may have affected the natural ecology and habitats. Tourists claimed that chances of observing wild animals dropped. Therefore, legislation and enforcement come into play in enhancing the effectiveness of the plans.

The recreational activities seemed quite exciting and varied but lacked educational value. There was a lack of information on flora and fauna species and directional signages, which caused the tourists to have difficulties understanding flora and fauna better when they did not hire any nature guide during their visits to the park. There were many accommodations and dining options in Kampung Kuala Tahan. Tourists can choose from the most economical to the most luxurious accommodation, for example, campsite, dormitory, guest house, hotel room, and chalet. They can try local, Asian, or Western cuisine based on their budget and preference. Perhaps tourists did not expect it to be so easy to access such facilities in a remote area like Taman Negara Pahang. Hence, they were pleased with the food and accommodation offered around the park area.

Nevertheless, transportation, service and hospitality, and tourism products and services charges showed areas for improvement. There was no official source for the public bus schedule. While most domestic tourists travelled by personal transport, international tourists faced difficulties accessing public transportation, except for those who took a coach provided by the travel agency. In addition, bus schedules were subject to last-minute changes based on passenger numbers. Apart from fixing the bus schedule, there is a need for air conditioning installation to cope with the hot weather in the country and consistent maintenance to improve the bus condition. Jerantut District and Land Office, the local authority, are urged to monitor and enhance the quality of facilities provided to address these issues.

Most local tourism operators did not have relevant qualifications, and others were poorly educated. They needed improvements in communication, hospitality, and language skills. In addition, there was a shortage of well-trained workers in service and hospitality. Relatively, the performance of nature guides and park rangers remained satisfactory. The result is consistent with the other study by Teo et al. (2010), though nature guides and park rangers received high compliments for their professional service. Similarly, Bhuiyan et al. (2021) also highlighted the importance of having skilled workers at the destination.

The Ministry of Tourism, Arts and Culture Malaysia (MOTAC) offers tourism-related courses such as tourist guide, mesra Malaysia, and Eco-host Malaysia for front-liners and other tourism operators to improve product knowledge, customer service, and communication skills. The ministry must identify the requirements for all front-line workers and mandate that they complete specific courses annually to monitor their performance. To keep the license valid, the existing nature guides must pass a tour guide course and attend two yearly tourism-related courses. Therefore, service quality is assured.

Many respondents did not hire nature guides due to perceived high fees. Nevertheless, tour guiding is vital in facilitating conservation and environmental education for ecotourism (Yamada, 2011). According to Manuel des Guides

(Ormsby & Mannle, 2006), nature guides play a crucial role in ecotourism by providing conservation education, ensuring environmental protection, guiding safely through wilderness areas, and maintaining visitor adherence to park rules. Most importantly, they need to ensure the safety of tourists in a wilderness area. Despite the cost, their professional service is highly valued.

Overall, tourist satisfaction in Taman Negara Pahang was above average. Respondents were satisfied with the journey and would recommend the place to others. However, most said they would not revisit the park due to the travel distance and time. Improving the maintenance of facilities and service quality among local employees could enhance the overall tourist experience and perception, potentially justifying current charges through added value in travel products and services.

International and domestic tourists' satisfaction

The data follow a normal distribution. The skewness is between -0.322 and -1.578, and the kurtosis is between -0.850 and 2.787. Therefore, independent sample t-tests were conducted to determine if there was a significant difference in satisfaction between domestic and international tourists visiting Taman Negara Pahang. The international tourists had higher satisfaction than domestic tourists except for recreational activities, as shown in Table 3. The result indicates they may not have high expectations of the tourist products and services. The independent sample t-tests reveal significant differences in satisfaction levels between the domestic and international tourists with regards to the park attributes ($t=-2.55$, $df=385$, $p<.05$), natural attractions ($t=-2.03$, $df=385$, $p<.05$), accommodation ($t=-6.95$, $df=385$, $p<.05$), food ($t=-5.13$, $df=385$, $p<.05$), transportation ($t=-6.07$, $df=385$, $p<.05$) and cost ($t=-4.18$, $df=385$, $p<.05$). But there are no significant differences between the two groups of tourists in service and hospitality ($t=-1.73$, $df=385$, $p>.05$) and recreational activities ($t=0.96$, $df=385$, $p>.05$). In general, there is no significant difference between nationalities in overall satisfaction.

The findings do not support the comparative analysis of international and domestic tourists who travelled to Ha Long Bay, Vietnam (Bui & Le, 2016). Generally, international tourists who visited Taman Negara Pahang had lower expectations and thus higher satisfaction levels with the tourist products and services than domestic tourists, except for recreational activities. According to Stone (2014), Western tourists love nature-based tourism and enjoy adventurous activities. Similarly, Matolo et al. (2022) also highlighted that international tourists left the destination feeling satisfied due to good services, reasonable prices, and a good image of the destination. Besides, this contradictory result may be that Malaysians are not adventurous and expect a more comfortable visit.

Table 3: Independent Sample T-Test on Tourist Satisfaction Attributes

Attribute	Nationality	N	Mean	Std. Deviation	t	Df	Sig. (2-tailed)
Park	Domestic	137	4.94	1.07	-2.55	385	.01
	International	250	5.20	0.91			
Natural attractions	Domestic	137	5.44	1.25	-2.03	385	.04
	International	250	5.69	1.05			
Accommodation	Domestic	137	4.40	1.98	-6.95	385	.00
	International	250	5.55	1.27			
Food	Domestic	137	4.82	1.70	-5.13	385	.00
	International	250	5.60	1.24			
Transportation	Domestic	137	3.85	1.32	-6.07	385	.00
	International	250	4.83	1.61			
Hospitality	Domestic	137	4.48	1.31	-1.73	385	.08
	International	250	4.72	1.33			
Recreational activities	Domestic	137	5.31	1.18	0.96	385	.34
	International	250	5.17	1.58			
Cost	Domestic	137	3.79	1.79	-4.18	385	.00
	International	250	4.43	1.20			
Overall satisfaction	Domestic	137	5.55	1.18	-1.36	385	.17
	International	250	5.71	1.01			

In particular tourism attributes, there are significant differences and similarities in satisfaction levels between domestic and international tourists. In contrast to an earlier finding (Campo & Garau, 2008), the result shows significant differences in tourist satisfaction with the park, natural attractions, accommodation, food, transportation and cost but not service and hospitality, and recreational activities. According to Saikia (2020), both categories of tourists favour cleanliness, improved amenities and safety and security as essential factors in ensuring overall tourist satisfaction. Regarding cost, Kang et al. (2022) discovered that local and international tourists have divergent preferences regarding their willingness to pay.

Taman Negara Pahang is a protected area with limited development. Hence, the existing recreation activities may be sufficient to meet the satisfaction of tourists, especially the highest peak (Gunung Tahan) in Peninsular Malaysia, one of the most extended canopy walks in the world, and a visit to the Orang Asli settlement, which is unique. Aziz et al. (2018) concluded that the existing adventure activities are essential attractions for young adults visiting the park. However, both groups of tourists responded that the service and hospitality of tourism employees required improvement. Possibly, due to the tourists' unfamiliarity with the area, there was an expectation for better service and hospitality in a remote and wilderness setting like a national park to enhance the travel experience.

On the other hand, there are significant differences in satisfaction levels, where international tourists were more satisfied than domestic tourists with the park, natural attractions, accommodation, transportation, and food. A possible explanation is that international tourists visit the park mainly because of its natural scenery and wildlife. In contrast, domestic tourists wanted to spend time with family and friends. Thus, international tourists could be more adventurous, willing to try new things, may not expect high amenities and facilities, and be ready to face challenges at natural-based destinations. In comparison, domestic tourists may seek comfort while spending time with family and friends. As a result, the purpose of travel may have influenced the focus on assessing their satisfaction level.

International tourists accounted for nearly two-thirds of the respondents, and more than 50% were European tourists. The higher exchange rate could have caused different perceptions of the costs of tourism products and services. Thus, international tourists perceived the cost to be cheaper than domestic tourists. Lastly, the two groups of tourists show no significant difference in overall satisfaction. Perhaps the overall performance of the national park would have met their expectation from different perspectives.

CONCLUSION

Tourist satisfaction is one of the indicators used to measure tourism sustainability. Previous studies found that tourist satisfaction was affected by the performance of tourism attributes and other factors such as tourist demographics, travel behaviour, cultural characteristics, tourism marketing, etc. This study attempted to assess tourist satisfaction with the performance and tourism development of Taman Negara Pahang and explore whether there is any difference in satisfaction between domestic and international tourists. The research findings show that tourists were satisfied visiting the national park. The ecological and biological resources were well conserved, besides the recreation activities, accommodation, and food businesses. While there were some comments about crowd management and park facilities, remarks from tourists regarding environmental issues were notably fewer.

However, the state tourism office and the local authority must pay close attention to the problems arising from the service and hospitality, transport arrangements, and costs. Together with the park manager, they become the key stakeholders who can contribute in different ways to sustainable tourism development in the national park. The park manager plays a role in conserving wildlife and its habitat; the state tourism office helps develop skilful and knowledgeable human capital in tourism, while local authorities provide guidelines in business setup and operations. Taman Negara Pahang and Kampung Kuala Tahan complement each other. Cooperation between key stakeholders is

essential in planning a more comprehensive tourism development that covers the national park and the opposite village, Kampung Kuala Tahan.

Significant differences and similarities exist in satisfaction with tourism attributes between domestic and international tourists. Generally, international tourists had lower expectations of tourism products and services than domestic tourists. International tourists travel to Taman Negara Pahang for its natural landscape and wildlife. They are more adventurous, have lower expectations, and are ready to face challenges when travelling to natural destinations. Instead, domestic tourists travelled to the park to spend time with family and friends. Therefore, they expected a well-equipped and comfortable tourist destination that would create a better travel experience. Travel motivations vary by location, so destination marketers can design promotional messages to achieve a more effective marketing strategy. Understanding these differences in tourist satisfaction based on nationality can help stakeholders identify strengths and weaknesses of the destination and improve services to better cater to tourists, regardless of their origin.

The present study has several limitations and suggestions for future research. First, convenience sampling employed in this study may weaken the generalisation of the results. Second, the researcher should avoid selecting day-trippers respondents. They may be unable to answer such questions accurately as they may not experience the accommodation and food the tourism operators provide. Further study can be developed based on regions or countries to understand better the differences in expectations that may exist due to the influence of national cultures among tourists. Besides, each of the critical stakeholders of Taman Negara Pahang plays an essential role in managing tourism activities and park conservation. Hence, more studies are necessary to assess stakeholders' involvement in park tourism planning and whether their interactions affect sustainable tourism development, eventually resulting in tourist satisfaction.

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CONCEPTUALIZATION OF TURNER'S VULNERABILITY – MOUNTAINOUS GEOGRAPHICAL TOURISM SENSITIVITY TO NATURAL DISASTER

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Abstract

While interest in studying the impact of natural disasters on tourism is growing, a noticeable gap exists in exploring destination-level tourism sensitivity, particularly in geographical contexts. This study addresses this gap by using the 2015 Ranau earthquake as a case study to assess the sensitivity of mountainous geographical tourism to natural disasters, employing the Turner Vulnerability Framework. In-depth interviews with Ranau's tourism entrepreneurs and operators, selected through purposive sampling, provide insights, and thematic analysis is conducted to understand qualitative responses comprehensively. The findings reveal that mountain tourism in Ranau showed significant sensitivity to the 2015 earthquake, primarily attributed to the Source element, including tourism products, business size, development, and perceived disaster impact. In contrast, the Power elements exhibited relatively lower sensitivity. These findings underscore the importance of tailoring geographical-based adaptations within tourism systems in response to natural disasters and emphasize integrating natural disaster management into tourism development for long-term sustainability.

Keywords: Tourism Sensitivity, Mountain-Geographical, Natural Disasters, Turner Sustainability Analysis

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INTRODUCTION

Tourism, a rapidly expanding industry of significant economic importance, plays a crucial role in currency exchange activities, as the World Tourism Organization (WTO) noted in 2013. It significantly contributes to social and economic development, particularly in communities reliant on tourism for livelihoods (Guo et al., 2018). However, tourism is highly vulnerable to natural disasters (Alvarez et al., 2022). Dahles and Susilowati (2015) argue that natural disasters pose substantial challenges for local tourism in developing countries, as core attractions are often provided by small and medium-sized businesses (Estevao & Costa, 2020). Consequently, natural disaster management is integral to sustainable tourism development (Orchiston, 2012). Tourism involves proactive measures to mitigate destruction and facilitate restoration (Faulkner, 2001). Despite this integration, there is limited discussion on the susceptibility of tourism destinations in mountainous areas to natural disasters. Each geographical area may exhibit unique sensitivities (Gong & Hassink, 2020). Understanding these sensitivities is essential for effective risk management, minimizing impacts, and promoting resilience and sustainability (Li & Wang, 2021). This paper aims to assess the sensitivity of mountainous tourism destinations to natural disasters. The recurring nature of these shocks highlights the need to address chronic sources of vulnerability, which make destinations susceptible to ongoing external shocks (Alvarez et al., 2022).

LITERATURE REVIEW

Vulnerability to Natural Disasters

Various sources comprehensively define vulnerability to natural disasters. The United Nations Office for Disaster Risk Reduction (2019) attributes vulnerability to societal and economic conditions impacting preparedness and responses. Sharma and Ravindranath (2019) describe it as a system's susceptibility to adverse effects from external shocks, tied to the characteristics of a social-ecological system or community determining their risk management abilities. Kaspersen et al. (2012) view vulnerability as the susceptibility of an exposed unit to hazards due to exposure to shocks, encompassing the capacity to respond, recover, or adapt. Birkmann et al. (2022) defines it as systemic societal vulnerability, focusing on society or its sub-systems (e.g., demographic groups or infrastructures), independent of specific climate-related hazards. The term "systemic" highlights inherent obstacles in dealing with and adapting to climate change and natural hazards. These definitions highlight that vulnerability is specific to certain system groups, involving internal and external factors. This perspective facilitates the exploration of location-specific factors and individual

circumstances contributing to varying levels of vulnerability and resilience (Rigg et al., 2008).

Tourism Sensitivity Analysis

Sensitivity, a crucial aspect of vulnerability, mediates risk exposure and resilience (Adger, 2006). Clark et al. (2000) define sensitivity as the extent to which a group or individual is affected by stressors, considering it a system-level attribute influenced by external factors. Community hazard perception is shaped by risk dissemination through social channels such as individuals, groups, media, and institutions (Kasperson et al., 2012). Understanding actors' narratives is essential for comprehending tourism vulnerability, particularly concerning natural disasters. Matusin et al. (2019) developed the Vulnerability Framework for Sustainable Tourism Development (VFSTD) to assess vulnerability in tourism destinations. VFSTD integrates two key components: Power, representing social capacity (Howitt, 2001), and Source, reflecting coping and adaptation abilities (Birkmann et al., 2022). The creation of tourism products is significantly influenced by destination image (Dredge & Jenkins, 2003). VFSTD highlights critical Source indicators such as Business Size, Tourism Products, Duration of Operation, and Tourism Disaster Management (Matusin et al., 2019). Natural disasters significantly impact tourists' perceptions of safety (Ritchie, 2008). Adjustments to reduce vulnerability are crucial for sustainable tourism (Baker & Coulter, 2007), underscoring the pivotal role of effective natural disaster management.

In VFSTD, the Power element focuses on social capital, encompassing bonding, bridging, and linking social capital. As defined by Coleman (1988), social capital refers to the benefits derived from relationships within social networks, which are invaluable during crises (Portes, 2000). In tourism, social capital aids destinations in navigating catastrophic situations (Hwang & Stewart, 2017), providing a theoretical basis for adaptation mechanisms and resilience (Guo et al., 2018). Social capital is fundamental for sustainable tourism development, facilitating collaboration and enhancing governance efficiency (Nunkoo, 2017). Post-disaster recovery relies on bonding (close internal relationships), bridging (external relationships among diverse individuals), and linking (trust-based vertical networks) social capital (Matusin et al., 2019). Matusin et al. (2020) highlighted substantial tourism exposure to natural disasters, amounting to 51% during the 2015 Ranau earthquake. However, the Sensitivity component of VFSTD requires empirical testing. This study aims to assess tourism sensitivity to natural disasters in mountainous areas using the Sensitivity component of VFSTD. Figure 1 illustrates VFSTD's Sensitivity adaptation, encompassing two critical vulnerability drivers.

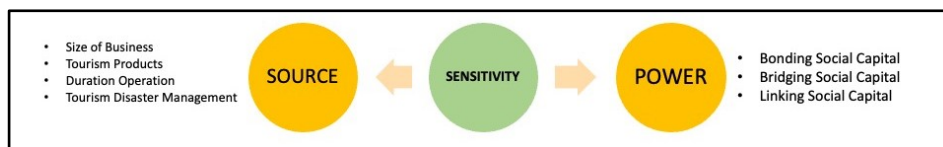


Figure 1: Sensitivity Component of VFSTD

Source: Matusin et al. (2019)

RESEARCH METHODOLOGY

Case Study – Mount Kinabalu Earthquake

The June 2015 Ranau earthquake, registering a magnitude of 6.0 and intensity level VII, is Malaysia's most powerful seismic event to date. The epicenter was located 7 km North-next of Kundasang Town and 13 km northwest of Ranau Town, at a depth of 10 km (US Geological Survey, 2015; Tongkul, 2015). This earthquake severely damaged infrastructure and the environment, impacting schools, mosques, churches, hostels, rivers, hiking trails, flora, and fauna (Tongkul et al., 2017). Tragically, climbers lost their lives, with many others stranded on Mount Kinabalu (Matusin et al., 2019).

Research Approach and Design

This study adopts a constructivist approach, emphasizing interactions within both the physical world and the human environment (Blaikie, 2010). Constructivists leverage personal experiences to explore phenomena (Creswell, 2014) comprehensively. Employing a qualitative case study methodology, this research aimed to glean insights from tourism entrepreneurs and operators in mountainous regions regarding the impact of the 2015 Ranau earthquake. This approach, commonly employed in tourism vulnerability studies, addresses the earthquake's effects on economic resilience (Cradock-Henry et al., 2018), recovery (Sanders et al., 2015), and vulnerability (Calgaro et al., 2014), providing nuanced understanding and in-depth data (Maxwell, 2005).

Data Collection and Analysis

The Ranau-Kundasang area was selected due to the significant impact of the 2015 Ranau earthquake, as documented by the US Geological Survey (2015) and Felix Tongkul (2015). Tourism entrepreneurs and operators in Ranau were chosen through purposive sampling based on specific criteria (Chua, 2014). Informants actively involved in tourism before the 2015 earthquake were selected. Face-to-face semi-structured interviews were conducted to gather detailed information, lasting 1.5 to 2 hours (Campiranon & Scott, 2014). Data collection took place from early September to late October 2018, involving 30 informants until a saturation point was achieved (Guest et al., 2006). Of the informants, 80% represented small and medium-sized enterprises (SMEs), while 20% came from

large-scale tourism companies. Verbatim transcripts were subjected to thematic analysis following Braun and Clarke's (2006) approach, focusing on vulnerability drivers within the Sensitivity component. Creswell (2014) recommends the inclusion of direct quotes and detailed descriptions to enhance validity. The six-phase thematic analysis framework proposed by Braun and Clarke (2006) was employed, with qualitative data quantified through percentage calculations for final scoring.

ANALYSIS AND DISCUSSION

This study emphasizes the Power and Source elements, with Figure 2 illustrating the thematic sensitivity analysis of Ranau's tourism sector concerning the 2015 earthquake. The diagram delineates three to four themes for each controlled variable. The source comprises nine subthemes: Tourism Product (Response, Attraction, Booking, Income), Size of Business (Staff, Facility), Duration of Operation (Development), and Disaster Perception (Trauma, Chaos). Power encompasses five themes: Bonding (Relationship, Cooperation), Bridging (Participation), and Linking (Collaboration, Research).

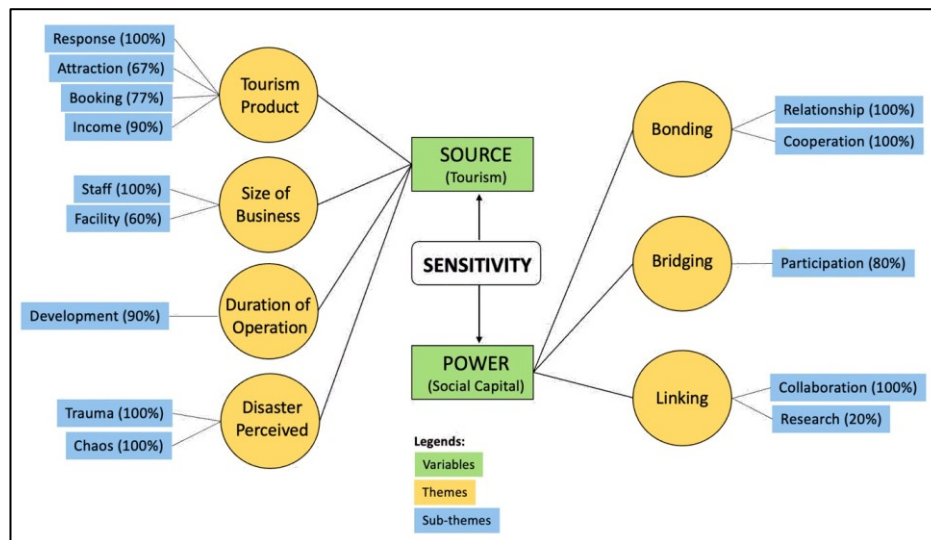


Figure 2: Themes of Tourism Sensitivity in Ranau to the 2015 Earthquake

Source – Tourism Product

In the "Tourism Product" category, four subthemes—Response, Attraction, Booking, and Income—underscore the sensitivity of Ranau's tourism sector. The Response subtheme highlighted significant declines in tourist arrivals due to apprehensions and damaged attractions. Interviewees expressed concerns about

visiting Ranau, particularly Mount Kinabalu, the earthquake's epicenter, resulting in a sharp decrease in tourist numbers within three to six months post-earthquake. Negative media portrayals exacerbated this decline. An informant stated, "After the earthquake, we lost our tourists. almost no tourist came within these six months" (Informant 18). Kinabalu Park reported a substantial shortfall of 103,359 visitors in 2015 (Table 1). The Attraction subtheme detailed the devastation of natural attractions, such as river streams and dislodged mountain rocks, leading to secondary consequences like mud floods. One informant described, "All the rocks have fallen, crashing through the vegetation" (Informant 13). Figure 3 illustrates the damage along Mount Kinabalu's climbing trail. The Booking subtheme focused on sudden cancellations of accommodations and travel packages post-earthquake. All providers reported a surge in cancellations, with some customers rescheduling. One informant noted, "After the earthquake struck, all the customers cancelled their bookings" (Informant 27). The Income subtheme revealed the earthquake's impact on informants' earnings, with many experiencing high booking cancellations and a lack of visitors. Some had to refund payments, significantly affecting their income. An informant summarized, "Our income has plummeted, and no activities are taking place at all" (Informant 14).

Table 1: Number of Visitors to Kinabalu Park (2012 to 2015)

Year	2012	2013	2014	2015
Number of visitors	285466	332838	314139	210780

Source: Sabah Park (2018)



Figure 3: Damage of Nature Trail of Mount Kinabalu due to earthquake 2015

Source: Utusan (2015)

Source – Size of Business

Within the "Business Size" theme, two subthemes emerged: Staff and Facility. This theme highlights the sensitivity of Ranau's tourism sector to the impact of the earthquake on their operations. The "Staff" subtheme reveals that operators maintained their staff continuity after the 2015 earthquake. Overall, informants confirmed that there were no reductions in staffing or labor force capacity. One informant stated, "All our staff members are still with us. They have continued their work as usual even after the earthquake, requiring some additional tasks to repair the damage" (Informant 12). The "Facility" subtheme details the sector's sensitivity to facilities in Ranau post-earthquake. Most informants reported damages, including cracks in walls and floors, water pipe leakages (especially in toilets), and a significant water shortage. An informant explained, "We lost our clean water supply after the earthquake. Our water catchment was severely affected due to mud floods. Water pipes are leaking, and the walls and floors have developed cracks" (Informant 28).

Source – Duration of Operation

Within the theme of "Source," there is a subtheme known as "Duration of Operation," which primarily focuses on "Development." This theme elucidates the sensitivity of Ranau's tourism development in response to the 2015 earthquake. Most informants described how their development activities during that year (2015) had to be temporarily halted. As discussed previously, the development activities in Ranau's tourism sector were significantly impacted by the variables related to tourism products and the size of businesses. Consequently, the development activities faced numerous challenges. One informant recounted, "We were building additional rooms for our accommodation, and everything was progressing smoothly until the earthquake struck. We had to halt the construction due to various challenges" (Informant 13).

Source – Disaster Perceived

The "Disaster Perceived" theme under "Source" includes "Trauma" and "Chaos," examining the tourism community's response to the Ranau earthquake. "Trauma" captures their initial experience with such a disaster, the strongest in Malaysia since 1972. One informant recalled, "We were all screaming out of fear. Our houses were shaking vigorously" (Informant 20). "Chaos" describes the confusion and lack of preparedness, with another informant stating, "We fled from our office, rushed out of our building. We were terrified" (Informant 13). Ranau tourism's sensitivity to the 2015 earthquake is categorized into affected aspects (e.g., decline in tourist arrivals, damage, booking cancellations) and unaffected characteristics (e.g., staff capacity). Sensitivity levels are high for

"Tourism Product," "Duration of Operation," and "Disaster Perceived," with "Size of Business" showing moderate sensitivity. Ranau tourism's Source sensitivity is 92%, indicating substantial sensitivity.

Table 2: Score of Ranau Tourism Sensitivity - *Source*

Controlled Variables (CV)	Subthemes	Characteristics	Sensitivity Level of CV
Tourism Products	<i>Response</i>	Affected	High
	<i>Attraction</i>	Affected	
	<i>Booking</i>	Affected	
	<i>Income</i>	Affected	
Size of Business	<i>Staff</i>	Unaffected	Moderate
	<i>Facility</i>	Affected	
Duration of Operation	<i>Development</i>	Affected	High
Disaster Perceived	<i>Trauma</i>	Affected	High
	<i>Chaos</i>	Affected	
Calculation Score			
Level	Score	Overall Score	12
Low	1	Source Score	3+2+3+3=10
Moderate	2	Sensitivity Percentage	92%
High	3	(Source)	

Power – Bonding, Bridging, Linking

The analysis explores Ranau tourism's sensitivity to the 2015 earthquake within the context of Power (social capital). The "Bonding" variable encompasses "Relationship" and "Cooperation." "Relationship" underscores the resilience of internal bonds, with informants noting uninterrupted relationships post-earthquake. One stated, "The earthquake did not disrupt our relationships" (Informant 4). "Cooperation" highlights strong team support during and after the earthquake, with an informant noting, "All our staff stayed together during the disaster" (Informant 17).

The "Bridging" variable reveals "Participation," assessing community involvement in tourism. Most informants reported unaffected or increased participation post-earthquake, with one explaining, "We have had more meetings and activities after the earthquake" (Informant 8). The final Power variable, "Linking," signifies the sensitivity of Ranau Tourism's networking and relationships with stakeholders post-earthquake. This variable includes two subthemes: "Collaboration" and "Research." "Collaboration" indicates strengthened cooperation among Ranau tourism stakeholders after the disaster, particularly with government agencies. An informant noted, "We were visited by

the Ministry of Tourism every week to monitor the situation here after the earthquake" (Informant 24). However, collaborations with some tourism agencies were disrupted, leading to booking cancellations and alternative packages. An informant explained, "After the earthquake, tourism agencies cancelled trips to Ranau, opting for other destinations due to apprehensions" (Informant 20). The "Research" subtheme highlights that research activities were postponed due to site closures post-earthquake. An informant clarified, "Any study or research had to be temporarily halted due to safety considerations" (Informant 3).

Overall, Ranau tourism's Power sensitivity to the 2015 earthquake includes both affected and unaffected subthemes. Research activities were impaired, while "Relationships," "Cooperation," "Participation," and "Collaboration" remained unaffected. Table 3 illustrates Power's sensitivity at 44%. "Bonding" and "Bridging" show low sensitivity, while "Linking" demonstrates moderate sensitivity. Combining Source and Power, Ranau tourism's overall sensitivity is 68% (Table 4), indicating significant sensitivity to the 2015 earthquake.

Table 3. Score of Ranau Tourism Sensitivity - *Power*

Controlled Variables (CV)	Subthemes	Characteristics	Sensitivity Level of CV
Bonding	<i>Relationship</i>	Unaffected	Low
	<i>Cooperation</i>	Unaffected	
Bridging	<i>Participation</i>	Unaffected	Low
Linking	<i>Collaboration</i>	Unaffected	Moderate
	<i>Research</i>	Affected	
Calculation Score			
Level	Score	Overall Score	9
Low	1	<i>Power</i> Score	1+1+2 =4
Moderate	2	Sensitivity Percentage	44%
High	3	(<i>Power</i>)	

Table 4. Collective Score of Ranau Tourism Sensitivity

Component	Sensitivity	Overall Percentages
<i>Source</i>	92%	68%
<i>Power</i>	44%	

DISCUSSION

The primary focus in assessing Ranau's tourism sensitivity lies in stakeholders' post-earthquake income decline, reflecting the indirect consequences of Ranau's tarnished image, particularly its natural attractions like Mount Kinabalu. The significant decrease in tourist arrivals was exacerbated by numerous booking

cancellations due to the negative perception of Ranau after the disaster, instilling fear among potential visitors. Chacko and Marcell (2008) highlight how shocks or pressures in an area can heighten the vulnerability of tourist destinations. The degradation of the destination's image, linked to both the disaster and negative publicity, can deter tourists due to safety concerns or negative feedback (Scott et al., 2008). This temporarily ceased tourism operations, severely impacting Ranau's tourism sector.

The study primarily explores the damage to Ranau's tourism infrastructure caused by the 6.0 magnitude earthquake, which underscores the inherent vulnerability of Ranau's mountainous terrain. Unlike lowland regions, tourism often develops in these sensitive areas due to their unique geographical allure and natural beauty. Jodha (1991) emphasizes the inaccessibility, topographical challenges, and ecological diversity of mountainous areas, which attract nature tourism but also pose significant challenges (Nyaupane & Chhetri, 2009). Petrosillo et al. (2006) explain that sensitivity depends on how environmental resources interact with changes caused by natural forces or human activities. Thus, the damage to Ranau's tourism facilities post-earthquake results from various internal and external factors.

Tourism product offerings and business scales hindered Ranau's post-disaster tourism sector development initiatives. Recovery efforts, including multitasking and managing financial constraints, took precedence over scheduled activities. About 80% of informants represented small-scale private tourism operators with limited capacity, contrasting with the 20% associated with larger operators equipped with contingency plans or recovery resources. Recovery was particularly challenging as none of the informants had specific natural disaster management protocols, resulting in traumatic experiences. This challenge arises from the lack of alignment between natural disaster management, disaster risk reduction, and broader national and local sustainable tourism development agendas, leading to a chaotic situation in Ranau's tourism sector.

Following the earthquake, Ranau's tourism sector exhibited low sensitivity across all social capital themes (Bonding, Bridging, Linking), consistent with Matusin et al. (2020). The relationship between exposure and sensitivity is crucial in determining system vulnerability. Clark et al. (2000) note that sensitivity measures the impact on a group based on exposure to stressors influenced by the strengths and weaknesses of the social system (Calgaro et al., 2014). Community participation is fundamental in enhancing tourism advantages and mitigating negative impacts (Azwar et al., 2023). This study underscores the importance of sensitivity in bolstering Ranau's tourism sector resilience, as it reveals vulnerabilities and triggers strategies to manage challenges. Therefore, standardizing and implementing a more sustainable disaster risk management system is imperative in all disaster-prone areas (Said et al., 2024).

The sensitivity of Ranau's mountainous system is influenced by two primary components: Source (environmental element) and Power (social capital). Source significantly impacts sensitivity, encompassing products, facilities, management, and human resources. Ranau's ecotourism heavily relies on its natural environment, shaping its destination image. Conversely, Power is crucial in regulating sensitivity, mainly when influenced by Source. This study illustrates how low social capital sensitivity can affect Ranau's tourism sensitivity, supporting Turner's Vulnerability Framework, which emphasizes the interplay between Environment and Human elements. Understanding this interplay is essential for analyzing system sensitivity.

CONCLUSION

Sensitivity in this context refers to a system's ability to detect and respond to external shocks or stressors, influenced by both human and environmental factors. This study highlights the significant sensitivity of mountainous geographical tourism destinations to earthquakes, particularly concerning tourism products, business size, duration of operation, and perceptions of disaster. Interestingly, the findings suggest that small and medium-sized tourism businesses may be more vulnerable to external uncertainties than to internal social factors. By applying Turner's vulnerability framework to the tourism context, this research contributes to a deeper understanding of vulnerability analysis across various fields and geographical areas. It underscores the importance of integrating natural disaster management within tourism destinations. Future research could expand this analysis by exploring additional sensitivity factors, such as macro-political economy, institutional dynamics, and global trends. This approach would provide a more comprehensive understanding of tourism sensitivity across different temporal and geographical contexts.

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DEMOGRAPHIC DYNAMICS AND URBAN PROPERTY CRIME: A LINEAR REGRESSION ANALYSIS IN KUALA LUMPUR AND PUTRAJAYA (2015-2020)

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Abstract

In an era where urbanization is rapidly transforming the landscape of cities, this study provides a crucial overview of how demographic shifts influence property crime in metropolitan areas. The paper delves into the complex interplay between property crime rates and demographic characteristics in the urban settings of Kuala Lumpur and Putrajaya, Malaysia, over six years from 2015 to 2020. Employing linear regression analysis, the study meticulously examines the relationship between property crime and various demographic factors, including total population, male and female populations, and residential and household densities. The findings indicate a consistent positive correlation between total population and property crime, emphasizing urban density's role in crime propensity. Notably, the male population shows a stronger correlation with property crime than females. The study also highlights how residential and household densities influence property crime in these urban settings. These insights are invaluable for policymakers and urban planners, guiding targeted strategies to reduce property crime in growing cities.

Keywords: Demography, Kuala Lumpur, Population, Property Crime, Putrajaya

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INTRODUCTION

Exploring the relationship between demographic factors and property crime rates reveals important insights. Research shows that population density has an inverse relationship with both property and violent crime rates (Hovel, 2014). In the United States, men are arrested for property crimes far more often than women (Statista, 2023). Additionally, there is an inverse relationship between regional crime rates and housing costs, indicating a complex link between crime and residential characteristics (Yang et al., 2022). However, current research does not clearly explain how specific demographic factors, such as total population, gender distribution, and residential and household characteristics, affect property crime rates. Further study on these demographic factors is necessary to better understand their impact on property crime rates.

Demographic factors undeniably influence property crime rates. Important factors include total population, gender distribution, residential density, and household density. Studies have shown connections between these demographics and property crime rates (Zhang et al., 2020). For example, areas with larger populations tend to have higher property crime rates due to more opportunities for crime and greater anonymity for criminals. The correlation between the male population and property crime rates is also notable, possibly due to socioeconomic disparities and peer influences (Yu et al., 2020). In Malaysia, property and violent crime rates dropped significantly in 2021, with a 19.3% decrease to 52,974 cases from 65,623 in 2020. This includes reductions in both crime types, with property crime decreasing by 13.4% and violent crime by 20.8% (Jabatan Perangkaan Malaysia, 2022). Despite this overall decrease, the Federal Territory of Kuala Lumpur has experienced a rise in property crime and violence in recent years. Authorities have implemented various measures to address this issue, but the effectiveness of these interventions still needs thorough evaluation (Jubit et al., 2022).

LITERATURE REVIEW

Several studies have explored the link between property crime and population. The complex relationship between population density and property crime is influenced by land use and traffic patterns in various U.S. cities (He & Li, 2022). Another study in Addis Ababa showed a negative correlation between property crime rates and strict law enforcement in areas with specific population sizes (Yigzaw et al., 2023). Other studies found that neighborhoods with higher percentages with certain ethnic groups and lower education levels have higher property crime rates (He & Li, 2022).

Walter et al., (2024) found a significant negative link between physical property investments and changes in crime rates on commercial and residential streets, highlighting the importance of urban planning. Household characteristics

and their relation to property crime have also been examined. The built environment and social disadvantages were found to be linked to property crime rates, with factors like commercial development, transit facilities, and alcohol establishments being positively correlated (He & Li, 2022). The physical environment's time-varying impacts on crime were studied, showing a connection between walkability and higher crime rates (Kim & Wo, 2023). Higher per capita income in certain neighborhoods was associated with higher property crime rates, while blighted property remediation was linked to domestic crime density (Kajeepeeta et al., 2020). The research by Jubit et al., (2020b), (2020a), (2021), (2023a); Masron et al., (2021); Nordin et al., (2020) provides insights into property crime in urban areas like Kuching and George Town. They used the Hot Spot Getis Gi* method to analyze burglary patterns but did not examine the correlation between demographics and crime rates. This underscores the importance and novelty of the present study in filling this research gap. Just as floods have socio-economic impacts, property crime also significantly affects individuals, businesses, and communities (Said et al., 2024).

RESEARCH METHODOLOGY

The study uses linear regression analysis to predict the value of one variable based on another. In this case, the variable being predicted is the dependent variable, while the variable being predicted is the independent variable (IBM, 2024). Linear regression is defined mathematically in Equation 1. The main goal is to understand the relationship between property crime (dependent variable) and various independent variables (IVs). This method helps uncover the complex connections within the data, focusing on the relationship between total property crime and selected independent variables. The research uses secondary data obtained from the Royal Malaysian Police Headquarters in Bukit Aman and the Criminal Investigation Department (Intelligence/Operations/Records-D4 Division JSJ) at the Contingent Police Headquarters in Kuala Lumpur, covering the period from 2015 to 2020. The study employs a linear regression model with property crime as the dependent variable (DV) and demographic factors as independent variables (IVs), such as total population, male and female population, and residential and household density. The analysis aims to examine and interpret the relationships and patterns in the dataset to understand how these demographic factors influence property crime rates. This comprehensive approach ensures an evidence-based exploration of the dynamics of property crime in the specified region and period.

$$Y_i = f(X_i, \beta) + e_i \dots \text{Equation 1}$$

Y_i = dependent variable

f = function

X_i = independent variable

β = unknown parameters

e_i = error terms

Study Area

The geographical scope of this study encompasses the Kuala Lumpur Contingent Police Headquarters (KLCPH), segmented into six distinct District Police Headquarters (DPH): Brickfields, Cheras, Dang Wangi, Putrajaya, Sentul, and Wangsa Maju. Within these boundaries lie a total of 24 police stations, each contributing to the rich tapestry of data used in this study. These stations, which include Brickfields, Pantai, Petaling, Sri Hartamas, Sri Petaling, Taman Tun Dr. Ismail, Travers, Bukit Jalil, and others, are strategically distributed across the KLCPH area. The spatial distribution of these stations is vividly illustrated in Figure 1. The mapping and spatial analysis of this study area have been conducted using the sophisticated ArcGIS software, developed by the Environmental Systems Research Institute (ESRI) (Ahmad, 2015; Ahmad et al., 2011, 2013, 2015; Ahmad & Masron, 2013; Basiron et al., 2014; Jubit et al., 2023b; Marzuki et al., 2023; Mohd Ayob et al., 2013, 2014; Zakaria et al., 2023). The utilization of ArcGIS is supported by various scholarly works, which collectively underscore the relevance and efficacy of this software in conducting geographical analyses of this nature (Ahmad et al., 2024a, 2024b, 2024c, 2024d, 2024e, 2024f, 2024g, 2024h; Ariffin et al., 2024; Jubit et al., 2024).

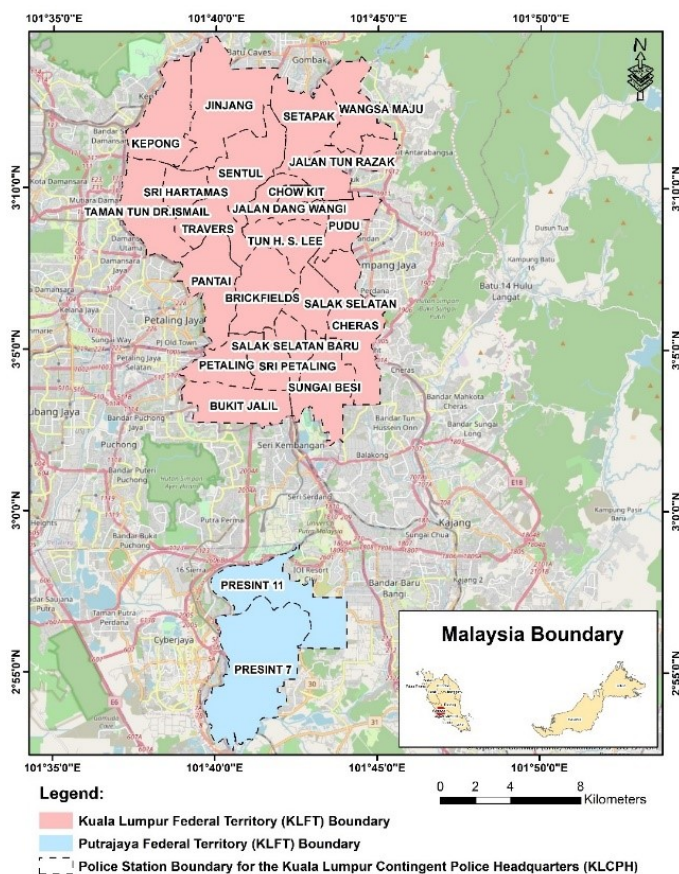


Figure 1: Police Station Boundaries for the Kuala Lumpur Contingent Police Headquarters (KLCPH)

RESULTS AND ANALYSIS

Linear Regression

The analysis, presented in Table 1 to Table 6, details the offenses of property crime under related sections and enforcement actions taken in the year 2015-2020. A notable observation is that the highest numbers of enforcements are predominantly associated with financial aspects, such as collected sums and accounting matters. In the linear regression analysis for 2015 (Table 1 & Figure 2), a moderately positive relationship between total population and property crime is evident, with an R-squared value of 0.422. This indicates that the total population accounts for a significant portion of the variation in property crime. The male population displays a weaker positive correlation with property crime, evidenced by an R-squared value of 0.262, suggesting it is a less robust predictor

compared to the total population. The female population shows the weakest link among the population categories, with an R-squared of 0.160, implying a minor role in property crime fluctuations. Residential factors exhibit a moderate positive relationship with property crime (R-squared of 0.378), signifying their significance but not as predominant predictors. Similarly, household demographics demonstrate a moderate positive correlation with property crime, as indicated by an R-squared of 0.352.

In 2016 (Table 2 & Figure 3), the total population maintains its positive correlation with property crime, albeit with a reduced R-squared value of 0.294, suggesting a slight decline in explanatory power. The trend continues with the male population, which exhibits a consistent yet weaker correlation (R-squared of 0.179). The female population's impact on property crime diminishes further (R-squared of 0.101), pointing to its minimal influence. Residential factors maintain a moderate relationship (R-squared of 0.270), indicating their continued influence on property crime. Household factors also show a moderate correlation, with an R-squared of 0.247, slightly lower than the previous year. In 2017, the relationship between total population and property crime remains positively significant (R-squared of 0.357), suggesting a steady influence (Table 3 & Figure 4). The correlation with the male population decreases (R-squared of 0.212), aligning with the trend of diminishing impact. The female population maintains a weak but positive relationship (R-squared of 0.109). Residential factors continue to exhibit a moderately positive correlation (R-squared of 0.333). The household factor also presents a moderate positive relationship (R-squared of 0.294).

The 2018 data indicates that the positive correlation between total population and property crime persists, though with a reduced R-squared value of 0.266 (Table 4 & Figure 5). The male population continues its trend of declining relationship strength (R-squared of 0.150). The female population retains a weak positive correlation (R-squared of 0.067). Residential factors show a moderate positive correlation (R-squared of 0.254), and the household factor exhibits a moderate correlation (R-squared of 0.214). In 2019, the total population demonstrated a relatively strong positive relationship with property crime (R-squared of 0.425), indicating an increase in explanatory power. The male population displays a moderate positive correlation (R-squared of 0.262) while the female population continues with a weak correlation (R-squared of 0.126). Residential factors exhibit a relatively strong relationship (R-squared of 0.416). The household factor shows a moderate to strong correlation (R-squared of 0.353) (Table 5 & Figure 6).

In 2020, total population maintains a significant positive relationship with property crime (R-squared of 0.405). The male population exhibits a moderate positive correlation (R-squared of 0.257), while the female population

continues with a weak positive relationship (R-squared of 0.123) (Table 6 & Figure 7). Residential factors display a strong correlation (R-squared of 0.409), and the household factor presents a moderate to strong positive relationship (R-squared of 0.341). Overall, the total population consistently demonstrates a significant positive relationship with property crime across the years, often emerging as the strongest predictor. The male population tends to exert a more substantial impact on property crime than the female population, though both exhibit positive correlations. Residential and household factors consistently show moderate to strong positive correlations with property crime, underscoring their importance in explaining property crime variations. These trends indicate that while all these factors are relevant, total population and residential factors are consistently more significant predictors of property crime in this dataset. The strength of these relationships is potentially shaped by a range of socioeconomic and environmental factors, warranting further exploration.

Table 1: Linear Regression 2015

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0049	130.71	0.422
2.	Male Population	0.0022	217.23	0.262
3.	Female Population	0.0013	304.61	0.160
4.	Residential	0.0041	148.47	0.378
5.	Household	0.0033	160.05	0.352

Table 2: Linear Regression 2016

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0047	175.79	0.294
2.	Male Population	0.0020	268.95	0.179
3.	Female Population	0.0012	357.26	0.101
4.	Residential	0.0039	189.25	0.270
5.	Household	0.0031	205.00	0.247

Table 3: Linear Regression 2017

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0036	105.39	0.357
2.	Male Population	0.0015	185.25	0.212
3.	Female Population	0.0008	257.20	0.109
4.	Residential	0.0030	114.04	0.333
5.	Household	0.0023	131.67	0.294

Table 4: Linear Regression 2018

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0027	148.00	0.266
2.	Male Population	0.0011	217.98	0.150
3.	Female Population	0.0005	277.34	0.067
4.	Residential	0.0023	152.71	0.254
5.	Household	0.0017	171.79	0.214

Table 5: Linear Regression 2019

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0031	85.44	0.425
2.	Male Population	0.0012	161.48	0.262
3.	Female Population	0.0007	226.88	0.126
4.	Residential	0.0025	87.30	0.416
5.	Household	0.0019	109.67	0.353

Table 6: Linear Regression 2020

No.	Independent Variable (IV)	Coefficient	Intercept	R ²
1.	Total Population	0.0023	67.91	0.405
2.	Male Population	0.0009	126.50	0.257
3.	Female Population	0.0005	175.90	0.123
4.	Residential	0.0019	66.23	0.409
5.	Household	0.0014	86.10	0.341

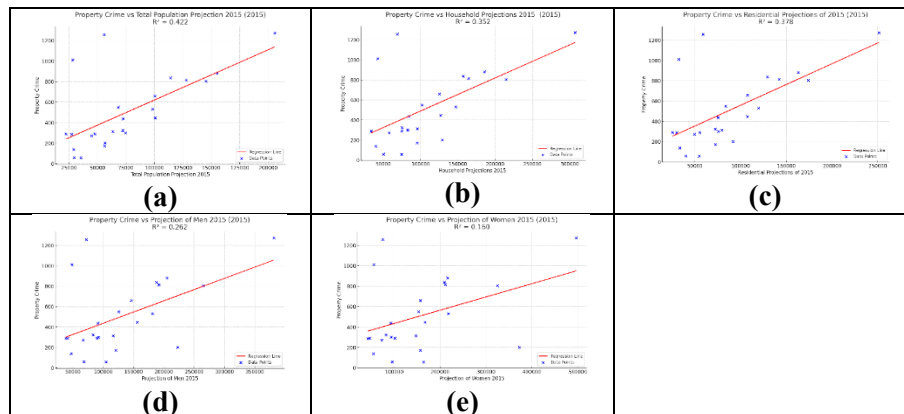


Figure 2: (2015) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

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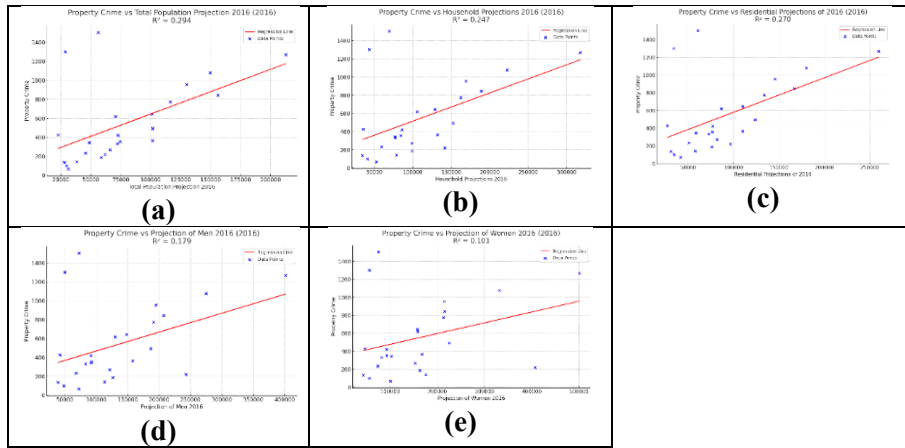


Figure 3: (2016) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

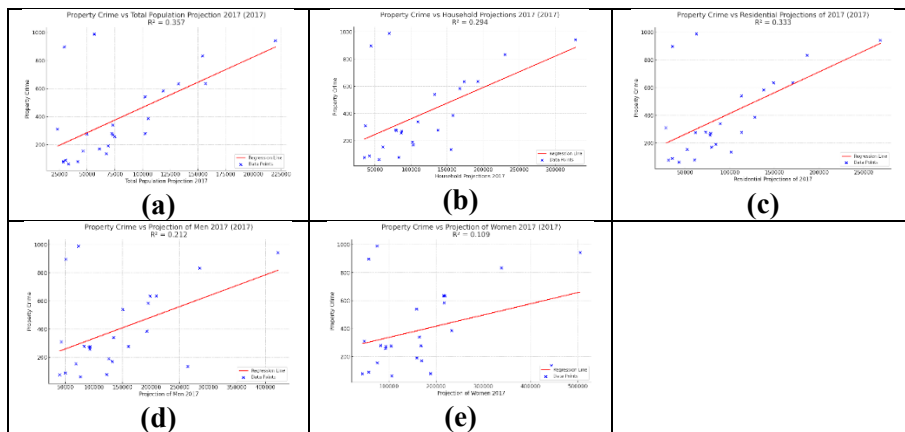


Figure 4: (2017) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

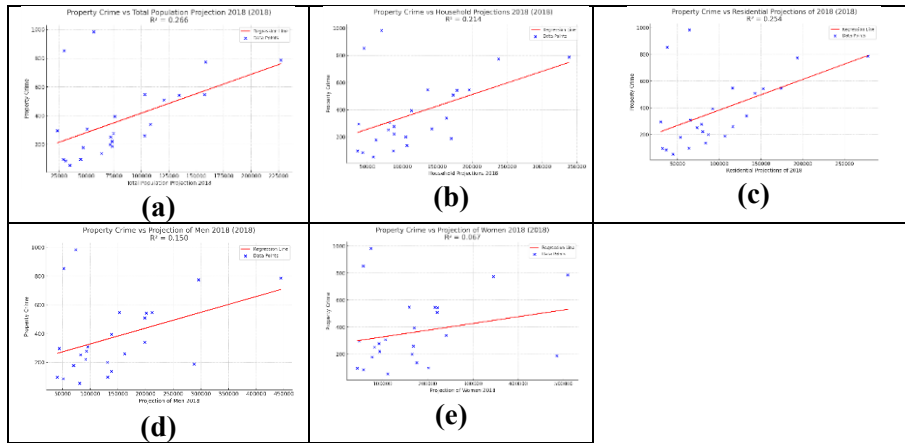


Figure 5: (2018) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

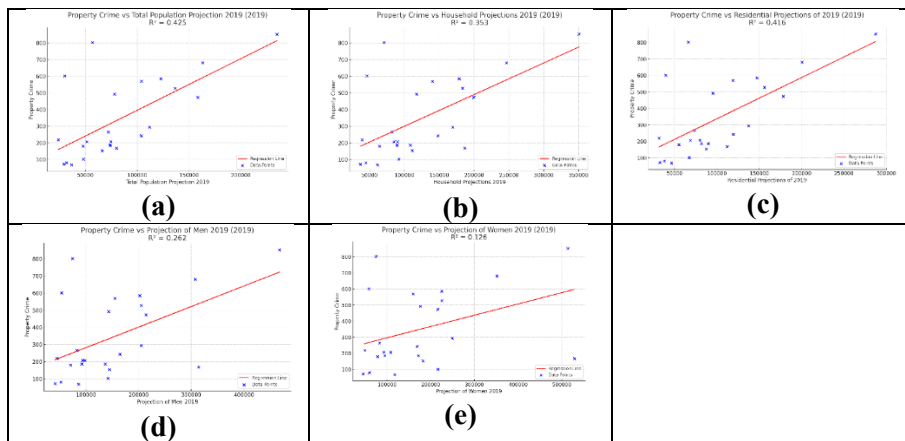


Figure 6: (2019) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

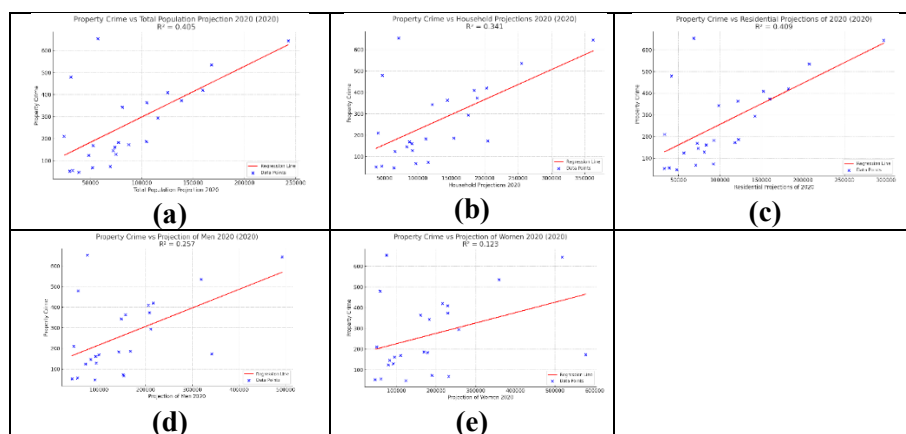


Figure 7: (2020) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

DISCUSSION

Interpretive Analysis of Results

This study's exploration into the nexus between property crime and demographic variables in Kuala Lumpur and Putrajaya presents a rich tapestry of socio-spatial dynamics that are at play in urban environments. The substantial and consistent correlation between the total population and property crime rates across the studied period reinforces the notion that urban centers, with their dense population matrices, serve not only as hubs of economic and social activity but also as fertile grounds for property-related criminal activities. Intriguingly, the male population exhibits a less potent but still significant relationship with property crime, hinting at the underlying socio-cultural and economic fabric that shapes male-oriented criminal behavior. This finding dovetails with gender-based criminological theories that argue for the influence of societal constructs and peer dynamics in shaping male predispositions towards property crimes. Conversely, the female population's weaker linkage with property crime underscores the gendered nuances of criminal engagement, possibly pointing towards differing societal roles, opportunities, and perhaps even deterrents that operate distinctly for women in urban spaces (Jones et al., 2021). The moderate to strong correlation of residential and household density with property crime rates is a compelling finding. It highlights the significance of urban design and residential configurations in facilitating or inhibiting criminal activities (Piroozfar et al., 2019).

Implications

This study adds a rich layer of empirical evidence to several criminological theories. It reaffirms routine activity theory by providing a robust empirical foundation for the concept that higher populations catalyze increased criminal opportunities. Simultaneously, it lends credence to social control theory, particularly regarding gender-specific criminal behavior, highlighting how societal norms and peer group dynamics potentially fuel male-associated property crimes (Stewart et al., 2021). Moreover, the study enriches our understanding of environmental criminology. The observed correlations between crime rates and residential as well as household densities resonate with the theory's assertion of the environment's pivotal role in shaping criminal behavior. Additionally, the findings validate crime pattern theory, affirming that crime clusters in specific urban locales where potential offenders are likely to converge.

Moreover, the findings provide practical, actionable insights for law enforcement agencies and urban planners. Law enforcement can leverage these insights for strategic resource allocation and focused crime prevention efforts in identified high-risk areas. Urban planners, on the other hand, are presented with a compelling case to integrate crime prevention through environmental design (CPTED) principles in urban layouts to mitigate property crime risks (Lee et al., 2023). Customized community policing initiatives, especially in areas with a higher male demographic, could prove more effective. Such initiatives could be tailored to address the unique socio-demographic and economic realities of these neighborhoods, thereby enhancing their efficacy in crime prevention.

Limitation of the Study

While the study offers valuable insights, it is not without its limitations. Firstly, the use of linear regression, while effective in discerning correlations, stops short of establishing causality. This limitation necessitates a cautious approach in interpreting the results, particularly in policy formulation contexts. Secondly, the study's reliance on reported crime data might not comprehensively capture the complete spectrum of property crime due to possible underreporting and recording disparities. This limitation underscores the need for more robust data collection and reporting mechanisms. Another notable limitation is the geographical focus on just two federal territories, which may not accurately reflect the diverse socio-economic and cultural landscapes of Malaysia. This geographical limitation might affect the study's generalizability and applicability to other Malaysian regions or similar urban settings elsewhere. Moreover, the study does not account for other potentially influential factors like economic conditions, law enforcement efficiency, or broader cultural dynamics, which could significantly impact property crime rates. These factors should be

considered in future research to provide a more comprehensive understanding of property crime dynamics.

CONCLUSION AND FUTURE WORK

The comprehensive analysis illuminates the complex interplay between demographic factors and property crime in Kuala Lumpur and Putrajaya, revealing a marked correlation between population density and crime rates. It underscores the influence of urban dynamics and gender on criminal activities, highlighting the significant role of residential patterns in shaping property crime. These insights provide a multi-dimensional perspective on urban crime, offering crucial guidance for effective urban planning and law enforcement strategies. For future work, this research sets a foundation for expansive studies in urban criminology, paving the way for deeper investigations into the socio-economic, cultural, and environmental factors that influence crime patterns in diverse urban settings. It encourages exploring beyond Kuala Lumpur and Putrajaya to include diverse urban environments, enhancing the generalizability and comparative depth of property crime dynamics. Future studies should integrate varied factors such as economic trends, law enforcement methods, and cultural impacts to enrich our understanding of their complex interplay with property crime. There's a need to shift towards causal investigations, delving into the underlying mechanisms beyond mere correlations. This progression in research will not only enrich the empirical landscape of urban criminology but also foster the development of tailored and effective strategies for crime prevention and urban safety.

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THE INFLUENCE OF TOURIST ATTRACTION POSITIONING ON TOURIST DECISIONS TO VISIT THE ‘XYZ’ IN SAMARINDA, INDONESIA

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Abstract

To develop a good image, a tourist attraction must have good positioning so that it creates a positive impression and invite tourists to visit. This research aims to examine the influence of the positioning of a tourist attraction, consisting of experimental concept, price concept, and product attribute concept variables, on tourists' decisions to visit the "XYZ" tourist attraction in Samarinda. This quantitative study involved 100 tourist respondents who visited the "XYZ" tourist attraction in Samarinda, selected using non-probability purposive sampling technique. Data analysis in this research employed multiple linear regression. Data was processed using SPSS 27.00 for Windows. The results of the study show that the positioning of the tourist attraction consisting of experimental concept, price concept, and product attribute concept variables has a positive and significant impact on tourists' decisions to visit the "XYZ" tourist attraction in Samarinda. The product attribute concept variable is a dominant factor influencing tourists' decisions to visit the "XYZ" in Samarinda, with a coefficient value of 0.398, followed by the experimental concept variable with a coefficient value of 0.249, and the price concept variable with a coefficient value of 0.218.

Keywords: positioning, tourist attraction, tourists, visit

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INTRODUCTION

Tourism sector has been acknowledged as having the most significant contribution to the national revenue of Indonesia (Wijijayanti et al., 2020). While Samarinda has diverse tourism potentials, development in the tourism sector is still uneven. Tourist attraction is a crucial element of tourism, as it serves as the destination that tourists aim to visit. Natural attractions are tourist attractions whose appeal stems from the beauty of nature and its environment, whether in its natural state or after development (Martins & Futeemma, 2022; Wahyono, 2014).

According to Latip et al. (2023), achieving a positive image for a tourist destination requires effective positioning to leave a lasting impression on tourists and inspire them to visit the attraction. Tourists' visiting decisions are often influenced by various factors, including assessments of available facilities, the surrounding conditions, and the accessibility of the location (Bahri et al., 2023). To establish a favorable image for the tourism site, a solid positioning strategy is essential to create a positive impression on tourists' minds (Caroline et al., 2021; Ghafar et al., 2022).

Positive tourist attraction positioning, including Experiential Concept, Price, and Product Attributes, influences and stimulates return visits to tourist attractions in the city of Samarinda. This study aims to examine the impact of positioning factors such as Experiential Concept, Price, and Product Attributes on tourists' decisions to choose the "XYZ" attraction in Samarinda.

LITERATURE REVIEW

Positioning

According to Kotler et al. (2018), positioning refers to the strategy employed to design and shape a company's image which enables it to secure a position in the minds of consumers. Positioning can also be seen as a strategy to establish the image of a company and its products in the minds of various types of consumers, be it individuals, businesses, or governments (Hamdat, 2020). Tjiptono et al. (2020) state that positioning strategy is closely linked to consumers' perceptions of the benefits of a product, both actual and anticipated. Furthermore, positioning strategy delineates the competitive edge of a product, brand, name, or business through associative relationships (interrelations) (Butler, 2006; Caroline et al., 2021).

Positioning Objectives

According to Kotler and Keller (2008), the aim of positioning is to place a product at the forefront of consumer attention and make it memorable in their minds. Additionally, positioning seeks to create a product image with differentiating features that resonate with consumers. This differentiation leads to a competitive edge for the product, facilitating easier competition for the company (Janjua et al., 2023).

Positioning Variables

According to Kotler et al. (2018) and Tjiptono et al. (2020), several concepts must be considered when developing positioning strategies:

1. Experiential Concept

Emphasizing experiential needs (hospitality and comfort), tourism attraction managers aim to provide comfort and hospitality to visitors, ensuring their satisfaction during visits. This concept involves:

- a. Hospitality, measured by the service provided by attraction staff to enhance visitor satisfaction.
- b. Comfort, indicated by the environmental conditions at the attraction site managed by administrators, which is crucial given that the site leverages natural surroundings as its primary allure.

2. Price Quality Concept

The prices range from low to high (low and high prices). Fluctuations in tourism attraction prices on specific days can impact visitor numbers. This concept involves:

- a. Low prices, indicated by group discounts with predefined quantities that do not apply on holidays or weekends.
- b. High prices, observed during events involving the attraction.

3. Product Concept Attribute

This emphasizes one or more feature-customer benefits attributes linked to the brand, customer benefits (degree of importance and uniqueness). The uniqueness of the attraction often lies in its vast recreational areas. This concept involves:

- a. Degree of Importance, measured through conservation efforts or research at the attraction.
- b. Uniqueness, demonstrated by the natural appeal of the attraction, making it a popular tourist destination.

4. Visit Decision

Tourists' desire to visit locations to fulfill their satisfaction by experiencing new things they have not encountered before at the tourist attraction. Visitor decisions are based on:

- a. Repeat visits, assessed by a tourist returning to a particular attraction.
- b. Recommendations or word-of-mouth, indicated by a tourist sharing information about visited attractions with friends.

RESEARCH METHODOLOGY

Data Collection Techniques

This study employed the associative approach (Tharenou et al., 2007). According to Sugiyono (2020), a sample represents elements and characteristics of a population. Understanding this model implies its applicability to the entire population. Proportional random sampling was used in the study due to the non-homogeneous and proportionally stratified nature of the elements/members under observation. The research involved 100 respondents to test hypotheses, selected to represent the population, comprising tourists visiting the XYZ tourist attraction in Samarinda. The methodology is based on participation and intervention effectiveness assessed through pre- and post-designs. Data collected was analyzed using SPSS version 27, employing descriptive analysis and t-tests. All questionnaire items utilized a five-point Likert scale for measurement, ranging from 1 (indicating "strongly disagree") to 5 (denoting "strongly agree"). Subsequently, the gathered data underwent multiple regression analysis for further insights.

Data Analysis Method

Linear regression analysis was conducted using SPSS software. Multiple linear regression was applied to determine the impact of the Experiential Concept (X_1), Price Concept (X_2), and Attribute Product Concept (X_3) on tourists' visiting decisions (Y). Data processing was carried out with SPSS version 29.00. Hypothesis testing was performed through an analysis model of independent variables on the dependent variable (Sugiyono, 2020). The regression equation is as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \epsilon$$

Where: Y = Tourists' visiting decisions

a = Constant

b_1, b_2, b_3 = Regression coefficients

X_1 = Experiential Concept

X_2 = Price Concept

X_3 = Attribute Product Concept

ϵ = Error

ANALYSIS AND DISCUSSION

The data analysis method in this study explains the influence of Experimental Concept (X_1), Price Concept (X_2), and Attribute Product Concept (X_3) on tourists' visiting decisions (Y). Data processing was conducted using SPSS version 29.00. The results of the regression analysis are presented in the following table:

Table 1: Results of Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std.Error	Beta		
(Constant)	.706	.276		2.556	.012
X ₁	.264	.087	.249	3.049	.003
X ₂	.152	.066	.218	2.301	.024
X ₃	.355	.081	.398	4.366	.000

Source: Processed Data (2023)

The Multiple Regression Equation is as follows:

$$Y = 0.706 + 0.264X_1 + 0.152X_2 + 0.355X_3$$

1. The regression coefficient for the Experiential Concept variable (X₁) of 0.264 indicates that there is an influence between the experimental concept and tourists' visiting decisions. The magnitude of the coefficient being 0.264 reveals that the Experimental Concept variable ranks second in influencing tourists' visiting decisions.
2. The regression coefficient for the Price Concept variable (X₂) of 0.152 confirms an influence between the price concept and tourists' visiting decisions. A coefficient value of 0.152 indicates that the Price Concept variable ranks third in influencing tourists' visiting decisions.
3. The regression coefficient for the Attribute Product Concept variable (X₃) of 0.355 confirms a significant influence on tourists' visiting decisions. The coefficient of 0.355 indicates that the Attribute Product Concept variable holds the top rank or acts as the dominant factor influencing tourists' visiting choices.

This study aims to examine the influence of positioning, comprising the experiential concept, price concept, and attribute product concept, on tourists' visiting decisions at the 'XYZ' tourist attraction in Samarinda. The discussion of each variable is presented as follows.

1. The influence of the experiential concept on tourists' visiting decisions at the 'XYZ' tourist attraction in Samarinda

The results indicate that there is an influence of the experiential concept on tourists' visiting decisions. Various approaches can be used for positioning, and one of these is the experiential concept. In this approach, product placement is highlighted to fulfill the experiential needs of trying out the product, such as friendly services, well-maintained and comprehensive facilities, comfortable surroundings, and more.

Visitors' decisions to visit a tourist destination are typically influenced by various factors, including the accessibility and strategic location of the destination. Some visitors seek destinations with unique challenges to experience, adding to the allure of the tourist attraction. Additionally, the considerations of affordability in terms of vacation costs play a vital role. The facilities provided by the tourist destination are crucial for most visitors, emphasizing the significance of amenities. Furthermore, visitors pay attention to safety, comfort, cleanliness to ensure an enjoyable experience when visiting the 'XYZ' tourist attraction in Samarinda.

2. The influence of the price concept on tourists' visiting decisions at the 'XYZ' tourist attraction in Samarinda

The results indicate that there is an influence of the price concept on tourists' visiting decisions. Price encompasses all monetary costs borne by consumers to acquire, possess, or benefit from a combination of goods and services within a product. In the decision to visit, pricing can significantly affect this choice. Within a certain price range for a product, consumers may expect that higher prices reflect superior quality. Therefore, price stimuli can impact consumers differently when deciding to visit a product. Simultaneously, pricing strategies and competition are common challenges faced by marketing executives.

The price-quality concept involves positioning a product by using prices and qualities ranging from low to high (low price and high quality, and so forth). A tourism product can be more comprehensive when priced, as cost can serve as a measure for tourists to assess the quality of a travel package.

3. The influence of the product attribute concept on tourists' decisions to visit the 'XYZ' tourist attraction area in Samarinda

The results indicate that there is an influence of the product attribute concept on tourists' decisions to visit. The third factor influencing tourists' decisions to visit is the product attribute concept. The product attribute concept highlights one or more attributes associated with the brand, providing benefits to customers. Essentially, a product is created through a process, and the result from that process can be enjoyed to meet the desires and needs of each individual.

The decisions of visitors regarding a product can greatly benefit the existing companies. This is something that every company must maintain. Therefore, companies, especially in the tourism industry, face tough competition. Meeting the needs of visitors does not mean only providing the necessary products but also involves meeting other visitor needs through marketing activities. All companies must engage in marketing activities to understand to what extent the offered products can be accepted by the public or visitors. The initial process in making decisions about a product is through

observation, which will create an impression on visitors regarding that product.

A product offered to visitors by a company will endure in the market if the attributes of the product are accepted by visitors. Product attributes are components that are the characteristics of a product that ensure the product can meet the needs and desires expected by the buyer. The benefits of a product are communicated through product attributes, including the brand, packaging, labeling, auxiliary services, guarantees, these product attributes are provided to visitors aiming for them to meet the needs and desires applied by buyers, attract buyers, and if these attributes are accepted, visitors are expected to be satisfied with the product, ultimately leading visitors to become loyal to the product.

4. The influence of positioning consisting of the experiential concept, price concept, and product attribute concept on tourists' decisions to visit the 'XYZ' tourist attraction area in Samarinda

The results indicate that there is an influence of positioning consisting of the experimental concept, price concept, and product attribute concept on tourists' decisions to visit. This positioning strategy is utilized in various sectors, one of which is the tourism sector. Tourism is a growing service industry and one of the largest industries that contributes to increasing a country's revenue. In tourism, there are various types of companies, including travel agents, tourist transportation, hotels, and other accommodations. Additionally, there are catering services, bars, restaurants, and tour operators. All these companies complement each other, forming an industry with products and services purchased by tourists in the form of tour packages.

Tourist attractions are essential components in tourism because tourist attractions are the destinations that tourists aim to visit. Natural tourist attractions are destinations whose appeal stems from the beauty of nature and its environment, whether in its natural state or after human cultivation. Natural tourism is a form of activity that utilizes the potential of natural resources and the environment. These activities include recreation and tourism, research, cultural activities, and environmental appreciation that take place within natural tourist attractions.

The key to the success of positioning lies in the ability of tourism object managers to create the desired perception for customers. In the current globalization era, competition is extremely tough, making positioning crucial. New tourism products or companies cannot directly compete with well-established tourist destinations that have a strong position; they hold the highest and top position in the minds of customers or potential customers. In such a situation, positioning can play a role, allowing them to compete.

5. The variable that has the most significant influence on tourists' visiting decisions

As the results indicate, the product attribute concept variable is a dominant factor influencing tourists' decisions to visit the 'XYZ' tourist attraction in Samarinda, with a coefficient of 0.398, followed by the experiential concept variable with a coefficient of 0.249, and the last rank is held by the price concept variable with a coefficient of 0.218.

The product attribute concept is a dominant factor influencing tourists' decisions to visit the 'XYZ' tourist attraction in Samarinda. This is because a product is a range of services that not only have economic aspects but also social, psychological, and natural aspects, although tourism products are largely influenced by economic behavior. Tourism products are services that can be experienced or enjoyed by tourists while at the tourist destination, supported by tourism product components ranging from attractions, facilities, and accessibility, each of which has been well-prepared by the management.

There are three elements that make up a tourism product: attractions, facilities, and accessibility. Attractions are the elements contained in the destination and its environment, which either individually or in combination play a crucial role in motivating tourists to visit the destination. Facilities are destination elements that allow tourists to stay in the destination to enjoy or participate in the attractions offered. Destination facilities can include accommodation, restaurants, cafes, transportation, and other services, including information services, and so on. Accessibility relates to how easy or difficult it is for tourists to reach their desired destination. Accessibility is related to transportation Infrastructure, such as airports, and bus terminals.

CONCLUSION

The significant influence of the Experience Concept on tourist visit decisions highlights the importance of providing a satisfying experience, friendly service, and a comfortable and clean environment to attract tourists to the "XYZ" attraction in Samarinda, while the influence of the Price Concept reveals that competitive prices and attractive promotions can increase the number of visitors to the attraction; In addition, the Product Attributes Concept emerged as the most dominant factor, confirming the importance of the uniqueness, authenticity, and quality of the facilities offered by the "XYZ" attraction in Samarinda. Overall, the effect of the Experience Concept, Price, and Product Attributes Concept significantly shaped a positive image and strong placement strategy for the "XYZ" attraction in Samarinda, reflecting the importance for managers to continuously improve and display unique and high-quality product attributes.

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ANALYSIS OF EFFECTIVENESS OF HEALTH FACILITIES SERVICES IN MAGELANG REGENCY, INDONESIA

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Abstract

One of the priorities for health development in Magelang Regency is improving the quality of health services. In fact, it was found that the health facilities in Magelang Regency are adequate. However, it is imperative to figure out if they function well. Therefore, the purpose of this study was to assess the level of effectiveness of existing health facilities in this regency. The data used in this study are the number and coordinate points of the hospital and community health centres. The data analysis uses multi-ring buffer analysis. The results show that the level of effectiveness of hospital health services in the category of very high effectiveness, 0.94% of the total area. The effectiveness of the distribution of hospitals is in the low category can serve 12.16% of the total area. The effectiveness of the distribution of community health centres facilities is in the very high category, 0.43% of the district area, and the very low category covers 36.48% of the area of Magelang Regency.

Keywords: effectiveness, reach, health facilities

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INTRODUCTION

The consequence of the city's development is the increasing population activity, which increases the need for facilities to support the population's activities. Health facilities are one of the public facilities that residents need (Istiqomah & Ritohardoyo, 2006). The distribution of health facilities in urban areas is essential for health services in big cities (Mansour, 2016). Thus, analysis of the spatial relationship between the location of health facilities and accessibility to activity centres is an essential factor in decision-making, planning, and healthcare systems (Higgs et al., 2019; Perry & Gesler, 2000)

Health facilities provide health services to the community and play a strategic role in accelerating the improvement of public health status and controlling population growth (Kruk et al., 2018). The provision of health facilities is calculated based on the number of people served by these facilities (Mahendradhata et al., 2017). The placement of the provision of health facilities considers the range of radius that must be met to serve specific areas (Sadali et al., 2021). Indonesian National Standard No. 03-1733-2004 concerning Procedures for Environmental Planning states that a city/regency area has a standard for calculating health facilities based on the type of facility with the criteria of supporting population, the radius of achievement, and location qualifications.

The 2019-2024 Regional Medium-Term Development Plan for Magelang Regency contains strategic issues, including the quality of human resources, regional competitiveness, and clean and accountable governance. Magelang Regency Regional Medium-Term Development Plan is achieved through various sectors, including the health sector. This achievement is manifested through priority development programs in the health sector, namely improving health services that is getting better and more affordable.

Health is a development priority to improve human resources quality (Sadali et al., 2021). One of the priorities for health development in Magelang Regency is improving the quality of health services, which indicates the quality of public services. Good quality of health services will improve public health status (Yusyanti, 2021). The existing condition of health facilities in Magelang Regency is sufficient which covers 29 community health centres and five hospitals (BPS Kabupaten Magelang, 2021). Based on the Indonesian National Standard No. 03-1733-2004 calculation, the need for health facilities in Magelang Regency is five units of hospitals and 11 units of community health centres. It shows that the existing condition of health facilities in Magelang Regency has exceeded the standard requirement. Magelang Regency's position which is surrounded by Magelang City also influences the availability of health facility services. Magelang City, in 2021, had six units of general hospitals, two exceptional hospitals, and five community health centres. The availability of health facilities in Magelang City attracts community users from Magelang

Regency. The close distance causes; the quality of health services to be more comfortable and complete.

The large number of health facilities in Magelang Regency needs to be reviewed on the level of reach and effectiveness. Therefore, this study analyzes the reach and effectiveness of the distribution of health facilities in Magelang Regency. The results of this evaluation can be used as a basis for formulating a strategy for optimizing health facilities in Magelang Regency so that priority programs for development in the health sector can be achieved.

LITERATURE REVIEW

Provision of Health Facilities

Public health concerns threat to the general health of the community based on the analysis of population health (Maidin, 2008). Health facilities provide health services to the community, play a strategic role in accelerating the increase in public health status, and control population growth (Atmanti & Naylah, 2019). The basis for providing health facilities is based on the number of people these facilities serve. The basis for providing health facilities also considers the spatial requirements design approach. At the same time, the placement of the location for the provision of health facilities considers the range of service area radius that must be met. Law Number 36 of 2009 concerning Health states that Regional Governments can determine the number and type of health service facilities and grant operational permits based on area size, health needs, disease patterns, utilization, social functions, ability to use technology, and population size and distribution.

Public health services at the primary level in Indonesia are community health centres. Community health centres are health service facility organizing community and individual health efforts by prioritizing promoted and preventive efforts to achieve the highest degree of public health (Regulation of the Minister of Health Number 75 of 2014 Concerning Community Health Centres). The role of the community health centres in health development aims to create a society that has healthy behavior including awareness, willingness, and ability to live healthily, able to reach quality health services, live in a healthy environment, and have optimal health status; not only individuals, families, groups, but also communities. The community health centres are the government's foundation in providing health services to the public at the sub-district and sub-district levels. Hence, community health centres are one of the frontlines in the development of public health (Luthfia & Alkhajar, 2019).

Spatial distribution patterns can be used in making decisions on strategies and policies applied to project the density or abundance of a population (Krebs, 2014). According to Dewantara & Urufi (2021), health facilities' uneven distribution patterns and reach can be a particular spatial planning problem. This condition can be seen from various indicators: population density, spatial

distribution index of health facilities, radius/reach of health facilities, affordability, and travel time to the nearest health facility.

Effectiveness of Distribution of Health Facilities

Access to health facilities shows information about how easy it is for residents to access various kinds of health facilities (Paez et al., 2010). The health facility indicator is applied primarily to the poor and vulnerable individuals in accessing health facilities that are important for their lives. The ease of accessing these health facilities is measured using the distance from the village to the location where the facility is located. Health services can be measured from the convenience of the health insurance program and the geographical range of services, accessibility related to transportation, distance, and travel time. Regional accessibility to health facilities focuses on radius/reach, affordability, and travel time (Ramadan et al., 2021).

Effectiveness is defined as something that has an effect (consequences, influence), can bring influence, and can also mean coming into effect (regarding regulations). The effectiveness of health facility service coverage is measured through affordability. The affordability indicator can be seen from the ease of accessibility based on the distance to health facilities. Assessment of the effectiveness of health facility services is based on research conducted by (Ramadan et al., 2021) using GIS modeling (network analysis). Network analysis is considered as the area of the service area or the affordability of a service point in the form of a health facility based on distance and time. The results of the service area calculation based on distance and time are used as affordability parameters through data overlay techniques—the overlay results in the percentage of areas the nearest health facility covers.

RESEARCH METHODOLOGY

This research is held in Magelang Regency, which has an area of 1.086 Ha, consisting of 21 sub-districts with five hospitals and 29 community health centres. The data needed in research are in the form of primary data and secondary data. This study uses secondary data in the form of spatial planning regulations and policies, population per district, a list of hospitals and health centres, references to journals, and literature reviews. The data were obtained from various agencies, namely the Public Works and Spatial Planning Office of Magelang Regency, Magelang Regency Regional Development Planning Agency and Litbangda, Magelang Regency Health Office, and the Central Bureau of Statistics of Magelang Regency. This study also uses primary data from field observations, namely the coordinate point data for hospitals and health centres. The data analysis, in general, use descriptive analysis with a spatial approach. The spatial approach uses the multi-ring buffer analysis method to analyze the range of health facility services. In assessing the effectiveness of the distribution

of health facilities, affordability analysis was used with a weighting formula seen from the distance to the hospital and community health centre.

The Reach of Health Facilities in Magelang Regency

The technique for reach analysis of health facilities uses buffer analysis. Buffer or Proximity Analysis is an analytical technique used to identify the relationship between a point and the surrounding area, a proximity factor analysis. Proximity Analysis can be used as a marketing strategy analysis to determine sites/business land/trade (Aqli, 2010). According to (Prahasta, 2002), Buffer Analysis is a form of a zone that leads out from a mapping object which can be a point, a line, or an area (polygon). Zones can be used to identify the spatial proximity of an object on the map to the surrounding objects. The result is of buffering analysis can provide information regarding the optimal range of health facilities.

The buffering technique is based on providing health facility service reach in SNI 03-1733-2004. However, the standard still needs to regulate the range/radius of health facilities in serving the city/district scale. Therefore, to calculate the reach of health facilities uses the distance radius category. Referring to several studies, the service radius of health facilities generally used for community health centres is divided into four distance categories. It is 1 kilometre, 2 kilometres, 3 kilometres and 4 kilometres radius (Istiqomah & Ritohardoyo, 2006; Mamonto et al., 2022; Mansour, 2016; Ramadan et al., 2021; Xu, Yan, Hu, & Pu, 2022). Based on the Guidelines for Determining Minimum Service Standards in the Field of Spatial Planning, Housing and Settlements and Public Works, Decree of the Minister of Settlement and Regional Infrastructure No. 534/KPTS/M/2001, that the minimum service standard for a hospital is twice that of community health centres. With the radius approach, the distance between hospital services is twice the distance between community health centres services. The service radius for health facilities in the form of hospitals uses the distance categories of 2 kilometres, 4 kilometres, 6 kilometres, and 8 kilometres. The analysis was carried out by multiple ring buffer analysis for each type of health facility, hospital, and health centre in the four categories of buffer distances. This analysis was carried out using the multiple-ring buffer technique for each type of health facility—multiple ring buffer analysis using the ArcGIS software application. Multiple ring buffer analysis was carried out to obtain the extent of service coverage in each analysed radius. The next step is to intersect the district area so that the service area of the hospital and community health centres in each district is obtained.

The Level of Effectiveness of the Distribution of Health Facilities in Magelang Regency

The analysis of the effectiveness of the distribution of health facilities focuses on the ability of health facilities to serve affordably, indicating ease of access in

terms of distance. Identifying the effectiveness of the distribution of health facilities uses weighting based on the area served. In line with the research conducted (Dewantara & Urufi, 2021), the weighting formula is based on the area served (L) / health facilities with the following assumptions (Table 1).

Table 1: Value of Area Served of Health Facilities.

Area Served	Radius of Hospital (km)	Radius of Community Health Centers (km)	Value
L5	0 – 2	0 – 1	5
L4	2,1 – 4	1,1 – 2	4
L3	4,1 – 6	2,1 – 3	3
L2	6,1 – 8	3,1 – 4	2
L1	> 8	> 4	1

Weighting 1 to 5 is determined based on the parameters of the optimum service location of a network so that it can minimize the multiplication results between the shortest distances with the weights of all nodes originating from that network node (Rushton, 1979). Furthermore, this weight value is multiplied by the area based on the served radius with the following formula:

$$K = \frac{((L5 \times 5) + (L4 \times 4) + (L3 \times 3) + (L2 \times 2) + (L1 \times 1))}{(\Sigma L \times 5)} \times 100\%$$

The result of this calculation is the percentage value of affordability or effectiveness for each district which is categorized as follows:

- Very High if the affordability effectiveness is 75.01% - 100%
- High if the affordability effectiveness is 50.01% - 75%
- Medium if the effectiveness of the affordability is 25.01% - 50%
- Low if the effectiveness of the affordability is 0% - 25%
- Very Low if there is no health service coverage

ANALYSIS AND DISCUSSION

Health Facility Coverage in Magelang Regency

The placement of health facilities must consider accessibility so that it has implications for the optimal utilization of health services (Arif et al., 2018). This optimization is carried out by reducing the distance travelled to obtain basic needs and facility services based on the centre's service hierarchy (Sarwasih, 2020). Optimizing the reach of health services can improve community welfare, efficiency and cost-effectiveness (Arif et al., 2018). Health facilities have an essential role in improving the quality of health in the community, therefore; easy access to health service locations is one of the essential things to pay attention to

improve health services (Putri, 2018). The service level of health facilities is calculated by analysing the range of services. The analysis of the service reach of health facilities is classified into two: the analysis of the service reach of hospitals and the analysis of the service reach of community health centres.

Reach of Hospital

The analysis of the reach of hospital, health facility, is divided into four distance categories (Figure 1). The results of multiple ring buffer analysis show that the reach of the hospitals in a 2-kilometre radius covering an area of 5,161 Ha, 4-kilometre radius area of 11,032 Ha, radius of 6 kilometres covering an area of 12,520 Ha, radius of 8 kilometres covering an area of 15,370 Ha.

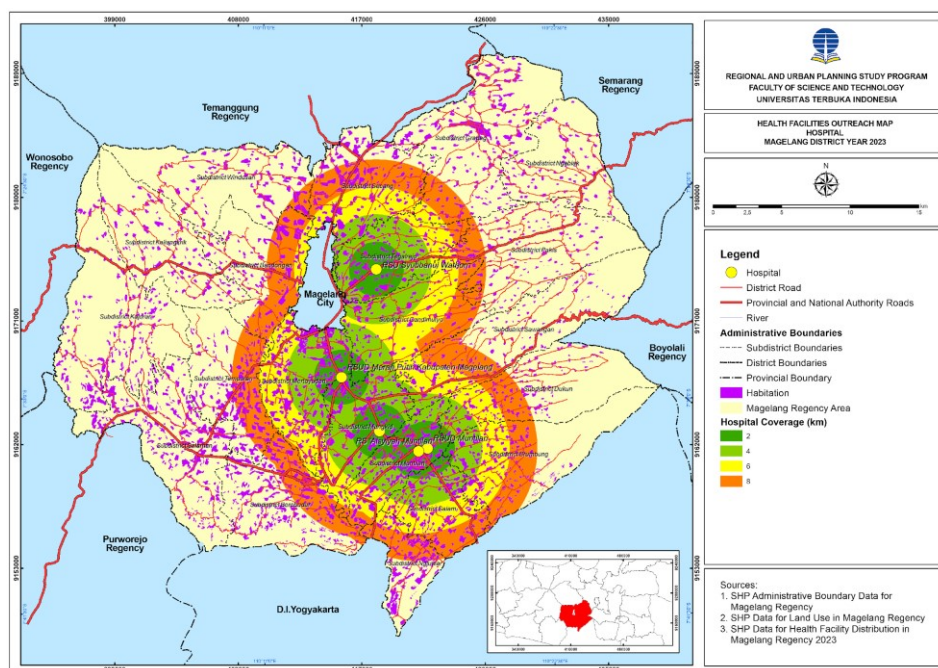


Figure 1: Multiple ring buffers at five hospitals.

The analysis of the reach of hospital in the Magelang Regency area shows that not all areas in Magelang Regency are covered by hospital health facilities. Several districts within a maximum radius of 8 kilometres are unable to reach the nearest hospital health facilities. The five hospitals in Magelang Regency that have reached health facilities are Kajoran, Kaliangkrik, Salaman and Ngablak District. The service coverage of hospital with a radius of more than 8 kilometres occupies 60.96% of the total area of Magelang Regency. Almost all

districts in Magelang Regency have reached health facilities yet in the form of hospitals optimally.

The percentage of hospital health facility coverage with a 75% -100% reaches only Candimulyo, Mertoyudan, Mungkid, Muntilan, Salam and Tegalrejo District. Affordability values between 50% -75% are Secang District and Srumbung District, and Hospital affordability with a percentage value of 25% -50% includes Bandongan, Borobudur, Dukun, Ngluwar, Sawangan and Tempuran District. The affordability of hospital around the district with a value of 0-25% includes Grabag, Pakis, Windusari, Kajoran, Kaliangkrik, Ngablak and Salaman District.

The highest range of hospital health facilities is in Ngluwar District at 98.19% and Muntilan District at 77.49%. It could be since several hospital locations are in the Muntilan District, which is adjacent to the Ngluwar District. Meanwhile, the district with a low affordability percentage value is located adjacent to Magelang City, where the number of hospitals in Magelang City has larger quantity with a narrower area. Districts with a low reach of hospital facilities can be served with health facilities at a level below the hospital (Heywood & Harahap, 2009). Health facilities can be reached, including health centres, auxiliary health centres, medical clinics, doctor's practices, and other health facilities (Haruna et al., 2019).

Reach of Community Health Centres

Magelang Regency has 29 community health centres spread evenly in each district. The classification of community health centres is divided into inpatient and non-inpatient classes. The health centres include in the hospitalization were Grabag I, Pakis, Sawangan 2, Borobudur, Salaman 1, Kaliangkrik, and Bandongan Health Center. While the other community health centres belong to in the non-inpatient class. The analysis of the coverage of community health centre facilities is divided into four categories (Figure 2).

The reach of community health centres within a 1-kilometre radius covers 8.06% of an area of 9,103 Ha. Community health centres within a 2-kilometre radius cover 22.37% of an area of 25,259 Ha. Community health centres within a 3-kilometre radius cover 27.58% of an area of 31,149 Ha. A 4 km radius within reach of the community health centres occupies 19.38% covering an area of 21,881 Ha. The reach of community health centres with a radius of more than 4 kilometres occupies 22.61% of the area of Magelang Regency covering an area of 25,532 Ha.

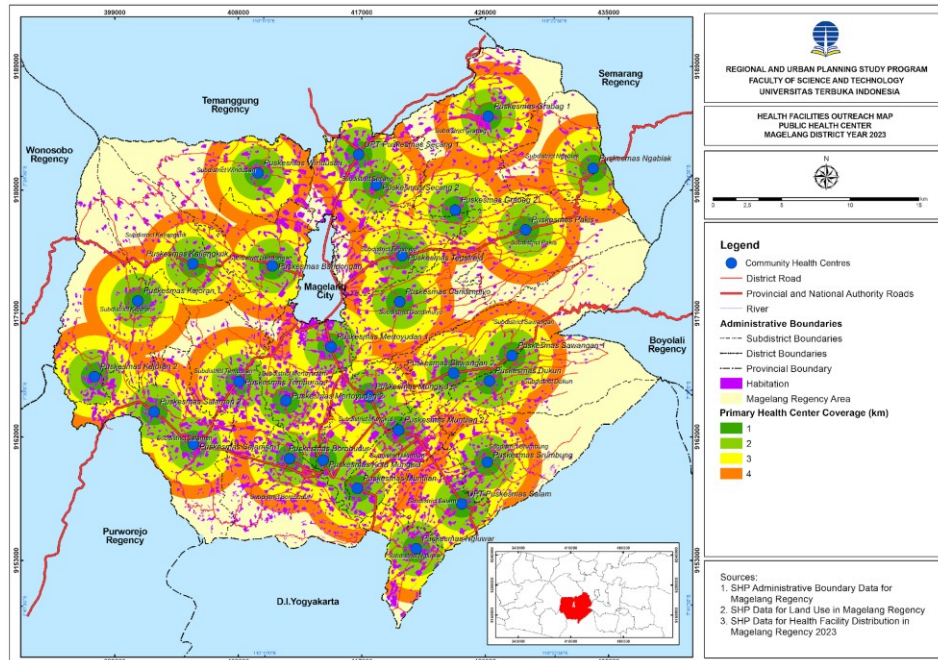


Figure 2: Multiple ring buffers at community health centres

The affordability of community health centres in the district area is obtained in the value category of 75-100% and 50-75%. Affordability value categories between 25-50% and 0-25% are not found. These results can be assumed that the affordability of health facilities in the form of health centres in Magelang Regency is in almost all areas served. The affordability category of community health centres with a value of 75-100% includes Bandongan, Candimulyo, Grabag, Mertoyudan, Mungkid, Muntilan, Ngluwar, Salam, Salaman, Secang, Tegalrejo, and Tempuran District. The percentage of reach of community health centres with a value of 50-75% includes Borobudur, Dukun, Kajoran, Kaliangkrik, Ngablak, Pakis, Sawangan, Srumbung and Windusari District.

The highest coverage percentage of health facilities at the health center in Magelang district includes Mungkid, Muntilan, and Salam districts. The districts cover 100% of the entire area of each district. Meanwhile, the five districts with the lowest coverage are Windusari, Srumbung, Sawangan, Dukun, and Kaliangkrik District. The district with the lowest coverage has implications for problems with accessibility to health facility services. Communities must travel longer distances to receive care and treatment services at the Puskesmas (Zainol & Pettit, 2016).

The Effectiveness Level of the Distribution of Health Facilities in Magelang Regency

The Level of Effectiveness of the Distribution of Hospital

The distribution of health facilities in the form of hospitals in Magelang Regency is expected to reach the entire community. The results of multiple ring buffer analysis at five hospitals were scored through weighting to get the level of effectiveness. The resulting categories are very high, high, medium, low, and very low effectiveness (Figure 3). A very high level of effectiveness can reach Muntilan and Mungkid Districts. The effective reach of hospitals in Muntilan District reaches 21.86% of the total area of the district. Mungkid district can be served with a very high level of hospital effectiveness, 9.78% of the district area.

The medium level of effectiveness covers Candimulyo, Mungkid, Sawangan, Mertoyudan, Muntilan, Dukun, Salam, Srumbung and Ngluwar Districts. The effectiveness of the distribution of hospitals in Salam District covers 34.62% of its area. Muntilan Hospital and Aisiyiah Hospital effectively distribute hospitals in the Salam District. Mungkid District can be served by a hospital distribution of 29.65% of its area. Hospitals that can serve Mungkid district are the Merah Putih Hospital, Gemilang N-21 Hospital, Muntilan Hospital and Aisiyiah Hospital.

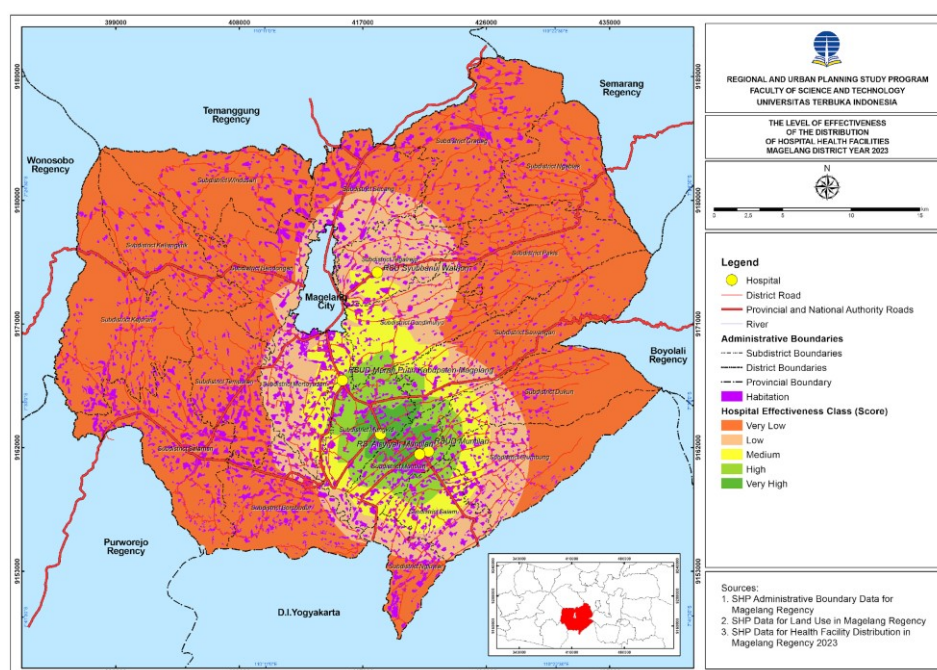


Figure 3: The Effectiveness of the Distribution of Hospital Health Facilities

The districts with very low effectiveness with a value of 100% are Grabag, Kajoran, Kaliangkrik, Ngablak, Pakis, Salaman and Windusari District. Other districts that are almost unreachable by hospital facilities with a range of percentage values of the sub-district area between 50-99% are Bandongan, Borobudur, Tempuran, Secang, Dukun, Ngluwar, Sawangan and Srumbung Districts. The level of effectiveness needs to be improved in almost all districts in the Magelang Regency.

Overall, the level of effectiveness is very high for the spread of hospital, reaching 0.94% of the total area of Magelang Regency. A very high level of effectiveness reaches the Muntilan and Mungkid Districts. The effectiveness of the distribution of hospitals at a high level reaches 3.63% of the total area. The area covered by the hospital at a medium effectiveness level is 5.90% of the total. Hospitals' low effectiveness level can serve 12.16% of the total area. The level of very low effectiveness covers almost all areas, with a total area of 77.37%. Although the effectiveness level in terms of hospital reach is low, lower-level health facilities, community health centres, can serve these areas.

Health service facilities' availability, distribution, and effectiveness in terms of location coverage, quantity, and quality are closely related to improving health facility services (Sadali et al., 2021). One of the indicators of community welfare in the health aspect is the increase in health facility services that are adequate and affordable for the community (Sadali et al., 2022). Improving the health and welfare of the population will produce reliable human resources. The strategy for improving the quality of human capital resources, the principle of efficiency, needs to be considered in planning the government's budget. If the efficiency level is high, government spending can decrease (Atmanti & Naylah, 2019).

The Level of Effectiveness of the Distribution of Community Health Center

The results of the analysis of the effectiveness of community health centres outreach can be divided into five levels (Figure 4). Results of the analysis of the effectiveness of the distribution of community health centres in Magelang Regency can be a percentage of the area of the district. The very low category covers 36.48% (41,195.85 Ha) of the district area. The districts with the highest scores in the very low effectiveness category were Windusari, Ngablak, Kaliangkrik, Dukun, Sawangan and Srumbung Districts. Meanwhile, the lowest scores were in the very low effectiveness category, namely Mungkid and Muntilan Districts. However, the community health facilities have served the area more optimally. The low category covers 37.97% (42,879.84 Ha). The medium effectiveness category occupies 20.99% (23,699.79 Ha) of the district's area. The effectiveness level of high distribution covers 4.14% (4,669.92 Ha) of the district area. The very high effectiveness category covers 0.43% (481 Ha) of the district

area. The very high level of effectiveness covers parts of Sawangan, Dukun, Mungkid, Mertoyudan and Borobudur Districts.

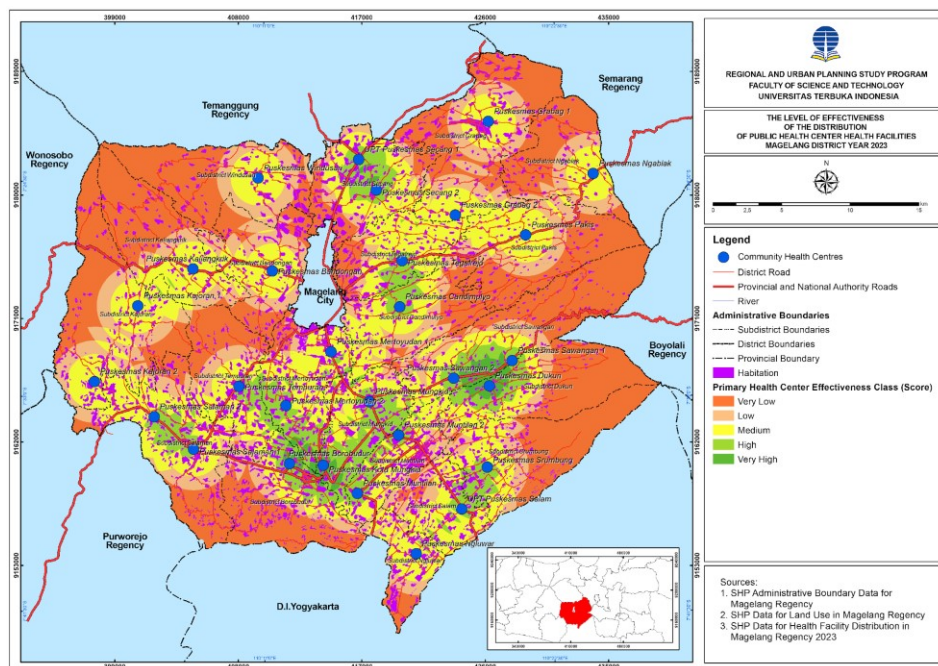


Figure 4: The Effectiveness of the Distribution of Community Health Centres

Most areas in Magelang Regency which are not served by health facilities in hospitals and community health centres are in high topography and belong to conservation areas. These inaccessible areas are in the Mount Merapi and Merbabu National Parks, and the Mount Sumbing and Menoreh Hills Areas. These areas are not covered by health facilities, such as hospitals and community health centres, and can be served by health facilities at the lower hierarchical level. Health facilities at the hierarchical level below hospitals and community health centres can be in the form of local health centres in every village, clinics/polyclinics, doctors' offices, etc. Minimum service standards at each level of a particular health facility, it will be possible to carry out an analysis regarding the level of fulfilment of service capacity or the effectiveness of service capacity of each health facility. Comparing the number of health facilities and the total population served are the parameter of the ideal number of health (Sadali et al., 2022).

CONCLUSION

The results of the analysis show that not all areas in Magelang Regency have access to hospital health facilities. The districts that have reached the health facilities of the five hospitals in Magelang Regency are Kajoran, Kaliangkrik, Salaman and Ngablak District. The affordability of health facilities in the form of community health centers in Magelang Regency shows that they can serve all districts which are out of the hospital covering radius. The outer areas like Kaliangkrik, Dukun, Sawangan and Srumbung Districts got limited access to health centers. It infers that the effectiveness of hospital distribution in Magelang Regency is concentrated in the southern part, especially on Jogjakarta-Semarang National Road. In general, the effectiveness of the distribution of community health centers is, however; evenly distributed and can cover almost all sub-districts. Overall, the Magelang Regency Government needs to enhance the quality of health facility services by enabling health centres that do not provide inpatient facilities to have inpatient services, particularly health centers in districts where people have not been able to reach hospital yet. The Magelang Regency Government is also recommended to improve accessibility to hospital to make the travel time can become more affordable. Since this research focuses on the range of services and the effectiveness of existing health facilities in Magelang Regency, a more in-depth study is needed to measure the accessibility of health facilities from settlements. Thus, it is highly recommended for future researchers to carry out more comprehensive research combining the reach of health facilities with economic and social aspects.

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TOURIST SATISFACTION AND PLACE ATTACHMENT: A VALIDATION IN GREEN INFRASTRUCTURE, HANGZHOU, CHINA

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Abstract

Green infrastructure (GI) constitutes important urban spaces and physical environments that contribute to scenic beauty, recreation opportunities, health, and wellness for tourists. However, the role of GI in tourism has not received much attention. This study aimed to validate the influence of tourist satisfaction on their place attachment in the context of GI. A self-administered survey was conducted at the selected GI locations of prominent tourist sites in Hangzhou West Lake, Zhejiang province, China. A sample of 225 domestic tourists was surveyed using the convenient sampling approach. The data were analysed using correlation analysis, linear regression, and one-way Analysis of Variance (ANOVA) in Statistical Package for Social Science (SPSS) software. The major findings of this study validate the positive and significant influence of tourist satisfaction towards place attachment when tourists visit GI. Further results indicate that tourist satisfaction and place attachment significantly differed regarding education level. The findings provide empirical evidence for a deeper understanding of the role of GI in tourism.

Keywords: Green Infrastructure, Tourist Satisfaction, Place Attachment, Hangzhou

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INTRODUCTION

In tourism, green infrastructure (GI) is the key element that forms tourists' feelings and behaviours. It constitutes essential urban spaces and physical environments that provide tourists with leisure, sightseeing, and learning opportunities. GI refers to an interconnected network of green space that conserves natural ecosystem values and functions and offers multiple benefits to human beings (Benedict & McMahon, 2002). It comprises waterways, wetlands, woodlands, wildlife habitats, greenways, parks, ranches and forests, wilderness, and other greenery, along with open spaces in and around the city on all spatial scales. They show aesthetic images to cities by expressing values and beliefs, shaping varied outdoor spaces and landscapes.

Researchers and urban planners worldwide have proven that GI is an efficient and long-term strategy to solve the adverse effects that have emerged along with rapid development, like excessive tourism, gentrification, landscape degeneration, and pollution. As many scholars stated, applying GI can assure environmental safety, address stakeholder conflicts, prevent tourism sites from losing integrity and maintain sustainability (Ramli et al., 2023). However, GI is an indispensable part of tourists' experience during the trip, consciously or spontaneously. Few empirical studies have focused on this field. This study aims to validate whether tourist satisfaction affects their place attachment in GI to give an understanding of GI in tourism. In general, the research objective of this study is to examine the relationship between tourist satisfaction and place attachment in the context of green infrastructure.

LITERATURE REVIEW

Green Infrastructure

Green infrastructure has been defined in various ways, with the three most common approaches focusing on (i) linked green spaces, (ii) urban ecology, and (iii) water management (primarily referring to stormwater management). For example, Benedict and McMahon (2002) see GI as an interconnected green space network that conserves natural ecosystem values and functions and provides associated benefits to human populations. Similarly, Natural England (2011) defines GI as a strategically planned and delivered network comprising the broadest range of high-quality green spaces and other environmental features. In the context of ecology, the European Commission (2014) defined GI "as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings". In other cases, GI focused only on stormwater management, explicitly a stormwater management technique as a cost-effective, resilient approach to managing wet weather impacts (Matsler et al., 2021).

The utilisation of GI in the tourism sector is evident in various instances. One such example is the revitalisation of the Cheonggyecheon River, where the conversion of rigid engineering projects into GI has transformed the area into the famous tourist destination, Cheonggyecheon River Linear Park, which boasts a natural and wilderness-like environment. Beyond mitigating flooding risks, urban heat island effects, and local air pollution, it has also emerged as a prominent landmark in Seoul, South Korea. Another compelling illustration of successful GI implementation for transformation is observed in The River of Life project in Kuala Lumpur, Malaysia. The conversion from concrete channelising structures to an appealing green space has turned the river into a noteworthy tourist destination.

Satisfaction

Tourist satisfaction is essential for sustainable tourism management (Latip et al., 2021). Moutinho (1987) notes that satisfaction is primarily a function of pre-travel expectations and post-travel experiences. Similarly, Pizam et al. (1978) define tourist satisfaction as the result of the comparison between a tourist's experience at the destination visited and the expectations about the destination. Del Bosque and San Martín (2008) state that satisfaction is the individual's response to a cognitive process where the consumption experience is compared with his expectations. Others focus on the experience at the destination. For instance, Tse and Wilton (1988) suggest that the tourist evaluation of service does not depend on the gap between the expectation and the performance but on the actual perception of the service. Ozdemir et al. (2012) consider satisfaction composed of affective and cognitive aspects and essentially decided during the visit.

Place Attachment

Place attachment is a positive connection or emotional bond between a person and a particular place (Williams & Vaske, 2003). It has been widely applied to examine the relationship between tourists and destinations. The concept of place attachment has at least two origins. One would be the place theory in geography, which explains the relationship between man and place from human feeling, psychology, culture, ethics, and morality. The other aspect would be attachment theory in psychology, which is an affection bond or a tie between an individual and an attachment figure, a basic human need for security (Bowlby, 1982). Place attachment is an affective bond or link between people and specific places (e.g. Altman and Low, 2012). Within the backdrop of China, Lin et al. (2019) reviewed the research progress of place attachment and proposed that place attachment is the cognitive, emotional, and behavioural connection between people and places.

Relationship Between Tourist Satisfaction and Place Attachment

From the tourism perspective, several studies suggest that satisfaction is a precursor to developing an attachment to a place. For example, research from Ramkissoon et al. (2012) indicates that satisfaction positively impacts place attachment. Similarly, Çevik (2020) reported that park satisfaction positively and significantly affected park attachment. This notion aligns with the insights provided by Halpenny (2006), who reported that satisfaction with various aspects of a national park, including its natural features, social atmosphere, and the conduciveness of activities, contributes significantly to the overall development of place attachment. Accordingly, the following hypothesis is formulated: Tourist satisfaction with GI positively influences place attachment.

RESEARCH METHODOLOGY

Study Sites

The questionnaires were distributed to domestic tourists through a convenient sampling method at the two selected tourist attractions (Su Causeway and Flowery Pond) around Hangzhou West Lake, Zhejiang province, China (as shown in **Figure 1**) from 19th and 20th September 2023. These two sites were chosen from ten famous nationwide sites identified as "the ten scenic spots of the West Lake". Scattered in and around the West Lake, they are the most classic, complete, and influential works of poetically named scenic places, originating from Chinese landscape aestheticism with a prominent associative cultural character. Data collected at these two spots is considered impractical because they are the core attractions, and the viewing places (points) and appreciation themes remain unchanged over ten centuries. Besides, the two locations were chosen because they include a variety of GI (e.g., lakes, ponds, greenways, gardens, and characteristic plants, etc.) along with tourism activities (e.g., sightseeing, boating, fish watching, cycling, etc.). Also, each scenic place has associated literature, historical or artistic works, and stories that represent traditional Chinese culture's spiritual and emotional bonds.



Figure 1: The location of Hangzhou West Lake

Survey Instrument

The questionnaire includes 27 questions divided into four sections related to (i) demographics, (ii) travel information, (iii) tourist satisfaction, and (iv) place attachment. This questionnaire explains the concept of GI at the forefront before the questions because people are not familiar with GI, according to related research conducted by Straupe and Liepa (2018). Demographic information (6 items) and travel information (5 items) in this study were from Isa (2017) and Ab Dulhamid et al. (2022). Additionally, satisfaction is assessed using four items from Isa et al. (2022), Minh et al. (2023), and Latip et al. (2021), while place attachment is measured with 12 items adopted from Isa (2020), Xiang and Mohamad (2023).

Quantitative Approach

Following the exclusion of unfinished questionnaires or those filled out with identical responses, the dataset was refined to ensure the inclusion of only valid and complete submissions. Consequently, the adequate sample size for analysis comprises 225 completed questionnaires. This study employed a quantitative approach. The data obtained from the respondents were analysed using descriptive statistics, correlation analysis, simple linear regression, and one-way Analysis of Variance (ANOVA) in SPSS 25.0. The findings were compared and used as a guide in developing criteria and strategies for the tourism development framework in the study area.

RESULT

Demographic Characteristics

The respondents' profiles encompass the details of gender, age, marital status, educational level, occupation, and monthly income of each domestic tourist participating in this study, as presented in **Table 1**.

Table 1: Sample Demographic characteristics

Characteristics	Classification	Number	Percentage (%)
Gender	Male	133	59.1
	Female	92	40.9
Age	<18	3	1.3
	18 ~ 25	75	33.3
	26 ~ 35	85	37.8
	36 ~ 45	36	16.0
	46 ~ 60	24	10.7
	>60	2	0.8
Marital status	Unmarried	139	61.8
	Married	85	37.8
	Others	1	0.4
Education level	Middle school or lower	1	0.4
	High school or secondary specialised school	23	10.2
	University or college	109	48.4
	Postgraduate or higher	92	40.9
Monthly income (CNY)	<3000	47	20.9
	3000 ~ 4999	19	8.4
	5000 ~ 6999	37	16.4
	7000 ~ 8999	41	18.2
	> 9000	81	36.0
Occupation	Students	30	13.3
	Housewife	4	1.8
	Public sector employee	40	17.8
	Unemployed	6	2.7
	Self-employed	27	12.0
	Private sector employee	88	39.1
	Retired	7	3.1
	Others	23	10.2

Regarding gender, the participation breakdown reveals that 92 (40.9%) respondents are female domestic tourists, while 133 are male tourists. Concerning age, most respondents were between 26 and 35 years old, constituting 85 (37.5%) respondents. The second-largest age group comprises tourists aged 18 to 25, accounting for 75 (33.3%) respondents. As for the description of respondents' marital status, results show that 139 (61.8%) respondents are unmarried, and 85 (37.8%) respondents are married; no one chose "others" in this study. In all, 89.3% of respondents have higher education, namely university or college (48.4%) or postgraduate or higher education (40.9%).

The monthly income among respondents was recorded in Chinese Yuan, CNY (¥). Results show that the highest percentage of monthly income among respondents is more than ¥9,000 (36.0%), followed by 14 (21.2%) respondents who earn less than ¥3,000(20.9%), ¥7,000-8,999(18.2%), ¥5,000-6,999(16.4%), and CNY3,000-4,999 (8.4%). Regarding tourists' employment, the highest percentages were for private and public sector employees (39.1% and 17.8%, respectively). The lowest percentages were for respondents who were housewives (1.8 %).

Travel information

The travel information of the respondents (refer to **Table 2**) contains their origin, travel information, motivation to visit, time(s) of visit, and their main activities.

Table 2: Travel information

Characteristics	Classification	Number	Percentage (%)
Origin	Hangzhou	27	12.0
	Other cities of Zhejiang Province	14	6.2
	Jiangsu, Anhui Province or Shanghai	38	16.9
	Other provinces of China	146	64.9
	Travel Companion	Alone	37
Travel Companion	With tour group	7	3.1
	With families	65	28.9
	With friends	106	47.1
	Others	10	4.5
	Motivation	Sightseeing and vacation	170
Visit relatives or friends		21	9.3
Learn knowledge		14	6.2
Attend meetings or activities		4	1.7
Religious purposes		17	7.6
Shopping		17	7.6
Others		20	9.1
Time(s) of visit	1	85	37.8
	2	44	19.6
	3	34	15.1
	≥4	61	27.2
Main activities	Sightseeing	174	77.3
	Relaxation	153	68.0
	Socialising	44	19.6
	Taking photos	146	64.9
	Cycling	24	10.7
	Walking	170	75.6
	Other activities	4	1.7

Results from the travel information analysis of respondents found that the majority of respondents (64.9%) came from other provinces of China, followed by 38 (16.9%) tourists from Jiangsu, Anhui Province, or Shanghai (the

Yangtze River Delta areas). 27 respondents (12.0%) came from Hangzhou. Correspondingly, 14 (6.2%) came from other cities of Zhejiang province.

Out of 225 respondents, 106 (47.1%) respondents travelled with friends. Respondents who travelled with families accounted for 65 (28.9%). The number of tourists who travelled alone and with a tour group were 37 (16.4%) and 7 (3.1%), respectively. Most tourists came motivated by sightseeing and vacation (75.6%). While respondents visit Su Causeway and Flowery Pond for meetings or activities, they are the least. The repeat tourists are 62.2%, compared to the first-time visitors who are 85 (37.8%). In addition, the main activities in Su Causeway and Flowery Pond were sightseeing (77.3%), followed by walking (75.6%), relaxation (68.0%), and taking photos (64.9%).

Validation of Hypothesis

Correlation analysis

According to Fricker and Hengartner (2001), correlation can be defined as a statistical measure that helps to discover the extent of the relationship between two or more variables or even factors. Pearson Correlation Analysis was adopted in this research to show the significant correlation between tourist satisfaction and place attachment.

Based on Table 3, the results show a significant and positive correlation between tourist experience and place attachment, which is 0.742. Thus, it can be concluded that the relationship between the independent variable (tourist satisfaction) and the dependent variable (place attachment) is significant.

Table 3: Correlation analysis of tourist satisfaction and place attachment

	Place Attachment	Tourist Satisfaction
Place Attachment	1	
Tourist Satisfaction	.742**	1

** . Correlation is significant at the 0.01 level (2-tailed).

Regression Analysis

To test the research objective further, this study conducted a simple regression analysis using SPSS 25.0 to determine the effect of tourist satisfaction on place attachment. The results are presented below in Table 4, in which the R² indicates the degree of variability in the target variable explained by the model or independent variables. In this study, the value is 0.550, which means that the independent variable (tourist satisfaction) explains 55.0% of the variation in the dependent variable (place attachment), which was 0.550, representing 55.0%. The F-value of 78.186 was significant at the 0.001 level, indicating that the fit of the regression model in this study is promising. Thus, tourist satisfaction ($\beta = .685$; $p < 0.05$) positively impacted place attachment. The relationship between tourist satisfaction (TS) and place attachment (PA) can be described by the following simple linear regression equation: $PA = 0.685 * TS + 1.044$

Therefore, it can be concluded that tourist satisfaction can positively influence place attachment to a degree of 68.5%. This result aligns with Ramkissoon et al. (2012) and Çevik (2020), who also confirmed the positive impact of tourist satisfaction on their place attachment.

Table 4: The regression results among tourist experience and satisfaction on place attachment

Independent Variable	Unstandardised Coefficients		Standardised Coefficients	t-Value	Sig.
	B	Std. Error	Beta		
(Constant)	1.044	.318		3.279	.002
Tourist Satisfaction	.685	.078	.742	8.842	.000
R ²	.550				
F Value	78.186				
P-value	<0.001				

Note: The dependent variable is place attachment.

Further Analysis of Tourist Satisfaction and Place Attachment

To compare the performance of demographics on tourist satisfaction and place attachment, a one-way Analysis of Variance (ANOVA) was carried out. The Scheffe post hoc test located the significant differences among the education levels. The results of multiple comparisons are presented in **Figure 2**. It revealed that the differences between "High school or secondary specialised school" and "postgraduate or higher" (Sig = .010) and between "university or college" and "postgraduate or higher" (Sig = .035) were significant. The other differences in demographics were not statistically significant in this study. "High school or secondary specialised schools" and "universities or colleges" performed significantly better than postgraduate or higher on the satisfaction and place attachment post-test. This result is consistent with Ma et al. (2018), who also concluded that education level was negatively correlated with tourists' satisfaction with management and educational value among Chinese tourists.

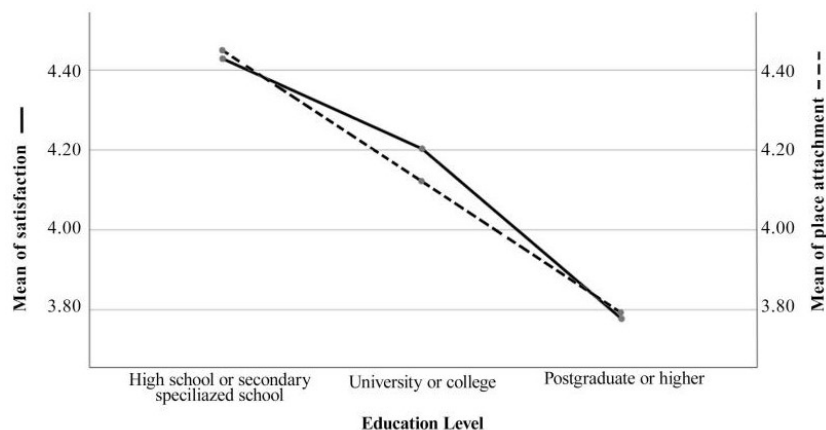


Figure 2: Multiple comparisons of education level on satisfaction and place attachment

CONCLUSION

The following conclusions can be drawn from the collected data and tests that were conducted. The motivation for domestic tourists to visit Su Causeway and Flowery Pond is predominantly centred on sightseeing and vacation. The results indicate that the primary activities at selected sites included sightseeing and walking, relaxation, and photography. For domestic tourists, tourist satisfaction and place attachment play crucial roles when visiting GI. Also, consistent with previous studies, the relationship that tourist satisfaction exhibits a positive and significant influence on place attachment is validated in the context of GI tourism. Furthermore, it is noteworthy that there were substantial differences in both satisfaction and place attachment based on education levels, a distinction not observed in other demographic factors. The result indicates that the higher-educated population showed lower satisfaction and attachment to the GI they visited. It is hoped that future research can make a horizontal comparison of different types of GI to understand its role in tourism further because this research only focuses on the people-place relationship, not the feature of physical characteristics.

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KNOWLEDGE AND ATTITUDE OF CLIMATE CHANGE ADAPTATION: THE VIEW OF MALAYSIAN UNIVERSITY STUDENTS

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Abstract

Sustainable consumption involves climate change adaptation. International organisations are emphasising and encouraging youth climate change preparation. This study examines undergraduate students' climate change adaptation knowledge and attitudes. A total of 384 undergraduate students from Universiti Malaya, Universiti Putra Malaysia, and Universiti Kebangsaan Malaysia responded to the survey. The findings showed a high level of knowledge and attitude among the students. The study also discovered significant and positive relationships between knowledge and attitude towards climate change. Furthermore, construct basic knowledge has a greater impact on climate change adaptation attitudes than risk perception. Their primary source of information is the internet. In light of these findings, internet information sources have an effect on students' knowledge and attitudes. This study provides an indicator of the youth's knowledge and attitude patterns, in order for policymakers and educational institutions to consider climate change adaptation more effectively.

Keywords: climate change adaptation; sustainable development; youth; belief; understanding

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INTRODUCTION

Children born around 2000 appear to live on a planet that is 0.8 °C to 2.6 °C warmer and where the sea level is 5 cm to 32 cm higher than in 1990 (IPPC, 2013). According to a World Meteorological Organization (WMO) assessment of a global report on climate change, the report found that weather, climate, or water disasters have happened every day for the past 50 years, killing 115 people and costing USD 202 million (WMO, 2021). The context and dimensions of climate change encompass the numerous causes and impacts of climate change on the human environment (Putri Setiani, 2020). Climate change causes landslides, intense monsoon floods, flash floods, droughts, and storms (Syafrina et al., 2017). Additionally, climate change exacerbates preexisting social and economic inequalities and disproportionately affects vulnerable populations (Mohammad Sabri & Ponrahono, 2024).

Malaysia is one of the Southeast Asian nations negatively impacted by El Nino in terms of regional climate anomalies and the socioeconomic well-being of its population (Syafrina et al., 2017). The flood of 2021–2022 was one of the most extreme flood disasters in Malaysian history, with losses of up to MYR 6.1 billion and daily evacuations of approximately 70,000 victims (Tew et al., 2022). These disasters risk affecting lives and livelihoods globally and cause extensive property damage if appropriate adaptation actions are not taken (Evangelista et al., 2017). More significant action is needed to reduce the impact on humans and the environment. Tang (2019) stressed that climate change adaptation in Malaysia is still inadequate and limited at the institutional and individual levels regarding data and public access. Therefore, this study aims to determine the level and relationship of knowledge and attitudes toward climate change among university students.

KNOWLEDGE AND ATTITUDE TOWARDS CLIMATE CHANGE

Public involvement adaption studies have focused on systems rather than individual response aspects (Oakes et al., 2016). Article 12 of the 2015 Paris Agreement reemphasizes the importance of education and communication (UN, 2015). Sustainable Development Goal (SDG) 13 of the UN Agenda 2030 seeks to "improve education, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning" (Cordero et al., 2020; United Nations General Assembly resolution, 2015). Agenda 21 recognises youth and children as one of nine civil society groups committed to sustainable development (Narksompong & Limjirakan, 2015).

Knowledge is one of the best ways to understand oneself and others (Ahmad et al., 2020; Phuoc et al., 2019). Knowledge acquisition includes cognitive characteristics, including perception, memory, learning, and prediction, which are called knowledge (Salas-Zapata & Cardona-arias, 2018; Saad et al., 2018). Attitude is "a condition of mental and nervous preparation that directly

determines a person's behavior toward all objects and events" (Ahmad et al., 2020). Attitude is also a predetermined psychological state, like a thought pattern developed before a person acts (Fishbein & Ajzen, 1975). Ajzen (1991) emphasised attitude evaluation in the theory of planned behaviour (TPB).

From a theoretical standpoint, TPB, Akrofi et al. (2019) found that environmental attitudes indicate climate action motivation. Climate change awareness and knowledge will influence these behaviours. Genc and Akilli (2019) suggested that education could increase knowledge and attitudes regarding new developments. As a result of the literature study, the researcher discovered that the construct for domain knowledge that has to be measured is basic knowledge and risk perception towards climate change adaptation. Attitude's realm is belief and experience. The researcher developed this study's conceptual framework (Figure 1).

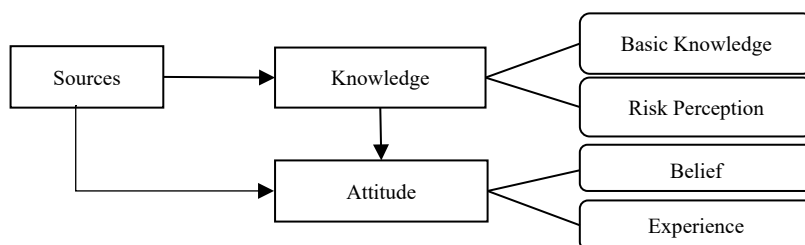


Figure 1: Research Framework

RESEARCH METHODOLOGY

Universities provide climate information to make social and cultural reforms for climate adaptation and mitigation (Barreda, 2018; Nursey-Bray et al., 2019). Thus, Universiti Malaya, University Putra Malaysia, and Universiti Kebangsaan Malaysia were chosen as study sites. These universities were chosen because QS World University Rankings ranked them highly in Malaysia (2021). Krejcia and Morgan (1970) estimated a sample size of 382 for a population of 75,000 but less than one million. The study population was selected using stratified sampling. This study requires undergraduate students aged 19–25 in their first, second, third, and fourth (if applicable) years of Bachelor's Degree studies. Table 1 shows the study's sample size by institute.

Table 1: Population and sample size

Institute	Population	Sample Size
1. Universiti Malaya	31,416	$31,416 \times 384 / 83,690 = 144$
2. Universiti Putra Malaysia	26,053	$26,053 \times 384 / 83,690 = 119.5 (120)$
3. Universiti Kebangsaan Malaysia	26,221	$26,221 \times 384 / 83,690 = 120$
Total	83,690	384

Knowledge and attitude questions were answered on a Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree). The total number of items was adjusted based on the results of a validity test conducted by three experts, followed by Cronbach's alpha value derived from 30 samples from other colleges. According to Majid Konting (1990) and Malhotra (1996), a Cronbach's alpha value that is above 0.6 has high reliability and can measure the research concept. The results revealed that all variables' Cronbach's alpha values exceeded 0.6: basic knowledge ($\alpha = 0.896$), risk perception ($\alpha = 0.668$), belief ($\alpha = 0.775$), and experience ($\alpha = 0.718$).

ANALYSIS AND DISCUSSION

This study includes 117 males (30.5%) and 267 females (69.5%). About 324 students (84.4%) were Malay, followed by 23 Indians and 23 Bumiputras from Sabah and Sarawak (6.0%) and 14 Chinese (3.6%). While 116 (43.2%) third-year undergraduates responded, followed by 96 (25%) second-year and 82 (21.4%) first-year students, about 39 (10.3%) and 1 (0.3%) fourth-year and fifth-year students, respectively. Next, most respondents were Muslims, with 340 (88.5%) students, followed by Hindu respondents, with 19 (4.9%) students. The remaining respondents were Buddhists and Christians, with 13 (3.4%) and 12 (3.2%) students, respectively.

Sources of Information about Climate Change

The highest results indicated that 332 students sourced information through internet sources (social media, Google Chrome, blogs, YouTube). The study by Anderson (2017) on the effects of social media on attitude, knowledge, and behaviour indicated there is some evidence that information sharing through social media could enhance awareness and inspire more environmentally friendly behaviour in people. From the 384 students, 178 and 154 sourced information from school/university and family/public, respectively. This result indicates that approximately only half of them acquired knowledge about climate change at their place of study.

In addition, there are also youth who obtain knowledge about climate change via radio, scientific books, and magazines/news, as shown from this study's respondents, with 109, 86, and 49 students, respectively. A total of 14 respondents chose other sources to obtain information, such as television, forums, and conferences about climate change. In conclusion, the internet is the dominant source for disseminating information about climate change. On the other hand, news and articles on social media enable communication to spread exceptionally quickly and cheaply (Aleksandrina et al., 2019). Al Yuosuf (2016) showed that education best predicts climate change awareness.

Level of Knowledge and Attitude

Table 2 shows that items 1 to 9 represent the basic knowledge construct, while items 10 to 14 represent youth risk perceptions of climate change. The results indicated that all the mean levels for basic knowledge are high because they exceed 3.66, with 4.43 (Item 2) being the lowest and 4.65 (Item 7) being the highest out of 5. The youth understand that technology and environmental, ecological, social, and economic aspects impact climate change. They also realize that deforestation, forest burning, CFC use, and fossil fuel combustion cause an increase in carbon dioxide (CO₂). Youth also understand climate change's impacts on people, ecosystems, and future generations. They also understand the physical risks, such as ozone depletion, sea level rise from ice melting, and prolonged droughts and floods.

The mean value for the risk perception construct shows that one item is at a moderate level (item 14) with a mean value of 3.38 out of 5. Meanwhile, the other four items show a high level of perception, with a mean value between 3.82 to 4.60 out of 5. The risk perception indicator shows youth concerns about climate change. Based on the results, youth agreed that developed countries cause climate change and developing countries are also affected. The results show that most youths agree that climate change has affected Malaysia but are unaware of its impacts on poverty and unemployment. Khan et al. (2020) found that climate change affects impoverished agricultural and rural communities in developing nations due to their low income and inability to adapt. Kamaruddin et al. (2021) state that while climate change affects everyone, people experiencing poverty and those in low-income countries take it more seriously. Climate variability has made livelihoods and poverty elimination more difficult (Aniah et al., 2019; Adzawla et al., 2020).

Table 2: Frequency and mean distribution of knowledge

Item	Mean	Standard Deviation
1. Climate change is a global phenomenon that affects both humans and ecosystems.	4.50	0.58
2. The relationship between technology, nature, society, and the economy is what causes climate change.	4.43	0.65
3. The threat posed by climate change to future generations.	4.48	0.67
4. Deforestation and forest burning lead to climate change.	4.63	0.57
5. Climate change is caused by chlorofluorocarbons (CFCs) such as insect repellents.	4.53	0.64
6. Carbon dioxide (CO ₂) emissions are caused by the combustion of fossil fuels (coal, gasoline, and natural gas) by automobiles and industry.	4.53	0.65
7. The depletion of the ozone layer increases the global temperature.	4.65	0.57
8. Rapid sea level rise caused by the melting of glacier saddles.	4.49	0.70

Item	Mean	Standard Deviation
9. Droughts, heavy rain, and extended flooding are the results of climate change events.	4.54	0.68
10. The effects of climate change will be more severe for developing nations (Malaysia, Indonesia, Thailand, Russia, etc.) than for developed nations (the United States, Norway, Australia, etc.).	3.82	0.95
11. Globally, developed nations are accountable for the consequences of climate change.	4.17	0.85
12. Humans are responsible for climate change.	4.60	0.58
13. In Malaysia, the effects of climate change are already being felt.	4.43	0.61
14. Climate change has increased poverty and unemployment.	3.38	0.93

Table 3 illustrates the mean distribution of attitude for items 1 to 11 in the belief construct and 12 to 15 in the experience construct. The results show that item 10 in the belief construct has a moderate mean value (3.30). Conversely, the other items are at a high level, between 3.91 to 4.61 out of 5. This result shows that the youth believe they are responsible for reducing the effect of climate change. They are also ready to adapt to climate change, such as using public transport. The youth also believe that natural resource exploitation affects future generations' health. Thus, the current generation must preserve natural resources for future generations. Strengthening the legislation and making green products companies accountable can help combat climate change. The respondents also believe climate change affects their family life but are unsure how it will change their lifestyle. All items predicting experience have high mean values of 3.95 to 4.41 out of 5. This situation indicates that youth agree that climate change is causing malaria, increasing temperature, and affecting physical health, stress, and anxiety. Previous research has shown that the detrimental effects of pollution on human health are intimately linked to a dirty environment, which reduces the quality of life (Sahrir et al., 2022). Communities that rely on these ecosystem services can sustain their livelihoods from efforts to adapt, conserve, and preserve essential habitats. According to Kamaruddin et al. (2021), adaptation measures will help reduce greenhouse gas emissions, improve human health and welfare, and create green jobs by gradually shifting to a lower culture.

Table 3: Frequency and mean distribution of attitude

Item	Mean	Standard Deviation
1. It's great that I'm working to reduce global climate change.	4.50	0.57
2. Climate change is real.	4.62	0.55
3. I am willing to work towards climate change adaptation.	4.17	0.79
4. I am ready to take the necessary actions to reduce the effects of climate change.	4.33	0.68

Item	Mean	Standard Deviation
5. I believe that consuming more natural resources will endanger the health and well-being of people	3.93	1.12
6. I believe that legislation should be strengthened in order to protect the environment.	4.57	0.61
7. Public transportation is enjoyable for me.	4.10	0.95
8. We should ensure that future generations experience the same quality of living as we do today.	4.52	0.73
9. I believe businesses are accountable for minimising the use of packaging and discarded items.	4.52	0.63
10. My family has been impacted by global warming.	3.30	1.16
11. My lifestyle will alter due to climate change.	3.91	0.91
12. Malaria and other hazardous diseases are affected by climate change.	3.95	0.85
13. Climate change contributes to the rise in warm temperatures.	4.41	0.62
14. My physical health is likely to be affected by climate change.	4.22	0.78
15. The effects of climate change on my stress, anxiety, and depression are significant.	4.06	0.94

Relationship between Knowledge and Attitude

The Pearson correlation test determined the relationship between knowledge and attitude. The results demonstrate a moderate and significant positive association between knowledge and attitude with a correlation value of $r=0.608$ ($p=0.000$) (Table 4). Basic knowledge and risk perception are significantly related to belief and experience. Risk perception shows a weak positive relationship with belief ($r=0.499$) and experience ($r=0.455$). Thus, basic knowledge affects attitude more than perception in the knowledge construct.

Table 4: Pearson Correlation between knowledge and attitude

	Attitude
Knowledge	Pearson Correlation 0.608
	Significant (2-tailed) 0.000

Table 5: Pearson Correlation to all construct.

		Basic Knowledge	Risk Perception	Believe	Experience
Basic Knowledge	Pearson Correlation	1	0.497**	0.520**	0.408**
	Significant (2-tailed)		0.000	0.000	0.000
Risk Perception	Pearson Correlation	0.497**	1	0.499**	0.455**
	Significant (2-tailed)	0.000		0.000	0.000

A simple linear regression analysis was examined to determine a variable's connection, effect, and dominance variance. A summary model in Table 6 illustrates how much knowledge explains attitude variance. The result found the values of R squared ($R^2 = 0.370$) and adjusted R squared ($R^2_{adj} = 0.368$). Therefore, the total variance is 37%, and the knowledge factor explain 36.8% over attitude. Table 7 shows that the overall regression model is statistically significant in predicting a relationship between the knowledge factor and attitude with a significant value ($p = 0.000, p < 0.05$).

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.608 ^a	0.370	0.368	0.35540

a. Predictors: (Constant), Knowledge

Table 7: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	28.279	1	28.279	223.889	0.000 ^b
	Residual	48.250	382	0.126		
	Total	76.529	383			

a. Dependent Variable: Attitude

b. Predictors: (Constant), Knowledge

The coefficient table (Table 8) displays the standardized coefficient beta (= 0.608) and its significant value ($p = 0.000$). This result means that knowledge is positively related to attitude and is a significant predictor of attitude, with a beta value of 0.608 or 60.8%. The linear regression equation that can be formed is $DV = Constant + B \times (Knowledge)$ [Attitude = $1.418 + 0.632 \times (Knowledge)$].

Table 8: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	1.418	.187	7.587	.000	
	Knowledge	.632	.042	.608	14.963	.000

a. Dependent Variable: Attitude

This research proves Ahamad and Ariffin (2018), Mohiuddin et al. (2018), Songlar et al. (2019), and Ahmad et al. (2020) findings that knowledge and attitude are statistically related. Ahamad and Ariffin (2018) stated that environmental knowledge is crucial for fostering an environmentally conscious attitude, and the two concepts are intimately interrelated. Mohiuddin et al. (2018) found that business students' environmental knowledge and awareness correlated

with their positive attitude toward environmentally efficient vehicles. In the study by Songlar et al. (2019), it was discovered that participants' knowledge was also a factor in their positive attitudes toward earthquake safety and security. While, in Ahmad et al. (2020), consumer views towards green fashion innovation were positively influenced. This study found that basic knowledge influences youths' climate change attitudes more than risk perceptions.

Relationship between source of information, knowledge, and attitude

Table 9 correlated sources of information with climate change adaptation knowledge and attitudes. The Internet had a significant negative connection with knowledge ($r = -0.208$, $p = 0.000$) and attitude ($r = -0.177$, $p = 0.000$). Ahamad and Ariffin (2018) found that social media, followed by television and newspapers, was the best source of environmental education for students. According to Anderson (2017), a study found that sharing information on social media may raise awareness and inspire pro-environmental behaviour.

Table 9: Relationship between source of information with knowledge and attitude

	Source of knowledge	Knowledge	Attitude
Internet	Pearson Correlation	-0.208**	-0.177**
	Significant (2-tailed)	0.000	0.000
Radio	Pearson Correlation	-0.004	-0.044
	Significant (2-tailed)	0.942	0.385
Scientific Book	Pearson Correlation	-0.086	-0.033
	Significant (2-tailed)	0.094	0.513
Magazine/News	Pearson Correlation	-0.089	-0.140**
	Significant (2-tailed)	0.082	0.006
School/University	Pearson Correlation	-0.161**	-0.080
	Significant (2-tailed)	0.002	0.117
Family/Public	Pearson Correlation	-0.116*	-0.010
	Significant (2-tailed)	0.023	0.840
Others	Pearson Correlation	-0.012	0.067
	Significant (2-tailed)	0.813	0.192

However, Gronlund and Berrocal (2020), Shen et al. (2020), Valois et al. (2020), and McKenzie (2021) found that science and environmental understanding only sometimes enhance concern or action. School/university information sources had a strong relationship with knowledge but not attitude ($r = -0.161$, $p = 0.002$). According to Thomas et al. (2015) and Barreda (2018), positive or negative attention to climate change drives knowledge. Salehi et al. (2016) demonstrated that existing knowledge could greatly impact students' ability to accept new understanding and affect how they evaluate, judge, and memorize. Mahat et al. (2017) and Cordero et al. (2020) added that environmental preservation should be taught early to establish attitudes, values, responsibilities,

and skills. Family/public also negatively affects knowledge ($r = -0.116$, $p = 0.023$). Saptutyingsih et al. (2020) found that friends and family can help people learn about adaptation and assess climate change risks.

Dirani et al. (2021) found that public relations can help small family farmers implement sustainable climate change adaptation practices. This study supports Nor Diana et al. (2022) finding that family members influence farmers' climate change adaptation knowledge. In addition, Attitude also negatively correlates with magazine/news reading ($r = -0.140$, $p = 0.006$). Rode et al. (2021) explained that motivated reasoning can occur in information selection (e.g., news sources) and information processing (i.e., how one's beliefs change in response to new information). According to Chen et al. (2019), mass media organisations, including newspapers, magazines, radio, and television, are significant market voices offering society news and reports fundamentally different from firm-initiated advertising messaging.

RECOMMENDATION AND CONCLUSION

Abdul Malek et al. (2022) state that in the Malaysian context, most young people are under the impression that they can make small adjustments at the community level, while a small number of them are of the opposite opinion. Thus, future research can investigate the practices or behaviours of youth to determine how they can adapt to climate change. This study only used a quantitative methodology to describe their perspectives based on the instrument developed. In future studies, it is advised that future research develop instruments based on present issues that are more in-depth about climate change adaptation. Monroe et al. (2017) also proposed that a survey of research publications cannot adequately describe the state of climate change education and policy. However, more research is needed to comprehend the response of nations to climate change and the benefit or expense of a national curriculum that determines how this issue will be delivered.

In conclusion, this study contributes to understanding the relevance of understanding university students' views on climate change adaptation. This study's findings support the advancement of knowledge on climate change adaptation. In addition, politicians, institutions, and non-governmental organisations can embrace it as a guide to enhance the knowledge and attitude of Malaysian youth on climate change.

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COMMUNITY PARTICIPATION, COMMUNITY READINESS, AND PREFERENCES TO PROMOTE EDU-TOURISM IN MANGROVE AREAS OF TELUK AWUR VILLAGE, JEPARA, INDONESIA

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Abstract

Community readiness is a crucial element in tourism development, essential for the sustainability of mangrove edu-tourism. The development of mangrove edu-tourism can also provide co-benefits to the community. This study analyzes community readiness and preferences for involvement in edu-tourism development in Teluk Awur, Jepara, Indonesia. Quantitative methods with scoring techniques were used to assess community readiness based on sustainability indicators and criteria such as capacity building, participation, awareness of sustainability, and local resource utilization. The results indicate that community readiness scores are low, showing unpreparedness for edu-tourism development. This lack of readiness is attributed to insufficient capacity building and community participation. The study recommends educating the community about the co-benefits of mangrove edu-tourism to enhance their participation and capacity.

Keywords: edu-tourism, mangrove, community readiness, co-benefit

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INTRODUCTION

Edu-tourism has become a notable trend in recent years. Although its popularity has declined somewhat, many tourists still choose this form of tourism (Badan Otorita Borobudur, 2022). Ritchie (2003), as cited in Alipour et al. (2020), described edu-tourism as encompassing educational activities, learning, and knowledge acquisition. Edu-tourism can be categorized into various types based on the potential of specific objects or places, such as ecological tourism, heritage tourism, village tourism, and community tourism (Smith, 2013). In developing edu-tourism, both natural and human resources play crucial roles and can be integrated to form a strong foundation for tourism (Ilham, 2018).

Mangrove forests play a crucial role in life on earth, particularly for coastal communities (UNDP, 2021). Mangrove conservation offers co-benefits, especially in the economic sector, food security, tourism, and culture, as noted by Setiadi and Nadhiroh (2021) in Handayani (2021). Co-benefits are defined as indirect or secondary benefits resulting from a program (Handayani et al., 2021). The World Bank, as cited by Floater et al. (2016), provides a slightly different definition, describing co-benefits as benefits received by the local environment from mitigation and adaptation actions aimed at addressing global climate change. These co-benefits include increasing the area available for agriculture and creating public spaces around infrastructure development sites. Given the significant benefits of mangrove forests, edu-tourism was selected because education is key to understanding and implementing the sustainability pillars (economic, social, and environmental) (Jones et al., 2016).

Teluk Awur has potential for mangrove forest edu-tourism due to the presence of mangroves in the area. This mangrove forest also serves as an erosion barrier around the Marine Science Techno Park (MSTP) in Teluk Awur and has potential as an edu-tourism site. MSTP Teluk Awur can generate co-benefits in the economic, tourism, and cultural sectors. Using approaches such as Small Urban Parks can offer socio-economic benefits that mitigate the adverse impacts of climate change, including improved physical and mental health, social cohesion, and economic development (Sabri & Ponrahono, 2024).

An example of mangrove forest development as a tourist attraction is Wonorejo Mangrove Forest Tourism in Surabaya. According to Mochammad and Umilia (2021), this tourism site has provided significant benefits to the community. These benefits, as stated by Umam et al. (2015), include social comfort, job creation (economic), and numerous business opportunities in agribusiness, such as the mangrove syrup and mangrove chips industries derived from mangrove fruit. Another example is the mangrove ecotourism in Sei Nagalawan Village, Perbaungan District, Serdang Bedagai Regency. Harahap and Absah (2020) noted that this ecotourism offers knowledge about mangroves. Local communities actively manage mangrove ecotourism by utilizing coastal

natural resources to support economic situations, either individually or in groups. While ecotourism is often linked to nature conservation, effective natural resource management still emphasizes conservation and allows tourism policymakers and communities to oversee nature-based tourism (Junaid et al., 2023).

Both studies highlight activities in mangrove forest tourism and strategies for edu-tourism development in these areas. However, few studies address community readiness and preferences, as discussed by Alipour et al., (2020) and Wijaya et al. (2020). This study differs from the previous ones by incorporating additional criteria. It not only uses the sustainability dimensions from Alipour et al. (2020), but also includes criteria such as community capacity building, community participation, awareness of sustainability aspects, and local resource utilization as noted by Wijaya et al. (2020). Interest in mangrove co-benefits has increased due to their role in climate change mitigation through blue carbon storage in coastal areas. With high carbon storage capacity and biodiversity, mangroves offer co-benefits for both climate change mitigation and biodiversity conservation.

The purpose of this study was to assess the readiness and preferences of the people of Teluk Awur Village for developing mangrove-based edu-tourism at the Marine Science Techno Park (MSTP) Teluk Awur. The assessment focused on evaluating community readiness for the development and enhancement of mangrove edu-tourism. The variables and indicators were derived from previous studies and adapted to the study location. A scoring method was used to assess community readiness, and a Likert scale was employed to gauge community involvement preferences. The results from identifying the level of readiness and community preferences were used to formulate recommendations for increasing public awareness and participation in mangrove forest co-benefits.

RESEARCH METHODOLOGY

Research Area

Teluk Awur Village is located in Tahunan Sub-district, Jepara Regency, Indonesia. The village spans an area of 1.45 km² and is adjacent to the Java Sea coast to the north. It houses the Marine Science Techno Park (MSTP) Teluk Awur, a key location for tourism development (Figure 1).

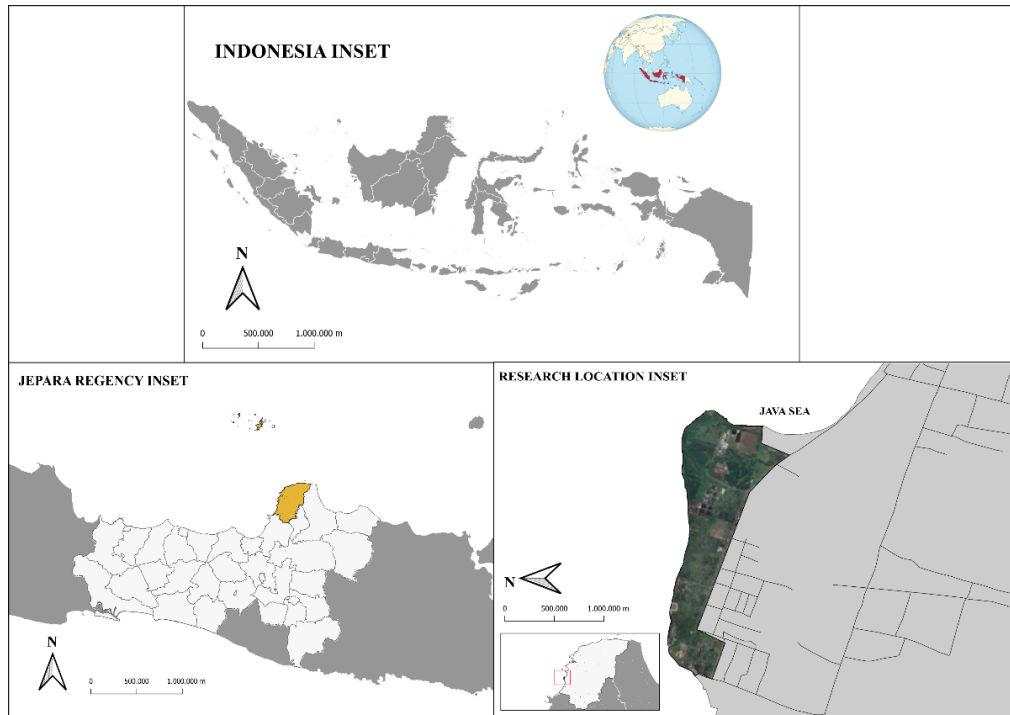


Figure 1: Location of Primary Survey Data Collection
Source: Orthomosaic drone file taken by SDGs Center of Universitas Diponegoro, 2023

MSTP Teluk Awur has the potential to develop mangrove forests into edu-tourism attractions. It is located along Jalan Teluk Awur, a district road that provides external accessibility and serves as the main route to the campus, connecting it to Jepara city center.

Analysis Technique

This research employed a qualitative approach with quantitative methods for data analysis. A primary survey was conducted, involving interviews and questionnaires administered to the community. Scoring analysis was used to determine community readiness, while the Likert scale measured preferences for edu-tourism. The research included the following stages:

- (1) Delineation of the research area, covering about 500 meters from MSTP Teluk Awur.
- (2) Preparation of 32 questionnaires corresponding to the number of houses in the delineation area.
- (3) Measurement of community readiness using scoring analysis.
- (4) Measurement of community preferences using the Likert scale.

Table 1: Variables and Criteria in the Community Readiness Assessment

Variables	Criteria	Indicator	Score
Social	Community capacity building	The provision of knowledge and skills to community groups regarding mangrove edu-tourism	Yes = "1" No = "0"
		The community has received training in mangrove tourism development	Yes = "1" No = "0"
		Information dissemination activities to increase public awareness on natural resource conservation	Yes = "1" No = "0"
		Establishment of a mangrove tourism management monitoring unit at the community level	Yes = "1" No = "0"
	Community Participation	There is already community group involvement in the development of mangrove edu-tourism	Yes = "1" No = "0"
Environment	Awareness of sustainability aspects	Awareness of the importance of mangrove maintenance in mitigating climate change	Yes = "1" No = "0"
		Awareness of the importance of mangroves as a habitat and food source for marine biota	Yes = "1" No = "0"
Economy	Local Resources Utilization	Community creativity is growing in terms of mangrove utilization	Yes = "1" No = "0"
		The existence of community economic development in the tourism sector	Yes = "1" No = "0"

(5) Source: Wijaya et al., 2020

Scoring Analysis

This research uses a scoring model to assess community readiness. According to Drobne and Liseč (2009), a scoring model (system) or Weighted Linear Combination (WLC) is intended to show the level of proximity, relationship, or weight of certain impacts of a phenomenon spatially. The formula used for the scoring analysis is taken from Sihotang (2016) and is explained as follows:

Calculating the lowest and highest scores:

$$X_{min} = \sum_{i=1}^n X_{min_i} \text{ and } X_{max} = \sum_{i=1}^n X_{max_i} [1]$$

Calculating the score range:

$$(X_{max} - X_{min})/m$$

Description:

Xmin = lowest score

Xmax = highest score

Xmin_i = the lowest score of the-i entered parameter

Xmax_i = the highest score of the-i entered parameter

n = number of parameters entered

m = number of classes required

Likert Scale

In this study, the Likert Scale was used to determine the preferences of the community in Teluk Awur Village regarding the development of edu-tourism at MSTP Teluk Awur. A Likert Scale is a psychometric scale commonly used in survey research (Taluke et al., 2019). The statements are weighted as follows: statements with the highest value of 3 are all positive, those with a weight of 2 include one positive and one neutral statement, and those with a weight of 1 are neutral or tend to be negative. The statement weights are: Agree and Want to Participate = 3, Agree but Do Not Want to Participate = 2, and Disagree/No Preference = 1.

RESULT AND ANALYSIS

The Condition of Teluk Awur Village Community in Welcoming the Development of Edu-tourism

Community attitudes towards tourism development are fundamental to sustainable tourism planning and management. This study analyzed the readiness of the community in Teluk Awur Village to respond to the development of mangrove edu-tourism from three aspects: environmental, economic, and social. Before conducting a scoring assessment, this research examined the current condition of the Teluk Awur community's perspective using a three-aspect approach.

In the environmental aspect, this research evaluates the extent to which people understand the importance of mangrove edu-tourism in maintaining coastal sustainability. From the economic aspect, it examines the community's response to developing businesses in the tourism sector to support mangrove tourism. In the social aspect, it assesses the level of community involvement in joint actions to preserve mangroves and information dissemination programs related to mangrove edu-tourism development. The study of existing conditions was carried out using questionnaires and direct interviews.

On the environmental aspect, there is still limited knowledge about mangrove ecosystems, which can absorb and store blue carbon from the atmosphere, helping to mitigate climate change (Sondak, 2015). Previous studies indicate that mangrove forests have a greater carbon storage capacity than almost

any other forest on earth. Carbon sequestration can be estimated by multiplying the mangrove area by the carbon stock value (Sejati et al., 2020). It is crucial to disseminate knowledge about the benefits of mangroves in mitigating climate change to the surrounding community to encourage participation in mangrove conservation. This can support efforts to achieve SDG 13, which focuses on Climate Action.

The physical benefits of mangrove conservation not only support SDG 13 but also contribute to SDG 11, which is related to Sustainable Cities and Communities. Community awareness of the benefits of mangroves in preventing abrasion, sea level rise, and erosion (Tresiana et al., 2022) is vital to fostering community involvement in mangrove conservation. This knowledge aims to raise public awareness and can serve as capital for developing mangrove edu-tourism. Surveys and interviews with the Teluk Awur community show that 65.6% of the community recognize the benefits of mangroves in preventing abrasion, 50% in preventing erosion, and 78.1% in reducing sea level rise. However, this awareness has not sufficiently increased public participation in mangrove conservation, and some people remain unaware of these functions.

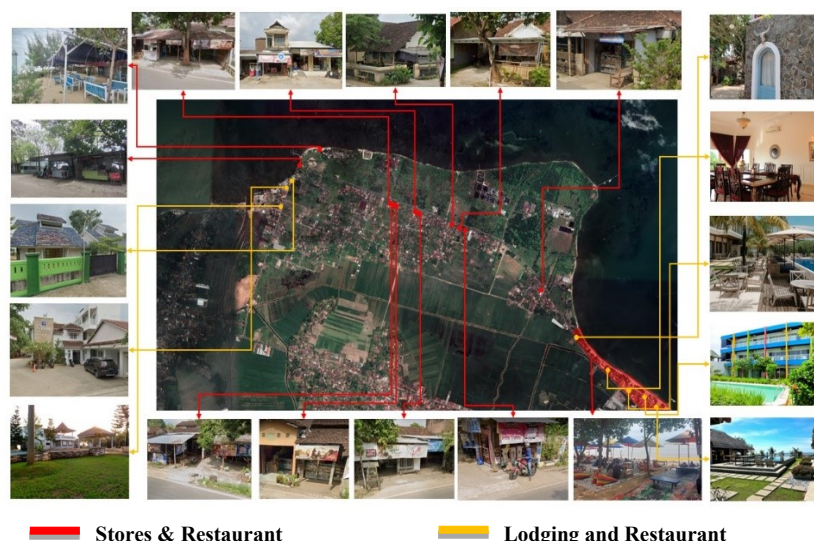


Figure 2: Distribution of community business around mangrove edu-tourism development.

Source: Analysis Result, 2023

Second, the condition of the community is seen from the economic aspect. The data shows that 59% of coastal communities in Teluk Awur have opened businesses such as stalls, boat rentals, and lodging around the location of mangrove edu-tourism development. **Figure 2** shows the distribution of

community businesses around mangrove edu-tourism development. However, access to places to open businesses is still limited to a few people, causing some to open stalls in their homes.

Utilization of mangroves from an economic perspective can be seen in how people can process mangroves into various products with selling value. Several studies have mentioned that mangroves can be processed into crafts, food, medicines, and cosmetics (Tresiana et al., 2022; Putri et al., 2020; Santoso et al., 2019; Abubakar et al., 2019). The results showed a lack of activities to develop mangroves into various tourism products due to insufficient training.

Third, community conditions related to edu-tourism development are also viewed from the social aspect. Field conditions indicate a lack of information dissemination activities related to building readiness for edu-tourism development. While mangrove conservation activities involving the community have existed since 2009, currently, there are no more planting or preservation activities that involve the community directly.

Community Readiness in Mangrove Edu-tourism Development

The assessment is based on community readiness criteria reviewed from several previous studies. In this study, four criteria are used to assess community readiness in mangrove edu-tourism development: community capacity building, community participation, awareness of sustainability aspects, and the use of local resources. The scores were obtained from questions asked to 32 communities living around the edu-tourism development location.

Based on the assessment in **Figure 3**, the highest score is on the indicator of awareness of the importance of mangroves as a habitat and food source for marine biota, with a score of 0.75, followed by the indicator of community economic development in the tourism sector, with a score of 0.59. The lowest score is on the training indicator in terms of mangrove tourism development and the formation of mangrove tourism management monitoring units at the community level, with a score of 0. Information dissemination activities to increase public awareness of natural resource conservation also have a relatively low score, with a score of 0.03, followed by the indicator of community group involvement in mangrove edu-tourism development, with a score of 0.19. The indicators with very low scores are included in the community capacity building and community participation criteria.

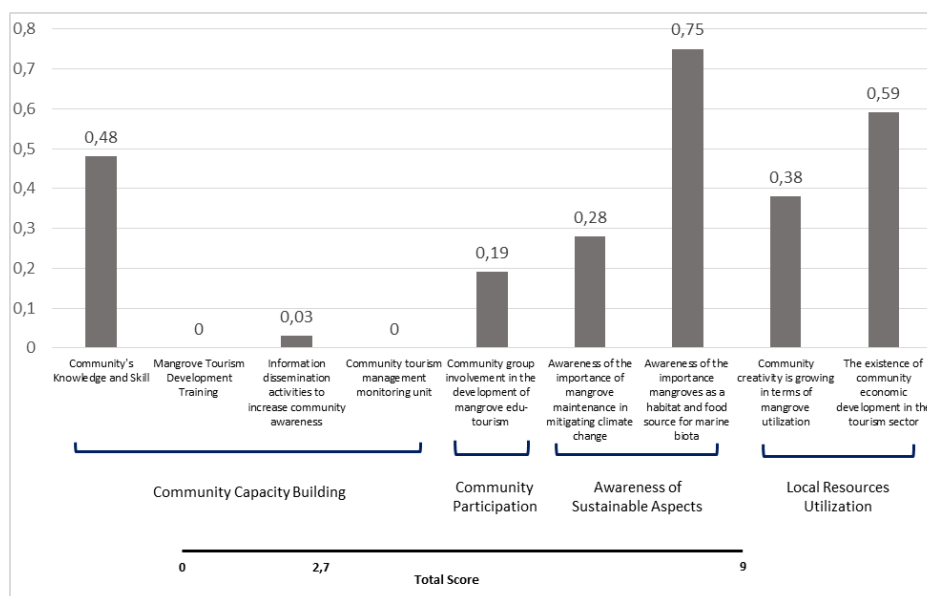


Figure 3: Graph of Community Readiness Score.
 Source: Analysis Result, 2023

Based on the assessment of all criteria, the results showed (see Figure 3) that community readiness was at a score of 2.7 out of 9. This score indicates that the readiness of the Teluk Awur community for the development of mangrove education is far from the maximum score. The low score in the criteria for increasing community capacity is due to a lack of information dissemination and training activities regarding mangrove-based tourism management and the absence of mangrove tourism management units at the community level. Meanwhile, the low score in community participation criteria is due to the lack of community invitations to be directly involved in the preservation and development of mangrove edu-tourism.

This assessment shows that community involvement in mangrove edu-tourism development is oriented towards environmental, economic, or social aspects. Previous research has shown that mangrove rehabilitation through community involvement provides many environmental benefits while economically helping local communities by providing income from ecosystem services (Ranjan, 2019). Based on the results in Figure 4, the primary orientation is on environmental aspects, followed by economic and social aspects. The highest score is in the environment because the community realizes the importance of maintaining the sustainability of their coastal area. The second orientation is on the economy, where the community is willing to open businesses around mangrove edu-tourism development if there are suitable locations. From

a social perspective, the community agrees on the need for collaborations in mangrove conservation.

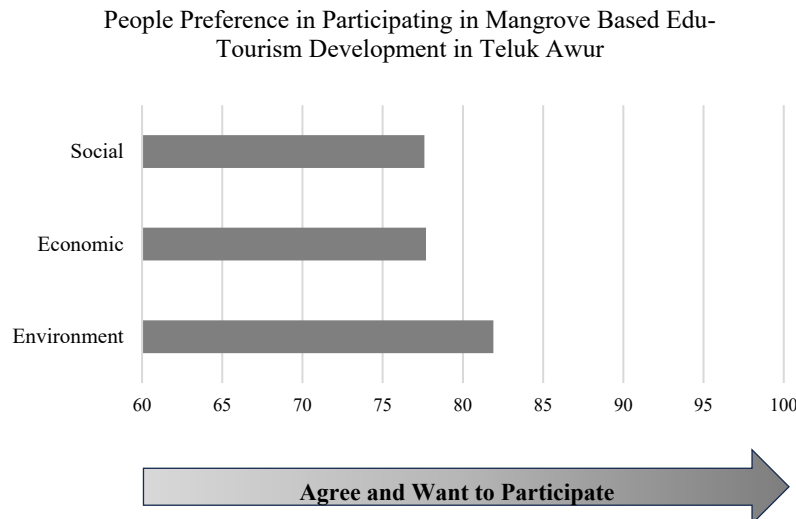


Figure 4: Score of People Preference in Participating in Mangrove Based Edu-Tourism Development in Teluk Awur.

Source: Analysis Result, 2023. Description: 0-33=Disagree, 34-66=Agree but do not want to participate, 67-100=Agree and want to participate.

Based on these results, it can be concluded that the community is willing to participate in mangrove conservation and edu-tourism development. However, the community needs the involvement of the village government or external parties, such as academics, to provide direction.

DISCUSSION: INCREASING COMMUNITY PARTICIPATION WITH MANGROVE'S CO-BENEFITS

Based on the research results, the low score of readiness is influenced by a lack of community participation, which is impacted by the absence of invitations for the community, lack of information dissemination, insufficient training programs, and the absence of a mangrove tourism management monitoring unit at the community level. Several previous studies have proven that the success of mangrove rehabilitation and conservation is determined by the participation of local communities, as they have a direct interest in the mangrove ecosystem.

Interviews with the Teluk Awur community revealed varying levels of awareness: some already knew; some had informal information; some had limited information; and some were unaware of the mangrove tourism development in their environment. This disparity in awareness has impacted the low score of

community participation in the analysis results. Community-based mangrove tourism development can provide opportunities for income distribution, thereby enhancing community welfare through economic independence at the village level (Snyder & Sulle, 2015; Sakata & Prideaux, 2013).

The development of sustainable mangrove eco-tourism requires a balanced role among stakeholders, including the government, private sector, and community (Putri et al., 2020). Promotional activities should be organized by all stakeholders, including relevant agencies and local operators (Mohamad et al., 2023). The analysis results show that the low score on community participation is also influenced by the absence of invitations or programs that involve the community in mangrove edu-tourism development. Village governments and initiators of mangrove edu-tourism development need to facilitate the community in accessing various needs, both material and knowledge. Infrastructure projects involve many key participants with different roles and responsibilities in project implementation (Ismail et al., 2024). While the government provides access, the community needs to increase its willingness and capacity to protect and utilize mangrove resources sustainably (Datta et al., 2012).

As stated by Floater et al. (2016), people are more likely to take action and support a program when there are additional benefits that impact their daily lives. Based on the analysis, the lowest scores are on the criteria for increasing community capacity and participation. To address this, the concept of co-benefits needs to be emphasized and communicated to the community. Co-benefits are generally indirect or secondary benefits resulting from a program (Handayani et al., 2021). Co-benefits can open opportunities for various parties by generating additional advantages. It is about how the community develops these co-benefits and how these benefits impact the community.

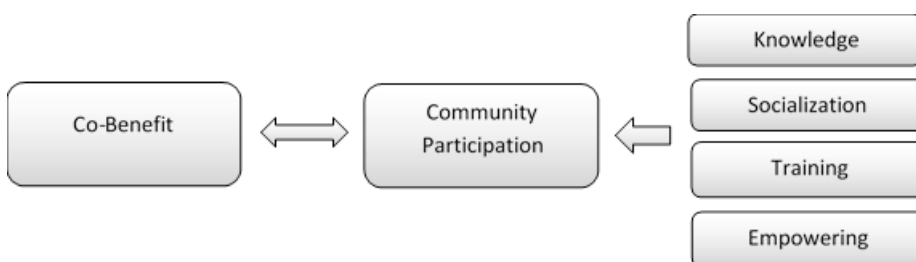


Figure 5: Concept of co-benefit linkages with community participation.
Source: Analysis Result, 2023

As shown in Figure 5, the existence of co-benefits and the level of community participation influence each other. Community participation is needed to determine the extent of co-benefits that can be generated, and co-benefits provide a reason for the community to be involved. Factors that can

support optimizing community participation include knowledge, information dissemination, training, and empowerment. Additional benefits arising from the development of edu-tourism need to be communicated to the community to increase participation and willingness to enhance their capacity.

Communities need to be facilitated in accessing funding, facilities, the latest market information, and tourism services to accelerate tourism economic development. This approach aims to help the community develop micro, small, and medium enterprises (MSMEs) independently and improve their economic standards (Putri et al., 2020; Singgalen, 2020). The achievement of mangrove co-benefits cannot be realized if tourism activities are not operational. Therefore, all parties, including the community, government, and managers, need to collaborate to ensure optimal development.

CONCLUSION

The results of the analysis of the Teluk Awur community showed that the score of the community readiness in mangrove edu-tourism development efforts is still low (2.7 out of 9). This study concluded that the low readiness score of the Teluk Awur community in the development of mangrove edu-tourism is strongly influenced by a lack of community participation, which is affected by the absence of invitations for the community, lack of information dissemination, insufficient training programs, and the absence of a mangrove tourism management monitoring unit at the community level. The low values of community participation and capacity indicate the need for efforts to improve these two criteria. The concept of co-benefits resulting from the mangrove edu-tourism development program needs to be emphasized to provide advantages for all parties. These benefits can synergize the roles of the government, tourism developers, and the community in developing edu-tourism together.

The government and mangrove tourism developers need the role of community involvement to develop tourism activities and realize this superior tourism. Meanwhile, the people of Teluk Awur Village need economic co-benefits arising from edu-tourism activities, such as new business opportunities in the tourism sector. To realize these co-benefits, the community needs assistance or facilitation from the local government or academics in accessing funding, facilities, the latest market information, and tourism services. By increasing the capacity and participation of the community, it is hoped that it will also increase the awareness and ability of the community to utilize local resources. Thus, the people of Teluk Awur can open new economic opportunities and contribute to maintaining the sustainability of the coastal area where they live.

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DISCLOSURE STATEMENT

The authors declare no competing interests that relate to the research described in this paper.

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MODELLING STUDY ON CENTRAL COURTYARD SHADING STRATEGY IN TROPICAL CLIMATE REGION MALAYSIA

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Abstract

A courtyard is an open multi-functional space and an effective daylight passive design strategy in a building. However, to have a courtyard in a tropical country, it had to deal with the issue of visual discomfort, which requires some consideration in adaptation to the climate condition. These visual comfort issues include inconsistent light distribution, inappropriate illuminance levels, glare, and a lack of shaded areas. The focus of this research paper is to address the solution of shading strategies towards the visual discomfort issues associated with courtyard spaces. The solution is done by modelling study method on courtyard ratios and courtyard configuration to determine the effect on the internal courtyard percentage shaded area. This research aims to explore the potential benefits of using courtyards as a daylight shading design as a strategy in buildings. Besides, it is also to examine courtyard design variables in enhancing visual comfort, particularly in the context of commercial building design in Malaysia. Kuala Lumpur is chosen to represent the tropical climate region. The aim is achieved by identifying optimum courtyard ratios that can improve daylight, shading, and visual comfort that make courtyards functional and usable spaces. Results show that a small and deep courtyard is found to be best suited to tropical climate conditions with the configuration of the courtyard's height being double the size or more than the size of the courtyard's width. This courtyard ratio is able to produce a full shaded area during daytime. While courtyard length does not have any impact on the percentage of shaded area, wide and narrow courtyard need to adapt to the tropical climate constraint by having aided shading strategies such as multi-layered height of trees, independent covered structures like a canopy or gazebo, shading panels, awnings, and extended roof overhangs.

Keywords: Courtyard, Shading Strategy, Commercial building, Visual comfort

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INTRODUCTION

Courtyard can be one of the passive design strategies for commercial building design in solving massive design issues and acting as a central hub of public activities (Mee, 2021). Other than thermal comfort, achieving good visual comfort carries the same crucial consideration in designing a space or a building. Despite the significant advantages of courtyards, research initiatives towards courtyard design requirements are scarce (Markus et al., 2017), especially in terms of daylight and visual comfort. As courtyards are imported from hot and dry regions (Edwards et al., 2006), there is a need for adaptation to tropical climate conditions. The allowable natural lighting in tropical climate regions might not work independently facing hot and intense solar radiation, which consequently causes discomfort and overexposure (Guedouh & Zemouri, 2017). This leads to visual discomfort issues for occupants who like doing activities in outdoor protected areas such as courtyards.

One of the visual discomfort issues identified at the courtyard includes inconsistent distribution of light. According to Indoor Environment and Well-Being-The Saint Gobain Building Science Handbook (2016), inappropriate illuminance whether too little or too much light can have a negative effect on the visual performance of the user when doing certain tasks such as reading, typing, and eating. Due to the inconsistency of light distribution, it leads to an uncontrolled illuminance level in the courtyard area. The other issue is glare as a courtyard is an open space exposed to direct sun exposure. According to Fekry, Elshazly and Almrazky (2015), the difficulty of doing various activities in an open space due to sun exposure led to an increase needs for specialised indoor space for other activities independently such as a hall and entertainment area. Besides that, issues of a lack of shaded areas are also part of the constraints that are affected by the tropical climate. Courtyard open space with a lack of shades always left empty or treated with minimal architectural and landscape elements leads to courtyard dysfunction, thus defeating the purpose of its existence in the first place (Madiah et al., 2022). All of these constraints contribute to the aim of the research, which is to seek an architectural approach that can help improve daylight, shades, and visual comfort that makes the courtyard a functional and usable space but is adapted to the tropical climate in Malaysia.

This paper identifies courtyard strategies for achieving visual comfort. By identifying courtyard criteria that relate to visual comfort, shading strategy as one of the visual comfort parameters is focused in order to investigate courtyard configuration to optimize shading, daylight, and visual comfort in tropical regions. The investigation examines the ranges and ratios of the courtyard that have a significant effect on the shaded area cast in the courtyard. Then, by studying the ranges, courtyard ratios that can achieve optimal visual comfort performance at the central courtyard are suggested.

LITERATURE REVIEW

Courtyard Criteria

Courtyards originated from the hot and dry regions (Edwards et.al., 2006) and have evolved in architecture for many centuries, from the 10th millennium B.C. until today in a modern world, expanding from both Eastern and Western countries. Starting from a small courtyard house, it later developed into a larger building such as a university or institutional building (Rong & Azizi, 2023). Though it has evolved in terms of its functions, courtyard characteristics and criteria share similarities across all regions. Literature review and observation of all commercial buildings with courtyards around Kuala Lumpur and Selangor were conducted, analysed and summarised. From these studies, it is concluded that the criteria for a courtyard consist of form, orientation, layout, ratios, elements, wall treatment, material, and colour. Based on its significant effects, only these criteria are selected: form, orientation, layout, and ratios.

Courtyard Form

In terms of courtyard form, it comes in two categories. The first category is based on forms (square, rectangular, circular, curvilinear, and others) and the second category is based on shape (O, U, L, T, Y, and others) (Ranjit, 2019). Rectangular and square forms are the most commonly adopted for a courtyard, even though there is no particular form that is considered the most suitable (Almhafdy et al., 2013).

Courtyard Orientation

In terms of orientation, one of the most important factors that affects the duration of sunlight in building design is site layout. There are two main issues affecting site layout: orientation and overshadowing (Paul, 2011). The factors with a direct impact on courtyard micro-climatic behaviour include the location of the sun, the direction of the wind, the shading effect, and radiant heat (Bagneid, 2006).

Courtyard Layout

Meanwhile, for the layout criteria, the spatial layout of the courtyards can be divided into four categories: centralised layout, decentralised layout, serial layout, and combined layout. In centralised layout, the courtyard space is at the core and becomes a central point of design. Decentralised layout is where the courtyard is surrounded by buildings, structures, and plants, with the buildings being scattered in the courtyard and connected by corridors. The serial layout is derived from the layout by organising spaces through a series of courtyards with a strong spatial sequence. The combined layout merges the first three layouts, with a courtyard system not only visible in the overall layout but also in its different sections (Sun et al., 2019).


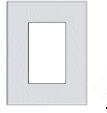

Courtyard Ratio

Mohsen (1979) developed a geometrical descriptor to have a better understanding of the courtyard's geometrical influences through several ratio descriptors, that are: R_1 as the ratio of perimeter to height (P/H), R_2 as the ratio of width to length (W/L), and R_3 as the ratio of the area of the top opening to the area of the ground (At/Ag). Besides that, Reynolds (2002) also described the courtyard descriptors as AR which is equal to the ratio of width to height (W/H), which is called the Aspect Ratio.

Comparative Studies

Every commercial building in Kuala Lumpur and Selangor with a courtyard was identified, observed, and analysed. Then, suitable case studies were selected based on the preset criteria. Three buildings that have been selected and meet the criteria are The Linc (Kuala Lumpur), Bangi Gateway (Selangor), and Tamarind Square (Selangor). However, each case study has its own constraints in the daylight shading strategy; each of the courtyards has been either covered by a roof or planted with trees. In solving the problem of the constraint, a based model was synthesised for the simulation method by building a courtyard model that can meet the optimum courtyard criteria.

Table 1: Courtyard criteria comparative case studies.

Criteria	The Linc	Bangi Gateway	Tamarind Square
Courtyard Plan			
Nos of Storey			
Building Height	10 m	15 m	20 m
Total Site Area	3.67 acre	6.0 acre	14.5 acre
Total Plan Area	8 860 m ²	17 000 m ²	33 000 m ²
Courtyard Area	890 m ²	2 940 m ²	7228.5 m ²
Courtyard Type	Open courtyard enclosed by 4 blocks	Covered courtyard enclosed by 4 blocks	Open courtyard enclosed by 4 blocks
Courtyard Form	Cube type	Flat Type (Square plan)	Cube type
Courtyard Layout	Decentralised	Centralised	Centralised
Courtyard Orientation	North West	North west	North
Courtyard Opening Ratio	10%	17 %	21.9 %

Criteria	The Linc	Bangi Gateway	Tamarind Square
Building massing			
Courtyard massing			
Courtyard Configuration	Small and deep	Wide and shallow	Wide and deep
Courtyard Ratio (Width: Length: Height)	2:3:1	10:6:2	5:5.5:2

RESEARCH METHODOLOGY

Simulation

Based model was developed for the purpose of comparative studies. From the comparative studies, shop lot is found to be the preferred approach as perimeter space in commercial building with courtyard. Shop lot size was constructed with the size of 6096 mm x 24384 mm (20 ft x 80 ft) based on the standard size of shop lot in Malaysia. Each side of the courtyard perimeter consists of four shop lots. Thus, this configuration creates a square shape of courtyard with the size of 24384 mm x 24384 mm with corridor all around in 3000m length, following the reference size of the smallest courtyard taken from comparative case studies, The Linc, Kuala Lumpur. Meanwhile, the high of each floor was set at 4m, for floor-to-floor height, referring to the standard height of commercial buildings in Malaysia.

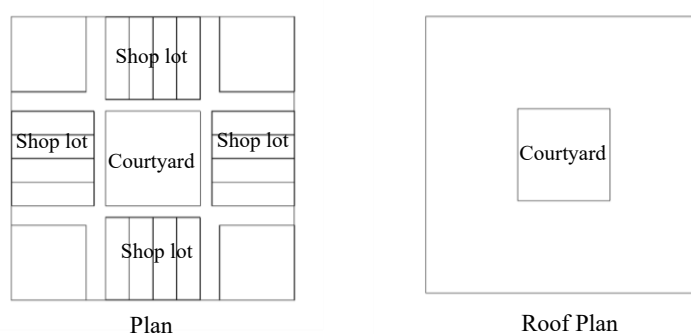


Figure 1: Based model layout for courtyard simulation

Study Parameters

The location of the study was set out at the capital city of Malaysia, Kuala Lumpur. The tropical region of the Earth is generally defined geographically as the area between 23.5° to the north latitude and 23.5° to the south latitude from the Equator. The city is located in west-central Peninsular Malaysia, with a latitude of about 3° North of the Equator (3°N, 101°E). The study was conducted on two different days in March and December, as in both days the sun represents the two extremes. March represents the highest noon altitude and December represents the lowest noon altitude (Zain et al., 2002). The two days fall on Sunday for each month, as Sunday was considered the most peak day for commercial buildings to be operated throughout the week.



Figure 2: Map of Malaysia and location of Kuala Lumpur
Source: mapsoworld.com

The simulation timing set up is from 10 a.m. to 10 p.m. based on commercial opening hours. However, only from 10 a.m. to 6 p.m. is the daylight exposure hour. Then, the time period for each simulation was divided into four phases of time in a day during the most peak hours. The phases were according to the dining hours: late breakfast (10 a.m.-11a.m.), lunch (12 p.m.-3 p.m.), tea (4 p.m.-5 p.m.), early dinner (6 p.m.). This dining hour was considered a simulation period because it is a peak hour for public to come and visit the commercial building and a crucial hour to consider the shading strategies for outdoor dining space at courtyard.

There are three variables involved in this research, namely courtyard height, courtyard orientation, and courtyard ratio. For courtyard height, the height is set at 2 storeys as the minimum height and 6 storeys as the maximum height. Each story height was set at 4 meters for floor-to-floor height level. For the second variable, courtyard orientation was examined in two stages. The first stage was to orient the courtyard towards North, South, East, and West. Then the simulation results were compared to the second stage of courtyard orientation that is facing towards North-East, North-West, South-East, and South-West. The last variable is courtyard ratios, and the ratios were divided into two ratios. The first ratio, R_1 , is a ratio of courtyard width to building height (W:H). Height in this simulation case is referring to the height of one block that casts shade area at the courtyard, while the other 3 blocks will remain constant. The height was added consistently according to the ratio of 1:0.5 to 1:>2 as per Table 2. The second ratio, R_2 , is a ratio of courtyard length to building height (L:H). In this case, the procedure was done by simulating the model into four ratios. Two sets of simulation models were set at constant length but with different heights, as per Table 3. The first set of the model height was set at same as the courtyard length, while the second set of the model height was set at twice the courtyard length.

R_1 = Ratio of courtyard width to building height (W:H)
 R_2 = Ratio of courtyard length to building height (L:H)

All of the simulation models were facing north except the simulation variable that involves courtyard orientation. The simulations that involve simulation are oriented towards eight main sun path orientations (North, South, East, West, North-East, North-West, South-East, and South-West).

Table 2: Relationship between Courtyard Variables and Study Parameter

Ratio		R_1, R_2	-	-	-	R_2
Height		2 storeys	3 storeys	4 storeys	5 storeys	6 storeys
Orientation	North	•	•	•	•	•
	South	-	-	-	-	•
	East	-	-	-	-	•
	West	-	-	-	-	•
	North-East	-	-	-	-	•
	South-East	-	-	-	-	•
	North-West	-	-	-	-	•
	South-West	-	-	-	-	•
Time	10 a.m.-11 a.m.	•	•	•	•	•
	12 p.m.-3 p.m.	•	•	•	•	•
	4 p.m.-5 p.m.	•	•	•	•	•
	6 p.m.	•	•	•	•	•

ANALYSIS AND DISCUSSION

The simulation was done by determining the variables that affect shading percentage cast on courtyard floor area. There are three variables involved in this modelling study. The variables are courtyard height, courtyard orientation, and courtyard ratio. These variables are a sequence from one finding to another. First, the modelling study was done on height variables. In this study, the highest height was chosen to study the orientation variables to see the effect on courtyard area. Finally, the findings on both variables lead to the final modelling of the courtyard ratio to find out the optimum ratio that provides the highest percentage of shaded area at the courtyard.

Independent Variables 1: Courtyard Height

The courtyard height simulation result is as per Figure 2. From the simulation, it is to find out that the percentage of shading area cast on the courtyard floor area is increased as the height is increased. Shadow is cast the most for 6 storey height and the least at 2 storey height. Shadow is cast full (or almost full) in the morning during late breakfast time (10 a.m. -11a.m.), during tea and early dinner time (4 p.m. – 6 p.m.) only for 4 storey height to 6 storey height, covering the whole courtyard area, but not for 2 storeys and 3 storeys. Meanwhile, during lunch hour (12 p.m. until 3 p.m.) the least shadow cast at the courtyard area is at 2 p.m., while the most it can reach is only half of the courtyard area. It is justified by the sun path position being at the centre and straight with no obstruction of any building block.

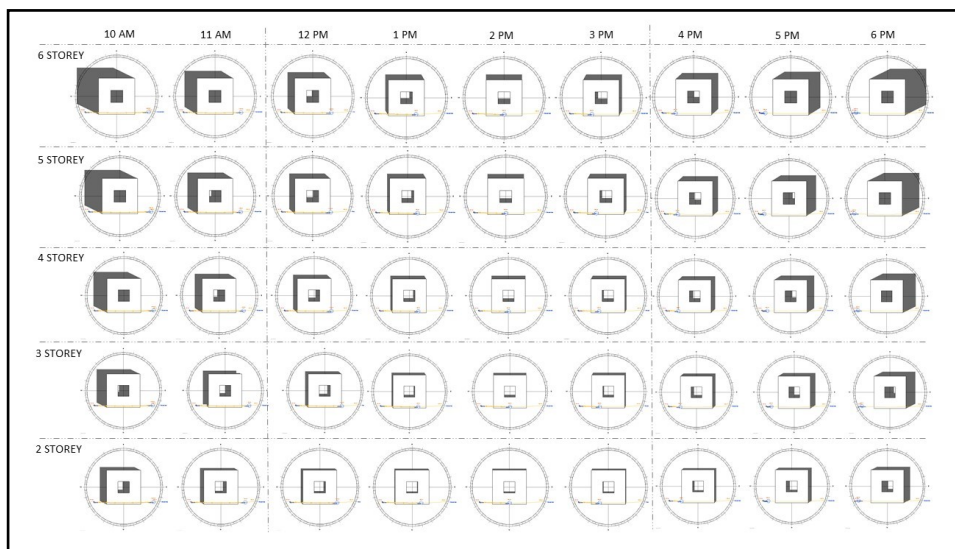


Figure 3: Courtyard height variable simulation result

Independent Variables 2: Courtyard Orientation

The courtyard orientation simulation result is as per Figure 3. From the simulation, it is to find out that the percentage of shading area cast on the courtyard floor area remains constant though the orientation is changed. For instance, during the brightest hour at 2 p.m., the percentage shadowed area is 50% for every sun path position. The percentage is not affected by the changes in the courtyard orientation, but only the position of where it is cast is different. For north-oriented courtyard, the shadow is casted at the bottom part of the courtyard area, while for south-oriented courtyards, the shadow is cast at the top part of the courtyard area. For east-oriented courtyards, the shadow is cast at the right part of the courtyard area, while for west-oriented courtyards, the shadow is cast at the left part of the courtyard area. The percentage of shaded area of all orientations remains the same. This result also remains consistent for North-West and North-East as shown in Figure 3.

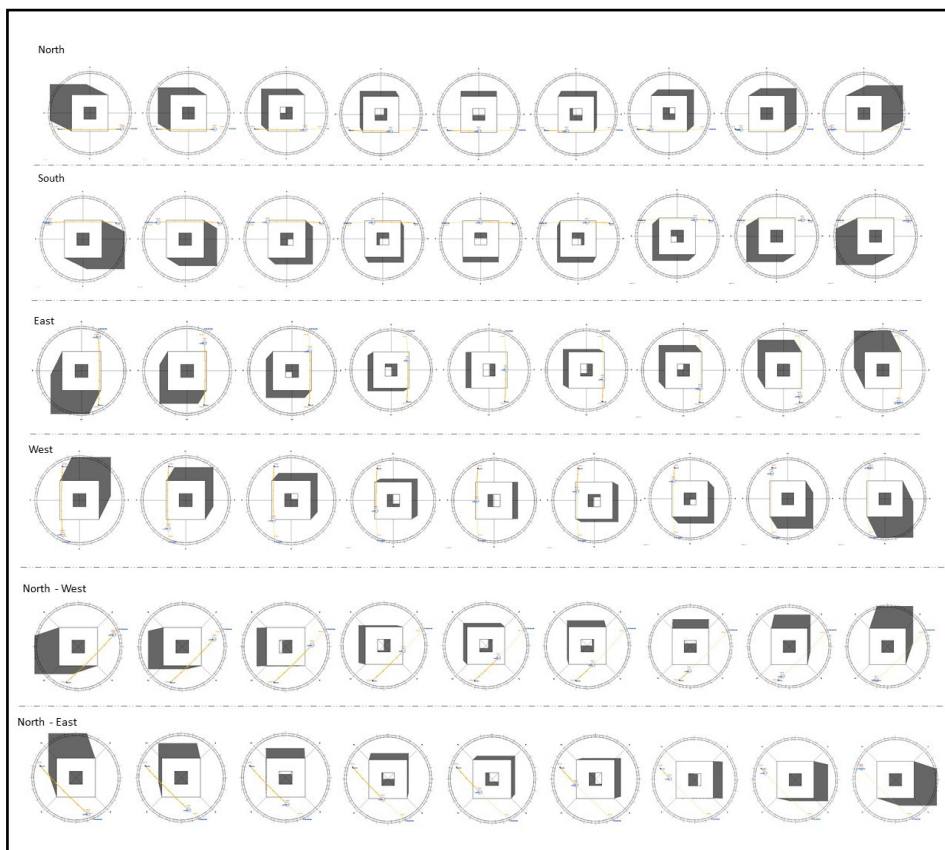


Figure 4: Courtyard orientation variable simulation result.

Independent Variables 3: Courtyard Ratio

The courtyard ratio simulation result is presented in Table 2 and Table 3. From the simulation, it is to find out that the percentage of shading area cast on courtyard floor area is increased as the ratio is increased for simulation R_1 . Meanwhile for R_2 , the percentage of shaded area remains the same though the length is changed. For R_1 simulation result, when the ratio is 1:1, the percentage of shaded area cast only reaches up to 50%, which means a ratio less than 1:1 will achieve less. Meanwhile, the courtyard only achieved 98% shaded area by the ratio of 1:2. This result indicates that when the ratio is more than 2 (1:>2) only the courtyard floor area will be shaded up to 100%. In this case, as the courtyard is 24m in width, to achieve the ratio of 1:>2, the height needs to be more than 48m.

By the simulation with floor-to-floor level set at 4m per floor, it reaches 100% shaded area at 52m. For R_2 simulation result, as the length is changed from 1:1 to 2:1, no difference is detected in the percentage of shaded area. When the courtyard length is equal to 24m and the height is adjusted at 24m and 52m, the percentage is constant at 50% for both cases. While the courtyard length is equal to 48m and the height is adjusted at 24m and 52m, the percentage of shaded area resulted in 100% for both cases.

Table 3: Courtyard ratio simulation for R_1

Configuration	Sun Path Simulation				
R_1 = Ratio of courtyard width to building height					
Ratio	1:0.5	1:1	1:1.5	1:2	1:>2

Table 4: Courtyard ratio simulation for R_2

Configuration	Sun Path Simulation			
R_2 = Ratio of courtyard length to building height				
Ratio	1:1	1:2	2:1	2:2

CONCLUSION

From this research, it is found that a good strategy for courtyard design in a tropical climate is to design the courtyard with a small size (W x L) but deep in height, as it provides cool shades. Courtyard ratio for width: height (W:H) = 1:2 or 1:>2 is needed to cover all courtyard area with shades at all times (from 10.00 a.m. to 6.00 p.m.). Thus, the courtyard can be functional in the avoidance of glare without any aided shading strategy. Meanwhile, wide and big courtyards will allow more exposure to sunlight in tropical climate conditions. Therefore, it is not advisable to design in such a way as it will not provide enough shade. However, if the courtyard ratio does not meet the ratio of 1:2 or 1:>2 due to design constraints, another aided shading strategy is needed. Added shading strategies suggested to adapt to the tropical climate are multi-layered height of trees, shading panels, awnings, extended roof overhangs, and independent covered structures like a canopy or gazebo.

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AN INTEGRATED ANALYSIS OF GREEN HIGHWAY ASSESSMENT CRITERIA FOR SUSTAINABLE INFRASTRUCTURE DEVELOPMENT

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Abstract

In line with the Sustainable Development Agenda 2030, all industries are slowly moving toward a greener approach through their activities and practices. The construction industry is a major contributor to overall economic growth as it provides infrastructure and physical facilities for people. However, the activities involved have caused several environmental impacts, such as pollution, climate change, destruction of natural habitats, landfill waste, and overconsumption of global resources. Therefore, this study presents a comprehensive analysis on the infrastructure work, which is the green highway assessment. The assessment criteria and rating methods were derived from seven prominent frameworks, including Greenroads, WISE, GreenLITES, I-LAST, BE2ST, Greenroads Manual, and MyGHI. Moreover, this research evaluates these sustainable criteria across five elements of green highway development: sustainable design and construction activity, energy efficiency, environmental and water management, materials and technology, and social and safety aspects. This research adopted a systematic literature review and comparative analysis to identify commonalities, differences, and gaps in existing assessment frameworks, providing insights into the holistic evaluation of green highways and sustainable infrastructure projects. The findings of this research contribute to advancing the understanding of green highway initiatives, especially in the local context, and policy development in the field of sustainable infrastructure.

Keywords: Green Highway, Assessment, Criteria, Sustainable, Infrastructure

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INTRODUCTION

Innovation and infrastructure are goals in sustainable development. One element of infrastructure is highways, and Malaysia has seen rapid development of a large amount of highway infrastructure (Mohamed Anuar & Ahmad, 2018). The ratio of highways in Malaysia is considerably high compared to the population, with 68 meters per 1,000 urban population (Mohamed Anuar & Abdullah, 2020). In the early 1960s, construction projects, including highway construction, were observed to have adverse effects on the environment, resources, raw materials, and people (Mohd Nusa, et al., 2015). Gambatese & Rajendran (2005) agree that highway construction negatively impacts the environment, directly or indirectly. The construction of highways involves a wide range of activities, including deforestation and earthwork, which have a significant impact on global warming and climate change. Bryce (2008) emphasizes the importance of incorporating best practices that minimize the environmental impact of highway construction.

Most attention and effort in the development of sustainable construction globally has been devoted to buildings (Huang & Yeh, 2008). Experience in sustainable building is useful for promoting green highway construction, but there's limited literature on evaluating it. As a result, developed countries such as the United States and the United Kingdom have implemented green highway approaches to enhance environmental quality and minimize environmental harm. Green highway focuses on improving the environment, transportation system development, ecosystems, urban growth, public health, and surrounding communities (Mohd Affendi et al., 2013).

LITERATURE REVIEW

Overview of Green Highway

The lifecycle of highway construction involves various processes, namely planning, construction, and maintenance. A comprehensive analysis of current research reveals that the definition of a green highway varies based on the perspective of each researcher. Table 1 summarizes the definitions of green highway from previous researchers.

Green highways include more sustainable practices than modern construction techniques, aiming to maximize the lifetime of a highway (Bryce, 2008). Krebs (2009) defined green highway as an effort to go beyond compliance and leave the project area 'better than before' through community partnering, environmental stewardship, and transportation network improvements in safety and functionality. Green highway can also be defined as watershed-driven stormwater management; life cycle energy and emission reduction; recycle, reuse, and renewable; conservation and ecosystem management; and overall societal benefits (Malaysia Highway Authority, 2010).

Muench et al. (2011) defined a green highway as a roadway project that has been designed and constructed to a level of sustainability that is substantially

higher than current practices. In addition, a green highway is a highway constructed using materials that emit little to no pollutants and are environmentally friendly (Reddy, 2011). Green highway is also defined as an approach to help developers achieve a friendly environment, ecological responsiveness, and social responsibility to improve long-term profitability and gain a sustained competitive advantage (Zhang et al., 2011). Washington Department of Transportation (2013) defined green highways as an initiative to promote the use of cleaner fuels. Green highway is defined as a roadway design based on a relatively new concept that incorporates transportation functionality and ecological requirements (LLM & UTM, 2014).

Table 1: Definition of Green Highway

Researcher	Definition
Bryce (2008)	Sustainable practices are more advantageous to modern construction techniques as focus on maximizing the lifespan of a highway.
Krebs (2009)	An effort to go beyond compliance and leave the project area 'better than before' through community partnering, environmental stewardship and transportation network improvements in safety and functionality.
Malaysia Highway Authority (2010)	The watershed driven storm water management, life cycle energy and emission reduction, recycle, reuse and renewable, conservation and ecosystem management and overall societal benefits.
Muench et al., (2011)	Roadway project that has been designed and constructed to a level of sustainability that is substantially higher than current practices.
Reddy (2011)	Highway constructed using materials that emit no or low concentration of pollutants and are environmentally friendly.
Zhang et al. (2011)	Approaches for helping developers achieve friendly environment, ecological responsiveness and social responsibility to improve long-term profitability and gain sustained competitive advantage
Washington Department of Transportation (2013)	Initiative to promote the use of cleaner fuels.
LLM & UTM (2014)	Green Highway is a roadway design based on relatively new concept for roadway design that integrates transportation function and ecology.

Source: Bryce (2008), Krebs (2009), Malaysia Highway Authority (2010), Muench et al. (2011), Reddy (2011), Zhang et al. (2011), Washington Department of Transportation (2013) and LLM&UTM (2014)

Each of the aforementioned definitions of green highway listed above addresses similarities and differences regarding the various approaches to green highway. Based on the comprehensive review, it can be inferred that the concept of green highways represents a novel and forward-thinking approach to infrastructure development, aimed at fostering a safe environment and delivering ecological advantages for future generations. Green Highways can be

characterized as the utilization of recycle materials, effective ecosystem management, energy conservation, enhancement of stormwater runoff quality and management, and the maximization of societal benefits.

Green Highway Approaches

Several green highways approach available, which are Greenroads, Washington Internships for Students of Engineering (WISE), GreenLITES, Building Environmentally and Economically Sustainable Transportation (BE²ST), Illinois Livable and Sustainable Transportation (I-LAST), Greenroads Manual, and Malaysia Green Highway Index (MyGHI). Each approach has its own set of criteria and rating methods for evaluating green highways. These criteria may vary depending on the climate and can be similar or different across different approaches.

Greenroads

Greenroads is the pioneering green road rating system, which established in the United States in 2007. It serves as a voluntary third-party rating system for road projects, aiming to acknowledge and impulse the implementation of sustainable practices in roadway development. The categories of Greenroads are sustainable design, material and resources, stormwater management, energy and environmental control, construction activities, and innovation (Soderlund et al., 2008).

Washington Internship for Students Engineering

WISE is a program designed for engineering students. It established in August 2008 at the University of Missouri in the United States. The program's core objective is to explore and develop innovative strategies in the realm of sustainable transportation, with a particular emphasis on the concept of green highways. The key areas include watershed-driven stormwater management; lifecycle energy and emission reduction; recycle, reuse, and renewable; overall societal benefits; and conservation and ecosystem management (Bryce, 2008).

GreenLITES

The New York State Department of Transportation is committed to improving the quality of transportation infrastructure in ways that minimize impacts on the environment, including the depletion of irreplaceable resources (GreenLITES, 2008). GreenLITES was introduced in September 2009 as a self-certification program that aims to distinguish transportation projects based on their level of integration of sustainable design choices. GreenLITES has five main categories, which are sustainable sites, water quality, material and resources, energy and atmosphere, and innovation (GreenLITES, 2008).

Illinois Livable and Sustainable Transportation

The Illinois Livable and Sustainable Transportation (I-LAST) system established in January 2010 as a comprehensive rating system and guide. I-LAST serves as a robust sustainability performance metric system, jointly developed by the Joint Sustainability Group comprising of the Illinois Department of Transportation, the American Council of Engineering Companies-Illinois, and the Illinois Road and Transportation Builders Association. I-LAST has eight categories of green highway, which are planning, design, environmental, water quality, transportation, lighting, material, and innovation (Illinois Department of Transportation, 2010).

Building Environmentally and Economically Sustainable Transportation

Building Environmentally and Economically Sustainable Transportation is a manual that was initiated by the University of Wisconsin in 2010. BE²ST outlines six key components of a green highway. The components consist of material reuse or recycling, energy use, water consumption, global warming potential, life cycle cost, and hazardous waste (Recycled Materials Resource Centre & University of Wisconsin-Madison, 2010).

Greenroads Manual

The Greenroads Manual was published in 2011 by the University of Washington. It serves as an updated and enhanced version of the initial Greenroads publication from 2007. This comprehensive manual provides in-depth information on every project requirement and voluntary credit incorporated within the Greenroads Rating System. The Greenroads Manual consists of five main criteria of green highway: environment and water, access and equity, construction activities, material and resources, and pavement technologies (Muench et al., 2011).

Malaysia Green Highway Index

MyGHI introduced as an assessment tool for green highways in 2014. The MyGHI serves as a guide for promoting sustainability in roadway design and the adoption of green construction practices. It outlines five categories for the development of green highways, which are sustainable design and construction activity, energy efficiency, environment and water management, materials and technology, and social and safety (LLM & UTM, 2014).

RESEARCH METHODOLOGY

A systematic review of the literature conducted to provide a rational, unbiased, and critical view (Charlton, 2012). The systematic review addressed the research question “What are the criteria related to the green highway assessment”? The keywords and characters required for further database search were determined by reviewing literature related to green highway, green highway approaches, and

criteria of green highway. The search was carried out in commonly used research databases, such as Scopus, Google Scholar, Web of Science, and Science Direct (Xiao & Watson, 2017). The search was conducted using identified keywords such as “Green Highway”, “Green Highway Approaches”, and “Criteria of Green Highway”.

To investigate the most relevant articles addressing the research problem, this study employed specific inclusion and exclusion criteria for a more comprehensive review of selected literature. The criteria are as follows:

1. Publication year: Articles published from 2008 to 2023 were considered, reflecting the rapid expansion of the construction industry.
2. Publication type: Only articles from high-quality, peer-reviewed journals were included.
3. Research domain: Literature unrelated to green highway and criteria of green highway were excluded from the study.

ANALYSIS AND DISCUSSION

All the criteria related to the green highway assessment were listed. The criteria adapted from (1) Greenroads, (2) Washington Internship for Students of Engineering (WISE), (3) GreenLITES, (4) Illinois Livable and Sustainable Transportation (I-Last), (4) Building Environmentally and Economically Sustainable Transportation (BE²ST), (5) Greenroads Manual, and (7) Malaysia Green Highway Index (MyGHI) were analyzed. The analysis was conducted utilizing the five key components identified in the current green highway assessments. Each criterion was comprehensively listed and examined individually. The elements under discussion include: Element 1 - sustainable design and construction activity, Element 2 - energy efficiency, Element 3 - environmental and water management, Element 4 - materials and technology, and Element 5 - social and safety.

Sustainable Design and Construction Activity

Table 2 showcases the classification of sustainable design and construction activities. This classification is comprised of nine criteria and thirteen sub-criteria. The criteria encompass the construction management plan, noise mitigation control, equipment and machinery efficiency, quality management, context-sensitive design, erosion and sedimentation, alignment selection, pollution reduction, and life cycle. These categories guarantee a minimized impact of the highway on the natural environment.

All assessments, with the exception of BE²ST, indicate the necessity for context-sensitive design in the development of environmentally friendly highways. When designing and constructing highways, the environment must be the primary consideration (New York State Department of Transportation, 2009).

This aligns with the criterion of reducing environmental impact, which necessitates comprehensive assessments. The development of green highways aims to minimize environmental harm (Michigan, 2008).

Furthermore, reducing emission through efficient equipment and machinery was identified as a crucial criterion for all assessments, except for GreenLITES and I-LAST. According to Kibert (2001), the construction sector accounted for 6% of total industrial greenhouse gas (GHG) emissions in the United States in 2002. In Malaysia, the construction industry poses a significant environmental threat due to GHG emissions (Klufallah, et al., 2013). The construction industry in Malaysia ranked 30th globally in terms of carbon emissions (Klufallah et al., 2013). As part of vision 2020, the construction industry aims to reduce carbon emissions by up to 40% (Klufallah, et al., 2014).

The analysis revealed that the sub-criteria of air pollution, as well as erosion and sedimentation, were only addressed by the MyGHI. Malaysia’s tropical climate is prone to heavy rainfall, which can result in landslides, flash floods, and other disasters (Che Ahmad & Husin, 2015). As this criterion contradicts the research, it was excluded from the factor analysis process. Air pollution remains a significant issue in Malaysia that needs to be addressed. The largest contributor to air pollution in Malaysia is mobile sources, particularly motor vehicles, which account for 70%–75% of total air pollution (Afroz, et al., 2003). Given that the construction of highways involves numerous machinery, proper planning is essential to minimize gas emissions from both machinery and vehicles.

Table 2: Sustainable design and construction activity

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Construction Management Plan	Waste Management	/	x	x	x	x	/	/
	Air Pollution	x	x	x	x	x	x	/
	Innovation	/	x	x	/	x	x	/
Noise Mitigation Control	Technique	/	x	/	/	x	/	/
	Equipment	x	x	x	x	x	x	/
Equipment And Machinery Efficiency	Natural & Emission Reduction	/	/	x	x	/	/	/
Quality Management	Management Plan & Training	/	x	/	x	x	/	/
Context Sensitive Design	Design Flexibility	/	/	/	/	x	/	/
Erosion & Sedimentation	Erosion & Sedimentation	x	x	x	x	x	x	/
Alignment Selection	Environmental Impact Reduction	/	/	/	/	x	/	/
Pollution Reduction	Air and Noise Pollution	x	/	x	x	x	x	/
	Light Pollution	/	/	x	x	x	/	x

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Life Cycle	Life Cycle Assessment	x	x	x	x	/	/	x

Source: (1) Soderlund et al. (2008), (2) Bryce (2008), (3) GreenLITES (2008), (4) Illinois Department of Transportation (2010), (5) Recycled Materials Resource Centre & Universiti of Winconsin-Madison (2010), (6) Muench et al. (2011) and (7) LLM&UTM (2014)

Energy Efficiency

Table 3 illustrates the energy efficiency category, which seeks to tackle the problem of carbon emissions. Most assessment systems encompass energy efficiency in a broad manner, without specific criteria, with the exception of MyGHI. It shows that MyGHI uniquely prioritizes energy efficiency based on the area. This is demonstrated by the Malaysian scenario, for example, the PLUS Highway spans 772 km from Bukit Kayu Hitam to Johor Bharu, featuring 65 interchanges, 48 lay-bys every 25–50 km, and 24 rest and service areas located every 80–100 km (PLUS Malaysia Berhad, 2014). In contrast, along the highways of Washington spanning 701.88 km, there are only three toll plazas and 48 rest and service areas (Washington State Department of Transportation, 2015).

The MyGHI framework encompasses four key component areas and one policy management aspect to address energy efficiency. These component areas include rest and service areas, toll plazas, compound and car parks, and interchanges. The policy management aspect is further categorized into renewable energy policies, commissioning of building energy systems, and an energy plan for maintenance. It is important to note that MyGHI primarily concentrates on enhancing energy efficiency within these component areas.

Table 3: Energy Efficiency

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Management policy	Renewable energy policies	x	x	x	x	x	x	/
	Commissioning of Building Energy System	x	x	x	x	x	x	/
	Energy Plan for Maintenance	x	x	x	x	x	x	/
Rest & service area	Reduced electrical consumption	x	x	/	/	x	x	/
	Sustainable Infrastructure	x	x	x	x	x	x	/
Toll plaza	Tool booth	x	x	x	x	x	x	/
	Lighting Zone	x	x	x	x	x	x	/
	Administration and supervision	x	x	x	x	x	x	/
Compound and carpark	Energy efficiency performance	x	x	x	x	x	x	/
Interchange	Reduce Energy Consumption	x	x	x	x	x	x	/

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
General	Stray Light/Light Pollution Reduction	x	x	/	/	x	x	/
	Energy Control	/	x	x	x	x	x	x
	Energy Use	x	x	x	x	/	x	x
	Energy Lifecycle	x	/	x	x	x	x	x
	Material & Resources	x	x	x	x	x	/	x

Source: (1) Soderlund et al. (2008), (2) Bryce (2008), (3) GreenLITES (2008), (4) Illinois Department of Transportation (2010), (5) Recycled Materials Resource Centre & University of Wisconsin-Madison (2010), (6) Muench et al. (2011) and (7) LLM&UTM (2014)

Environmental and Water Management

Table 4 presents the category of environmental and water management. This category divided into five criteria and fifteen sub-criteria. The criteria include environmental management systems, stormwater runoff quantity, stormwater runoff quality, ecosystem protection, and water consumption. The category focuses on stormwater management to preserve the ecosystem and protect wildlife. The analysis reveals that Greenroads, Greenroads Manual, and MyGHI meet all criteria for environmental management systems, stormwater runoff quantity, stormwater runoff quality, and ecosystem protection. However, their assessment does not include water consumption. On the other hand, WISE does not include ecosystem protection and water consumption in its assessment.

While BE²ST only highlights water consumption in the environmental and water management category, its objective is to reduce water consumption during highway construction by utilizing alternative designs. A study by Lee et al. (2011) tested the construction of highways using rigid pavement and flexible pavement as alternative materials. The results showed that the use of flexible pavement required less water compared to rigid pavement (Lee, et al., 2011).

The MyGHI focuses on the drainage system. Inefficient drainage system is the main cause of floods in Malaysia (Sadali, 2016). Nowadays, Malaysia experiences heavy rainfall regardless of the season. The Malaysian Meteorological Department reported that many areas in peninsular Malaysia received total rainfall amounts exceeding 60% of the average value (Malaysian Meteorological Department, 2013). In contrast, Sarawak experienced rainfall amounts that were 100% above the average value (Malaysian Meteorological Department, 2013). Therefore, it is crucial for the drainage system to be well-maintained to avoid flash floods.

Table 4: Environmental and water management

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Environmental Management System	EMS Certification	/	x	x	x	x	/	/
	Temporary Stormwater Control	/	x	x	x	x	x	x
	Innovation Stormwater Technology	/	x	x	x	x	x	x

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Stormwater Runoff Quantity	Water Tracking	x	x	x	x	x	/	x
	Runoff Flow Control	/	/	/	x	x	/	/
	Disaster Cost Analysis	/	x	x	x	x	/	/
	Drainage System	x	x	x	x	x	x	/
Stormwater Runoff Quality	Water Pollution Reduction	x	/	/	/	x	x	/
	Runoff Treatment and Water Bodies	/	/	/	/	x	/	/
	Reuse Water by Infiltrate Ground Water Table	x	/	x	x	x	x	x
Ecosystem Protection	Habitat Restoration and Protection	x	x	/	/	x	/	/
	Site Vegetation	x	x	/	/	x	/	/
	Tree & Plants	x	x	/	/	x	x	/
	Ecological Connectivity	/	x	/	x	x	/	/
Water Consumption		x	x	x	x	/	x	x

Source: (1) Soderlund et al. (2008), (2) Bryce (2008), (3) GreenLITES (2008), (4) Illinois Department of Transportation (2010), (5) Recycled Materials Resource Centre & University of Wisconsin-Madison (2010), (6) Muench et al. (2011) and (7) LLM&UTM (2014)

Material & Technology

Table 5 presents the materials and technology category, which is further divided into four criteria and fifteen sub-criteria. These criteria include innovation and technology, reduce, reuse, and recycle, economical material and pavement, and erosion control. The focus of this category is to prevent the production of excessive waste, pollution, and harmful gas emissions.

The analysis reveals that all assessment systems emphasize the importance of reducing, reusing, and recycling materials in the construction of green highways. Additionally, all assessments highlight the significance of recycling pavement or implementing sustainable techniques in green highway construction. A case study conducted on the Burlington Bypass project, found that pavements made from recycled materials had a service life three years longer than those made from conventional materials. According to Lee et al. (2011), recycled materials possess different engineering properties compared to conventional materials, making them more sustainable.

Table 5: Material & Technology

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Innovation Technology	Research Development	x	x	x	x	x	x	/
	Usage Of Industrial by Product	x	x	/	/	x	x	/
	Sub Grade Improvement / Soil Stabilization	x	x	x	/	x	x	/
	Cool Pavement	/	x	x	x	x	/	/

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reduce, Reuse & Recycle	Reuse Of Topsoil	x	x	x	/	x	x	/
	Reuse And Recycle of Non-Hazardous Material	/	/	/	/	/	/	/
	Earthwork Balance	x	x	x	/	x	/	/
Economical Material & Pavement	Regional Material	/	x	x	x	x	/	/
	Pavement Design Life	/	x	x	/	x	/	/
	Recycle Pavement/New Sustainable Technique	/	/	/	/	/	/	/
	Permeable Pavement	/	x	x	/	x	/	/
	Quiet Pavement	/	x	x	x	x	/	/
	Warm Mix Asphalt	x	/	x	x	x	/	x
	Pavement Performance Tracking	x	x	x	x	x	/	x
Erosion Control	Soil Biotechnical Engineering Treatments Green Techniques	x	x	/	x	x	x	/

Source: (1) Soderlund et al. (2008), (2) Bryce (2008), (3) GreenLITES (2008), (4) Illinois Department of Transportation (2010), (5) Recycled Materials Resource Centre & University of Wisconsin-Madison (2010), (6) Muench et al. (2011) and (7) LLM&UTM (2014)

Social & Safety

Table 6 illustrates the social and safety category, which is divided into six criteria and eighteen sub-criteria. The criteria encompass services and facilities, economy, public acceptance, environment, management issues, and access. The primary focus is to enhance the comfort and safety of highway users, improve the economy, and ensure good environmental quality.

The social and safety aspect is a novel concept in the development of green highways. It serves as both an infrastructure and a means to promote tourism through billboards along the highway (Che Ahmad & Husin, 2015). This approach also drives economic growth by stimulating business activities and creating job opportunities at rest areas, service areas, and toll plazas. The majority of the criteria for the social and safety category are emphasized in the MyGHI, as compared to other assessment systems.

However, the MyGHI does not encompass criteria for pedestrian, bicycle, and transit access. In the hot and humid climate of Malaysia, it may not be suitable to construct pedestrian and bicycle facilities along the highway. On the other hand, in Washington, the District Department of Transportation provides dedicated lanes for bicycles and pedestrians along highways. These facilities encourage people to use bicycles as a means of commuting to work,

school, or other destinations, thereby reducing road congestion and greenhouse gas emissions (District Department of Transportation, n.d.).

Table 6: Social & Safety

Criteria	Sub-Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Services & Facilities	Intelligent Traffic System	x	x	x	x	x	/	/
	Provision Of Basic Facilities	x	x	x	x	x	x	/
	Provision Of Additional Facilities	x	x	x	x	x	x	/
Economy	Business Enhancement	x	x	x	x	x	x	/
	Number Of Job Creation	x	x	x	x	x	x	/
	New Development	x	x	x	x	x	x	/
Public Acceptance	Tourism	x	x	x	x	x	x	/
	Perception	x	x	x	x	x	x	/
Environment	Aesthetic Initiative	x	/	x	x	x	x	/
	Landscaping	x	x	x	x	x	x	/
	Scenic Views	x	x	x	x	x	/	x
Management Issue	Cultural Outreach	x	x	x	x	x	/	x
	Road Safety Audit	/	x	x	x	x	/	/
Access	Contractor Warranty	x	x	x	x	x	/	x
	Traffic Flow Improvement	/	x	/	/	x	x	x
	Pedestrian Access	/	x	/	/	x	/	x
	Bicycle Access	/	x	/	/	x	/	x
	Transit Access	x	x	x	/	x	/	x

Source: (1) Soderlund et al. (2008), (2) Bryce (2008), (3) GreenLITES (2008), (4) Illinois Department of Transportation (2010), (5) Recycled Materials Resource Centre & Universiti of Winconsin-Madison (2010), (6) Muench et al. (2011) and (7) LLM&UTM (2014)

Based on the analysis, the category of sustainable design and construction activity for green highways is divided into nine criteria and thirteen sub-criteria, aiming to reduce environmental impacts and increase societal benefits. The need for context-sensitive design emerges as crucial across assessments, highlighting its importance in the development of green highways. The primary focus includes the reduction of environmental impacts, as conventional highways significantly contribute to GHG emissions and air pollution, particularly in Malaysia's construction industry.

The following category, which is energy efficiency, varies accordingly. The MyGHI emphasizes energy efficiency by area, reflecting Malaysia's diverse highway infrastructure compared to other regions mentioned earlier, like Washington. This study summarizes that environmental and water management prioritizes stormwater management and ecosystem preservation, which include

various assessments addressing criteria such as environmental management systems, stormwater runoff, and ecosystem protection for green highways. In terms of the materials and technology criterion, it emphasizes waste reduction and emissions through innovation, recycling, and sustainable pavement techniques. The social and safety criterion encompasses services, economic impact, public acceptance, and access, aiming to enhance highway users' comfort, safety measures, and economic opportunities. Among all the frameworks, the MyGHI stands out the most for its comprehensive coverage; however, it does not cover pedestrian and bicycle access criteria due to climate considerations in Malaysia. Overall, these assessments underscore the multifaceted approach required for green highway development in integrating environmental, social, and economic aspects to mitigate environmental impact and promote societal well-being.

CONCLUSION

In conclusion, this research provides a comprehensive analysis of green highway assessment criteria derived from various established frameworks. The study examines five key elements: Element 1 - sustainable design and construction activity, Element 2 - energy efficiency, Element 3 - environmental and water management, Element 4 - materials and technology, and Element 5 - social and safety. This research sheds light on the multifaceted nature of sustainable infrastructure development, especially on green highways. This analysis reveals both commonalities and disparities among existing assessment frameworks, emphasizing the need for a more integrated and holistic approach for green highway initiatives especially tailored to the Malaysian context in terms of its criteria and sub-criteria. These green highway projects can enhance environmental resilience, promote sustainable development, and support social equity. In essence, this study represents a crucial step toward promoting sustainable development practices in construction.

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EMOTIONAL SOLIDARITY IN TOURISM DEVELOPMENT: HOW POLICY AND KNOWLEDGE DRIVE SUPPORT IN GILGIT BALTISTAN, PAKISTAN

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Abstract

The participation of local communities is vital in developing tourism, as their attitudes and behaviours can significantly impact the growth and success of a destination. As the primary recipients of future tourism developments, the perspectives of local communities should guide the creation of sustainable policies aimed at maximising benefits and minimising negative impacts. The study examines how government policy, tourism knowledge, emotional solidarity, and support for tourism development are interrelated among the residents of Gilgit-Baltistan, Pakistan. Based on a quantitative and cross-sectional research design with two sampling stages comprising quota and purposive sampling, 216 responses from the residents of Gilgit-Baltistan were collected and analysed through Partial Least Square-Structural Equation Modeling (PLS-SEM). It was revealed that government policy and tourism knowledge influence residents' welcoming nature and emotional closeness, and they contribute to their support for tourism development. The findings underscore the importance of establishing targeted and effective support systems between stakeholders to sustain the benefits of tourism development.

Keywords: Government policy, Tourism knowledge, Emotional solidarity, Support for tourism development

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INTRODUCTION

The residents of tourist destinations are crucial constituents in the tourism sector, as their support is crucial for ever-evolving tourism planning and growth (Stylidis, 2020). Over the past thirty years, researchers and policymakers have emphasised understanding residents' support for tourism, resulting in numerous studies examining their perceptions and attitudes (Nunkoo & So, 2016). Earlier research primarily investigated local factors influencing residents' views on tourism. However, recent empirical studies by Ganji et al. (2021) and Tosun et al. (2021) highlighted the crucial role of residents' subjective knowledge of tourism as a key internal factor. Residents' attitudes toward tourism are shaped by its impact and personal benefits, and these internal perceptions can be influenced by various factors. While most research focuses on identifying these factors, only a few studies have delved into residents' complex feelings toward tourists and ways in which they have the potential to affect support for the growth of tourism (Aleshinloye et al., 2021; Joo et al., 2018). Despite predictions about residents' attitudes, a scarcity of studies assessing their behaviour through the dynamics of solidarity and intentional support was noted (Wu et al., 2023).

This gap is significant because emotional solidarity is crucial, and it drives residents in tourist planning and indirectly shapes their behavioural intention to support tourism development (Aleshinloye et al., 2021). Notably, some scholars suggest that residents may exhibit solidarity with tourists based on their perceived knowledge of tourism (Munamura et al., 2023), and well-informed residents can readily discern tourism's effects (Joo et al., 2019). This belief is evident in the observed beneficial effects of tourism to prompt residents to express emotional solidarity with tourists and vice versa (Hasani et al., 2016). Furthermore, the role of external factors, such as government policy, cannot be understated. Good government policies can positively affect the dynamics between residents and tourists, thereby influencing residents' emotional solidarity with tourists (Airey, 2015). Thus, exploring this relationship is crucial, as it can shed light on effective governance and community engagement in tourism initiatives. Existing studies highlight the necessity of government trust in shaping residents' attitudes and embracing the advancement of tourism (Jiang et al., 2023). However, in-depth empirical investigations on the direct nexus between government policy and residents' support for tourism development are scarce and need to be addressed.

The interrelationship between government policy, tourism knowledge, emotional solidarity, and support for tourism development is supported by social exchange theory (SET). In a situation that involves the interaction between individuals and groups, SET encapsulates the reciprocal exchanges between these actors. Past studies have extensively employed this theory to comprehend the perceptions of the residents and their supportive attitudes toward tourism

development (Munanura et al., 2023; Stylidis, 2020). Effective government policies and increased tourism knowledge offer significant benefits that lead to the fostering of residents' warm disposition, intimate bond, and empathetic comprehension. In this sense, whenever the advantages surpass the disadvantages, the local populace tends to engage in positive interactions with visitors, and this positive interaction will foster a positive attitude towards tourism.

LITERATURE REVIEW

Government Policy

The government's role in developing tourism has been a focal point in the literature for several years (Bramwell, 2011; Nunkoo, 2015). In tourism, planning and policy-making strategies will look at government bodies, non-government organisations, and business entities as keys (Ruhanen, 2013). The trust that people place in the government is pivotal for community development (Hussain et al., 2022). Ruhanen (2013) argued that governments have amplified accountability for and commitment to tourism destination planning and development. Insufficient government intervention and inadequate tourism management may lead to land use problems and resident displacement (Bramwell, 2011), contributing to negative perceptions of tourism impacts. Thus, effective destination planning can mitigate these negative impacts, enhance positive outcomes (Ruhanen, 2013), and foster residents' supportive attitudes toward tourism.

Tourism Knowledge

Residents possess an extensive awareness of tourism, including information about the development of tourism and the role of the local government in the business. Prior research has shown that residents' attitudes towards the perceived impacts of tourism are influenced by their knowledge of the subject. Andreck et al. (2005) highlighted that when residents have greater knowledge of tourism, they will be more readily in identifying the negatives and positives of tourism development, and revealed that residents with higher levels of tourism knowledge tended to perceive more positive impacts. In contrast, Nunkoo and So (2016) discovered that there is a notable relationship between knowledge and the perceived adverse effects of tourism. Thus, it can be argued that residents' knowledge of tourism does not affect their perception of the benefits, as residents perceive similar benefits regardless of their level of tourism knowledge. Next, Joo et al. (2019) established a positive association between tourism knowledge and residents' empowerment, highlighting the need for further investigation into how tourism knowledge influences residents' emotional solidarity and support for

tourism. In conclusion, the impact of tourism on residents' emotional solidarity and support remains an underexplored area, warranting further research.

Emotional Solidarity

Emotional solidarity can be traced back to Durkheim's theory, which posits that affective bonds are formed through interactions, beliefs, and shared behaviours. The theory of emotional solidarity emerged as the preferred alternative to explain support for tourism the social exchange theory was critiqued for its inability to clearly define tangible and intangible aspects of tourism support. Initially introduced by Woosnam et al. (2009) in sociology, this concept was later applied to tourism. Subsequently, numerous scholars have utilised emotional solidarity to understand residents' support for tourism. As a result, the emotional solidarity scale (ESS) was developed, and this scale incorporates emotional closeness to visitors, welcoming nature, and sympathetic understanding (see Erul et al., 2020; Ganji et al., 2021; Joo et al., 2018). Since its introduction, many studies have adopted these three dimensions to assess residents' support for tourism (Munanura et al., 2023).

HYPOTHESES DEVELOPMENT

Government Policy and Emotional Solidarity

In tourism, government involvement during planning, decision-making, coordination, and resource management plays a vital function in promoting sustainable tourism and benefiting the residents of tourism destinations (Ruhanen, 2013). Public tourism initiatives encourage residents to adopt a welcoming nature by promoting respectful and inclusive interactions with tourists. This attitude can prepare residents in engaging positive, helpful, and informative interactions with tourists (Chancellor et al., 2021). Additionally, the government's inclusion of communities in tourism planning can help cultivate stronger emotional bonds and sympathetic understanding between residents and tourists, ensuring that tourism development aligns with local values and interests and promoting emotional closeness (Tolkach & King, 2015). Inclusive policy-making that considers residents' and tourists' needs and concerns can lead to more harmonious interactions, subsequently increasing residents' sympathetic understanding of the tourism sector. Residents must be regularly made aware, exposed, and well-informed concerning short and long-term tourism goals and plans by destination and policy planners. This awareness would offer greater opportunities for residents' current dynamics with tourists to be understood (Aleshinloye et al., 2021). Drawing from these empirically supported facts, the following hypotheses have been developed to prove the relationship of government policy with the three factors of emotional solidarity.

H1: Government policy significantly predicts the welcoming nature of residents towards tourists.

H2: Government policy significantly predicts the emotional closeness of the residents with the tourists.

H3: Government policy significantly predicts the sympathetic understanding of the residents of tourists.

Tourism Knowledge and Emotional Solidarity

Tourism impacts residents' perceptions, which are influenced by their understanding, as noted by Nunkoo and So (2016). Andereck et al. (2005) showed that residents who possess more knowledge about tourism will have the ability to recognise the costs and benefits of tourism, maintain a positive view of its impacts, and show appreciation for the industry. This appreciation can lead to a more supportive attitude towards tourism (Meimand et al., 2017). Another study also suggested that well-informed residents about tourism's economic and social advantages are more likely to engage positively with tourists, resulting in increased hospitable and supportive behaviours, thus creating a welcoming atmosphere for tourists (Tekalign et al., 2018). Residents with cultural or subcultural knowledge are likely to communicate with tourists actively, fostering emotional intimacy (Li et al., 2022). Residents who are more connected with tourists and tourism tend to have a more positive disposition and sympathetic understanding towards them (Helgadóttir et al., 2019; Martín et al., 2017). Based on these studies, the hypotheses are:

H4: Residents' tourism knowledge significantly predicts their welcoming nature towards tourists.

H5: Residents' tourism knowledge significantly predicts their emotional closeness with the tourists.

H6: Residents' tourism knowledge significantly predicts their sympathetic understanding of tourists.

Emotional Solidarity and Support for Tourism Development

Emotional solidarity has been extensively employed in the tourism literature to understand the dynamic between residents' emotions about tourists and their support for tourism (Munanura et al., 2023). The prevailing literature indicates that the residents of tourism destinations perceive positive impacts, such as employment and investment opportunities, alongside negative impacts as well, like environmental pollution and traffic congestion (Nunkoo & Smith, 2013). Numerous empirical studies have confirmed that support for tourism among residents is positively influenced by the perceived positive impacts of tourism. Conversely, this support will be diminished when residents harbour perceived

negative impacts (Nunkoo & Smith, 2013). Munanura et al. (2023) reported that support for tourism development is predicted by the three factors of emotional solidarity. Contrarily, Aleshinloye et al. (2021) observed that the best predictors of tourism support are the two dimensions of welcoming nature and sympathetic understanding. Moghavvemi et al. (2017) also discovered that the attitude of residents towards tourism development is strongly influenced by the welcoming nature and sympathetic understanding among the three factors of emotional solidarity, although variations can occur based on different personality traits. Based on these findings, these hypotheses have been formulated to further investigate the dynamics of residents' emotions and their impact on support for tourism.

H7: Residents' welcoming nature towards tourists significantly predicts their support towards tourism development.

H8: Residents' emotional closeness with the tourists significantly predicts their support for tourism development.

H9: Residents' sympathetic understanding of the tourists significantly predicts their support for tourism development.

The following Figure 1 exhibits the research model.

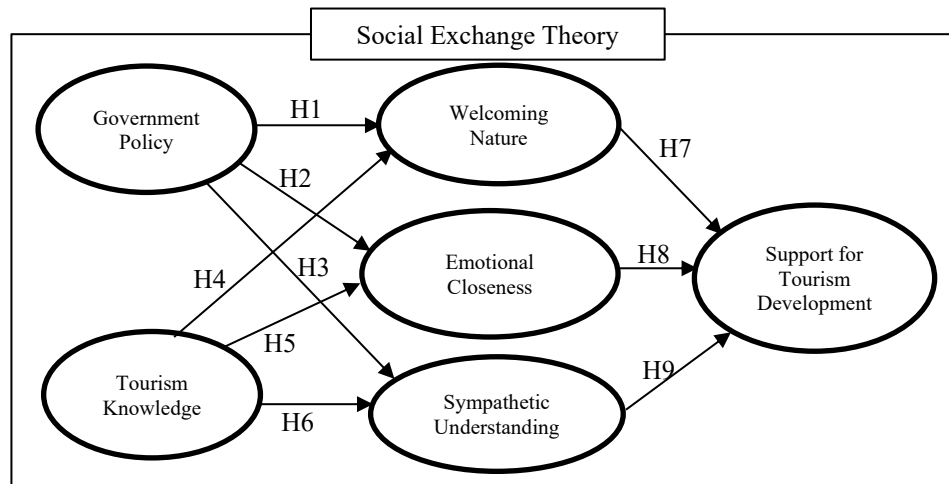


Figure 1: Research Model

RESEARCH DESIGN

This study is a quantitative and cross-sectional research conducted in three prominent tourist destinations within the Gilgit region of Gilgit-Baltistan,

Pakistan. The study focuses on the main tourist districts of Hunza, Nager, and Ghizer (see Figure 1). According to the Tourism Department of Gilgit-Baltistan, these districts are highly popular among mountaineers, trekkers, and adventure enthusiasts. Their scenic landscapes and rich cultural experiences attract thousands of international and local tourists, particularly during peak seasons.

The sampling was carried out in two stages. Firstly, quota sampling was used in the three districts to ensure representativeness and sample size adequacy were achieved for the study. Then, purposive sampling was utilised to select the participants to ensure the specificity and relevancy of the results regarding tourism development in their regions. To participate in the survey, respondents were asked four screening questions to determine their eligibility. Eligible participants must be 18 or older, have lived in Gilgit-Baltistan for more than two years, understand tourism, and be aware of any tourism development planning in Gilgit-Baltistan.

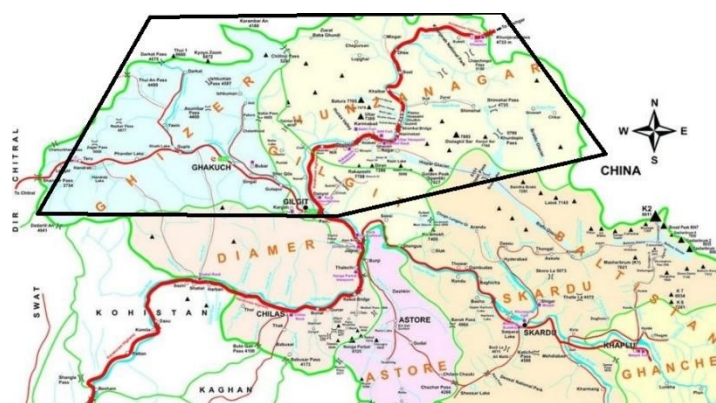


Figure 2: The research setting for this study – Hunza, Nagar, and Ghizer

This study employed the G*Power method to calculate and analyse the minimum size of samples. Based on the G*Power calculations, a minimum of 166 samples were needed for this study. Before the actual fieldwork, the draft questionnaire was vetted by two experts in tourism to establish face validity. Next, the questionnaire underwent a pilot study ($n = 30$) to ensure validity and reliability. Then, 216 responses were collected in the fieldwork from the residents of the three selected tourist districts of the Gilgit region.

The questionnaire was self-administered to collect the primary data, and it has two sections. The first section contains socio-demographic information, and the second section includes the variables of the research model: government policy (Ali et al., 2022), tourism knowledge (Nunkoo, 2015; Stylidis & Quintero, 2022), the three dimensions of emotional solidarity of emotional closeness,

welcoming nature and sympathetic understanding (Aleshinloye et al., 2021), and support for tourism development (Li et al., 2023; Neuts et al., 2021). A five-point Likert scale was utilised to assess each item, with responses ranging from one (Strongly Disagree) to five (Strongly Agree).

The Partial Least Squares-Structural Equation Modeling (PLS-SEM) was utilised to analyse the proposed model and conduct hypothesis testing. PLS-SEM is recognised for its strong and reliable capability to estimate structural models, making it a preferred alternative in assessing the complex dynamics among the constructs.

ANALYSIS

Assessment of Measurement Model

The reliability, convergent validity, and discriminant validity of the constructs can be analysed through the measurement model. Construct reliability can be assessed using factor loadings, composite reliability (CR), Cronbach's alpha, and average variance extraction (AVE). As explained by Hanafiah (2020), if most of the CR and Cronbach's Alpha exceed the minimum criterion of 0.7, it indicates dependable study constructs. For convergent validity, it is indicated by looking at the by item loadings and AVE of the variables, and checking whether these variables surpass the suggested threshold (Hair et al., 2017). However, sympathetic understanding, a dimension of emotional solidarity, did not meet the threshold and, thus, consequently removed from the model due to low factor loadings and AVE that affected the measurement model's reliability and validity. Discriminant validity was established using the Heterotrait-Monotrait (HTMT) ratio of correlation, and none of the HTMT values reached the threshold value of 0.90, signifying adequate discriminant reliability.

Assessment of Structural Model and Hypotheses Testing

In Table 1, the results of the structural model assessment are presented. The assessment of the R^2 , Q^2 , and f^2 values falls within the acceptable thresholds as per Hair et al. (2017) and Hanafiah (2020). Specifically, it is indicated that 7.5 per cent ($R^2 = 0.075$) of the variation in the welcoming nature construct can be accounted for by government policy and tourism knowledge. A similar low variance was also recorded for the variance of emotional closeness (9 per cent or $R^2 = 0.090$) construct, which was also contributed by the government policy and tourism knowledge. The highest variance was recorded by the support for tourism development, with all the variables attributed to 21.4 per cent ($R^2 = 0.214$). This variance is deemed to be a moderate contribution by Cohen (1988). In the analysis of predictive relevance (Q^2), it was found that welcoming nature, emotional closeness, and support for tourism development reflect Q^2 values of 0.033, 0.062, and 0.135, respectively, indicating a significant predictive model (Henseler,

2012). The impact of welcoming nature on support for tourism development ($f^2 = 0.216$) is considered to be of medium strength per Cohen (1988). Next, the effect size of government policy and tourism knowledge on the intention to recommend ($f^2 = 0.140$) is small. A similar small effect size was observed for the relationship between tourism knowledge and emotional closeness ($f^2 = 0.086$).

Regarding path coefficients, the analysis shows that government policy ($\beta = 0.191^{***}$) and tourism knowledge ($\beta = 0.203^*$) positively affect residents' welcoming nature. This positive influence is also evident in the relationship between tourism knowledge and emotional closeness ($\beta = .291^{***}$). As for the support of tourism development, only welcoming nature reflects a significant positive coefficient ($\beta = .458^{***}$). In contrast, the relationship between government policy and emotional closeness and the link between emotional closeness and support for tourism development provides a statistically insignificant relationship. Based on the results, only H1, H4, H5 and H7 were supported.

Table 1: Structural Path Analysis

Path Analysis	Beta (β)	P-values	f^2	R^2	Q^2
Government Policy -> Welcoming Nature	0.191**	0.002	0.037	0.075	0.033
Tourism Knowledge -> Welcoming Nature	0.203*	0.016	0.040		
Government Policy -> Emotional Closeness	0.096	0.272	0.010	0.090	0.062
Tourism Knowledge -> Emotional Closeness	0.291***	0.000	0.086		
Welcoming Nature -> Support for Tourism Development	0.458***	0.000	0.216	0.214	0.135
Emotional Closeness -> Support for Tourism Development	-0.025	0.835	0.000		

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

DISCUSSION

This study analysed the nexus between the perceived internal and external factors towards support for tourism development. It focused primarily on two independent variables: government policies and tourism knowledge. The internal and external based variables were analysed in relation to residents' support for tourism development by integrating the perspectives of tripartite emotional solidarity dimensions of welcoming nature, emotional closeness and sympathetic understanding. Such integration produced empirical evidence that bridges the gap between tourism knowledge, government policies and support for tourism development.

Accordingly, residents' knowledge of tourism positively impacts their welcoming nature and emotional closeness. Specifically, emotional closeness is

affected stronger than the former. There is limited literature on this area, however this finding was postulated to be similar to Tucker (2016) to a certain degree. Tucker (2016) found that when tourism providers and residents better understand tourists' experiences and feedback, it can lead to increased empathy and support. This understanding requires strong networks between the residents and relevant tourism suppliers, as tourists' experience is shaped by coherent destination planning and management (see Azinuddin et al., 2020; Azinuddin et al., 2023).

Conversely, government policy significantly influences the welcoming nature of residents toward tourists but not the emotional closeness between them. This study suggests that government policy shapes the overall environment and perceptions around tourism, impacting how welcoming residents are to tourists (see Nunkoo, 2015). However, creating a deeper emotional bond between residents and tourists may require more targeted efforts that transcend government policy. When comparing the impacts of government policy and tourism knowledge, the findings have shown that the latter has a stronger influence on residents' welcoming nature and emotional closeness. This result may be due to the emotional solidarity aligning with the self-concepts of the residents in creating more meaningful connections compared to external influences such as government policy.

The findings on the link between a welcoming nature and support for tourism development aligned with the earlier research by Woosnam et al. (2012). This study indicates that the impact of emotional closeness on support for tourism development is insignificant, a finding consistent with Hasani et al. (2016). These findings suggest the absence of a strong emotional connection between tourists and residents, indicating that more time is needed to build this connection. Building emotional closeness is not immediate and depends on the residents' self-concept and willingness to form relationships with tourists. This lack of immediate emotional closeness can explain the absence of a substantial on support for tourism development. Perhaps this absence can be remedied through strategic curation of destination reputation using technologies and social media to bridge the gap between residents and tourists, as studies have verified its influence in shaping fundamental destination performance-based antecedents in the form of trust and perceived value (see Ibrahim et al., 2023; Mior Shariffuddin et al., 2023; Mohd Salim et al., 2024).

A similar conclusion can be said in the context of sympathetic understanding. In this study, the sympathetic understanding was removed from the model equation, contradicting many works of past studies that used similar instrumentations (see Alenshinloye et al., 2021; Woosnam & Norman, 2010). The reasoning for this may lie in the cultural relevancy of the residents in Gilgit-Baltistan, where sympathetic understanding might not play a significant role

considering the specific needs, concerns and priorities compared to other regions studied by past researchers.

CONCLUSION

The study significantly contributes to the tourism body of knowledge by extending SET, and simultaneously integrating government policies, tourism knowledge, emotional solidarity and support for tourism development in a research model. This model is considered novel for several reasons. Firstly, the inclusion of government policies and tourism knowledge enables a comparison of the role of internal (tourism knowledge) and external-based (government policy) independent variables in facilitating residents' support for tourism development. Secondly, the operationalisation of emotional solidarity at the dimension level allows a deeper identification of the distinctive impacts of each dimension in explaining the unique differences between government policy and tourism knowledge in shaping the varying levels of support for tourism development among the residents of Gilgit-Baltistan. Subsequently, this study heightens the need for policymakers to draft more significant targeted efforts beyond just government policies, such as facilitating meaningful intercultural exchanges and fostering a sense of shared experiences and values. Therefore, a more context-specific and data-driven approach is required, given the complexity and nuances of tourism development for the community. This is proven by the different patterns of empirical evidence generated in the study compared to previous research.

In light of this, it is imperative to treat the result of this study with caution as it employs non-probability sampling techniques. Thus, the findings may not be applicable to populations outside of the study. As for future study recommendations, other mediating and moderating factors can be considered, such as place image, community participation, and perceived empowerment of residents. All these variables are suggested, given their characteristics and predispositions closely related to the well-being and sustainability of the community and destinations.

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SPATIOTEMPORAL OF NITROGEN DIOXIDE (NO₂) CONCENTRATION IN THE URBAN ENVIRONMENT OF KLANG VALLEY, MALAYSIA

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Abstract

The high concentration of nitrogen dioxide (NO₂) directly results in Klang Valley's air quality deterioration, causing a public health risk. This study was conducted to analyse the daily-averaged and annual concentration of nitrogen dioxide (NO₂) on a spatial-temporal scale at five continuous monitoring stations under the Department of Environment (DOE) in Klang Valley, namely, Klang, Shah Alam, Petaling Jaya, Kajang, and Cheras from 2000 to 2009 using Mann-Kendall statistical analysis and interpolation technique in Geographic Information System (GIS). The result clearly showed that the Petaling Jaya station was identified as the most polluted compared to other stations, with an average concentration of more than 0.050 ppm every year and reaching the maximum concentration of 0.069 ppm where the mean was 0.030 in 2001. Based on the p-value derived from the Mann-Kendall statistical analysis, the Klang, Petaling Jaya, Shah Alam, and Cheras stations recorded a significant trend with p-values < 0.05 at 0.0001 and 0.020, respectively. The annual concentration of NO₂ in all the stations was in the range of 0.015 to 0.04 ppm from 2004 to 2009, compared to 0.005 to 0.01 ppm from 2000 to 2003. The highest annual-averaged NO₂ concentration was reported at the Petaling Jaya station between 0.035 and 0.004 ppm for all years except 2007 and 2009 when concentrations were in the 0.03 to 0.035 ppm. Notably, the Petaling Jaya station had the highest annual NO₂ concentration, which ranged from 0.025 to 0.04 ppm due to emissions from motor vehicles. The major pressure on road infrastructure was recognised, mainly a lack of space to accommodate the effect of the maximum density of motor vehicles and traffic, resulting in traffic congestion in the city centre.

Keywords: Air Quality, NO₂ Concentration, Spatiotemporal Analysis, Mann-Kendall Statistical Analysis, Interpolation Technique GIS, Klang Valley, Malaysia

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INTRODUCTION

Currently, air pollution is a significant cause of mortality and disability. The World Health Organisation (WHO) estimates that urban and rural outdoor air pollution causes 3.7 million deaths annually (WHO, 2014). The Worldwide Burden of Disease (GBD) (2015) and the World Bank (2016) have identified air pollution as a global health risk factor. Numerous research has examined the links between air pollution and unfavourable health consequences (Dehghani et al., 2018; Delikhooon et al., 2018). Around 90% of children worldwide are exposed to air pollution above WHO recommended limits (WHO, 2018a), posing immediate and long-term health concerns. Notably, nitrogen dioxide (NO₂) is a toxic gas that is linked with both outdoor (e.g. traffic) and indoor (e.g. gas cooking) sources. In outdoor urban environments, NO₂ is derived primarily from the oxidation of nitric oxide (NO) a primary traffic pollutant (Huangfu & Atkinson, 2020).

Therefore, NO₂ along with particulate matter and ozone, is a significant air contaminant that requires frequent monitoring. Urbanisation has exposed 5% of Europe's population to NO₂ concentrations over the EU's yearly limit value of 40 g/m³ (EEA, 2019). Road mobility is the primary source of urban air pollution (San et al., 2021), accounting for 39% of the total NO_x emissions in European cities in 2017. The EU and WHO have established critical levels to protect the population from gaseous NO₂ influence on health. NO₂ has negative health effects at levels below the WHO recommended limits, with 92% of paediatric asthma cases occurring in places with annual exposures below WHO NO₂ limits (Achakulwisut et al., 2019).

The deterioration of NO₂ pollution in recent years has caused severe risks to public health while also increasing the economic cost (Eum et al., 2019; Fenech & Aquilina, 2020). According to existing studies, the most significant source is the burning of fossil fuels, specifically the presence of coal-fired power stations (Liu et al., 2019). The population and motor vehicles are other major contributors (Abdullah et al., 2024).

Numerous studies have confirmed that NO₂ pollution affects the risks of all-cause mortality, respiratory mortality, cardiovascular mortality, and asthma (He et al., 2020; Lu et al., 2020; Hoon Leh et al., 2011). A meta-analysis of 23 and 48 publications concluded that NO₂ pollution increased the fatality rate of the inhabitants significantly (Atkinson et al., 2018). Brønnum-Hansen et al. (2018) examined the effect of NO₂ on the life expectancy of inhabitants. According to the research, decreasing NO₂ levels in metropolitan areas to the levels demonstrated in rural areas would enhance urban inhabitants' life expectancy by two years. Through meta-analyses, Khreis et al. (2017) discovered a strong positive connection between NO₂ pollution and asthma. Two national-scale cross-sectional studies in Australia and Vietnam have verified the statistically

significant correlation that is identified above (Knibbs et al., 2018). Therefore, this study aims to analyse the daily average on a temporal scale and the annual concentration of NO₂ in spatial aspects at five continuous monitoring stations under the Department of Environment (DOE) in Klang Valley, namely, Klang, Shah Alam, Petaling Jaya, Kajang, and Cheras, from 2000 to 2009.

MATERIALS AND METHODS

Study Area: Klang Valley

Centred in Kuala Lumpur, the Klang Valley is a significant area in Malaysia, encompassing 2911.5 km², including the surrounding towns and cities (Rahman et al., 2015). With a population of 8.3 million in 2020, it is the main focus of Malaysian property, industry, and commerce developments (DOE, 2020). The region is known for its rapid urbanisation, population growth, industrial activities, and high traffic volume, making it vulnerable to air quality issues. The Air Pollution Index (API) determines air quality in the Klang Valley, with 52 air monitoring stations that are located in industrial, urban, and suburban areas. This research examined the average annual concentration level of NO₂ from 2000 to 2009 using five DOE air quality monitoring stations, including Klang, Petaling Jaya, Shah Alam, Cheras, and Kajang. Figure 1 and Table 1 provide detailed information on the features of DOE air quality monitoring stations in the Klang Valley.

Data Sources

The main data input for NO₂ concentration in this study comes from the Air Quality Division of the Malaysian Department of Environment (DOE), which was the average annual concentration at the Klang, Petaling Jaya, Kajang, Shah Alam, and Cheras stations, from 2000 to 2009. Since 1995, the Department of Environment (DOE) of Malaysia has appointed Alam Sekitar Malaysia Sdn Bhd (ASMA) for the monitoring of NO₂ concentration data and conducting air monitoring. Before being distributed to the stakeholders, the DOE will verify and validate the data set that ASMA has prepared. ASMA employed an ambient air gas analyser device to test NO₂ for the study. Hourly data is used to manage the data, which is then averaged daily and annually for additional study.

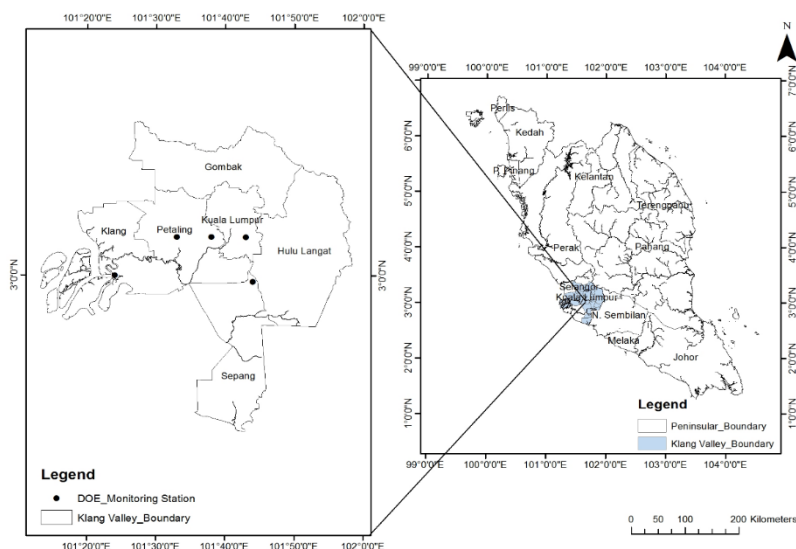


Figure 1: Map of Peninsular Malaysia and DOE monitoring station sites in the Klang Valley.

Table 1: Detailed Information on the Air Quality Monitoring Stations in the Klang Valley

Site Id	Site Location	Area	Coordinates	Area Category
CAC 011	SM (P) Raja Zarina, Klang	Klang	101 24.484°E 3 0.620°N	Urban
CAC 016	SK Sri Petaling, Petaling Jaya	Petaling Jaya	101 42.274°E 3 6.612°N	Industrial
CAC 023	Country Heights, Kajang	Kajang	101 44.417°E 2 59.645°N	Residential
CAC 025	Sekolah TTDI Jaya, Shah Alam	Shah Alam	101 33.368°E 3 6.278°N	Urban
CAC 054	SMK Permaisuri, Cheras	Seri Cheras	101 43.072°E 3 6.376°N	Urban

Mann-Kendall Statistical Trend Analysis

Temporal trend analysis of NO₂ concentration at Klang, Petaling Jaya, Kajang, Shah Alam, and Cheras stations using daily NO₂ concentration data input from 1st. January 2000 to 31st. December 2009 by passing the Mann-Kendall trend test in XLSTAT software.

Statistical trends are patterns of significant data change over time, detected through parametric and nonparametric tests. Through this study, the daily concentration trend of NO₂ at five monitoring stations, namely, Klang,

Petaling Jaya, Kajang, Shah Alam, and Cheras was analysed using the Mann-Kendall train test and sen-slope value to determine the magnitude of the NO₂ concentration trend. The Mann-Kendall (MK) test (Mann, 1945; Kendall, 1975) serves to assess rainfall distribution patterns and is a nonparametric test characterised by having no conditions on normal data. The MK test is conducted based on the null hypothesis (H₀), which shows that there is no trend of change in annual rainfall distribution, as well as the alternative hypothesis (H_a), which explains that there is a trend pattern of change in rainfall distribution data at study stations (Gadedjisso-Tossou et al., 2021). In terms of the increasing or decreasing trend flow, it is determined by the sen-slope value, i.e., a positive value to show the increasing trend of annual rainfall distribution, and a negative value represents the decreasing trend of rainfall distribution. MK trend analysis was performed using Equation 2 and Equation 3 below:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^n \text{sgn}(x_j - x_k) \quad (2)$$

Where:

x_i and x_k are sequential data series and:

$$\text{sgn}(x_j - x_i) = \begin{cases} 1 & \text{if } x_j - x_i > 0 \\ 0 & \text{if } x_j - x_i = 0 \\ -1 & \text{if } x_j - x_i < 0 \end{cases} \quad (3)$$

The value of variance S is estimated using Equation 4 below:

$$\text{VAR}(S) = \frac{1}{18} \left[n(n-1)(2n+5) - \sum_{p=1}^g t_p(t_p-1)(2t_p+5) \right] \quad (4)$$

Where:

t_p = determine the pth value relationship

q = number of bound values

The standard static test for the Mann - Kendall (Z) test is calculated using Equation 5 below:

$$Z = \begin{cases} \frac{s - 1}{\sqrt{\text{var}(s)}} & \text{if } S > 0 \\ 0 & \text{if } S = 0 \\ \frac{s + 1}{\sqrt{\text{var}(s)}} & \text{if } S < 0 \end{cases} \quad (5)$$

Where:

Z = trend direction. A negative Z value indicates a downward trend and vice versa. At the 5% significance level, the null hypothesis (H0), i.e., no trend is rejected if the absolute value of Z is higher than 1.64.

Spatial Interpolation Analysis

Geographical Information Systems (GIS) is a crucial research tool in environmental science and engineering, enabling various methods such as description, explanation, pattern prediction, and model creation (Mandelmilch et al., 2020). Spatial analysis techniques monitor on-the-ground conditions, quantify temporal changes, compare populations, and transmit actionable data to impacted individuals, governmental organisations, and politicians. Spatial analysis is increasingly used to evaluate proximity exposure to air pollution, reducing exposure misclassifications and improving the accuracy of proximity model assessments.

Correspondingly, interpolation techniques use data from sampled locations to estimate the value of a parameter in an un-sampled place, revealing spatial patterns in concentrations across geographical scales. This allows for the examination of patterns in concentration due to specific occurrences, such as air quality episodes. Interpolated findings can be used in empirical models or to produce estimated exposure patterns. Some interpolation methods produce error and probability surfaces, analysing uncertainty in geographic estimations and the likelihood of the violation of air quality regulations. Significantly, estimating error can help to determine the placement of additional monitoring stations, resulting in more accurate interpolated surfaces.

The inverse distance weighted (IDW) interpolation approach weights the contribution of each input (control) point by the normalised inverse of the distance between the control and interpolated point. According to IDW, each input point has a local affect that decreases with distance. It gives more weight to points closest to the processing sites than to those further away. The output value for each location is determined by a set number of points or by all the points within a defined radius. In the IDW interpolator, the power parameter governs the impact of the surrounding points on the interpolated value. A greater power

means less impact from distant spots. In this study, the IDW equation used was Equation 1:

$$z(x) = \frac{\sum_{i=1}^n w_i(x)z_i}{\sum_{j=1}^n w_j(x)}, w_i(x) = \frac{1}{d(x,x_i)^p} \quad (1)$$

Where:

$Z(x)$ = predicted value at the interpolated point; x_i = value of the i -th known sample point, i.e., the annual average concentration of NO₂ at five air quality stations; d = distance between the known sample point and the prediction point; n = total number of the known sample points and refers to the five air quality stations, namely, Klang, Petaling Jaya, Kajang, Shah Alam, and Cheras; w_i = weight assigned to i -th known sample point and p = weighting power and commonly this value was considered as 2.

The five DOE air quality station in this investigation represented the Klang Valley region. Default settings interpolate the distribution of NO₂ concentration in the IDW spatial interpolation method. In this case, it was predicted that the closest sites would have greater or nearly identical concentrations, and vice versa with ArcMap version 10.3 in ArcGIS.

RESULT AND DISCUSSION

The annual average of NO₂ at all Klang Valley was found to be lower than the standard RMAQG from 2000 to 2009. The Petaling Jaya station was identified as the most polluted of the five stations, with an average concentration of more than 0.050 ppm annually, the maximum reaching 0.069 ppm and the mean was 0.030 in 2001. In addition, Klang and Cheras were the second most polluted stations, with NO₂ levels ranging from 0.035 ppm to 0.054 ppm between 2000 and 2009. In 2002 and 2004, the maximum NO₂ concentrations were reported at the Klang and Cheras stations, both at 0.054 ppm. The Shah Alam station is the fourth station to report the highest NO₂ levels, at 0.048 ppm in 2008, compared to previous years. The lowest NO₂ concentration station is Kajang, which only reported a maximum average of 0.033 ppm in 2008, with a mean of 0.013.

Daily-averaged of NO₂ Concentrations

Based on the p-value derived from the Mann-Kendall statistical analysis in Table 2, there was an average trend in NO₂ concentration as observed at the Klang, Petaling Jaya, Shah Alam, and Cheras stations. The Klang, Petaling Jaya, Shah Alam, and Cheras stations all recorded a significant trend with p-values < 0.05 at 0.0001 and 0.020, respectively, demonstrating this condition. However, the situation is different at the Kajang station, which shows no significant trend, and

has a p-value > 0.05, i.e., 0.490, indicating that NO₂ concentrations have not changed from 2000 to 2009. In terms of trend shape, either growing or decreasing, the sen-slope values obtained are negative values of -3.737E-7, -6.614E-7, and -2.055E-6, respectively, throughout the 10 years of the research; this also demonstrates that Klang, Petaling Jaya, and Cheras stations display a downward trend. This condition clearly demonstrates that the NO₂ concentrations in Klang, Petaling Jaya, and Cheras have dropped between 2000 and 2009. From 2000 to 2009, the cumulative daily concentration of NO₂ at Petaling Jaya station did not surpass 0.07 ppm, with the maximum reading being 0.069 ppm on November 29, 2001. However, from 2004 to 2009, the NO₂ concentration started to fall below 0.06 ppm, with the exception of August 8, 2007, when a NO₂ concentration of 0.061 was reported. Apart from that, the Klang station reported NO₂ readings of less than 0.05 ppm from 2000 to 2009, with the exception of 0.054 ppm and 0.051 ppm on 14th March 2002 and 22nd February 2002, respectively. Except for a few days when the NO₂ concentration was higher than 0.04 ppm, the NO₂ concentration fell to 0.04 ppm. In reality, the Cheras station demonstrated the same condition, with a declining trend in daily NO₂ concentrations from 2004 to 2009, with an overall concentration of less than 0.05 ppm. However, compared to the other days, the 14th of October 2004 had the highest daily NO₂ concentration of 0.054 ppm. This circumstance directly indicated that the daily NO₂ concentrations were high in 2004-2005 and then fell below 0.04 ppm from 2006 to 2009, with the exception of a few days in August 2009, when high concentration of 0.047 ppm and 0.042 ppm were reported.

Table 2: Statistical analysis of Mann-Kendall and sen-slope trends of NO₂ concentration in the Klang Valley

Station	Sen Slope	Kendall tau (t)	Mann-Kendall (s)	p-value	Alpha	Interpretation
Klang	-3.737E-7	-0.052	-335826.00	< 0.0001	0.05	Reject H0
Petaling Jaya	-6.614E-7	-0.059	-389540.00	< 0.0001	0.05	Reject H0
Kajang	0	0.008	50638.00	0.490	0.05	Accept H0
Shah Alam	0	-0.026	-170482.00	0.020	0.05	Reject H0
Cheras	-2.055E-6	-0.147	-345065.00	< 0.0001	0.05	Reject H0

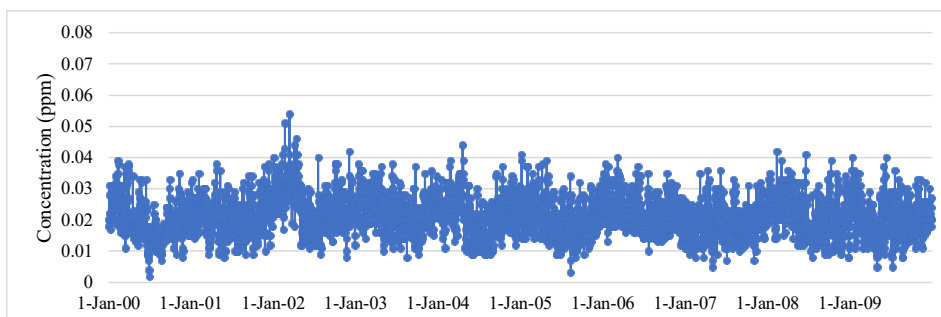


Figure 2: Daily-Averaged of NO₂ Concentration Trend in Klang Station from 2000 to 2009

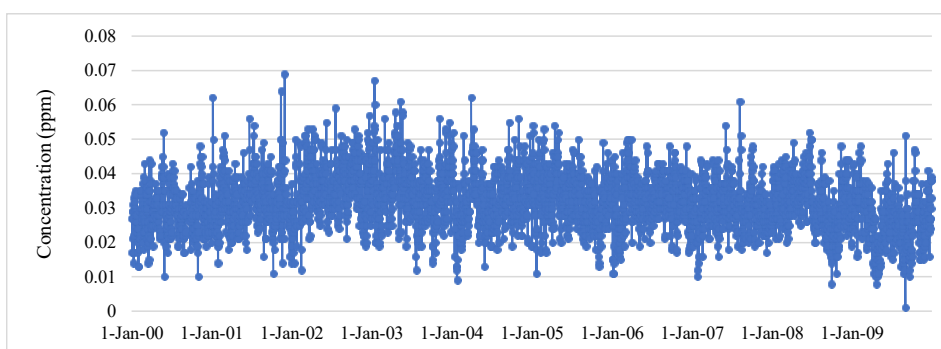


Figure 3: Daily-Averaged of NO₂ Concentration Trend in Petaling Jaya Station from 2000 to 2009

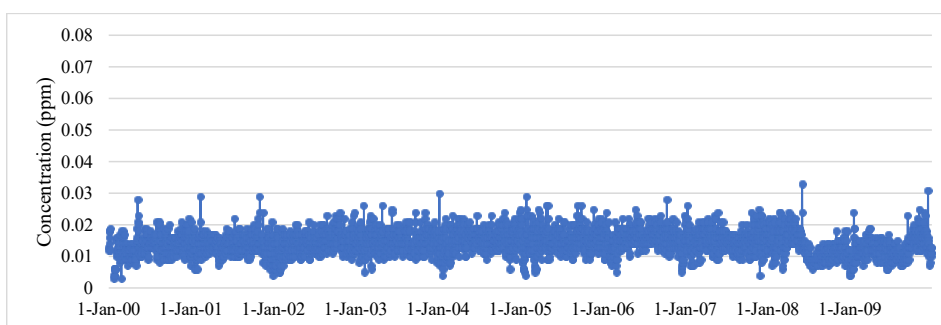


Figure 4: Daily-Averaged of NO₂ Concentration Trend in Kajang Station from 2000 to 2009

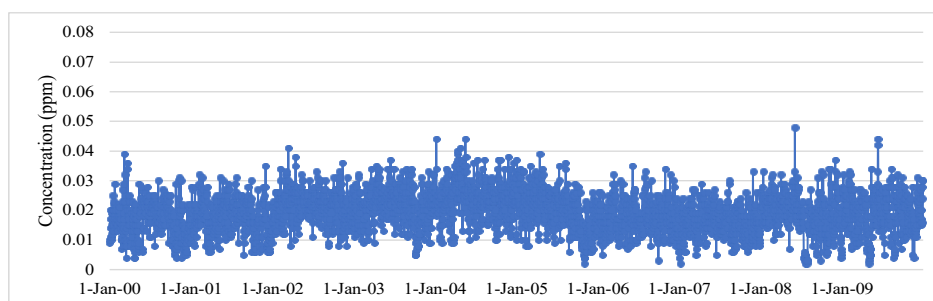


Figure 5: Daily-Averaged of NO₂ Concentration Trend in Shah Alam Station from 2000 to 2009

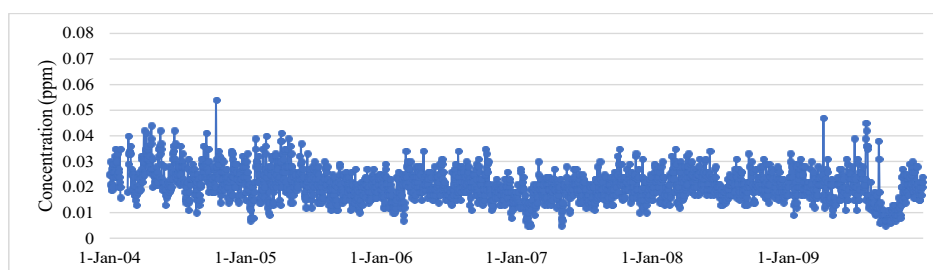


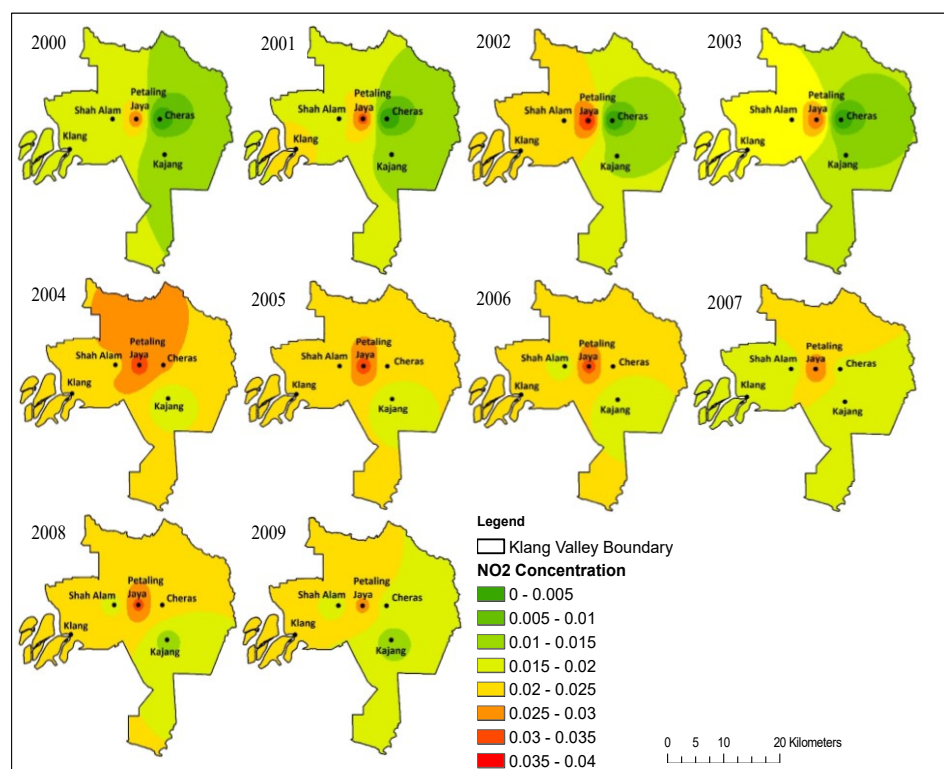
Figure 6: Daily-Averaged of NO₂ Concentration Trend in Cheras Station from 2000 to 2009

From 2000 to 2009, there was no trend in NO₂ content at the Kajang and Shah Alam stations; The Kajang station is the lowest, with a daily NO₂ concentration of less than 0.03 ppm on average. However, on June 4th, 2008, and December 15th, 2009, the daily NO₂ concentrations were greater than 0.03 ppm, with 0.033 ppm and 0.031 ppm, respectively. In reality, the Shah Alam station reported a general daily reading of less than 0.04 ppm from 2000 to 2009, with the exception of a few days when they were 0.048 ppm on 4th June 2008, 0.04 ppm on 12th June 2009, and 0.042 ppm on 14th June 2009. This circumstance demonstrates that, in contrast to 2004 and 2005, the daily concentration of NO₂ has been rather high for a few days in 2009.

Spatial Distribution of Annual-averaged of NO₂ Concentrations

The spatial distribution of annual-averaged NO₂ concentrations at Klang, Shah Alam, Petaling Jaya, Kajang, and Cheras stations increased from 2004 to 2009, according to IDW interpolation analysis. The annual concentration of NO₂ in all the stations was in the range of 0.015 to 0.04 ppm from 2004 to 2009, compared to 0.005 to 0.01 ppm from 2000 to 2003. The highest annual-averaged NO₂ concentration was reported at the Petaling Jaya station, which was between 0.035 and 0.004 ppm for all years except 2007 and 2009, when concentrations were in the 0.03 to 0.035 ppm range. Klang is the second highest station, with an annual average level of NO₂ between 0.025 and 0.03 ppm in most years, including 2001, 2002, 2004–2006, 2008, and 2009. However, the Klang station recorded a

minimal annual-averaged NO₂ concentration of 0.02 to 0.025 ppm in 2003 and 0.01 to 0.015 ppm in 2000. The Cheras station, for example, showed a rather high annual-averaged NO₂ concentration of 0.03 to 0.035 ppm in 2004, as well as 0.025 to 0.03 ppm in 2005, 2006, and 2008. Lower annual-averaged NO₂ readings in the range of 0.015 to 0.02 ppm were observed in 2007 and 2009. However, the Shah Alam station, which reported the highest annual-averaged NO₂ content of approximately 0.02 to 0.025 ppm for several years, namely, 2002, 2004, and 2005, demonstrated a contrasting scenario. However, the annual-averaged NO₂ level at Shah Alam station declined from 0.015 to 0.02 ppm between 2006 and 2009. The Kajang station had the lowest annual NO₂ concentration, which was only 0.005 to 0.015 ppm from 2000 to 2003, starting from 0.015 to 0.02 ppm from 2004 to 2007, and then decreasing back to 0.01 to 0.015 ppm in 2008 and 2009.



Petaling Jaya station clearly had the highest annual NO₂ concentration, which ranged from 0.025 to 0.04 ppm due to a number of factors. The major cause of the deterioration of air quality in Malaysia is due to the emissions from motor

vehicles. In fact, motor cars and traffic have been demonstrated to be the primary and dominating sources of urban air pollution in Malaysia.

The Malaysian Road Transport Department (MRTD) reported an 8.16 per cent increase in the number of motor vehicles registered in the country from 4,335,863 units in 2003 to 28,224,407 units in 2017, driven by economic development factors. The cumulative Gross Domestic Product (GDP) per capita has been steadily increasing alongside the number of registered motor vehicles. This trend, which began in 2001 with 11,302,545 units and reached 25,044,872 units in 2015 (WDI, 2017), significantly increases individuals' buying power and spending capacity, promoting product and service mobilisation.

The high density of motor vehicles and traffic in cities such as Kuala Lumpur has led to significant pressure on road infrastructure, causing traffic congestion. In 2010, urban building saturation increased by 114.82%, compared to a loss of 70.2% in green space (Rosni et al., 2016). This high concentration of built-up areas causes traffic congestion, especially at intersections and traffic signals. According to Bajcinovci (2017), the physical structure of a city and busy traffic conditions directly influence air pollution levels. The crowded and dense transportation network and urban area with numerous active service activities contribute to this issue. Significantly, urban traffic pollution has severe consequences for agriculture, ecosystems, buildings, human eyesight, and lung health.

Individual exposure to pollution is exacerbating the issue, especially near major metropolitan roadways. The intensity and frequency of traffic flow, especially during peak hours, contribute to the growing exposure. High pollution levels are worsened by the distance between emission sources and city centres, as well as the dispersion and fluidity of pollutants in the air. Climate factors, such as wind, temperature, and humidity, and topography also influence air chemical reactions. High urban surface roughness, especially in city centres, increases pollution concentrations.

CONCLUSION

A serious urban air quality deterioration occurs in the Klang Valley due to the production and release of air pollutants, especially from motor vehicles. The results of the study summarised that Petaling Jaya station was identified as the most polluted of the five stations, with an average concentration of more than 0.050 ppm every year with the maximum reaching 0.069 ppm whereby the mean was 0.030 in 2001. In terms of spatiotemporal, Klang, Petaling Jaya, Shah Alam, and Cheras stations recorded a significant trend with p-values < 0.05 at 0.0001 and 0.020, respectively. The obtained sen-slope values were negative, demonstrating that the NO₂ concentrations in Klang, Petaling Jaya, and Cheras had decreased between 2000 and 2009. Furthermore, the highest annual-averaged

NO₂ concentration was reported at the Petaling Jaya station, which was between 0.035 and 0.004 ppm for all years except 2007 and 2009, when concentrations were in the 0.03 to 0.035 ppm range. This situation is evidenced by the maximum total number of motor vehicles that are recorded in Wilayah Persekutuan, Kuala Lumpur, i.e., 2,301,024 units, compared to a total of 906,432 units that represent the state of Selangor throughout the years 2000 to 2009. This situation is indicated by the number and types of private vehicles and goods identified as the main cause of increased production and release of pollutants. The major pressure on the road infrastructure was recognised to be mainly due to a lack of space to accommodate the effect of the maximum density of motor vehicles and traffic, resulting in traffic congestion in the city centre.

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CONFLICTS OF INTERESTS

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ADDRESSING THE COMPETENCY OF PRACTITIONERS WITHIN BIM E-SUBMISSION IN MALAYSIAN LOCAL AUTHORITIES

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Abstract

This paper delves into the impact of the transition to Building Information Modelling electronic submission (BIM e-Submission) within local authorities (PBT) in Malaysia. The study comprehensively analyzes the essential competencies necessary to implement BIM e-Submission successfully. It emphasizes the potential dire consequences of inadequate skill allocation in Malaysia's BIM e-Submission initiatives, underlining the urgency of addressing this issue. Using a multi-method qualitative approach to gather primary data and thoroughly examine existing literature, the research constructs a robust conceptual framework elucidating the critical competencies required of BIM e-Submission practitioners within the PBT domain. The findings underscore the necessity of developing a BIM e-Submission occupational competency framework as a development strategy to enhance the training and proficiency of BIM e-Submission practitioners. This paper aims to advance understanding of BIM e-Submission in Malaysia, increase stakeholder awareness of relevant roles, responsibilities, and competencies, and promote the advancement of digital construction through optimized utilization of BIM e-Submission practices.

Keywords: Building Information Modelling (BIM), BIM electronic submission, BIM roles and responsibilities, individual BIM competencies

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INTRODUCTION

Malaysia's new investment in Building Information Modelling Electronic Submission (BIM e-Submission) by introducing the National BIM e-Submission (NBeS) system is a notable example of the country's dedication to the digital transformation of the built environment (Lee & Tan, 2022). A more effective and transparent regulatory environment will be promoted by NBeS, a digital platform for building plan submission and approval, which is positioned to expedite administrative procedures and shorten approval timelines (Ibrahim et al., 2020). However, NBeS practitioners' proficiency determines the system's installation and long-term viability (Zhang & Lim, 2021). The complexity of the system and the increased degree of knowledge it requires mean that defining and standardizing the competencies needed by professionals involved in BIM e-Submission is imperative (Wong & Chong, 2023). Despite the well-established benefits of BIM, integrating it with regulatory electronic submission procedures comes with a unique set of challenges (Patel & Kumar, 2019; Nguyen & Pham, 2022). A particular set of skills is required due to the complexity of BIM software and the unique demands of e-Submission protocols (Omar & Hassan, 2020). It is also necessary for practitioners to study continuously to keep up to date with the newest advancements because technology is a dynamic field (Tan & Lee, 2021). This continuous learning is not just a necessity, but a key to staying relevant and competitive in the industry. It is important from an efficiency standpoint and national economic stance that professionals are adequately prepared to handle the intricacies of NBeS (Ali & Yusof, 2022). This study addresses the competence challenges practitioners encounter in overseeing and guaranteeing the future success of Malaysia's BIM e-Submission. This research intends to pave the road for a more robust and resilient BIM e-Submission occupational competency framework by exploring the present competence landscape in PBT, finding gaps, and suggesting remedies (Zhang & Lim, 2021). It is impossible to overestimate the importance of BIM-skilled practitioners in Malaysian PBT as Malaysia moves closer to being a developed country (Wong et al., 2023). The literature on BIM competencies that has already been written will be examined, the study methodology used will be explained, our findings will be presented, and their implications for the future of BIM e-Submission in Malaysia will be discussed in the following parts.

LITERATURE REVIEW

The Concept of BIM e-Submission

The building industry has significantly transformed with the advent of BIM, which provides a comprehensive digital representation of a facility's functional and physical attributes (Eastman et al., 2011). BIM enhances critical information retrieval, analysis, and storage, thereby improving management (Mustafa et al., 2019). Within this context, the concept of e-Submission has become integral to

the BIM ecosystem (Agus et al., 2019). Fundamentally, e-Submission involves electronically sending specific data files for renewal, update, or approval processes (Suzana et al., 2018). This typically means that industry participants submit digital building or development plans to a regulatory agency, where automatic compliance checks ensure adherence to current standards and regulations (Suzana et al., 2018). The complexity and error-proneness of manual verification underscore the necessity of e-Submission. Manual techniques for ensuring compliance with national codes are cumbersome and susceptible to human error (Suzana et al., 2018).

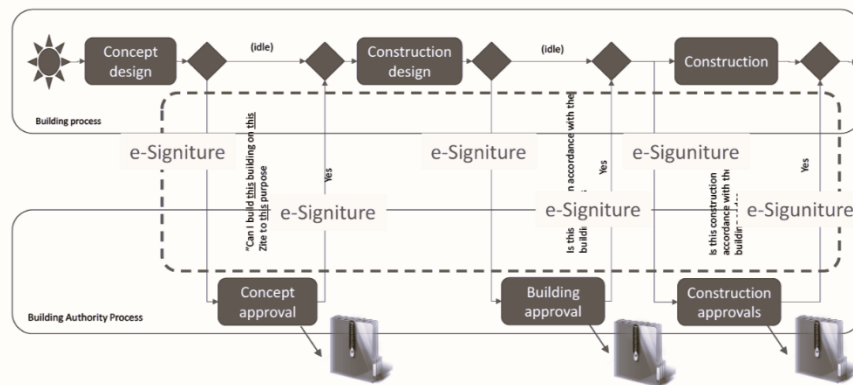


Figure 1: e-Signature and archive in data exchange between the applicant and regulatory body (buildingSMART International, 2020)

According to Lee et al. (2010), automated rule checking allows software to evaluate a design by analyzing object placements, interrelations, and characteristics without altering the architectural design. The digitalization of construction documentation and regulatory processes has progressed significantly with BIM e-Submission, allowing building professionals to submit digital models for assessment and approval rather than traditional paper-based submissions. This study explores the development of BIM e-Submission and its impact on the construction sector, particularly on local governments in Malaysia. Researchers have investigated BIM technology's potential to streamline regulatory procedures (Azhar, 2011), acknowledging that BIM e-Submission can enhance code compliance, reduce errors, and accelerate approval processes (Succar, 2009). BIM e-Submission involves creating a digital building model with detailed design data for regulatory approval, utilizing automated code checking (ACC) to ensure compliance (Ding et al., 2016).

Case studies have demonstrated that BIM e-Submission shortens approval times and enhances regulatory compliance (Cheng & Lu, 2015), improving accuracy and administrative efficiency while fostering a transparent regulatory environment. The future of construction lies in integrating BIM with e-Submission systems, such as Singapore's CORENET, South Korea's KBIM, and the United Kingdom's D-COM Network (Brito et al., 2022). Singapore, in particular, mandates BIM e-Submission for projects larger than 5000 m², setting a model for other countries (Suzana et al., 2018; Khemlani, 2005; BCA, 2011). Despite its advantages, BIM e-Submission faces challenges, including resistance to change, lack of BIM model uniformity, and substantial technology and training investments (Kassem et al., 2015). In Malaysia, these challenges are exacerbated by regional law variations and differing local government BIM development levels (Mohd et al., 2018). Successful implementation in Malaysian PBT requires technological investments and a focus on practitioner competency development (CIDB, 2022).

NBeS: The First BIM e-Submission in Malaysia

Malaysia launched its NBeS project in 2017 as part of the Construction Industry Transformation Program (CITP) 2016-2020, spearheaded by the Construction Industry Development Board (CIDB) Malaysia, to augment the efficiency of the construction sector through the automation and digitization of the Building Plan submission procedure. NBeS, different from the current One Stop Centre (OSC) 3.0 Plus Online System, is an innovative endeavour as the first-in-the-world Auto Checker system (CIDB, 2023). Building plans are intended to be reviewed and approved by the PBT using this approach. NBeS uses 3D BIM models instead of the conventional approach, which uses 2D drawing plans for the Uniform Building By-Law (UBBL) compliance evaluation and other associated procedures.

NBeS HIGH LEVEL PROCESS

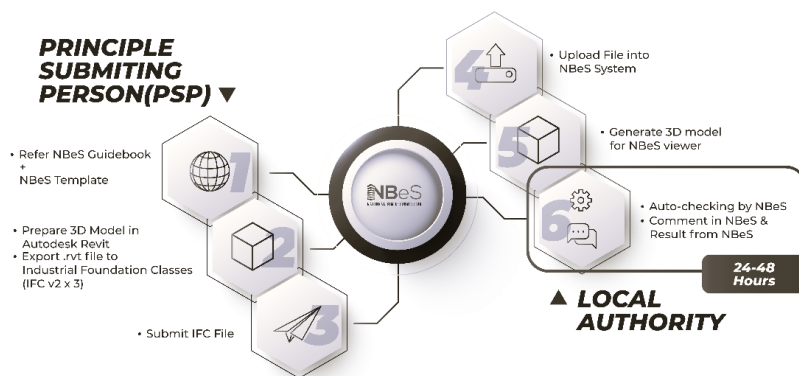


Figure 2: NBeS Process Flow (CIDB, 2023)

In January 2017, CIDB E-Construct Services Sdn. Bhd. (CIDBEC) produced the NBeS prototype, ushering in a new era for building plan submissions (CIDB, 2022). The term “PBT” refers to government bodies that are generally led by civil servants holding the titles of President (*Yang Di-Pertua*) for municipalities and rural districts and Mayor (Datuk Bandar) for cities, with a few exceptions known as "special and modified local authorities." In 2019, five PBT – Putrajaya Corporation (PPj), Petaling Jaya City Council (MBPJ), Kangar Municipal Council (MPK), Historic Melaka City Council (MBMB), and Kuching North City Hall (DBKU) – implemented pilot projects to assess the system's usefulness.

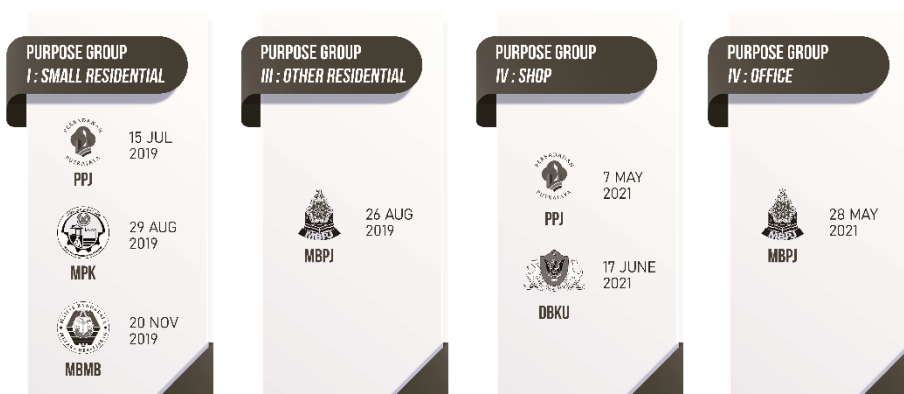


Figure 3: NBeS Pilot Project (CIDB, 2022)

Based on the NBeS Report by CIDB (2022), many of these authorities' feedback was optimistic and positive. However, they also understand that a defined structure is necessary to direct its implementation (Ahmad & Rahman, 2021). Their assessment score of 92% showed a high degree of accomplishment. Additionally, simulations showed that NBeS integration with the OSC 3.0 Plus Online system might yield a 70% improvement in the building plan approval procedure. The accomplishment of this project demonstrates how crucial it is to align BIM technology with legal procedures. This involves specifying the skills professionals need to utilize BIM e-Submission systems efficiently (Zhang & Lim, 2021). With the launch of the NBeS initiative, Malaysia has established a leading position as nations worldwide recognize the many benefits of BIM (Ahmad & Rahman, 2021).

COMPETENCY ISSUES IN MALAYSIA'S BIM E-SUBMISSION

Despite the strong demand for expertise in this area, Ahmad and Rahman (2021) highlight a significant gap in local government units' understanding of roles, duties, and competencies associated with BIM e-Submission. CIDB (2022) underscores that a significant obstacle to the successful implementation of NBeS is the competency required for processing building plan approvals. This is particularly critical given the importance of PBT officers' roles and responsibilities in Malaysia's initial BIM e-Submission project. The absence of a structured competency framework has hindered the consistent quantification of BIM adoption successes or failures from a capability-building perspective. The lack of comprehensive BIM e-Submission competence units may impact the recognition of internal BIM talent among PBT technical personnel in future formal skills certification programs. This raises concerns about the capability and training required for the Principal Submitting Person (PSP), internal technical agencies (ATD) officers, and external technical agencies (ATL) officers for future NBeS implementation.

Addressing this research gap necessitates thorough studies exploring the capabilities needed for BIM e-Submission in the Malaysian context. This includes defining the duties and responsibilities of PBT officers, the skills required of PSP, and the training and development requirements for ATD and ATL officers. Methodical research and training initiatives are crucial for closing the capability gap and ensuring the successful deployment and sustainability of NBeS (CIDB, 2022). Future research should incorporate recent findings (2018–2023) and relevant case studies to elucidate the specific abilities required to navigate NBeS complexities. It should also consider the evolving BIM technology and its incorporation into regulatory processes.

Resolving competence issues becomes paramount as Malaysia advances programs like NBeS to develop its construction industry. Skill gaps affect the building sector and the country's economic development and

international competitiveness. Addressing this capability gap is essential for the efficacy and efficiency of NBeS and the overall growth of Malaysia's construction sector in the digital age. The OSC 3.0 Plus Manual (KPKT, 2019) emphasizes the shift towards digital submission management, requiring all documents to be digitally created and reviewed by qualified individuals in Malaysian PBT. While this transition is positive, it exposes the unconscious shortcomings of the involved parties. The NBeS Guidebook for PSP (CIDB, 2021) defines the roles and responsibilities of PSP but omits those of PBT officers, underscoring the need for a comprehensive understanding and adherence to rules. The PSP's responsibilities include setting up the NBeS submission account, approving BIM e-Submission documents, and ensuring correct BIM model implementation. This highlights the critical need for PSP competence in the BIM e-Submission environment. However, the roles, responsibilities, and individual competencies necessary for PBT officers to ensure BIM e-Submission success remain undefined. Integrating these standards and objectives into the Malaysia Smart City Framework adds complexity, especially given the lack of competency studies among PBT officers to improve efficiency. Consequently, while integrating NBeS into the OSC 3.0 Plus Online system is a positive step, it unintentionally highlights the lack of awareness regarding competency in managing BIM e-Submissions.

Incompetency of PSP, ATD, and ATL Officers in Executing New 3-D System
CIDB (2022) highlights a range of incompetency among the PSP who come from the private consultation firms, and ATD and ATL officers who mainly come from PBT and other public agencies, which have been brought to light by the introduction of BIM e-Submission in Malaysia. Shahrudin et al. (2020) emphasized that being competent in a BIM setting involves more than being technologically savvy; it also involves having abilities in project execution, change management, and strategic planning. Nevertheless, there is a noticeable disparity in these competencies across PSP, ATD, and ATL officers in the Malaysian context. This disparity stems from a lack of technology savvy and knowledge of the larger BIM ecosystem and how it affects workflow. All papers must be created in digital format by a competent PSP and checked by competent ATD and ATL officers, as mandated in the OSC 3.0 Plus Manual (KPKT, 2019) and NBeS Guidebook for PSP (CIDB, 2021). Therefore, to overcome these inadequacies, a concentrated effort must be made to create training programs tailored explicitly to practitioners' needs, specifically among PBT officers, before Malaysia can fully use its BIM e-Submission.

Unclear Baseline to Define Roles, Responsibilities, and Competencies in the Malaysian BIM e-Submission

The implementation of BIM e-Submission in Malaysia is hindered by the absence of a common baseline for defining roles, duties, and capabilities. The NBeS Guidebook for PSP (CIDB, 2021) outlines an Autodesk Revit process, emphasizing the need for organized digital BIM models to meet technical and local ordinance specifications. However, it fails to establish a uniform capability standard among practitioners, particularly in PBT. While aiming to expedite urban management and development procedures, the guidebook does not address the specific operational requirements of local authorities for BIM e-Submission, focusing instead on procedural frameworks for building plan approval and development control. This oversight highlights the need for a defined baseline to manage and succeed with BIM e-Submission programs (Al-Ashmori et al., 2020).

Despite the recognized advantages of BIM, its implementation in Malaysia is impeded by building professionals' lack of understanding and incomplete comprehension of the technology (Othman et al., 2020). This is exacerbated by the absence of a structured framework delineating the specific responsibilities and skill sets required for efficient BIM implementation (Shahrudin et al., 2020). Consequently, there is a fragmented approach to BIM adoption, with varying interpretations of roles during the e-Submission process.

Future studies should explore the dynamics of collaboration within and across enterprises for BIM adoption to establish a clear baseline for roles and responsibilities (Sinoh et al., 2020). Ibrahim et al. (2018) emphasize the importance of organizational behaviour, particularly communication and responsibility, for practical BIM projects. Empirical research is crucial in defining a precise set of duties and skills specific to the Malaysian BIM e-Submission environment (Uhm et al., 2017). Addressing this gap will create a standardized and effective BIM e-Submission system in Malaysia, fostering its advancement within local authorities. A coherent and focused research approach is essential for defining BIM e-Submission duties and ensuring a viable, standardized infrastructure.

The Unsuitability of Global Documents Towards Malaysia's BIM e-Submission

One major obstacle to the successful deployment of BIM e-Submission in Malaysia is that any global documents and scholarly papers are unsuitable for defining BIM roles, responsibilities, and competencies in the unique operational environment of Malaysian PBT. They frequently overlook Malaysia's BIM e-Submission requirements, resulting in discrepancies between global norms and regional customs, although worldwide standards provide a starting point (Al-Ashmori et al., 2020). Che Ibrahim et al. (2018) emphasize the need for localized research because much of the existing literature represents a small group of BIM

practitioners' views, which may not entirely reflect the more significant Malaysian sector. This emphasizes the necessity of a BIM competency development strategy that is inclusive and customized for the Malaysian context. Sinoh et al. (2020) call for a study that explores the coordination dynamics inside enterprises to provide a clear baseline for BIM e-Submission roles and duties in Malaysia. Furthermore, Jang and Collinge (2020) point out systemic industrial traits that result in ongoing issues with BIM asset management, implying that international norms might not readily apply to Malaysian contexts. This highlights even more how important it is to create rules considering Malaysia's unique BIM e-Submission processes. According to Othman et al. (2020), Malaysia is still in the early phases of BIM adoption, with a significant disparity between potential and actual utilization. The dependence on international studies that do not address the unique characteristics of the BIM environment in Malaysia exacerbates this disparity.

Difference in Jurisdictions between Public Agencies & PBT

The Local Government Act 1971 of Malaysia defines local government in Malaysia as city councils, municipal councils, and district councils. Several jurisdictional issues are involved in integrating BIM into the building approval system executed by the Malaysian PBT, notably the Sabah Local Government Ordinance 1961 and the Sarawak Local Authority Ordinance. Different legal and procedural frameworks govern how public organizations and local authorities' function, making adopting and using BIM technology consistently more challenging (Wong & Gray, 2019). The variation in jurisdictions is a noteworthy obstacle to the standardization of BIM e-Submission procedures, resulting in inefficiencies and irregularities that may hinder the completion of projects. The many operating settings of local authorities, each with its own set of regulations and procedures for building project permits, exacerbate the absence of a cohesive strategy. This scenario differs from the story of global BIM adoption, where uniform principles frequently fail to consider local variations and governance systems (Al-Ashmori et al., 2020). The Malaysian BIM e-Submission system needs a customized strategy that conforms to its local government bodies' unique legislative and regulatory framework. There is limited research on how these jurisdictional disparities affect the effectiveness of BIM e-Submissions in Malaysia. Research on the relationship between technology, competency, and governance is desperately needed to create a framework that considers the particulars of Malaysia (Latiffi et al., 2015). In addition to closing the present competency gap, this study would speed up the development of a reliable, efficient, and contextually appropriate BIM e-Submission system. The differences in jurisdiction between local authorities and public bodies in Malaysia highlight the need for locally specific, research-based rules for BIM e-Submission. It is imperative to address this issue to ensure that BIM e-

Submission's full potential is utilized to expedite the building approval process and improve the competencies needed to manage and thrive in Malaysia's BIM e-Submission projects.

The Absence of BIM e-Submission Occupational Competency Document in Malaysia

This paper recognizes that the absence of an occupational competency document significantly hinders the adoption of BIM e-submission in Malaysia because it is essential to equipping local authorities with the information required for the training process (CIDB, 2022). Al-Ashmori et al. (2020) highlight the benefits of BIM deployment and emphasize that one huge challenge is the lack of knowledge and comprehension of BIM technology among construction experts. This competency gap affects more than just technology; it also affects abilities related to project delivery, change management, and strategic planning (Shahrudin et al., 2020). Malaysia's BIM e-Submission system is now in its infancy and it is clear that there is a dearth of industry experience and training options (Eadie et al., 2013). Ibrahim et al. (2018) also point out that the perspectives expressed in previous studies are frequently restricted to small-scale BIM practitioners, indicating a more extensive knowledge and research vacuum throughout the sector. There is a significant gap between promise and practice as seen by the limited use of BIM in both the public and private sectors (Othman et al., 2020). According to Kong et al. (2020), there is potential for BIM deployment to be effective; nevertheless, it is crucial to solve the primary competence challenges. The building sector and academic institutions must work together to develop strategies for developing BIM-skilled individuals through relevant instruction and training (Ibrahim et al., 2020). Additionally, knowing the standards for evaluating an organization's BIM capabilities may help develop industry-specific tools, which might then influence the formulation of policies for hiring and educating BIM specialists (Rajabi et al., 2022). One of the significant challenges to Malaysian local authorities building a robust BIM e-Submission framework is a lack of vocational expertise in BIM e-Submission. There is an immediate need for focused research and teaching programs to develop a distinct set of skills and duties appropriate for the Malaysian BIM e-Submission environment (Uhm et al., 2017). It is still challenging to manage and be successful in Malaysia's BIM e-Submission without this fundamental ability.

RESEARCH METHODOLOGY

This paper forms a crucial part of ongoing research and employs a comprehensive literature review methodology to investigate the competencies of BIM e-Submission practitioners within Malaysian PBT. The review encompasses articles published between 2012 and 2022, focusing on BIM, BIM e-Submission, and individual BIM competencies. Keywords such as "BIM e-Submission,"

"Individual BIM Competencies," "BIM Adoption in Malaysia," and "Smart City in Malaysia" ensured the retrieval of relevant articles. Only articles discussing BIM within the construction industry context, particularly electronic submission processes, roles, responsibilities, and individual competencies, were included. The review was confined to documents written in English and Malay and published in peer-reviewed journals, ensuring high-quality and reliable sources. Articles that did not directly address the BIM e-Submission process or the Malaysian context were excluded. Document analysis was conducted on guidelines and standards defining the BIM body of knowledge concerning roles, responsibilities, occupations, and competencies in Malaysia, as detailed in Table 1.

Table 1: Selected BIM Guidelines for Document Analysis

Author	Guideline
AEC (UK) BIM (2012)	AEC (UK) BIM Protocol Implementing UK BIM Standards for the AEC industry 2.0
myBIM Centre (2016)	BIM Guide 2016: Adoption
myBIM Centre (2017)	BIM Guide 2017: BIM Execution Plan
DSD (2020)	Occupational Framework MSIC 2008 F43 – Specialized Construction Activities. Garis Panduan Program Persijilan BIM Jabatan Kerja Raya – BIM Modeller
JKR (2020)	Garis Panduan Program Persijilan BIM Jabatan Kerja Raya – BIM Coordinator Garis Panduan Program Persijilan BIM Jabatan Kerja Raya – BIM Manager

The literature synthesis employed thematic analysis to identify, analyze, and report patterns within the data. This method facilitated the identification of core competencies required by BIM e-Submission practitioners in Malaysian local authorities. Databases such as Scopus, Web of Science, Emerald, and Science Direct were searched due to their extensive coverage of peer-reviewed articles in the built environment field. A multi-method qualitative research approach was adopted, recognizing the complex reality behind the current building plan approval process in PBT implementing BIM e-Submission (Saunders et al., 2009). The primary objective was to gather comprehensive views from NBeS pioneer participants and interpret these insights to improve the current situation (Creswell & Creswell, 2018).

The research design leverages the Design and Development Research (DDR) Approach – Model Research (Type 2) as described by Richey and Klein (2007), integrating the Developing Standard and Curriculum (DESCUM) method by DSD (2020). This design is well-suited for developing practical solutions to complex issues encountered in BIM e-Submission processes. Data collection involved face-to-face interviews and focus group discussions (FGDs) with BIM e-Submission practitioners from various relevant agencies, selected based on their involvement in the first Malaysian BIM e-Submission pioneer project (2017-2020).

The purposive sampling technique was employed to identify informants based on specific criteria outlined in DESCUM (DSD, 2020), such as years of experience with BIM-based projects and knowledge of BIM e-Submission in PBT. Feedback from NBeS practitioners was collected through face-to-face interviews to uncover challenges faced in managing BIM-based construction projects. The inspection of BIM document reviews assessed compliance with BIM e-Submission standards. The study unit comprises technical officers operating NBeS from 2017-2022, with sub-units including BIM e-Submission in the building drawing approval process, competency issues, and solutions. The overall research design is illustrated in Figure 4.

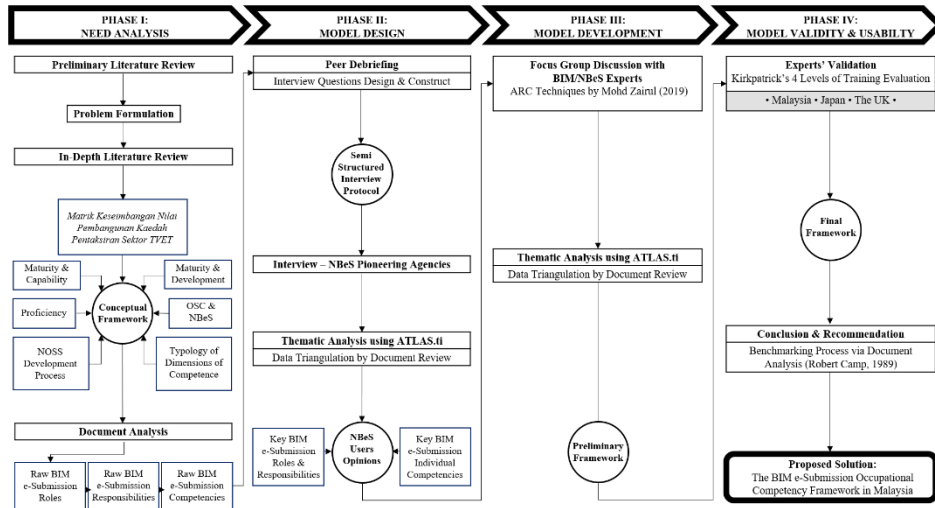


Figure 4: The research design for the proposed study

The constructs focused on BIM e-Submission roles and responsibilities, individual BIM e-Submission competency, and the preliminary BIM e-Submission occupational framework, which will be evaluated by local and international experts in the final phase to determine validity and suitability for future operations within Malaysian PBT jurisdictions. Participants were informed about the study's purpose, consent was obtained before interviews and FGDs, and confidentiality and anonymity were maintained. Malaysia, Japan and the UK experts will validate the preliminary framework in *Phase IV: Model Validity & Usability*.

FINDINGS

The research requires further investigation concerning the right individual BIM e-Submission competencies that PBT officers should master in executing it. As highlighted above, many missing parts must be improvised to solve the ambiguities and inadequacy issues. The full potential of BIM e-Submission in Malaysia demands a high level of collaboration that can integrate the client, PSP, PBT, and other relevant agencies differently from the non-BIM e-Submission environments they used to work in. It can also add more value to the BIM supply chain by showing the interrelationships among stakeholders throughout the building life cycle. The findings disclosed that the integration of individual competency among PBT officers with the context of BIM e-Submission in Malaysia remained unknown. Hence, this study could lead to a reasonable prospect of overcoming the inadequacy of the roles, responsibilities, and competencies of BIM e-Submission within the various phases of the building plan approval process. The study's findings reveal a competency gap that spans several dimensions, including technological proficiency, strategic planning, and interdisciplinary collaboration. An inspection of BIM documents was also conducted to assess compliance with NBeS and OSC 3.0 Plus Online system requirements. Modifications to the proposed BIM e-Submission process were explored during primary data collection. Theoretical frameworks were selected from preliminary reviews (Table 2), and a conceptual framework for this research was proposed (Figure 5).

Table 2: Selected Theoretical Frameworks Used for the Conceptual Framework Development

Author	Guideline
Bew & Richard (2008)	BIM Maturity Level
Succar (2009)	BIM Capability Stages
Barison & Santos (2012)	Level of BIM Proficiency
BuildingSMART International (2020)	BIM e-Submission Maturity Level
BuildingSMART International (2020)	BIM e-Submission Development Level
KPKT (2019)	OSC3.0 Plus Online Process
CIDB (2021)	National BIM e-Submission (NBeS) Process
Le Deist & Winterton (2005)	Typology of Dimensions of Competence
Zulkifli M. S. (2018)	<i>Matrik Keseimbangan Nilai Pembangunan Kaedah Pentaksiran Sektor TVET</i>
DSD, 2020	NOSS Development Process

The conceptual framework proposed in this research (refer to Figure 5) is a testament to the need for a strategic process protocol framework to navigate the complexities of BIM e-Submission. This conceptual framework is predicated on the principles of process protocol, adapted to the unique requirements of BIM e-Submission. It envisages a phased approach to BIM e-Submission, delineating the PBT officers' roles, responsibilities, and individual competencies within each

phase and subphase of the building plan approval process. Integrating NBeS process principles within Malaysia's OSC 3.0 Plus Online system context is a novel exploration. It can also address identified competency gaps, facilitating a more seamless and effective BIM e-Submission process within Malaysian local authorities. The findings of this study underscore the imperative to address the competency gaps in BIM e-Submission. They advocate for a strategic occupational competency framework attuned to the nuances of BIM e-Submission work processes and the evolving competencies of PBT officers. As Malaysia strides towards a future where BIM is an integral part of the construction industry, developing and applying such a framework will be pivotal in realizing the transformative potential of BIM e-Submission.

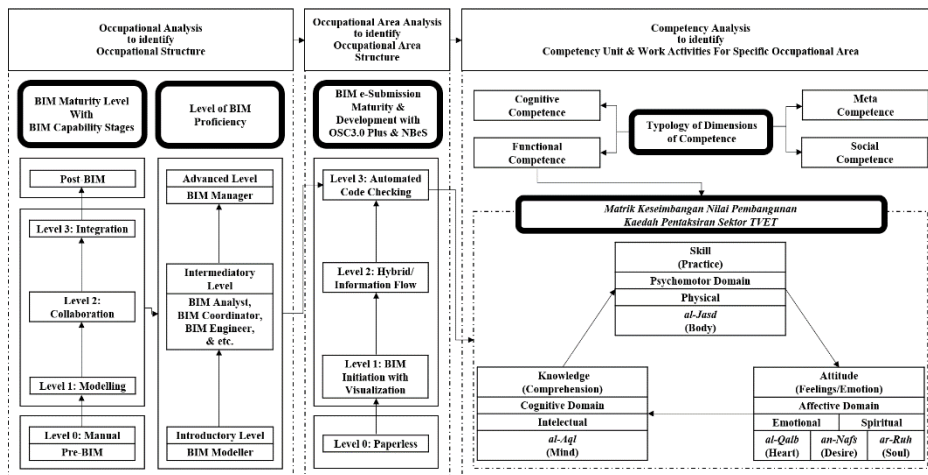


Figure 5. Conceptual framework of the proposed study

CONCLUSION

To fully harness Building Information Modelling (BIM) in Malaysia's construction industry, examining the competencies of BIM e-Submission practitioners is essential. The study, "Addressing Competency of BIM e-Submission Practitioners within Malaysian Local Authorities," examines into the underexplored domain of BIM e-Submission, where competencies remain inadequately defined. Utilizing findings from the literature review, a conceptual framework for the BIM e-Submission Occupational Competency Framework was developed. This framework integrates identified competencies into a structured model to assess and enhance BIM practitioners' capabilities within Malaysian local authorities. Concerns about BIM's legal and contractual issues stem from its complexity during implementation. The NBeS implementation has highlighted significant competency issues. Transitioning to BIM e-Submission requires a thorough understanding of BIM processes and tools. However, a gap in defining

roles and responsibilities for practitioners within local authorities persists (Shahrudin et al., 2020). This gap impedes effective BIM adoption and its potential benefits to Malaysia's construction industry.

The limited efforts to delineate roles and responsibilities in BIM e-Submission among Malaysian local authorities have resulted in a lack of standardized practices, leading to inefficiencies and potential quality declines (Jacobsson & Merschbrock, 2018). The absence of a unified BIM competency framework exacerbates this situation, leaving practitioners without clear paths to acquire the necessary skills. This paper proposes developing Malaysia's *BIM e-Submission Occupational Competency Framework* to address these challenges. The framework aims to empower PBTs by providing structured information to aid training and delineating necessary competencies and responsibilities at various expertise levels (Dakhil et al., 2019). This framework is a transformative tool designed to standardize BIM practices across local authorities, facilitating seamless BIM integration into local governance and enhancing e-Submission efficiency, accuracy, and quality (Eadie et al., 2013). Furthermore, it will provide a benchmark for educational institutions to align curricula with industry needs, ensuring graduates are equipped with relevant BIM competencies (Russell et al., 2014). In conclusion, addressing current competency issues is crucial for implementing and managing BIM e-Submission in Malaysia. The proposed BIM e-Submission Occupational Competency Framework offers a pivotal solution, calling on Malaysian local authorities to enhance BIM competencies proactively, ensuring BIM e-Submission's future success.

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FROM PERCEPTION TO SUPPORT: THE ROLE OF POLITICAL BUREAUCRACY IN RURAL TOURISM DEVELOPMENT IN LOMBOK, INDONESIA

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Abstract

Numerous studies emphasise the importance of local governance and governmental support in promoting long-term rural tourist growth. Political bureaucracy, which encompasses the duties and activities of government officials and institutions, plays an important role in developing policies, providing required infrastructure, and fostering stakeholder collaboration. The challenge at hand is the ambiguous relationship between perceived benefits (economic, social, and environmental) and community support influenced by political structures. This study explores moderating role of political bureaucracy on the relationship between the impact of perceived tourism benefits and the community support for rural tourism development in Lombok, Indonesia. The objective is to understand how these perceptions affect support when moderated by political bureaucracy. Data were collected using quantitative methods from 183 residents via online surveys and analysed using SmartPLS SEM for measurement and structural model assessments. The findings revealed no significant relationship between perceived economic and social benefits and community support. However, environmental benefits showed a positive influence. The moderating role of political bureaucracy was found to be minimal. The study suggests that enhancing awareness and empowerment of local communities could improve support for tourism. These insights are vital for policymakers and stakeholders to develop strategies that foster sustainable rural tourism.

Keywords: Rural Tourism, Perceived Benefits, Community Support, Political Bureaucracy, Sustainable Development

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INTRODUCTION

Rural tourism has the potential to generate significant economic, social, and environmental benefits for rural communities, engaging travellers with the local culture and environment while promoting economic recovery, social regeneration, and environmental conservation (Litheko & Potgieter, 2021; González et al., 2019). Community engagement in tourism management is crucial for achieving these long-term benefits (Alamineh et al., 2023). However, balancing the community's needs with tourism demands requires careful planning and sustainable management (Özgit et al., 2022). Understanding the factors influencing local community support is vital for designing and implementing successful rural tourism initiatives (Obeidat, 2023).

Political bureaucracy plays a significant role in shaping rural tourism's social, economic, and environmental impacts by developing policies that encourage community engagement, cultural preservation, and social inclusion (Nzomo, 2020; Li et al., 2022). Effective political bureaucracy can support sustainable development through regulations on carrying capacity, waste management, and resource conservation (Hahury et al., 2023). However, rigid bureaucratic processes can impede the implementation of rural tourism initiatives, leading to community frustration and doubts about the viability of tourism benefits (Ilham et al., 2023). Therefore, examining the function of political bureaucracy as a moderating factor is essential to realising the full potential of rural tourism.

Despite extensive research on rural tourism's benefits, the role of political bureaucracy in regulating the relationship between perceived tourism advantages and community support remains underexplored. This study addresses this gap by investigating how political bureaucracy moderates the relationship between perceived economic, social, and environmental benefits and community support in Lombok. Prior studies highlight the importance of local perceptions and administrative perspectives on rural tourism development (Castanho et al., 2021; Isa et al., 2022). This research offers crucial insights for policymakers and stakeholders, aiding in developing strategies that enhance public engagement and support for sustainable rural tourism initiatives. By understanding residents' views on tourism's benefits, the findings provide actionable insights to improve the success and sustainability of rural tourism projects in Lombok.

LITERATURE REVIEW

Rural Tourism

Rural tourism involves visitors engaging in nature-based activities, agriculture, rural lifestyles, culture, and sightseeing in rural areas characterised by natural landscapes and cultural heritage (UN Tourism, 2023; Dewi & Ginting, 2022). This form of tourism can foster economic growth by generating income, creating

jobs, and promoting local products and services, thus supporting community development (Pimid et al., 2023). The local community's perception of these benefits is crucial to their willingness to support rural tourism development. Rural tourism promotes regional sustainable development by encouraging economic growth and community development (Tong et al., 2022). Visitors immerse themselves in rural lifestyles, participating in outdoor activities and learning about local traditions, while rural areas offer distinctive natural sceneries and rich cultural assets that attract tourists (Aldora et al., 2022). However, the influx of tourists can strain local infrastructure and increase the demand for natural resources, potentially causing environmental damage if not managed responsibly (Tong et al., 2022). Therefore, sustainable and responsible rural tourism management is essential to minimise negative impacts and maximise benefits (Radzanowski & Uğur, 2020).

Economic Benefits Perception

Economic benefits perception in rural tourism includes a variety of factors that lead to the financial well-being of local populations, such as creating employment opportunities for residents, reducing unemployment, and boosting livelihoods in hospitality, tour guiding, transportation, and handicraft production (Odozi et al., 2022). Furthermore, tourism development often necessitates infrastructure improvements, including roads, transportation networks, lodging facilities, and public amenities (Roda & Portela, 2023). These upgrades benefit tourism and residents by enhancing accessibility, connectivity, and overall quality of life. Finally, local economic participation is crucial in shaping perceptions of economic benefits. When local communities actively engage in tourism activities, they can directly capitalise on the economic opportunities it presents (Zantsi & Nkunjana, 2021). Active participation allows the local community to capture a larger share of the economic benefits, contributing to local economic development and empowerment. Thus, the following hypothesis is formed:

H1: There is a positive relationship between economic benefits perception and support for tourism development among the local community in Lombok.

Social Benefits Perception

Cultural preservation is a crucial contributor to the social benefits of rural tourism as it promotes local heritage, traditions, and arts, allowing residents to express their cultural identity and share it with visitors, fostering communal pride and cultural continuity (Tsybeskov, 2022). Rural tourism also empowers communities and promotes intercultural interchange by facilitating interactions between tourists and locals, encouraging cultural awareness, tolerance, and global citizenship while breaking down preconceptions (Zheng et al., 2020). Additionally, tourism growth often enhances social infrastructure, such as

community centres, parks, and recreational facilities, benefiting tourists and residents by providing better amenities (Lunt et al., 2022). The perception of social benefits in rural tourism includes cultural preservation, community empowerment, intercultural interchange, social infrastructure development, and social capital augmentation, all of which enhance social well-being, resilience, cultural pride, community participation, and social cohesion. Understanding and encouraging these benefits can significantly improve rural regions' social fabric and quality of life. Therefore, the following hypothesis is formed:

H2: There is a positive relationship between the perception of social benefits and support for tourism development among the local community in Lombok.

Environmental Benefits Perception

Rural tourism's environmental benefits include observing and enjoying natural resources, which contribute to their preservation and conservation (Chacon-Ortiz et al., 2022). This engagement fosters awareness of the importance of environmental conservation and the need to protect essential ecosystems. Sustainable practices in rural tourism aim to reduce negative impacts through waste reduction, recycling, energy and water conservation, and the use of environmentally friendly materials and technology (Zhidebekyzy et al., 2022). Rural tourism also provides opportunities for environmental education, allowing visitors to learn about local ecosystems, biodiversity, and conservation initiatives, fostering a sense of environmental responsibility (Butcher et al., 2022). Ecotourism emphasises ethical travel that benefits both the environment and local communities, allowing interactions with natural environments such as mountains, forests, rivers, and wildlife, which in turn support conservation efforts and provide economic benefits to local communities (Chacon-Ortiz et al., 2022). Based on the literature, the following research hypothesis is developed:

H3: There is a positive relationship between environmental benefits perception and support for tourism development among the local community in Lombok.

Political Bureaucracy and Rural Tourism Support

Political bureaucracy refers to the rules and procedures that regulate public project administration, defined by hierarchical structures and regulations (Park & Oh, 2023). It significantly impacts the economic, social, and environmental benefits of rural tourism and the level of support for its development. Policies providing financial incentives, infrastructure development, and marketing assistance can attract investment and encourage economic activity in rural tourism (Xu et al., 2022). Thus, efficient political bureaucracy is critical for maximising economic benefits.

Politically, bureaucracy influences social aspects by developing policies that promote community engagement, cultural preservation, and social inclusion. Local involvement in planning and decision-making enhances community benefits and conservation support (Nzomo, 2020). Sustainable development regulations, such as those governing carrying capacity, waste management, and resource conservation (Li et al., 2022; Hahury et al., 2023), can also minimise environmental impacts. Overall, political bureaucracy's efficiency, competence, and commitment are crucial for maximising rural tourism benefits while minimising negative impacts. This discussion led to the following hypothesis.

H4: Political bureaucracy moderates the relationship between local perceptions of rural tourism benefits and their support for rural tourism development in Lombok.

Conceptual Framework

Figure 1 depicts the research structure, which includes independent variables such as perceptions of economic, social, and environmental gains from rural tourism. On the other side, the dependent variable assesses the level of support for rural tourism growth. In this concept, political bureaucracy is a moderating variable, influencing the link between benefit perceptions and tourism support. The research aims to fill gaps in the literature by investigating the impact of economic, social, and environmental benefits on support for rural tourism growth, with political bureaucracy serving as a moderating variable.

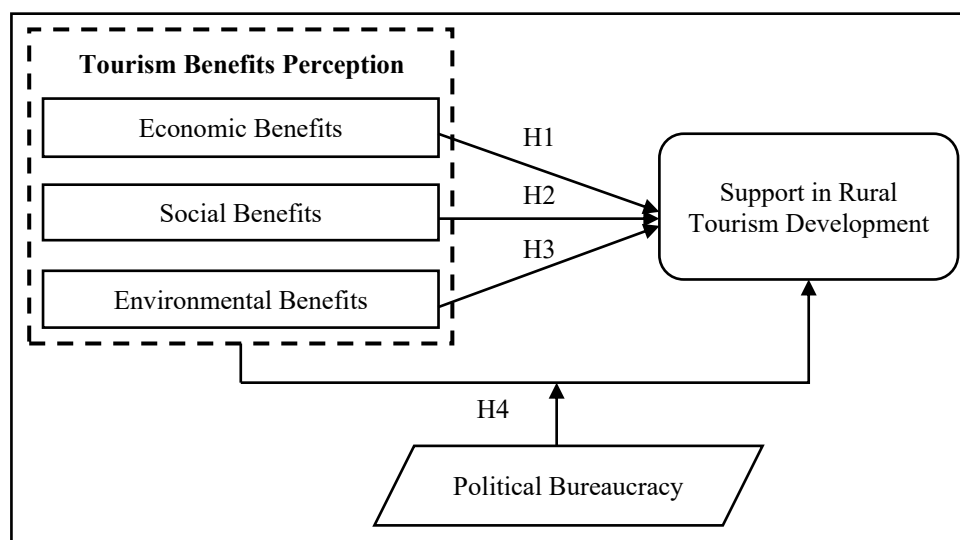


Figure 1: The conceptual framework.

METHODOLOGY

This study employs a quantitative research design to examine the influence of perceived tourism benefits (economic, social, and environmental) on local community support for rural tourism development in Lombok, Indonesia, with political bureaucracy as a moderating variable. The map of the research location is depicted in Figure 2. The research adopts a cross-sectional survey approach, collecting data using online surveys distributed via Google Forms. The survey targeted Lombok residents, focusing on those aged 18 and above and engaged in various sectors, including tourism, agriculture, education, and government. Based on G*Power estimates, this investigation required at least 95 samples. A total of 183 responses were received and used for the final analysis. The survey instrument was designed to capture the perceptions of economic, social, and environmental benefits, community support for tourism development, and political bureaucracy's influence. Each construct was measured using multiple Likert scale items ranging from 1 (strongly disagree) to 5 (strongly agree).



Figure 2: Map of the research location (Source: Google Map, 2024)

RESULTS AND FINDING

Demographic Profile

The following table shows an overall summary of respondents' profiles based on the frequency of gender, age, marital status, education level, employment status, and workplace. The survey included 183 respondents. The demographic profile of the sample showed a predominance of males, who comprised 60.07% of the participants, compared to 39.93% of females. The age distribution indicated a majority in the 25–44-year age group (51.97%), followed by the 45–64-year age group (34.87%), with the youngest cohort (18–24 years) representing 13.16%.

Marital status revealed a reasonably balanced distribution between single individuals (36.14%) and married individuals (47.63%), while 26.23% of participants chose not to disclose their marital status.

Regarding educational attainment, most participants held a bachelor's degree (59.64%), followed by those with a senior high school education (35.54%). A smaller portion had completed junior high school (9.64%), and an even smaller segment held master's or Ph.D. degrees (5.38%). Employment status showed that a substantial majority (72.66%) were employed, with 27.34% being unemployed. In terms of sectors, the agriculture sector had the highest representation (31.72%), followed by the tourism industry (28.62%), education (16.13%), and government (5.38%). Other sectors accounted for the remaining 18.13% of the employment distribution.

Reliability and Validity Test

Bagozzi and Yi (1988) recommended a threshold of 0.7 for item factor loadings, while Churchill (1979) suggested discarding data with loadings below 0.4. Therefore, measures with loadings less than 0.70 were excluded to increase composite reliability (Hair et al., 2011). Both Bagozzi and Yi (1988) and Hair et al. (2014) indicated that an average score of 0.5 shows that each construct can explain more than half of the variance in the items. Loadings were compared to their respective constructs using Partial Least Squares (PLS) analysis to assess each indicator's reliability. Only items with loadings greater than 0.4 were retained. The PLS measurement model's factor loadings and cross-loading values indicated that all items loaded distinctly onto the specified latent variables. Additionally, the Average Variance Extracted (AVE) values for Economic Benefit (EB) Perception, Environmental Benefit (ENB) Perception, Political Bureaucracy (PB), Social Benefit (SB) Perception, and Support for Tourism Development (STD) were significantly higher than the minimum threshold of 0.50. These findings confirm the acceptability of the items used in this study.

Table 1: Measurement Model Assessment.

Construct	Items	SFL	CR	AVE	CA
EB	EB1	0.776	0.931	0.691	0.910
	EB2	0.848			
	EB3	0.852			
	EB4	0.842			
	EB5	0.853			
	EB6	0.815			
ENB	ENB1	0.798	0.896	0.632	0.854
	ENB2	0.840			
	ENB3	0.804			
	ENB4	0.742			

Construct	Items	SFL	CR	AVE	CA
	ENB5	0.789			
PB	PB1	0.815	0.920	0.657	0.895
	PB2	0.832			
	PB3	0.845			
	PB4	0.850			
	PB5	0.828			
	PB6	0.682			
SB	SB1	0.740	0.928	0.592	0.913
	SB2	0.714			
	SB3	0.819			
	SB4	0.716			
	SB5	0.785			
	SB6	0.626			
	SB7	0.846			
	SB8	0.843			
	SB9	0.808			
STD	STD1	0.849	0.942	0.697	0.927
	STD2	0.856			
	STD3	0.876			
	STD4	0.849			
	STD5	0.801			
	STD6	0.762			
	STD7	0.846			

Note: SFL: Standardized factor loading; CA: Cronbach's alpha; CR: Composite reliability; AVE: Average variance extracted.

Structural Model

The structural model illustrated the hypothesized relationships between latent variables through specified paths. The researcher could validate or invalidate each hypothesis by examining the structural model. This analysis also provided insights into the magnitude of correlations between dependent and independent variables. Regression coefficient (β) values were analyzed to assess the significance of path relationships, with their significance determined by t-values obtained through the PLS Bootstrapping procedure. Ultimately, the significance of each hypothesized relationship was based on the generated t-statistics. Table 2 presents the results of a comprehensive statistical analysis investigating the relationships between various factors and their influence on "Support for Rural Tourism Development" (STD). Figure 2 illustrates the standardized path coefficients among the factors. Each row in the table corresponds to a specific hypothesis regarding these relationships.

Table 2: Hypothesis testing of the study

Direct Effect	Beta (β)	t-value	p-values	Decision
EB -> STD	0.008	0.067	0.946	Rejected
ENB -> STD	0.349	2.871	0.004	Accepted
SB -> STD	0.070	0.711	0.477	Rejected
PB x ENB -> STD	-0.003	0.040	0.968	Rejected
PB x SB -> STD	0.030	0.311	0.755	Rejected
PB x EB -> STD	-0.029	0.299	0.765	Rejected

Note: $p < 0.05$

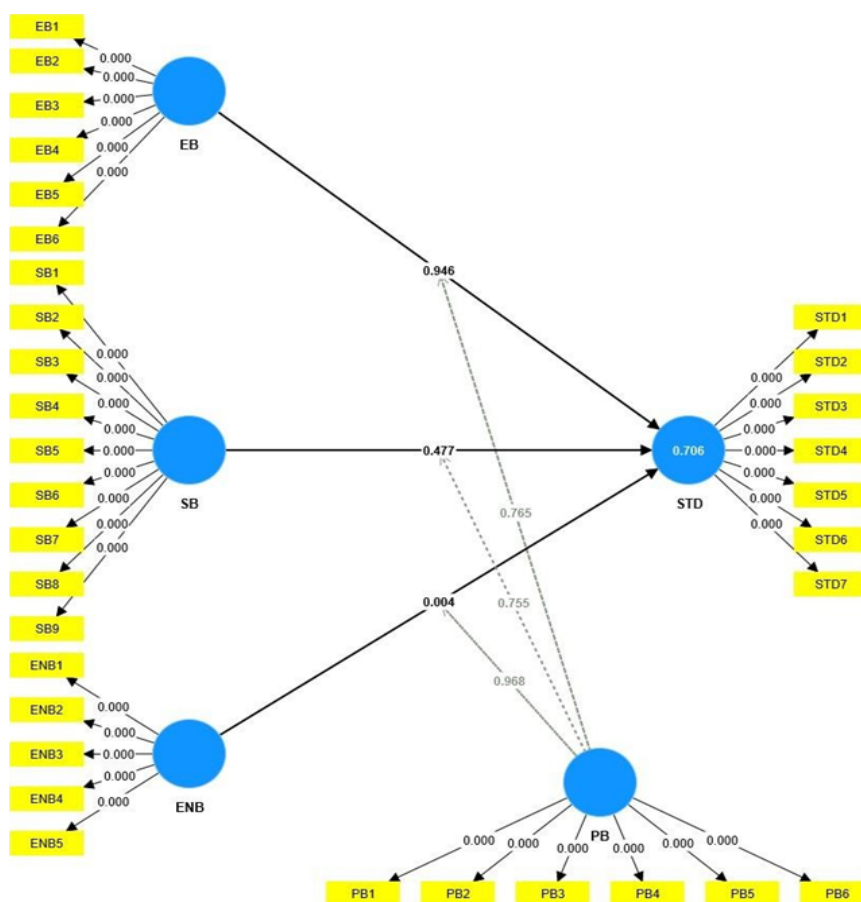


Figure 3: PLS Structural Equation Model.

The analysis reveals a weak positive association between Economic Benefits Perception (EB) and Support in Rural Tourism Development (STD) with

a minimal path coefficient ($\beta = 0.008$), a t-statistic of 0.067, and a high p-value of 0.946, leading to the rejection of the hypothesis. In contrast, the relationship between Environmental Benefits Perception (ENB) and STD is significant, with a substantial path coefficient ($\beta = 0.349$), a high t-statistic (2.871), and a low p-value (0.004). Political Bureaucracy (PB) also strongly correlates with STD ($\beta = 0.449$, t-statistic = 3.901, p-value = 0.000). The relationship between Social Benefits Perception (SB) and STD is weak and non-significant ($\beta = 0.070$, t-statistic = 0.711, p-value = 0.477).

The analysis of interaction effects between PB and the other variables (EB, SB, and ENB) shows minimal and statistically insignificant path coefficients (-0.029, 0.030, and -0.003, respectively). These findings highlight the varying degrees of influence exerted by different factors on support for rural tourism development, providing valuable insights into what contributes to or hinders the development of rural tourism initiatives.

CONCLUSION

The findings indicate insufficient evidence to establish a strong link between perceptions of economic gains and support for tourism growth, contrasting with previous studies such as Bajrami et al. (2020) and Chiciudean et al. (2021), which found a positive relationship. Limited local participation hinders the creation of business opportunities and jobs, highlighting the complex relationship between local involvement and economic growth.

The hypothesis suggesting a positive relationship between the perception of social benefits and support for tourism development was also not supported, contradicting Hammad et al. (2018) and Ali (2020). This finding is significant in shaping conclusions and implications, improving understanding of social benefits' influence on community support for tourism growth. Conversely, compelling evidence of a positive relationship between perceptions of environmental benefits and support for tourism growth was found. The tourism industry positively impacts the environment by acting as a catalyst for protection, consistent with Halim et al. (2022) and Bozdoglar (2023). These insights are crucial for guiding sustainable tourism activities and emphasise the critical role of environmental benefits in garnering local support.

The study highlights the influence of political bureaucracy on rural tourism, examining its moderating role on perceptions of economic, social, and environmental benefits. The findings reveal subtle but significant relationships, underscoring the importance of political processes in shaping community views on tourism benefits. Despite modest correlation coefficients and small effect sizes, the study provides valuable insights into the complex mechanisms by which political bureaucracy influences support for rural tourism development. It emphasises the importance of political stability and well-functioning institutions,

as highlighted by Bhat et al. (2022) and Hassan et al. (2022). Understanding the moderating effect of political bureaucracy is crucial for developing strategies that enhance public engagement and support for sustainable rural tourism initiatives.

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ESTABLISHING MANGROVE FOREST PRODUCTS FOR ECO-TOURISM ACTIVITY AT KOTA KINABALU WETLAND RAMSAR SITE, SABAH. MALAYSIA

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Abstract

Mangrove forests are found ubiquitously across the global landscape and are known to assume a pivotal role in supporting the surrounding ecosystem. The study purposely estimates the ability of absorption in CO₂ towards the subject area to understand the precautions of visitors in future demand. By leveraging the advanced technology of Geographic Information Systems (GIS) and employing carbon footprint analysis, the study estimated the daily footfall to the area and the resultant carbon footprint. The analysis conclusively revealed a surplus of minus 7,957.65 tons/year, indicating that the area can assimilate more CO₂. This underscores the wealth of natural resources and the potential to accommodate a larger number of visitors in the future.

Keywords: Ramsar Site, KK Wetland, Mangroves Forest, Urban Forest

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INTRODUCTION

Mangroves are among the most carbon-rich tropical forests (Donato et al., 2011) and are considered natural barriers to carrying capacity for maintaining coastal urban environmental health (Analuddin et al., 2023). Furthermore, Diaz et al. (2016) and Hsu (2019) indicate that the forest contributes to economic activity directly and indirectly, especially in wetland tourism. The activity required stakeholders' initiative in handling the limited mangrove area's resources at the micro and macro levels. Latip et al. (2013) and Pimid et al. (2020) initiate the importance of forest management, especially in wetland areas. Meticulous frameworks are crucial in ensuring all forest matters are covered. Globally, the Convention on Wetlands is an intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources (Ramsar, 2014). Worldwide currently registered Ramsar sites up to 2,471 sites, covering 256,192,602 ha, including Malaysia, with a total area of 134,182 ha.

RESEARCH BACKGROUND

Visual mapping from NASA (2010) indicates the location and relative density of mangrove forests covering 137,760 square kilometres of the earth's surface involving 118 countries. UNESCO (1987) indicates that the world's largest mangrove forest is the Sundarbans Reserve Forest (SRF) in Bangladesh. Mangrove forests are an ecosystem located between the land and sea. The forest contributes an economic gain to locals by providing a source of fisheries and tourist activity and coastal protection from erosion and weather changes (Anuar & Latip, 2020). According to NOAA (2023), mangrove forests stabilise the coastline, reducing erosion from storm surges, currents, waves, and tides, and the intricate root system of mangroves makes these forests attractive to marine species seeking shelter from predators. Moreover, its potential services related to the ecosystem and human health primarily cover the supply of water, food, nutrition, and medicine, purification of waste products, and buffering against adverse flooding and climate effects (Skov, 2019). Mangroves store up to five times as much organic carbon as tropical upland forests (Donato et al., 2011). Brander et al. (2012) indicated that mangrove forests contribute to ecosystem services and human well-being by providing nursery habitat for many species of plants, birds, insects, crabs, fish, and cultural services.

Table 1 presents a comprehensive catalogue of wetland services and functions that are indispensable in preserving the ecosystem. All the stakeholders and relevant authorities must give due and diligent attention to these services and functions. As per an empirical study conducted by The Conservation Fund, it has been observed that the capacity of wetlands to store carbon ranges from 81 to 216 metric tons per acre, depending on the specific type and location of the wetland.

Table 1: List of Wetland Services

No	Services	Statement
1	Habitat and Biodiversity	Nature Tourism Commercial and Recreational Fisheries
2	Recreation	Hunting and Fishing Revenues
3	Nutrient Regulation	Reduced Water Purification Costs
4	Soil and Sediment Regulation	Reduced Water Purification Costs Reduced Soil Erosion
5	Disturbance & Natural Hazard Regulation	Storm Surge Mitigation Runoff and High-Water Event Mitigation
6	Cultural Values and Aesthetics	Sabah
7	Water Supply	Increased Water Quantity Increased Downstream Productivity (fisheries, etc.)
8	Food Production	Food (both plant and animal) and fibre harvest

Source: Authors (2024), Woodward & Wui (2001) and Cooley (2015)

Malaysia is known for its diverse and flourishing mangrove forests. However, it is essential to note that out of the numerous mangrove forests in the country, only seven have been officially gazetted and granted the esteemed Ramsar Site status. As indicated in Table 2, these sites have been judiciously selected based on their geographical location, size, and year of recognition.

Table 2: Ramsar Sites in Malaysia.

Year	Site No	State	Location	Area (ha)	Total (%)
1994	712	Pahang	Tasek Bera	38,446	28.65
2003	1287	Johor	Pulau Kukup	647	0.48
2003	1288	Johor	Sungai Pulai	9,126	6.80
2003	1289	Johor	Tanjung Piai	526	0.39
2005	1568	Sarawak	Kuching Wetlands National Par	6,610	4.93
2008	1849	Sabah	Lower Kinabatangan- Segama Wetland	78,803	58.73
2016	2290	Sabah	Kota Kinabalu Wetland	24	0.02
Total Area				134,182	100
Worldwide Ramsar Area				256,192,602	0.05

Source: Authors (2024) & Ramsar (2014)

Jonas & Yapp (2016), a researcher from The International Union for Conservation of Nature (IUCN) has conducted research on the mangrove forest and wetland in Sabah, identifying several critical issues such as pollution, human-wildlife conflict, and lack of awareness regarding renewable resources. To address these challenges, the IUCN recommends implementing good governance by introducing a Ramsar Site and Management Plan (RSMP). The proposed RSMP will provide the framework to mitigate the identified issues and promote sustainable management practices.

Study area: Kota Kinabalu Wetland Ramsar Site

Kota Kinabalu Wetland Ramsar Site (KKWRS) is in Kota Kinabalu city, 2 km from the city centre, with an area of 24.2 hectares. It is considered the city's hidden gem and green belt. Consists of 32 types of mangrove species, including rare and (Ono et al., 2016) critically endangered ones listed in the IUCN Red List of Threatened Species, namely *Bruguiera hainesii* (Rhizophoraceae). It coexists with *Limulus polyphemus*, well known by locals as 'Belangkas', which exist in the area as part of the marine life contribution. It was gazetted as a bird sanctuary in 2000, with more than 90 species in the area. As well as migrating birds from Siberia, namely *Leptoptilos javanicus* and *Egretta eulophotes*. The area is also a nursery ground for 21 fish and aquatic species, including crustaceans, molluscs,

horseshoe crabs and jellyfish (RAMSAR, 2017). Kota Kinabalu Wetlands is the 2nd Ramsar site in Sabah, after Hilir Kinabatangan-Segama and the 7th in Malaysia, with the registration Ramsar Site at 2,290 worldwide by the Ramsar Convention. The recognition entitles the KK Wetland as the 1st Ramsar Site in the city, nationally and the 2nd globally after the wetland in Yatsu-Higata, Chiba in Japan.

Table 3: Chronology to Ramsar Status.

Year	Statement
1980-an	Proposed as a protected area by the funding from World Wildlife Federation (WWF)
1996	Gazette as a protected area by Section 28 of the Sabah Land Ordinance (Cap 68) and managed by the 'Jawatankuasa Pengurusan Santuari Likas' (LWSMC)
1999	Gazette as a Cultural Heritage Site under the Cultural Heritage (Conservation) Enactment 1997
2000	Gazette as a bird sanctuary and known as the Kota Kinabalu Bird Sanctuary (KKCBS) in December
2005	The Sabah Wetlands Conservation Society (SWCS) was established and took over management from LWSMC in August
2006	Officially named KK Wetlands to expand its importance as a mangrove swamp ecosystem conservation area
2009	Proposed as a Ramsar site by the Sabah Ministry of Tourism, Culture and Environment
2011	Information relating to Ramsar sites is submitted to Ramsar headquarters
2013	Approved by the Sabah Cabinet as the second Ramsar site in Sabah in March, while by the Federal Cabinet in November
2016	Listed as the Seventh Ramsar Site in Malaysia on 22 December.
2017	Officially announced as a Ramsar Site by the Ministry of Natural Resources and Environment on 17 July, with the official launch on 21 September.

Source: Abdullah, (2017) and Lahasing et al., (2016)

Table 3 outlines the events that led to KK Wetland receiving a Ramsar site status. The wetland provides a range of visitor facilities to meet the needs of individuals and organisations. These facilities include an information centre, AV and meeting room (available for rental), a trail with a boardwalk (1.3km in length), informative signboards, a gravel path (200m in length), a nursery, an

outdoor classroom, a bird hide and an observation tower. In addition, there is an exhibition hall and an interactive library. The provision of these facilities demonstrates good governance of scarce resources in the study area.

The Sabah Wetland Conservation Society (SWCS) has taken a commendable initiative to synchronise human and natural attributes in conserving and enhancing the attractiveness of KK Wetland as a globally recognised Ramsar site. To maintain the sustainability of the forest involved, detailed studies on ecosystem balance must be conducted in the study area, both in the central area and the buffer zone. This will help ensure the perpetuation of the ecosystem's equilibrium and promote the attractiveness of the wetland.

METHODOLOGY

The Geospatial and Visual Impact Assessment (VIA) methods were utilised to determine the overall CO₂ levels present in the area. The GIS mapping technique was employed to estimate the size of the green space in the mangrove forest, which comprises three main types of plants that absorb CO₂, namely trees, bushes, and meadows. Although the VIA method is typically used for building assessments, it was modified in this case to confirm the actual situation on the ground after the GIS analysis. Additionally, secondary data on daily visitor estimates was collected from the information centre. It is interesting to note that the site mainly attracts international visitors. The estimated number of daily visitors ranges from 20 to 50 people, averaging 35 people per day. Most visitors are bird enthusiasts, environmental groups, researchers, scholars, and school groups on excursions. Visitors' presence is crucial to the study, whereby each visitor will contribute as the subject in calculating CO₂ emissions (Latip & Umar, 2022). Furthermore, Grey & Deneke (1978) and Idris et al. (2017) argue that the CO₂ produced by visitors to the area is the same at 0.3456 tons of CO₂/human/year. To complete the assessment, the formula modification by Latip & Umar (2022) imposes the attribute below:

$$P = J_p \times C_{\text{visitor}}$$

Where,

P = Total CO₂ emissions from the population (tons/year)

J_p = Total population (visitor)

C_{visitor} = Total CO₂ produced by humans, which is 0.3456 (ton/human/year)

The CO₂ absorption capacity is based on Table 2 with the type of plant, namely tree, bushy and meadow.

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Table 4: CO₂ Absorption Ability According to the Type of Plant

No	Type of Plant	CO ₂ Absorption Capacity (Kg/Ha/Day)	CO ₂ Absorption Capacity (Ton/Ha/Year)
1	Tree	1559.1	569.07
2	Bushy	150.68	55.00
3	Meadow	32.88	12.00

Source: Latip & Umar, (2022), Idris et al. (2017) and Prasetyo et al. (2002)

ANALYSIS AND FINDINGS

Table 5 portrays the recorded and estimated number of visitors to the study area. The average number of visitors per day is 35, and the estimated annual visitation number is 12,775. Consequently, the CO₂ emission is 4415.04, the Pt value.

Table 5: Average Visitor Daily (08.00-18.00)

Estimate Daily	The visitor (J _p)	CO ₂ /Visitor	Total CO ₂ (P)
Min	20	0.3456	6.912
Maximum	50	0.3456	17.28
Average Daily	35	0.3456	12.10
Annually (P _t)	12775	0.3456	4415.04

Source: Authors, (2024)

According to Figure 1, GIS estimated a point to measure consequences and calculate the study area, approximately 24.2 hectares.



Figure 1: Estimate Profile Area (24.2 ha)
 Kota Kinabalu Wetland Ramsar Site

Source: Authors, (2023)

As per the data presented in Table 6, the CO₂ absorption ability of different plant types in the study area is evaluated. The analysis was performed by computing the percentage of each plant type's occurrence in the area. The evaluation results indicate that trees had the highest presence in the area, covering 89% of the total area and exhibiting a CO₂ absorption ability of 12,257.77. On the other hand, small trees covered 8% of the area, with a CO₂ absorption ability of 106.15. Lastly, the remaining plant types covered 3% of the area and had a CO₂ absorption ability of 8.76.

Table 6: Estimate CO₂ Absorption Ability According to the Type of Plant

No	Type of Plant	Area (%)	Area (Ha)	Ability Absorb CO ₂ (Ton/Ha/Year)	Amount
1	Tree	89	21.54	569.07	12,257.77
2	Bushy (small tree)	8	1.93	55.00	106.15
3	Meadow (grass area)	3	0.73	12.00	8.76
The total amount of CO ₂ absorption ability for the area (T _t)					12,372.69

Source: Authors, (2024)

Carbon footprint Analysis (S value)

During the assessment of an area's functionality, it has been observed that negative S values signify the thriving status of the area, implying its capability to sustain an increase in visitors. Conversely, positive S values suggest that the area is not performing well and must be cautiously approached.

Table 5: Estimate Carbon footprint analysis (S value)

Variable	Description	Total
P _t	Total CO ₂ emissions from the population (tons/year)	4,415.04
T _t	Total CO ₂ absorption ability according to the type of plant (tons/year)	12,372.69
S value	P _t - T _t	-7,957.65

Source: Authors, (2023)

According to the estimations provided in Table 5, the existing trees in the area have a CO₂ absorption capacity with S values of -7957.65. This data indicates that the area can accommodate more visitors while maintaining its current carbon footprint. Therefore, KK Wetland, an area managed by Sabah Wetlands Conservation Society in partnership with the City Council of Kota

Kinabalu, has ample mangrove trees that meet visitors' needs and contribute to the environment's wellness.

CONCLUDING REMARK

Conclusively, the results of the conducted studies unequivocally demonstrate the potential of the subject sites to accommodate an increased number of visitors in the future. However, the realisation of this potential is contingent upon implementing a rigorous monitoring regime, providing expert guidance from relevant parties, and undertaking measures with utmost diligence to safeguard the existing area, particularly the site's buffer zone. This will necessitate meticulous planning and physical action, in strict parallel with the planning of local authorities and the state.

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THE IMPACT OF GREEN SPACES TO HUMAN PSYCHOLOGY AND THEIR MENTAL HEALTH.

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Abstract

With rapid urbanization, the increasing separation between humans and the natural environment is exacerbating mental health challenges. Research shows that contact with the natural environment yields significant psychological benefits. However, existing theories have limitations in sample diversity and explanatory power. This study reviewed and tested five major theoretical frameworks, aiming to develop a new interdisciplinary theoretical framework. Using a questionnaire, data from 413 participants were analyzed via structural equation modeling. The results confirmed the important roles of physiological and cognitive effects, and psychological needs satisfaction, in how the natural environment influences mental health. This research created a progressive theoretical framework that integrates these findings, enhancing understanding of the complex mechanisms by which nature affects mental health and informing urban planning. Future research, based on this framework and involving larger samples, will aim to develop a more comprehensive theoretical system.

Keywords: Natural Environment, Mental Health

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INTRODUCTION

The world is rapidly urbanizing, with United Nations projections showing nearly 68% of the global population living in urban areas by 2050 (United Nations, 2018). This shift has brought significant public health challenges, particularly the growing severity of mental health issues such as depression and anxiety, attributed partly to reduced contact with the natural environment (Herchet et al., 2022). Urban lifestyle factors, including a fast pace, high competition, and weakened social support, also contribute to increased mental health problems among city dwellers (Moreira et al., 2022).

In fact, substantial research evidence indicates that contact with the natural environment can bring a range of benefits to human psychological health (Astell-Burt & Feng, 2019; Bratman et al., 2021; Herchet et al., 2022; Klein et al., 2022; Latip et al., 2023). These positive effects include relieving stress and negative emotions, improving attentional capacity, enhancing immune system functions, and increasing subjective life satisfaction (Bratman et al., 2021; Herchet et al., 2022; Jones et al., 2021; Schertz & Berman, 2019). These benefits arise from various forms of nature experience like outdoor activities, viewing natural scenery, immersion in natural settings, and listening to natural sounds (Herchet et al., 2022; Jones et al., 2021).

Specifically in psychological aspects, interacting with nature has been shown to improve cognitive abilities like working memory, attentional control, and cognitive flexibility, as well as alleviating depression, anxiety, and increasing life satisfaction (Astell-Burt & Feng, 2019; Bratman et al., 2021; Klein et al., 2022; Schertz & Berman, 2019).

Among the positive effects above, the beneficial impacts of urban green spaces, as the primary daily natural ecosystems in the urban environment, on residents' mental health have received much attention and been widely validated (Lim et al., 2023). Major findings show that various forms of contact with urban greenery are closely associated with improved psychological health (Astell-Burt & Feng, 2019; Klein et al., 2022). For instance, residents living in communities with more green spaces, or closer to parks and other greenery, report higher levels of mental health and lower incidence rates of psychological disorders like depression (Klein et al., 2022).

Despite substantial evidence for the positive impacts of urban green spaces on mental health, deficiencies remain in related research and theoretical explanations. First, most existing studies utilize cross-sectional designs (Feng et al., 2022; Hubbard et al., 2021; Qiao et al., 2021; Ribeiro et al., 2021), which cannot rule out the influence of confounds like selection bias, making it difficult to establish causal relationships between greenery and mental health. This needs to be verified through prospective cohort studies. Second, current theories mostly stay at the psychological level, seldom considering relevant biological mechanisms, which requires more rigorous testing with biological indicators

(Herchet et al., 2022). Third, different types of green spaces like parks (Bustamante et al., 2022; Zhu et al., 2022), community gardens (Tae et al., 2022), and green roofs (J. Lee et al., 2022) differ in structure and function, so their mechanisms on mental health may also differ, but comparative research is still lacking. This calls for more extensive comparisons across types. Fourth, current theories pay little attention to individual differences like age and cultural background as moderators (Meuwese et al., 2021; Phuoc Nguyen & Nguyen, 2022), which need verification across different populations.

Therefore, it is necessary to conduct a comprehensive review and examination of existing theories, clarifying their contributions, deficiencies and directions for improvement, in order to establish a new multi-disciplinary theoretical framework to guide urban green space planning practices. The key to achieving this goal lies in systematically testing different theoretical perspectives to identify paths for theoretical integration and expansion, ultimately developing a new theoretical system with greater explanatory power.

Based on the current research landscape, the primary aim of this study is to review theories concerning the impacts of green spaces on mental health restoration, comparing different theories regarding their applicability, explanatory strengths and weaknesses, clarifying paths for integration and expansion, to lay the theoretical foundations for a new multi-disciplinary framework.

This study aims to provide a solid basis for developing a more comprehensive and rigorous new theory through a systematic review of current theories, clarifying the current status and deficiencies to propel rapid developments in this research field. This will not only benefit the field's growth, but also provide scientific guidance for designing public spaces that optimize the psychological benefits of urban greenery. Certainly, as an exploratory theoretical study, this research has its limitations, and the proposed new framework will need continual refinement in follow-up studies. However, this systematic theoretical examination will facilitate the maturation and progress of this emerging interdisciplinary field.

LITERATURE REVIEW

Five principal theoretical frameworks have been identified in the domain of the positive effects of natural environments on psychological health: attention restoration theory, stress reduction theory, biophilia hypothesis, self-determination theory, and flow experience theory.

Attention Restoration Theory, proposed by Rachel and Stephen Kaplan in 1989, posits that natural environments help restore human attentional resources (Kaplan & Kaplan, 1989). Empirical studies confirm its effects but also suggest it may not be universally applicable (Cassarino et al., 2019; Trammell & Aguilar, 2021). Stress Reduction Theory, introduced by Roger Ulrich et al. in 1991, claims

that natural environments mitigate physiological stress responses (Ulrich et al., 1991). While supported by empirical studies, the theory lacks deep explanatory mechanisms (Escolà-Gascón & Houran, 2021). Biophilia Hypothesis, conceptualized by Edward Wilson in the 1980s, suggests an innate connection between humans and nature (Wilson, 1986). However, the specific mechanisms behind this connection remain ambiguous. Self-Determination Theory, by Ryan and Deci in 1985, emphasizes the satisfaction of three basic psychological needs—autonomy, competence, and relatedness (Deci & Ryan, 1985). It posits that natural environments can enhance subjective well-being by fulfilling these needs. Flow Experience Theory, proposed by Csikszentmihalyi in 1990, emphasizes the positive emotional experiences derived from total engagement in activities (Csikszentmihalyi, 1990). The theory's application has been limited by its consideration of individual differences (Wang et al., 2023)

Tables 1 & 2 provide concise overviews of the core points, advantages, and limitations of each theory, as well as their interconnections.

Table 1: Core perspectives and limitations of each theory

Theory Name	Core Points	Application Advantages	Limitations	References
Attention Restoration Theory	Natural environments can restore attention	Emphasizes cognitive aspects	Does not account for individual differences	(Cassarino et al., 2019; Trammell & Aguilar, 2021; van den Berg, 2021)
Stress Reduction Theory	Natural environments have stress-reducing physiological effects	Emphasizes physiological mechanisms	Overlooks the factor of subjective cognition in stress reduction	(Escolà-Gascón & Houran, 2021; Herchet et al., 2022)
Biophilia Hypothesis	There is an inherent connection between humans and nature	Provides an evolutionary perspective	Fails to consider differing effects of various natural environments	(Bratman et al., 2019; Brymer et al., 2021; Herchet et al., 2022)
Self-Determination Theory	Satisfies basic psychological needs	Concerns higher-level psychological needs	Does not fully account for diverse psychological needs across varied natural settings and individual differences	(Landon et al., 2021; E. S. Lee et al., 2022; Yang et al., 2022)
Flow Theory	Nature environments provide subjective pleasant experiences	Focuses on emotional aspects	Overvalues subjective agency, underestimates nature's role	(Xie et al., 2022)

Table 2: Connections and differences among theories

Theory Name	Connection with other theories	Difference from other theories
Attention Restoration Theory	Shared emphasis on direct effects of nature with Stress Reduction Theory	Focuses on cognitive effects (Kaplan, 1995), whereas Stress Reduction Theory emphasizes physiological effects (Ulrich et al., 1991)
Stress Reduction Theory	Shared emphasis on direct effects of nature with Attention Restoration Theory	Focuses on physiological effects (Ulrich et al., 1991), whereas Attention Restoration Theory emphasizes cognitive effects (Kaplan, 1995)
Biophilia Hypothesis	Provides common basis and starting point for other theories	Other theories limited to psychological and physiological systems (Csikszentmihalyi, 1990; Kaplan, 1995; Ryan & Deci, 2000; Ulrich et al., 1991), whereas Biophilia Hypothesis examines human-nature relationship (Wilson, 1986)
Self-Determination Theory	Builds on fulfillment of lower-level needs to address higher-level needs	More focused on psychological needs (Ryan & Deci, 2000), whereas Attention Restoration Theory and Stress Reduction Theory are more foundational (Kaplan, 1995; Ulrich et al., 1991)
Flow Theory	Also examines impact of nature on positive affect	More focused on subjective emotional experiences (Csikszentmihalyi, 1990), while other theories are more objective

Building on these theories, this study introduces a multi-theoretical cyclical framework, encompassing four stages: natural affinity, physiological-cognitive benefits, psychological need satisfaction, and positive emotional experiences. This framework aims to present a comprehensive explanation of the mechanisms through which natural environments influence psychological well-being, emphasizing the interplay and amplification among the effects.

While the proposed framework offers a more comprehensive viewpoint than individual theories, it requires further validation and refinement. This study paves the way for future research, aiming for a robust interdisciplinary theoretical system that can inform urban planning and the promotion of public psychological well-being

METHODOLOGY

Research design and sample selection

The study employs quantitative research, targeting residents of Shanghai, China. As an economic center (Wei et al., 2022), Shanghai's rapid urbanization (Wu et al., 2019) and the fast pace of life present distinctive stressors, offering representative significance. Random sampling was utilized to select a diverse cross-section of the population across age, gender, occupation, and residential areas to ensure the representativeness and applicability of the findings.

Questionnaire Development

The core objective is to validate and support a newly proposed theoretical framework. A questionnaire was developed to gather data for testing this framework.

The questionnaire, grounded in previous research and new exploratory queries, comprises key sections aimed at delving deeper into the connection with nature, psychological restoration experiences, levels of physiological relaxation, satisfaction of basic psychological needs, and positive emotional experiences.

Table 3 provides an overview of the questionnaire sections, including their sources, objectives, and sample questions.

Table 3: Overview of Questionnaire Components and Sample Items

Section of Questionnaire	Source and Custom Items	Purpose	Sample Item
Nature Relatedness Scale (NRS)	Partially based on Mayer and Frantz (2004), with added custom items	To assess the degree of participants' connection with nature	I often feel a sense of oneness with the natural world
Psychological Restoration Scale (PRS)	Partly derived from Korpela et al. (2010), with additional custom questions	To holistically evaluate experiences of psychological restoration	In natural settings, I feel my attention is rejuvenated
Physiological Relaxation Scale	Entirely self-designed	To quantify participants' levels of physiological relaxation	In this environment, my breathing rhythm feels
Basic Psychological Needs Satisfaction Scale (BPNS)	Integrating items from Vlachopoulos (2008) with custom questions	To assess how natural environments meet fundamental psychological needs	In natural environments, I perceive my choices to be autonomous
Positive Affect Scale (PANAS)	Employing the scale designed by Watson et al. (1988)	To measure participants' positive emotional experiences	In natural settings, the extent of my 'excitement' emotion is
Reciprocal Mechanism Section	Completely self-designed	To deeply explore how natural environments influence emotions and connection to nature	Natural environments intensify my bond with nature

Data Collection

A random sample survey was executed in Shanghai, resulting in 413 valid questionnaire responses. To ensure the precision and integrity of our data, we incorporated several diagnostic questions within the questionnaire to discern the earnestness of the respondents' participation. Utilizing these control items, we were able to sift out responses that lacked due diligence, thus securing the quality of our data. Additionally, to further vouch for data quality, a brief overview of the survey's intent and content was presented to all respondents prior to their participation.

Data Validation

To ensure the rigor of the measurement model, both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were executed using AMOS.

Based on model diagnostics, several items were refined to optimize the model's fit. The salient validation metrics derived from this analysis include.

Table 4. Confirmatory Factor Analysis Results

Dimension	Item		Parameter significance estimation				Factor loading	Item reliability	Composite reliability	Convergent validity
			Unstd Estimate	S.E.	T-value	P	Std Estimate	SMC	CR	AVE
NR1	N1	<--	1.000				.631	.398	.828	.549
	N4	<--	1.067	.087	12.271	***	.798	.637		
	N5	<--	1.238	.100	12.389	***	.817	.667		
	N6	<--	1.000	.088	11.324	***	.702	.493		
PCB	PR1	<--	1.000				.741	.549	.847	.586
	PR2	<--	1.075	.065	16.413	***	.877	.769		
	PR3	<--	1.024	.065	15.826	***	.819	.671		
	PR7	<--	.633	.055	11.505	***	.596	.355		
ANF	A2	<--	1.000				.819	.671	.824	.611
	A3	<--	.893	.075	11.861	***	.803	.645		
	A5	<--	.920	.077	11.955	***	.719	.517		
PEE	EM1	<--	1.000				.821	.674	.859	.604
	EM2	<--	.817	.050	16.230	***	.785	.616		
	EM3	<--	.805	.054	14.844	***	.716	.513		
	EM4	<--	.919	.056	16.366	***	.782	.612		
NR2	C1	<--	1.000				.791	.626	.861	.674
	C2	<--	1.064	.063	16.945	***	.870	.757		
	C3	<--	.929	.057	16.400	***	.800	.640		

Factor Loadings: All item factor loadings consistently surpassed the recommended threshold of 0.6, denoting a robust association with their respective latent variables (Hair, 2009).

Item Reliability: The squared multiple correlations (SMC) for each item elucidated the reliability of individual items in relation to their assigned factors.

Composite Reliability: The composite reliability (CR) of all latent variables uniformly exceeded the advocated benchmark of 0.7, indicating commendable internal consistency (Nunally, 1978).

Convergent Validity: The average variance extracted (AVE) for each latent variable consistently surpassed the 0.5 benchmark, underscoring satisfactory convergent validity (Fornell & Larcker, 1981).

Furthermore, an inter-construct correlation analysis was conducted. Based on the comparisons between the square root of AVEs and the inter-correlations among constructs, multicollinearity was determined to be non-significant (Fornell & Larcker, 1981).

Table 5 offers a condensed view of the inter-construct correlation matrix. The diagonal values represent the square root of the average variance extracted (AVE) for each construct, while the off-diagonal values showcase the correlations between the constructs. As can be observed, the diagonal values (square root of AVEs) are consistently greater than the inter-construct correlations, validating the discriminant validity of our constructs.

Table 5. Correlation Matrix of Latent Constructs

	AVE	NR2	PEE	ANF	PCB	NR1
NR2	.674	.821				
PEE	.604	.639	<i>.777</i>			
ANF	.611	.588	<i>.775</i>	.782		
PCB	.586	.656	.706	.685	.766	
NR1	.549	.670	.658	.721	.678	.741

RESULTS

Model Fit

To validate our research model, we employed AMOS software for structural equation model analysis.

The Chi-square statistic is traditionally used to evaluate the level of inconsistency between the model and observed data (Curran et al., 2002). A lower Chi-square value suggests a smaller discrepancy. In our study, the Chi-square was 341.644 with 129 degrees of freedom, resulting in a Chi-square/degrees of freedom ratio of 2.648, indicating a good overall model fit.

Goodness-of-fit index (GFI), a metric that reflects the extent to which the model explains the variance covariance of the observed data (Mulaik et al., 1989). Values range from 0 to 1, with values close to 1 indicating excellent model fit. The GFI in this study was .915, indicating excellent model fit.

The Adjusted Goodness of Fit Index (AGFI) accounts for the degrees of freedom in the model, reflecting the impact of the model's complexity on its fit. Values close to 1 indicate a better fit (West et al., 2012). In this study, the AGFI value reached 0.887, which further supports the adequacy of the model fit.

The Comparative Fit Index (CFI) compares the actual model fit to a baseline model, with values nearing 1 indicating a good relative fit (West et al., 2012). The CFI in our research was notably high at 0.946, significantly surpassing the 0.9 standard and evidencing considerable improvement over an independent model, indicative of a very good fit.

The Root Mean Square Error of Approximation (RMSEA) evaluates the magnitude of error in the model, with values between 0.05 and 0.08 indicating an acceptable fit (West et al., 2012). Our study reported an RMSEA of 0.063, below the critical value of 0.08, demonstrating that the fitting model aptly reflects the structure of the sample data.

Taken together, these fit indices have achieved a favorable level, suggesting that the measurement model effectively represents the relationships between the latent variables and the measured variables, displaying a good fit.

Mediation Effect Analysis

Given the theoretical framework's emphasis on the sequential influence from natural affinity to positive emotional experiences, two potential mediators, physiological cognitive effects and psychological needs satisfaction, were examined. Both mediators were hypothesized to serve pivotal roles in translating the basic relationship with nature into tangible psychological benefits:

Physiological Cognitive Effects: Rooted in the Attention Restoration Theory and Stress Reduction Theory, this variable is expected to account for the immediate cognitive and physiological impacts of natural exposure, serving as a bridge to more enduring psychological benefits.

Psychological Needs Satisfaction: Drawing from the Self-Determination Theory, this variable captures the degree to which natural environments cater to our intrinsic psychological needs, ultimately fostering positive emotional experiences.

For mediation analysis, the focus was on the indirect effects. Point estimates provide the size of the mediation effect, while the confidence interval offers a range within which the true mediation effect lies. Using a 95% confidence level ensures that we are 95% confident that the true mediation effect lies within the stated interval. This is a standard practice in research to balance the trade-off between precision and confidence. The mediation effect of physiological cognitive effects had a point estimate of 0.337, with a confidence interval between 0.199 and 0.493. The mediation effect of psychological needs satisfaction had a point estimate of 0.43, with a confidence interval ranging from 0.261 to 0.7. The difference in their mediation effects produced a point estimate of 0.094, with a confidence interval that included zero, indicating no significant difference between the two effects (MacKinnon et al., 1995).

Table 5: Mediation Effect Analysis

SIE	Point Estimation	Product of coef.		Bias-corrected		Percentile	
		SE	Z	Lower	Upper	Lower	Upper
NR1→PCB→PEE	0.337	0.075	4.493	0.199	0.493	0.201	0.493
NR1→ANF→PEE	0.43	0.107	4.019	0.261	0.7	0.254	0.689
IE difference	0.094	0.125	0.752	-0.123	0.371	-0.129	0.361

In detail, the point estimate of 0.337 for the mediation effect of physiological cognitive effects, with a 95% confidence interval between 0.199 and 0.493 excluding zero, signifies its statistical significance (Shrout & Bolger,

2002). The point estimate of 0.43 for the mediation effect of psychological needs satisfaction, with its 95% confidence interval ranging from 0.261 to 0.7, also excludes zero, further denoting its statistical significance. The comparison of their effects, with a point estimate difference of 0.094 and a confidence interval that encompasses zero, indicates their similar strength in mediating the relationship.

In summary, both physiological cognitive effects and psychological needs satisfaction play intermediary roles, of comparable strength, in the pathway through which natural environments influence psychological states. This study validates these two pivotal intermediary links in the theoretical framework, offering empirical evidence for the intrinsic paths through which natural settings exert positive psychological impacts.

DISCUSSION

Discussion of Research Results

This study collected a sample data of 413 through a questionnaire survey. By fitting the model, it was validated that the influence of nature affinity on positive emotional experiences has multiple links. The scale has good reliability and validity. The fit analysis indicates that indicators such as GFI, AGFI, CFI, and RMSEA of the model met the good criteria, showing that the model matched the sample data well. The mediation effect analysis revealed that physiological cognitive effects and psychological needs satisfaction play almost equivalent mediating roles between the influence of the natural environment and individual mental health. The mediation effect estimates for both are 0.337 and 0.43 respectively, with no significant difference in the effect size. Both have a positive mediating effect on positive emotional experiences.

The results preliminarily verified the multi-link mechanism model of the influence of the natural environment on mental health constructed on a theoretical basis in this study, providing significant empirical support for the theoretical framework. By adopting a quantitative research paradigm and fitting a model to analyze quantitative data, the theoretical framework is empirically tested, which has a positive significance for promoting the development of this research field. This study confirmed the two key mediating mechanisms in the theoretical framework, contributing to a deeper understanding of the intrinsic process of the impact of the natural environment on psychology.

Comparison with Previous Research

Upon a systematic review of literature, past research predominantly stems from perspectives such as the Attention Restoration Theory and Stress Reduction Theory, focusing primarily on the direct effects of natural environments. In contrast, the present study posits a multi-link mechanism model grounded in theoretical foundations, incorporating various mechanisms including

psychological need satisfaction. This approach delineates the multifaceted processes through which natural environments influence individual psychology, thereby expanding the scope of previous studies. Specifically:

The Attention Restoration Theory accentuates cognitive functions while neglecting individual variances (Cassarino et al., 2019; Trammell & Aguilar, 2021). The novel framework of this research integrates the psychological need satisfaction from the Self-Determination Theory, elucidating how different individuals achieve psychological restoration by fulfilling diverse psychological needs. This addresses the shortcomings of the Attention Restoration Theory in overlooking individual differences.

The Stress Reduction Theory overly emphasizes physiological mechanisms (Herchet et al., 2022). The innovative framework introduced here incorporates the role of subjective cognition in stress alleviation, compensating for the Stress Reduction Theory's limitations in acknowledging cognitive factors.

The Biophilia Hypothesis offers limited exploration of individual differential effects (Bratman et al., 2019; Brymer et al., 2021). The proposed cyclical enhancement model in the new framework facilitates the examination of the distinct impacts of natural environments on different groups, rectifying the oversight of group variations in the Biophilia Hypothesis.

The Self-Determination Theory does not thoroughly consider the effects of varying natural environments (E. S. Lee et al., 2022; Yang et al., 2022). The new framework distinguishes between different types of natural settings, assessing their differential roles in satisfying psychological needs, thereby addressing the oversight of environmental variations in the Self-Determination Theory.

The Flow Theory places excessive emphasis on subjective experiences (Xie et al., 2022). The advanced framework in this research introduces objective physiological cognitive indicators to evaluate the tangible impacts of natural environments on individuals, countering the overly subjective orientation of the Flow Theory.

In summary, the newly proposed framework amalgamates the strengths of each theory, introduces novel mechanisms and indicators, differentiates between natural environments and individual variances, and systematically addresses the limitations of each theory, presenting a more comprehensive and enriched theoretical model.

Limitations of the Study

Firstly, this study adopted a cross-sectional research design, surveying the sample at a single time point, which makes it challenging to ascertain the chronological and causal relationships between research variables. External confounding variables could not be excluded. Future studies should adopt a prospective cohort design to confirm causative mechanisms.

Secondly, the sample was limited to the Shanghai area, presenting certain regional limitations. To enhance the generalizability of the results, future research needs to adopt a multi-center design, expanding the regional and demographic representation of the sample, or undertake international multi-center collaborative research to examine the cross-cultural applicability of the model.

Furthermore, this study primarily focused on validating the overall mechanism model. Future work can delve deeper into specific links in the model, such as the neural mechanisms of physiological cognition or which dimensions of psychological needs satisfaction play a major role, to clarify more detailed intrinsic processes. Individual differences can also be introduced to examine their moderating effects.

Lastly, this research only conducted a single questionnaire survey. Future endeavors should continue with larger sample studies, repeatedly validating the theoretical framework based on new data, continuously optimizing and revising the model, and establishing a continually improving cumulative big data platform.

Countermeasures and Outlook

In light of the study's limitations, future research should consider several approaches: Firstly, employing a prospective cohort design to track and record various indicators over time, enhancing the understanding of causative relationships. A randomized controlled trial could also be considered for more reliable causal inferences. Secondly, increasing the sample size and diversity through multi-center or international collaboration would improve the generalizability of the findings. This approach allows for subgroup analysis to explore the impact of individual differences. Thirdly, incorporating a broader range of indicators, including physiological measures like electrocardiograms and skin conductance, and potentially using fMRI to study brain activity in response to natural environments, can provide a more comprehensive understanding of the mechanisms involved. Fourthly, further specificity in research is needed to understand the distinct effects of various types of green spaces and the underlying psychological and physiological processes. Lastly, ongoing research with large samples and continuous model refinement based on new data is essential for the development of a robust and comprehensive theoretical framework.

Directions for Future Research

This study is a step towards a systematic framework on how the natural environment impacts mental health. Future research should adopt a prospective cohort design to track variables over time, enhancing understanding of their relationships. Expanding the sample size through multi-center or international

collaboration will improve generalizability. Incorporating a wider range of indicators, including physiological and neuroimaging techniques, is vital for understanding the environment's impact on brain activity. Distinguishing different types of natural environments and their effects is crucial. Longitudinal research can provide insights into developmental needs, aiding in tailored environmental planning. Practical applications of the theoretical model in areas like park design and therapy can validate and refine the theory. Continuous research with larger samples is essential for developing a comprehensive framework on the natural environment's role in mental health.

CONCLUSION

The primary aim of this research was to evaluate and synthesize extant theoretical models pertaining to the impact of the natural environment on mental health, identifying contributions, gaps, and potential enhancements, culminating in a novel, integrative cross-disciplinary theoretical framework. Through a critical literature review, this study established and assessed five predominant theoretical perspectives, substantiating the significant mediating role of physiological-cognitive effects and psychological needs fulfilment in the nexus between natural environments and individual psychology. The study depicted an advancement cycle, from environmental connection to internal psychological enhancement, providing a pivotal theoretical base for explicating the multifaceted mechanisms by which natural settings influence mental well-being. Despite its cross-sectional design and regional specificity to Shanghai, the study lays the foundation for future expansive research. Prospective studies are encouraged to employ longitudinal designs, enlarge sample sizes, integrate additional research metrics, and strive towards a comprehensive and empirical theoretical construct.

ETHICAL STATEMENT

In this study, all participants were fully informed about the nature and purpose of the research before it began, and their informed consent was obtained. The data collected in this study were anonymized to ensure the privacy of the participants. The research process strictly adhered to relevant ethical guidelines to ensure that the rights and privacy of the participants were respected and protected.

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**ANALYSIS OF THE ISSUES AND CURRENT FRAMEWORK IN THE
ADMINISTRATION AND DEVELOPMENT OF NON-ADMINISTERED
REAL ESTATE OF KAMPONG BHARU, KUALA LUMPUR,
MALAYSIA**

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Abstract

The unmanaged properties in Kampong Bharu, with over 60 billion immovable estates classified as frozen, are a pressing concern. Despite numerous proposed solutions, the current legal framework remains insufficient, and the challenge of addressing these unmanaged estates persists. Additionally, development planning in this area has been stalled with no resolution in sight up to the present day. This study analyses the issues and current framework in the administration and development of non-administered real estate in Kampong Bharu through a qualitative and descriptive cross-sectional analysis of governing statutes, reported cases, semi-structured interviews, surveys, and data from the respective administrative bodies. Several issues were identified, including the presence of multiple administrative bodies, uncertainty about the status of Malay Reservation Land, problems arising from multiple deaths, and challenges in enforcing the Land Acquisition Act 1960, highlighting the urgent need for more efficient legal administration and dispensation of justice.

Keywords: Non-Administered Real Estates, Kampong Bharu, M.A.S (Malay Agriculture Settlement), Kampong Bharu Development Corporation Act 2011, Kampong Bharu Development Master Plan 2040

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INTRODUCTION

Non-administered estates, as identified by Yusoff (2019), pertain to real properties that are categorised as frozen estates. The prevalence of non-administered estates has long been a concern for the community, and its significance has grown due to a yearly increase in such cases. This matter remains a subject of ongoing debate, without a definitive resolution. Numerous prior studies have indicated that non-administered estates result from the community's insufficient commitment to managing their properties. Additionally, a lack of awareness among community members regarding the methods and procedures for estate management contributes to the growth of non-administered properties in Malaysia. Misconceptions about the property administration and management system in Malaysia arise from diverse systems and heirs' limited knowledge of handling a deceased person's property. The complex process involved in applying for property division further exacerbates the rise in frozen estates. For instance, in Kampong Bharu, it is estimated that the value of non-administered real estates exceeds RM60 billion (Yusoff, 2019).

The media reports on non-administered real estates in Kampong Bharu serve as a warning to both the public and authorities, highlighting the urgent need for proactive measures to address this issue. Hence, proposing solutions for unlocking the administration of non-administered real estates in Kampong Bharu within the current legal framework becomes imperative. This research assesses issues related to the existing frameworks, scrutinising the challenges and obstacles arising from the current laws and legal structures governing non-administered estates in Kampong Bharu. The study also examines the limitations of non-administered real properties in Kampong Bharu, drawing insights from legal statutes, interviews with various stakeholders, data collection, and the researcher's observations of relevant administrative entities.

RESEARCH METHODOLOGY

This research employed qualitative methods consisting of content analysis and field studies. The content analysis involved a thorough review of relevant literature, encompassing primary and secondary legal sources, academic and non-academic publications, and legislative texts, to gather comprehensive information on non-administered land management, particularly in Kampong Bharu. The doctrinal analysis examined legal provisions, including statutes such as the Kampong Bharu Development Corporation Act 2011, the Land Acquisition Act 1960, and other relevant laws, along with non-legal literature.

The field studies included semi-structured interviews with pertinent agencies, such as the Kampong Bharu Development Corporation (KBDC), which sought insights into the issues and challenges in Kampong Bharu, as well as an

overview of how non-administered estates are managed in Malaysia, including the policies, legal aspects, stakeholders, organisational structures, and processes. This research combines findings from legal analysis and field studies to analyse the issues and current framework in the administration and development of non-administered real estate in Kampong Bharu.

LITERATURE REVIEW

It is essential to expedite the resolution of estate administration to prevent undesirable outcomes, underscoring the importance of beneficiaries submitting their applications early. Nonetheless, certain beneficiaries intentionally prolong the application process, which can be detrimental to estate administration. Yin and Abdullah (2020) discuss Kuala Lumpur's development control mechanisms to contextualise urban planning difficulties and regulatory frameworks related to Kampong Bharu's non-administered real estate administration and development. These factors can affect Kampong Bharu's real estate administration, suggesting that better regulatory frameworks are needed to handle urban planning issues in this location (Yin & Abdullah, 2020). Teriman, Yigitcanlar, and Severine (2009) compare urban sustainability and growth management in Kuala Lumpur with Hong Kong. Their analysis emphasises the need for sustainable growth solutions to manage Kampong Bharu's urban development. This analysis illuminates the challenges and methods for growth management in similar metropolitan contexts (Teriman et al., 2009). Various challenges regarding non-administered estates in Kampong Bharu include the perplexity surrounding the presence of multiple administrative bodies, the status of Malay Reservation Land, the complications arising from multiple deaths, and the enforcement of the Land Acquisition Act 1960.

The Existence of Multiple Administrative Bodies

The court has legislative jurisdiction to appoint a personal representative to manage the deceased's estate, whether testate or intestate. Malaysia has various administrative agencies with diverse jurisdictions that can handle estates, unlike this standard. The Estate Distribution Division, Public Trust Corporation, and civil High Court are important estate management administrative entities. Each body has specific authorities and grants legal authority to handle the deceased's estate.

The primary reasons for delayed applications are the confusion surrounding the selection of the appropriate administrative body and misperceptions held by the beneficiaries regarding these administrative entities. The estate distribution process in Malaysia involves various agencies and court systems. Under the existing legal framework, when an individual passes away, their heirs are required to contact relevant agencies such as the Estate Distribution

Division at the Land Office, the Public Trust Corporation, or the High Court (Azmi & Mohammad, 2015).

The existence of multiple administrative bodies in Malaysia has led to confusion among beneficiaries in Kampong Bharu when it comes to selecting the appropriate administrative entity to approach. Despite each body having its specific jurisdiction, this multiplicity has unintentionally created ambiguity among Kampong Bharu beneficiaries. This confusion leads to delays in estate administration, hindering them from promptly receiving their rightful shares of asset distribution. The process typically begins with the application for letters of representation from the relevant administrative bodies. It is crucial to highlight that, after the death, the heirs of the deceased bear the responsibility of taking specific actions immediately. These actions include assessing the deceased's assets, identifying the beneficiaries, and gathering the necessary documents for the application. Generally, these applications are submitted by the deceased's family members or, in some instances, by appointed solicitors. While solicitors are expected to be well-versed in matters of succession and the selection of appropriate administrative bodies for estate administration, beneficiaries lacking familiarity with the process often face challenges in determining which administrative body to approach due to limited knowledge of the distinctions between each entity (Malek, 2023).

A notable factor contributing to public misconceptions about administrative bodies is a lack of awareness. Despite the easy accessibility of information through resources like the Internet, many individuals remain unaware of the existence of these institutions and their respective roles. This lack of knowledge not only hampers the identification of the appropriate administrative body but also leads some individuals to delay their applications without actively seeking information on these matters (Malek, 2023).

Status of Malay Reservation Land

Malays own Kampong Bharu, which is planned under the Kampong Bharu Development Act, and replaced the Malay Agricultural Settlement (MAS) Administrative Board Rules. The Kampong Bharu Development Master Plan and Guidelines complement this Act. The present master plan, created in conjunction with the Kampong Bharu Development Corporation (KBDC), was created after the previous government's "willing buyer, willing seller" approach failed because only 61% of owners agreed (Azil, 2020). Under current law, the "willing buyer, willing seller" strategy requires 100% landowner permission. Along with the KBDC, the Ministries have begun breaking down the master plan into approximately 40 parcels to be developed individually in Kampong Bharu. Each parcel will be sold by landlord-developer willing-seller-willing-buyer agreements. The Ministries and KBDC will unveil a RM1.5 billion master plan.

Under review by the Attorney General's Chambers, the Kampung Baru Land Bill draft proposal seeks to preserve landowners' rights for the long future. Landowners and developers will sign leases for the development. No previous law protected Malay reserve land from status changes, hence this legislation fills the void (Bernama, 2021). Parliament will likely hear the Bill in early 2022.

The Malay Reservation Land (MRL) was established by the 1913 Malay Reservation Enactment and 1987 Land Enactment to secure Malay land ownership, particularly in urban areas, with tight transfer restrictions (Meade, 1976; D'Arcy & Keogh, 1999). By assuring continuous land ownership in Malay communities and for agriculture, the law protects the Malay community's social, economic, and physical integrity (Means, 1985). The Malay reserve restricts landowners from selling to non-Malays (Gomez, 2003). MRL transactions with non-Malays are void. Each state allocates MRL differently, with Melaka allocating 25% of its territory. State authorities set MRL block locations and sizes, resulting in distributed reserve territory within town borders. In the Kuala Lumpur Structure Plan, six Malay Reservation Areas were planned as traditional communities. These parcels have individual homes and smallholding land. As the city has grown, these MRL zones have been surrounded by urban growth, making many original structures and settlements unsuitable (Hanif & Azriyati, 2015). The MRL, designed exclusively for Malays and restricted from dealings with non-Malays, has faced several challenges. The restrictions introduced in 1913, meant to safeguard Malay ownership, inadvertently narrowed the market among financially disadvantaged Malays, leading to underdeveloped land. These restrictions also inhibited leasing to non-Malays, curtailed transactions among Malays, and rendered the land less attractive for development projects, resulting in large tracts of undeveloped land. To address these issues, experts have proposed initiating more infrastructure and facility projects, revising laws related to Malay Reservation land and inheritance, allowing extended leases to non-Malay individuals for further study, and launching government-led development projects. The assessment of Malay Reserve Land (MRL) is impacted by elements like its location, market demand, and, significantly, the land's ownership status rather than the landowners themselves. A comprehensive Malay Reservation database could streamline the valuation process, ensuring accurate and informative valuations and expediting assessments.

Malay Reserve land falls under the jurisdiction of state governments, each with varying provisions across Malaysia but sharing the common objective of preventing non-Malays from owning government land within Malay reserves and restricting private transactions between non-Malays and Malays involving Malay Reserve land. Section 89 of the Federal Constitution enforces this prohibition, preventing sale, mortgage, transfer, lease, and other transactions with non-Malays (Hussin & Rashid, 2014). These restrictions apply to estate

management and division, particularly in cases where non-Malays are involved. Regarding Kampong Bharu, the land acquisition process for the redevelopment of Kampung Sungai Baru is ongoing due to its successful execution and majority resident support. Most residents have approved the project, culminating in a joint venture agreement between the developer and 192 flats and 27 terraced house units. So far, land acquisition has been completed for 72 flat plots, with land acquisition also initiated for landowners who have not signed joint ventures with the developer. Only 37 terraced house units are pending investigation. The number of units ready for development has increased to 291 units, an increase from 219 (27 terraced lots and 192 flats), following the issuance of the Form K notice under the Land Acquisition Act 1960 by the Kuala Lumpur Federal Territory Directorate General of Lands and Mines. This encompasses 264 flat units and 27 terrace lots, equivalent to 88.72% completion.

However, achieving 100% consent from landowners remains a challenge, particularly when a change in government has occurred. The Kampong Bharu master plan, known as Pelan Induk 2040, is associated with a financial constraint estimated at RM10 billion for land use only. KBDC has actively promoted joint venture negotiations, but not all Kampong Bharu beneficiaries have granted 100% consent. When unanimous consent is not reached, land acquisition becomes necessary, as exemplified in Sungai Baru. Joint ventures between developers and landowners require that landowners first administer the estate. Failure to administer the estate results in compensation being paid to Amanah Raya Berhad (Malek, 2023).

Multiple Deaths

Delayed estate management can complicate heir difficulties, especially when there are multiple deaths. Multiple deaths involve the beneficiaries of the first deceased person. This can happen to first-, second-, third-, or even later-generation heirs. This issue causes a complex sequence of stacked or overlapping deaths in the faraid instance, delaying estate administration (Yusoff, 2019). This issue prolongs the process of determining the proper heirs for that generation, complicating estate management. Layered deaths are one of the hardest estate management tasks.

Kampong Bharu has many unadministered estates due to multiple deaths. Multiple deaths indicate land left unadministered after the owner dies and the beneficiaries die. Such scenarios are complicated when the land is shared among many beneficiaries. Land acquisition or reversion alone cannot solve Kampong Bharu's numerous deaths problem since recipients must actively manage these lands. Beneficiaries lose their rights when many deaths occur, especially in high-value commercial sectors. Multiple deaths complicate land

valuation and development benefit distribution. Multiple deaths make aligning Kampong Bharu's growth with the Golden Triangle difficult (Malek, 2023).

A training for Kampong Bharu landlords highlighted the area's main issue: many landowners and small parcels. Around 4,300 people own 884 lots in Kampong Bharu. According to records, 31% of these parcels have more than five owners, averaging 8–30. A large 83% of lots are under 1,000 square meters. The smallest parcel, 0.01335 square meters, is owned by 141 people and valued at RM13.35 per square metre at RM1000. The absence of landowner collaboration in Kampong Bharu is the main difficulty with multi-ownership. Their efforts and opinions differ, making consensus impossible. Lack of unity hinders local development planning. Kuala Lumpur City Hall has launched many Kampong Bharu programs, but planning has stalled. Many landowners are scattered around the country and have inherited stakes from deceased heirs, making it difficult to update ownership documents on paper. According to Steering BIG Property Consultant Chairman Nik Mohd Zain, getting all owners' approval is difficult, and any resistance undermines the planning process. Section III (1) (b) of the Land Acquisition Act 1960 allows authorities to acquire land without the owner's consent as a last resort (Sulong & Taha, 2016).

Enforcement of Land Acquisition Act 1960

Kampong Bharu redevelopment advanced in 2014. Kampong Bharu Development Corporation (KBDC) was founded in 2011 under the 1984 and 2003 Kuala Lumpur Structure Plan (KLSP) and 2008 Kampong Bharu Development Plan governance rules. The KBDC released the Comprehensive Development Master Plan of Kampong Bharu in 2014 to support the fourth scenario from the 2008 plan, which envisions major changes and interventions. This plan intentionally promotes Malay culture and Kampong Bharu's economic growth. It emphasises the need to include landowners in future development. The plot ratio in Kampong Bharu rose from 1:6 to 1:10 after the KBDC was established under Act 733, making it the highest in Kuala Lumpur. Business and commerce have replaced agricultural and residential land usage in the 1960s (Zainol, Sarayed-Din, Ahmad, 2017).

The Kampong Bharu Master Plan's enhanced plot ratio and land use options are government efforts to raise land value. Kampong Bharu landowners profit most from these reforms, who can expect increased yields. The KBDC is also asking the government to exclude Kampong Bharu landowners from estate management costs. Land administrators' orders cost 0.2% of the estate's worth, which might be onerous in circumstances with many candidates for estate status updates (Bernama, 2017).

Furthermore, under Section 3(1)(a) of the Land Acquisition Act 1960, the government is only permitted to acquire land in Kampong Bharu for public

development projects or public use. The government cannot forcibly take Kampong Bharu land for commercial purposes if the landowner does not agree to the RM1,000.00 per square meter offer. The Kampong Bharu development project, being commercial in nature, does not fall under the purview of the Land Acquisition Act 1960. Forced land acquisition with compensation under the Act will only be considered under specific circumstances (Bakar, 2019).

Beneficiaries have shown a lack of initiative in resolving non-administered estates, with many in Kampong Bharu apprehensive about their land being transferred to non-Malays. Some beneficiaries are unwilling to settle the estate unless they receive significant compensation in return. When a death occurs, the process of changing the name on the land title is often delayed. In Kampong Bharu, many beneficiaries have settled with payment but hesitated to update the name on the land title. This delay in the name-changing process at the Land Office is a significant oversight on the part of buyers, who mistakenly believe that the sale and purchase agreement is sufficient (Malek, 2023).

The land acquisition for the redevelopment project in Kampong Sungai Baru, Kampong Bharu, faces obstacles in its continuation, despite meeting the legal requirements under the Land Acquisition Act 1960. Some residents of Kampong Bharu oppose the redevelopment, and it can only proceed if the developer secures consent from at least 50% of the property owners, a threshold required to safeguard the interests and welfare of the involved residents. Many landowners are reluctant to permit the land acquisition for the project to proceed.

ANALYSIS AND DISCUSSION

From a legal perspective, the National Land Code of 1965, a cornerstone of national land legislation, contains established provisions addressing delays and failures in the division of inherited land. Section 100 grants the Land Administrator authority to declare land forfeited to the State Authority for non-payment of the required sum. Sections 351 and 352 provide for the possibility of reversion action against any land for which no application for estate division has been submitted. Failures in estate distribution may lead heirs to withhold land tax payments, potentially resulting in forfeiture of ownership under Section 100. Although these provisions are infrequently applied, heirs should be more attuned to their rights, ensuring they do not continue to lose inherited property that could be utilised and serve as an economic catalyst for the country (*UMBC v. Pemungut Hasil Tanah Kota Tinggi* [1984]; Buang, 1998).

As previously noted, the value of non-administered estates is substantial. If these estates were effectively managed and harnessed for the Muslim economy, they could significantly contribute to the overall economic improvement of Muslims. When liquidated, the profits could be channelled into research and development through research grants. Moreover, liquidation could

be employed to acquire houses allocated to Bumiputera that were returned due to a lack of buyers. This step would benefit the Bumiputera community and serve as a long-term government investment. The funds could also be used to establish endowments by creating women's shelters, haemodialysis centres, hospitals, schools, universities, banks, and other related infrastructure. The delay in administering these estates has left a substantial portion of agricultural land untapped, which has the potential to generate significant returns.

In the context of individual or family businesses, beneficiaries may struggle to secure financing from banks or financial institutions to expand their businesses due to their inability to provide proof of land ownership, as the estate title is still registered under the deceased's name. This hinders access to credit facilities for land development, potentially impacting beneficiaries like farmers who might be unable to maintain or develop their land, resulting in the loss of necessary income sources. Non-administered estates have led to various adverse consequences, as they are essentially frozen and remain unutilised, preventing heirs with rightful claims from asserting their rights or enjoying their share of the property. These issues should not be left unaddressed, as they hold significance for both the rightful heirs and the nation. In summary, non-administered estates yield adverse consequences and represent a waste to the country since they remain undeveloped, particularly in areas with high commercial value, which remain unutilised due to inheritance distribution issues, as seen in locations such as Kampong Bharu (Halim & Yusoff, 2019).

The comprehensive development of Kampong Bharu for the target year 2040 faces numerous challenges. The ongoing revision of the transformation project suggests the subdivision of the Malay enclave into smaller grids to facilitate further development. In 2018, the government introduced new offers to encourage landowners to participate, following a survey indicating that only half agreed to sell their land at RM1,000 per square foot. This plan mirrors the Kampong Bharu Detailed Development Master Plan, emphasising the area's transformation through cluster-based or retail agreements between landowners and developers. However, the feasibility of this idea was contested by former Federal Territories Minister Khalid Abdul Samad, who argued that Kampong Bharu lands should be developed as a whole rather than through plot amalgamation, considering the numerous plot owners and significant overlapping claims for land parcels. The previous government's proposal could not be implemented, as only 61% of landowners were willing to sell. To introduce a new approach, the government plans to conduct additional meetings with owners and heirs of Kampong Bharu land plots. The development will be segmented into specific grids and smaller plots and implemented in phases. Currently, seven plots have been identified and are ready for immediate development, including the area near Jalan Syed Mahadi and the vicinity of the new mosque. (Aziz, 2020).

On June 6, 2020, KBDC annulled the century-old Malay Agricultural Settlement (MAS) status. It was determined that the management of land plots in Kampong Bharu should be overseen by the Federal Territories Land and Mines Office, as outlined in Subsection 5(1) of the Constitution (Amendment) (No 2) Act 1973 (Babulal, 2020). The Malay Agricultural Settlement Board lost its relevance in the administration of land, planning, and township management in Kampong Bharu. This decision was reached after considering the legal opinions of the Attorney General's Chambers concerning the status of the MAS Administrative Board. The Sultan of Selangor, Sultan Sharafuddin Idris Shah, also concurred that matters pertaining to the MAS Administrative Board should be addressed by the Ministry of Federal Territories in accordance with existing laws.

The responsibility for land administration in Kampong Bharu has shifted to the Kuala Lumpur Federal Territory Land and Mines Office, departing from the MAS Rules, in accordance with the provisions of Section 5(1) of the Constitution (Amendment) Act (No. 2) 1973 [Act A206] (Bernama, 2020). As most MAS land has already been transferred to private ownership, with only remaining land awaiting allocation, the MAS Rules are deemed unnecessary. Matters pertaining to town planning and management in Kampong Bharu fall under the jurisdiction of the Kuala Lumpur City Hall, governed by the Federal Territories (Planning) Act 1982, the Kuala Lumpur City Act 1973, the Local Government Act 1976, and the Roads, Drains and Buildings Act 1974. The MAS Administrative Board is no longer involved in municipal management activities such as issuing hawking permits, collecting parking fees, and renting advertising space.

The MAS Administrative Board is now restricted from involvement in municipal management tasks, such as issuing hawking permits, collecting parking fees, and leasing advertising space. Likewise, the MAS Governing Board is no longer empowered to undertake development control responsibilities, such as approving development orders, building plans, engineering plans, permits for building work, earthworks, public road closures, and building occupancy permits. However, the MAS Administrative Board may continue its operations as a nongovernmental organisation (NGO) or consulting firm, supporting Kampong Bharu residents in addressing estate and land-related issues (Jaafar, 2020).

The Federal Territories Ministry has submitted the requisite documentation for a new development Act specific to Kampong Bharu to the Attorney General's Chambers (AGC). This Act is intended to replace the previous Malay Agricultural Settlement Act, which governed development and management within the Malay enclave. The new Act incorporates provisions designed to address legal obstacles that had hindered development and asset competitiveness in Kampong Bharu. Additionally, this new Act will integrate Kampong Bharu's development into the Kuala Lumpur Structure Plan for the

years 2020–2040, slated for gazetting in the near future. The plan’s goal is to ensure that Kampong Bharu remains aligned with the development of its surrounding areas, and it is currently in the finalisation process to establish Kampong Bharu as a special development area. The Act allows for the independent development of smaller land parcels ranging from 2 to 5 hectares, with a rough framework already in place to facilitate collaborative development initiatives between the government, various governmental agencies, landowners, and potential investors (Wahab, 2020).

The Kampong Bharu Development Corporation Act of 2011 will serve as a primary planning instrument for Kampong Bharu’s development, focusing on permanent land ownership for Malays. This Act will work in tandem with the Kampong Bharu Development Master Plan and Kampong Bharu Development Guidelines. The new master plan, developed in collaboration with the Kampong Bharu Development Corporation (KBDC), emerged as an alternative to the previous government’s development approach based on the “willing buyer, willing seller” concept. This new approach can proceed with the consent of 61% of landowners, as opposed to the requirement of 100% consent in the “willing buyer, willing seller” model (Yusop, 2021).

Following a change in government, the residents of Kampong Bharu expressed concerns about the continuity of redevelopment. Zulkurnain Hassan, Chairman of the Kampong Bharu Development Corp, reported receiving an influx of communication from anxious landowners following the political transition. Their primary concern revolved around whether the redevelopment project would continue (Babulal & Solhi, 2020). In the meantime, Kampong Bharu landowners have explored alternative strategies to make their lands available for redevelopment. Leasing the land, rather than selling the land rights, has emerged as a prospective approach. While the Land Act of 1897 initially imposed restrictions on selling and leasing land to non-Malays, landowners are considering more lenient amendments to allow leasing to corporate international expatriates (Adlene, n.d).

In a report from December 2021, some Kampung Baru residents were surprised to find themselves obligated to evacuate their flats and houses due to the government’s action under the Land Acquisition Act. The government utilised this Act to acquire land from Kampong Bharu residents for development purposes, offering compensation at an amount as low as RM400 per square metre. This was significantly less than the previous offer made by the Pakatan Harapan (PH) government, which had proposed RM1,000 per square meter. In July 2021, residents of Kampung Sungai Baru, Kampong Bharu, received notification via the Government Gazette Section 8, Land Acquisition Act of 1960, compelling them to vacate their land with the compensation offer. This decision was made after the developer’s previously ignored application was successfully processed

through the Land Office. The developer then posted a Form E notice, issued by the Land Administrator of the Federal Territory of Kuala Lumpur, on the dilapidated house walls in Kampong Bharu, informing residents about the commencement of the investigation (Ahmad, 2021).

Past endeavours to comprehensively redevelop Kampong Bharu have repeatedly encountered setbacks, often attributed to a lack of political will, financial crises, and challenges related to land ownership. Nevertheless, there has been a persistent commitment to rejuvenate this enclave. The Detailed Master Plan for the Development of Kampong Bharu, which previously served as the primary framework for development, faced numerous challenges, including a lack of support from the residents who were concerned about displacement and inadequate compensation. In response, Kampong Bharu Development Master Plan 2040 was introduced on November 25, 2021. This new plan represents a comprehensive framework for guiding development in the heart of the capital city over the next two decades. It demonstrates a higher degree of practicality by considering the residents' needs, as well as the intricacies of the region, with the aim of enhancing the well-being and quality of life for the populace, fostering equity, and promoting a competitive economy. It employs suitable approaches for engaging with landowners, developers, and investors to ensure that Kampong Bharu's growth evolves into an all-encompassing, high-calibre commercial and residential area that fosters a favourable environment (Malek, 2023). The summarize of the impact of non-administered estates at Kampong Bharu is shown in Table 1 below:

Table 1: Impacts of Non-Administered Estates at Kampong Bharu

1.	Legal Impact	Sections 100, 351, and 352 of National Land Code allow for land forfeiture and reversion actions due to non-payment and non-application for estate division
2.	Economic Impact	Non-administered estates, if managed, could significantly benefit the Muslim economy, support Bumiputera housing, establish endowments, and generate agricultural returns. Delays in estate administration hinder land development and access to credit facilities.
3.	Impact on Individual/Family Businesses	Lack of proof of land ownership prevents beneficiaries from securing financing for business expansion and land development, impacting income sources.

CONCLUSION

This study has thoroughly analysed the existing legal constraints and procedural obstacles impeding the proper administration of non-administered estates in Kampong Bharu, assessing the effectiveness of the current framework in addressing the issue of non-administered estates in the area. The analysis relies

on qualitative and descriptive cross-sectional research, incorporating a review of governing statutes, documented cases, semi-structured interviews, surveys, and data obtained from relevant administrative authorities. The chapter also outlines the consequences of non-administered estates in Kampong Bharu.

Several issues related to non-administered estates in Kampong Bharu have been identified, including challenges associated with the presence of multiple administrative bodies, the status of Malay Reservation Land, concerns regarding multiple deaths, and the application of the Land Acquisition Act 1960. The existence of these diverse administrative bodies has contributed to a complex, inconsistent, and often perplexing estate administration process within Kampong Bharu. Consequently, there is a pressing need for the adoption of more effective methods for legal administration and the fair dispensation of justice.

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TRAVEL MOTIVATIONS OF DOMESTIC TOURISTS TO PENANG, MALAYSIA

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Abstract

The services provided by those operating in the tourism industry, including destination managers, tourism strategists and tourism distributors, can be improved through a good understanding of the factors which prompt tourists to travel, or to opt for particular destinations. This study delves into the push and pull (P&P) theory, to identify the travel motivations (TMs) of domestic tourists, who visit the Malaysian state of Penang. A survey involving the participation of 504 domestic tourists, revealed these TMs as: (a) the natural sights and cultural experiences presented, (b) the gourmet dining and shopping attractions available, as well as (c) the quality tourist support infrastructure and services provided. It is our recommendation, that the findings derived through this investigation, be taken into consideration by local government officials and players in the Penang tourism industry, to enhance the quality of the tourism products available, as well as to promote the tourism products deemed most attractive to visitors.

Keywords: Domestic tourism, Penang, push and pull factors, travel motivation

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INTRODUCTION

The tourism industry plays a significant role in Malaysia's economy. The top five tourism attractions in Malaysia are the capital city of Kuala Lumpur, the hill resort of Genting Highlands, the island of Langkawi, the state of Penang, and the state of Malacca. Boosted by the well-organized 'Visit Malaysia' campaigns of 1990 and 1994, Malaysia's tourism industry developed steadily, to peak in 2014, with 27.4 million visitors. Malaysia was host to 26.1 million visitors in 2019, before the onset of the 2021 Covid-19 pandemic drastically reduced the number of visitors to 0.13 million in 2021. The tourism sector of Malaysia is currently on the road to recovery from this setback, with 20.1 million arrivals recorded in 2023, and 27.3 million arrivals the target for 2024 (Casey, 2024).

The expansion of the tourism sector serves to accelerate the rate of economic growth, provide additional and better employment opportunities, as well as promote the development of innovative concepts and entrepreneurship skills (Pololikashvili, 2019; Çelik & Dedeoglu, 2019; Aksoy & Kiyici, 2011; Marrocu & Paci, 2013; Martaleni, 2017). The development of the tourism industry is significantly influenced by the capacity of its players, to identify and deliver the requirements and expectations of their clients (Camilleri, 2019). Appropriate and timely adjustments will go a long way, towards meeting these tourist requirements and expectations (Happ et al., 2021; Martaleni, Hadiyati, & Yasa, 2021).

While domestic tourism is among the most important sectors in the tourism industry, it is frequently perceived less prestigious than international tourism, and less beneficial in terms of a country's economic growth and development. The United Nations World Tourism Organization (UNWTO, 2010), defines domestic tourism as the tourism activities carried out by a resident visitor, within the specified country, whether as part of a domestic trip, or an outbound excursion. Domestic tourists are individuals who travel for a period of ≤ 1 year, within the borders of the country they live in. Appropriately, Singh (2009) defines domestic tourism as travels involving vacations and accommodations beyond one's hometown, but within national boundaries. This research focuses on the domestic tourism activities of Malaysians holidaying in Penang, to gain a better understanding of the factors influencing their TMs.

THE GROWTH OF TOURISM IN PENANG

Known as 'The pearl of the orient', Penang draws visitors who prioritise natural surroundings, heritage sites, outdoor activities and a diversified cuisine. The must-visit attractions in this Malaysian state include Penang Hill, The Georgetown Penang National Park, Batu Ferringhi, and Balik Pulau. In 2008, the listing of George Town inner city (jointly with Malacca), as a United Nations Educational, Scientific and Cultural Organization (UNESCO) site, further enhanced its status as a major Asian tourist destination. As observed by the

Penang Exco for Tourism and Creative Economy (PETACE, 2021), the tourism industry of Penang has progressed significantly over recent years.

The growing popularity of Penang as the preferred tourist destination, led to the increased development of amenities and infrastructure, at strategic tourist locations. As a state with a multi-ethnic and multilingual population, Penang is home to a variety of cultural practices and religious beliefs. With a population of 1.7 million, and a land area of approximately 1048 km² (PETACE, 2021), Penang is a gastronomic paradise, and highly acclaimed for its diverse selection of Straits architecture and multicultural heritage. Each year, the state plays host to roughly three million domestic tourists (Table 1), as well as several million excursionists or day-trippers. The number of domestic tourist arrivals peaked in 2018, before dipping to 2.33 million in 2020, due to the onset of the Covid-19 pandemic. The post Covid-19 sees a steady recovery in the domestic tourist numbers which recorded 3.54 million in 2023. In 2018, the average length of stay for domestic travellers in Penang was four days, with each traveller spending an average of RM670 per visit (PETACE, 2019).

Table 1: Domestic Tourist Arrivals in Penang

Year	Arrivals (in millions)	Growth%
2010	2.94	
2011	2.96	0.7
2012	3.00	1.3
2013	2.64	-13.6
2014	3.62	27.1
2015	3.47	-4.3
2016	3.47	0.0
2017	3.47	0.0
2018	3.64	4.7
2019	3.54	-2.8
2020	2.33	-51.9
2021	2.85	18.2
2022	3.47	17.9
2023	3.54	2.0

Source: Tourism Malaysia (2021) *projection by Petace (2021)

THE IMPACTS OF THE COVID-19 PANDEMIC ON DOMESTIC TRAVELS

As reported by the United Nations Trade and Development (UNCTAD) authority, the Covid-19 pandemic led to the global infection of 179 million, and the demise of 3.9 million. The movement control orders (MCOs), border closures, and travel restrictions enforced to stem the global spread of Covid-19, brought the activities of the international tourism sector to a standstill (Peters et al., 2020).

In the context of Malaysia, the MCO, which was initiated on the 18th of March, 2020, restricted the activities of non-essential services, including the activities of tourism-related industries.

In June 2020, the Malaysian government's replacement of the MCO with the recovery movement control order (RMCO), served to ease the restrictions on domestic travels (PETACE, 2021). The lifting of the MCO led to a 50% increase in weekend patronage at tourist spots, which in turn led to a steady rise in domestic visitors (Trisha, 2020). To further encourage local and domestic travels, the Penang state government launched several initiatives, including the promotion of the 'Responsible Tourism' concept, and the introduction of the Covid-19 certification, which was aimed at enhancing the confidence of visitors, with regards to their safety from infection.

TRAVEL MOTIVATIONS (TMS)

According to Schiffman and Kanuk (2007), motivation is the driving factor that induces action. Pearce et al. (1998) define TM as the combination of travel behaviour, choices, and experiences, which provides visitors with a sense of value and direction.

McIntosh et al. (1995) identified four categories of TM: (1) TM prompted by physical issues, including those associated with relaxation, health, recreation, and enjoyment, (2) TM prompted by cultural curiosity, which involves visits to traditional sites, (3) TM prompted by the urge to establish new relationships, visit friends and family, as well as to participate in novel and unique activities, and (4) TM prompted by the pursuit of status and prestige through personal growth, ego expansion and physiological gratification. According to Hasnizam et al., (2022), the TMs prompting the visits of international tourists, has to do with the accumulation of knowledge, through the exploration of Penang's cultural and historical heritage sites. In 2019, the results from the 'Penang Tourist Survey' effort revealed that besides the lure of cuisine, leisure and recreational activities, 7.4% of domestic travellers made their way to Penang to visit friends and relatives (VFR).

Syed Darar and Ismail (2016) opined that the VFR market, previously perceived a passive market, currently plays a significant role, in the boosting of the local tourism economy. While the value of this niche market appears promising, the cultural inclination of VFR travellers, to stay with relatives or friends during their travels, renders this market unquantified. It has been observed that VFR travellers tend to spend less on accommodations, and more on dining and souvenirs, thereby contributing significantly towards the growth of the local economy.

The push and pull (P&P) motivation model, is generally recognized as the most effective means, for explaining the choices of travellers, with regards to their vacation destinations (Crompton, 1979; Prayag & Hosany, 2014; Zhang &

Peng, 2014). The P&P model, introduced by Dann (1977) to investigate visitor motivation, identified 'anomie' and 'ego-enhancement' as the two main push factors. He reported that the 'push factors' of tourists include their need for relief from tension, as well as their yearning for new experiences.

The connection between visitors' P&P, and their inclination to return to a previously visited location, was investigated by several researchers (Sastre & Phakdee-Auksorn, 2017). For instance, Khuong and Ha (2014) disclosed that P&P factors positively influenced the behavioural intention of tourists, in terms of their intention to revisit Ho Chi Min City, Vietnam, for leisure. Klenosky (2002) proposed that P&P variables should be perceived as correlated, instead of independent factors. Park et al. (2010, p. 307) opined that P&P TMs influence travellers' decisions, with regards to their visits to tourist sites.

THE INFLUENCE OF DEMOGRAPHIC CHARACTERISTICS ON TRAVEL MOTIVATIONS (TMS)

The demographic background of an individual influences his/her travelling behaviour. Zhang and Peng (2014) suggest that with a profound knowledge of the P&P TMs, and their connection with different demographic segments, destination marketers can develop and implement effective marketing strategies, for the enticement of key target groups. Personal characteristics affect one's impression of a destination, which in turn affects one's travel behaviour (Beerli & Martin, 2004). For instance, the study conducted by Gitelson and Kerstetter (1990) revealed that females are more likely than males, to associate with objectives related to relaxing, socialising and discovery.

Jönsson and Devonish (2008) reported that a tourist's urge for travel, is influenced by his/her age. According to their findings, older individuals favour leisure activities such as sightseeing and socialising, ahead of more vigorous activities such as sports. While Kattiyapornpong and Miller (2009) forwarded that the ages, income levels, and life stages of Australians influence their inclination to travel, Zimmer et al. (1995) and Sangpikul (2008) stated that the distance travelled is influenced by an individual's education level.

METHODOLOGY

This research, which used Penang as the case study, employed a quantitative methodology to collect data. The questionnaire was distributed between 5 July to 2 September 2021 via WhatsApp and email to 1000 respondents who had travelled to Penang. The responses were captured in a Google document for further analysis. Online data collection was deemed the most appropriate as Malaysia was then in the lockdown phase of the COVID-19 pandemic. The questionnaire comprised closed-ended questions in four sections. The first section collected the respondents' demographic details while the second collected information about their most recent trip to Penang. The third section required the

respondents to rate their TMs on a 5-point Likert scale. The data was analysed using IBM® Statistical Package for Social Sciences (SPSS®) version 23.

RESULT AND DISCUSSION

Of the 542 responses, 504 were valid. As seen in Table 2, 52.2% were women and 47.8% were men. The majority (60.1%) were of Malay ethnicity followed by 25.2% of Chinese ethnicity. They were mostly aged 21-50. Fifty-one percent (51%) were married, while 47% were single. Over 91.1% had completed their tertiary education. Apart from that, 48.8% worked in the private sector while 18.7% were government servants, 11.2% were students, and a further 11.2% were business owners. Lastly, most of the respondents resided in Selangor (39.1%) followed by Kuala Lumpur (15.9%) and Sabah (13.1%).

Table 2: Demographic Profile of Respondents

Variables	Description	Frequency (N)	Percentage (%)
Gender	Male	241	47.8
	Female	263	52.2
Age	< 20	15	3.0
	21-30	150	29.8
	31-40	158	31.3
	41-50	99	19.6
	51-60	61	12.1
	> 61	21	4.2
Ethnicity	Malay	303	60.1
	Chinese	127	25.2
	Indian	26	5.2
	Bumiputra Sabah	44	8.7
	Bumiputra Sarawak	3	0.6
	Others	1	0.2
Marital Status	Single	237	47.0
	Married	257	51.0
	Widowed/ Divorced	10	2.0
Level of Education	Primary school	3	0.6
	Secondary school	39	7.7
	College/ University	334	66.3
	Postgraduate	125	24.8
	Professional Certificate	3	0.6
Monthly Salary	< RM 2000	70	13.9
	Rm 2001- RM 4000	136	27.0
	Rm 4001 - RM 6000	87	17.3
	> RM 6001	124	24.6
	No salary	87	17.3

Variables	Description	Frequency (N)	Percentage (%)
Occupation	Private employee	245	48.8
	Government employee	94	18.7
	Business owner	56	11.2
	Temporary employee	11	2.2
	Student	56	11.2
	Unemployed	10	2.0
	Others	30	6.0

Table 3 presents some of the basic travel characteristics of the respondents. Most of the respondents visited Penang for leisure (59.7%) and stayed in hotels (65.3%). However, there is demand for tourist accommodations that can accommodate large groups as a quarter of them (25.2%) travelled with ≥ 5 companions. Therefore, although the Penang state government’s decision to ban Airbnb®-style accommodations will increase the use of hotels, it will significantly impact larger groups of travellers in the future. In the present study, 11.3% of the respondents stayed in Airbnb’s®, however, this number is expected to decrease in the future.

Table 3: Synopsis of Travel Characteristics

- 59.7% travelled to Penang for leisure
- 25.2% travelled in a group of 5 or more
- 56.7% relied on internet as the major source of information about Penang
- 53.8% stayed between 3-4 days
- 65.3 % stayed at hotels

FACTORS MOTIVATING DOMESTIC TOURISTS TO TRAVEL TO PENANG

As seen in Table 4, the factors motivating tourists to visit Penang included: (1) the natural attractions, (2) the cultural and historical attractions, (3) the shopping and culinary attractions, (4) the safe environment, as well as (5) the infrastructure and services. Based on the 5-point Likert scale, with 5 denoting ‘strongly agree’, the respondents consider Penang an attractive location for photo-taking sessions (4.43), with an exceptionally pleasing natural scenery (4.06). Penang’s colonial architecture and street art, beaches, and rural area settings (Kampung Agong and Balik Pulau) are among the most popular instagram sites for photography aficionados.

The cultural and historical attractions of George Town, a UNESCO world heritage site, represent significant motivating factors, for luring travellers (particularly status-seeking tourists) to Penang. In terms of the key elements that motivate domestic tourists to visit Penang, multiculturalism (4.44), historical

heritage (4.51), and architectural style (4.34) delivered ‘strongly agree’ scores on the 5-point Likert scale. Other than its fine dining establishments, Penang is also known for its street food, such as *Nasi Kandar*, *Char Kuey Teow*, and *Laksa*. Domestic tourists are also appreciative of the Penang state government for its assurance of public safety (4.10), and the provision of a peaceful environment (4.38).

Tourism infrastructure is another element influencing the travel decisions of tourists. Among the notable infrastructures facilitating tourist travels are the two bridges linking the island to the mainland, the Penang International Airport, the new ferry service, and the Penang Hills funicular tram. The survey respondents also delivered ‘strongly agree’ scores for good-quality eateries (4.34), hotels (4.23), and cruise ship docks (4.08). In the context of sea cruise tourism, George Town is a regular cruise ship docking location for cruises originating from Phuket in Thailand, and from Port Klang in Kuala Lumpur. On the downside, both locals and visitors alike are in agreement, that Penang’s public parking (2.77) system, is in need of an upgrade.

Table 4: Factors Motivating Domestic Tourists to Travel to Penang

Variables	Means	Std. Deviation
<i>Natural Characteristics</i>		
Place for taking pictures	4.43	0.713
Natural landscape	4.06	0.870
Relaxing atmosphere	3.96	0.923
Pleasant weather	3.82	0.851
Beautiful beaches	3.80	1.008
Place for agrotourism	3.67	0.967
<i>Cultural and Historical Attractions</i>		
Cultural and historical sites	4.51	0.691
Multicultural heritage	4.44	0.739
Variety of architectural styles	4.34	0.790
Local arts and craft	4.18	0.831
Many festivals	4.14	0.878
<i>Shopping and Dining Attractions</i>		
Wonderful local cuisine	4.72	0.603
Variety of foods	4.69	0.612
Food at reasonable price	4.06	0.988
Wide variety of local products	4.06	0.823
Local arts and craft (To shop)	4.05	0.835
Various types of shopping products	4.00	0.844
Convenient shopping	3.96	0.843
Good quality products	3.95	0.803
Shopping items at reasonable price	3.77	0.890

Variables	Means	Std. Deviation
<i>Environment and Safety</i>		
Quiet & peaceful environment	4.38	0.810
Personal safety & security	4.10	0.879
Place for family vacation	4.09	0.850
Safety at tourist spots	4.01	0.858
Unspoiled environment	3.73	1.040
Locals are friendly	3.59	1.019
<i>Infrastructure and Services</i>		
Good quality eateries	4.34	0.781
Good quality hotels	4.23	0.815
Good value for money	4.09	0.781
Strategic place for cruise ship trips	4.08	0.839
Staff attitude at place of stay is pleasant	3.99	0.912
Good facilities for conference or meetings	3.95	0.841
Good local infrastructure	3.92	0.865
Availability of travel information	3.88	0.898
Cost of place of stay are reasonable	3.76	0.877
Easy accessibility to tourists' spots	3.76	0.917
Good local transportation system	3.66	0.996
Entrance fees at tourist attractions	3.65	0.930
Good golfing experience	3.35	0.916
Local traffic is tolerable	3.14	1.151
Parking is easy	2.77	1.154

*Based on a scale of 5 where 5 is strongly agree.

CONCLUSION

Domestic tourists provide Malaysia's tourism industry with a lifeline during times of crisis, as evident during the period of the Covid-19 pandemic. As the number of international tourists dwindled, due to strict travel restrictions, the focus shifted to local and domestic visitors, to save the day. A variety of travel incentives and packages were offered by the states' tourism sectors, to entice visitors to their localities. According to Nengovhela et al., (2017), a good understanding of the reasons prompting travel, can facilitate the designing of new tourist products, as well as the promotion and positioning of existing ones.

In the context of local tourism industries, the onset of the Covid-19 pandemic, served to highlight the importance of long-term feasibility and resilience (PETACE, 2020). The TMs identified through this study, which prompt domestic travellers to visit Penang, are (a) the natural and cultural attractions, (b) the shopping and dining facilities, (c) the safe environment, as well as (d) the supporting tourist infrastructure and services. The findings derived through this survey, can be harnessed by the local authorities and players in the tourism industry, for the generation of products and services, which meet the

requirements and aspirations of visiting tourists. By taking into consideration the elements, which motivate visitors the most, strategic and effective promotional materials can be designed, to facilitate their arrival at favourable travel decisions.

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ASSESSING SATELLITE RAINFALL ACCURACY IN DENSE TROPICAL SABAH EAST COAST FOREST, MALAYSIA: A CROSS-VALIDATION OF DOWNSCALING TECHNIQUE

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Abstract

Rainfall is one of pivotal elements in the hydrological cycle that essential for ensuring the water balance in present and in the future. Traditional in-situ observations have been the conventional method for obtaining rainfall data, but their limitations arise from discrete point measurements that fail to represent the entire area. To overcome these limitations, this study utilizes satellite based TRMM data products for rainfall estimation. The research aims to cross-validate the TRMM 3B43-v7 product against corresponding in-situ measured rainfall, focusing on error localization in Sabah's east coast. The derivation of the rainfall rate from TRMM data is adequate with additional data from three manual gauges within the plots. The correlation between TRMM and ground was good ($R^2 = 0.78$, $RMSE = 65.65$ mm). The Nash and Sutcliffe Error results closed to value 1 indicate that the accuracy of the TRMM data compared to the rain-gauge data in Danum has a good agreement. This is due to the IDW downscaling method for satellite rainfall data using additional data from three manual-gauges within the plots to increase the accuracy of the TRMM data. In summary, the downscaling method proves capable of providing fine spatial resolution and increasing the number of pixels in the study area. Future research endeavours may benefit from incorporating more station data to further improve the interpolation of satellite data and derive more precise results.

Keywords: Rainfall, TRMM, satellite data, climate, downscaling

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INTRODUCTION

Accurate measurement of rainfall is crucial for understanding and modelling the Earth's hydrological cycle, particularly in the tropics that receive high annual rainfall. While traditional rain gauges offer high accuracy, they are limited to small areas, hindering a global perspective on hydrologic water balance. Remote area face challenges due to the cost of maintaining rain gauge stations, leading to measurement inaccuracies. Ground radar technology has addressed some limitations by providing high spatial-temporal capabilities, although it is still confined to a specific range of kilometres. Overall, the quest for precise rainfall data remains essential for robust hydrological modelling worldwide.

To address the limitations of traditional methods, this study employs remote sensing data, which offers valuable insights on a global scale and has been extensively utilized in various fields such as for forestry (Latip et al, 2022; Lindah Roziani et al, 2022; Jamru, Hashim and Phua, 2019; Jamru & Hashim, 2018; Jamru, 2018; Jamru & Hashim, 2015), Land use change (Jamru & Rahaman, 2018; Jamru, Rahaman & Ismail, 2013), agriculture (Jamru, Sharil & Yusoh, 2023; Jamru et al, 2023), urban (Shao et al, 2023; Latip et al, 2022) and hydrology (Mahmud et al, 2018).

In this study, rainfall rates are derived using TRMM3B43 Version 7 data obtained from the Tropical Rainfall Measuring Mission Multi-Satellites Precipitation Data Analysis, commonly known as TMPA. This dataset is chosen due to its frequent revisit times and extensive spatial coverage. The TRMM data product covering the latitude 50° was provided by the TRMM multi-satellite precipitation analysis by integrated precipitation estimates from multiple satellites and rain gauge. This study used TMPA 3B42 Version 7 data product, it provides a standard three-hourly rain rate at a global scale with a resolution of 0.25 degrees. The daily amount of rainfall is obtained by multiplying the average three-hour rainfall rate by eight datasets per day. The daily rainfall amount is then accumulated to estimate monthly rainfall.

Besides the advantage given by TRMM satellite data, there are also restrictions in using these data due to the limit of the coarse spatial resolution. Thus, the fine spatial temporal is limited only to a certain extent and is not applicable to a small area. In this study, re-projection and Inverse Distance Weighted (IDW) interpolation methods were used to obtain spatial resolution data of 1m to show the variation of rainfall. For assessment of rainfall rates, nominal assessment methods were used, for instance, root means square error (RMSE), bias analysis, coefficient of determination (R^2), and Nash- Sutcliffe Efficiency (NSE) are the commonly used ones in hydrology and related industries because it is robust and understandable by natural resources managers.

This study significantly contributes to the enhancement of our knowledge on the usefulness of TRMM rainfall at varying spatial and temporal

scales. The ability of the satellite to measure the hydrology element in remote areas with consistent spatial and temporal resolution provides a new opportunity in this field. Besides, with each of the same sensor capabilities improved with NASA's new sensors (e.g. Aqua and Terra Satellites), high-quality data can be produced. In addition, data providers are now starting to merge data such as the precipitation product (infrared, radar, and visible sensor) into TMPA to provide better information. Thus, the estimation of rainfall rate is now within our reach.

LITERATURE REVIEW

Accessible Satellite-Based Precipitation Estimation

Over the years, numerous precipitation retrieval attempts have been made by launching multiple Earth-orbiting satellites (Turk and Miller, 2005). Several satellites have been launched, for instance, Climate Prediction Centre (CPS) morphing technique (Joyce *et al.*, 2004), Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (Hsu *et al.*, 1997), Tropical Rainfall Measurement Mission (Huffman *et al.*, 2010), and Global Precipitation Measurement (GPM).

Among all the satellites, TRMM is the most well-known that delivers rainfall estimation from 50°N to 50°S in earth grid. This satellite-derived rainfall utilizes numerous advance sensors integrated together, which are active sensors (precipitation radar) and passive sensors (the visible and Infrared Scanner (VIRS) and the TRMM Microwave Imager (TMI) (Kummerow *et al.*, 1998). The TRMM TMI measured precipitation rates over the tropical regions as a collaborative science activity between NASA and the Japan Aerospace Exploration Agency (JAXA) (Maggioni, Meyers and Robinson, 2016). There are two types of rainfall measurements; and both methods had pros and cons.

First, direct methods that need visible and infrared wavelength to be incorporated together to observe cloud behaviour, for instance, temperature and external content differences. The benefit of this approach is that it is better suited for a large region. Second, the direct approach that used microwave wavelength to calculate precipitation rate (Todd *et al.*, 1995). The benefit of the direct approach is that it includes the rate of precipitation within time, which ensures that it is reliable in real time. The combination of the two types of methods contributes to a broader field of precipitation estimation of inaccurate real-time rainfall (Jobard, 2001).

TRMM rainfall is developed based on equations that combined various inputs from the available sensors. There are several versions of TRMM, such as the Version 1 data for the year 2007. The next introduction was accompanied by an upgrade in Revision 1.1 (2007), 1.2 (2007), 1.3 (2009), 1.4 (2010), 1.5 (2010), 1.6 (2010), 1.7 (2011), 2 (2012), and 2.2 (2013) for the respective years. All data released are corrected for their data limitations, failure of the sensor, uncertainty

of accuracy, and enhanced coverage (Huffman *et al.*, 2010) to improve the function of an input hydrological elements and improve satellite rainfall measurement techniques. Serrat-Capdevila, Valdes and Stakhiv, (2014) evaluated the latest of satellite precipitation products (SPPs) in hydrology and water resources management and demonstrated the utility of reliable precipitation measurements for landslide modelling, flood alerts, early warning systems, and reservoir operations.

TRMM 3B42 has been shown to be better than other precipitation satellite in terms of error rates, correlation with field data, and average errors in several regions. It was due to the bias correction contained in the formula, even though the research product may be heavily biased in regions with insufficient gauge coverage. However, 3B42 indicates a low detection likelihood (below 50%) in the equatorial region (Maggioni, Meyers and Robinson, 2016).

METHODOLOGY

Two data sets were used in this study, which are satellite-based precipitation and in-situ ground-based rainfall (rain gauge). Rainfall derived from TRMM satellite-based data product and ground rainfall data for station Sandakan and Tawau provided by Meteorological Department of Malaysia, and ground data in Danum Valley was collected by researcher. Both satellite and in-situ data used are from March 2015 until March 2016. Figure 1 shows the process of derivation rainfall data.

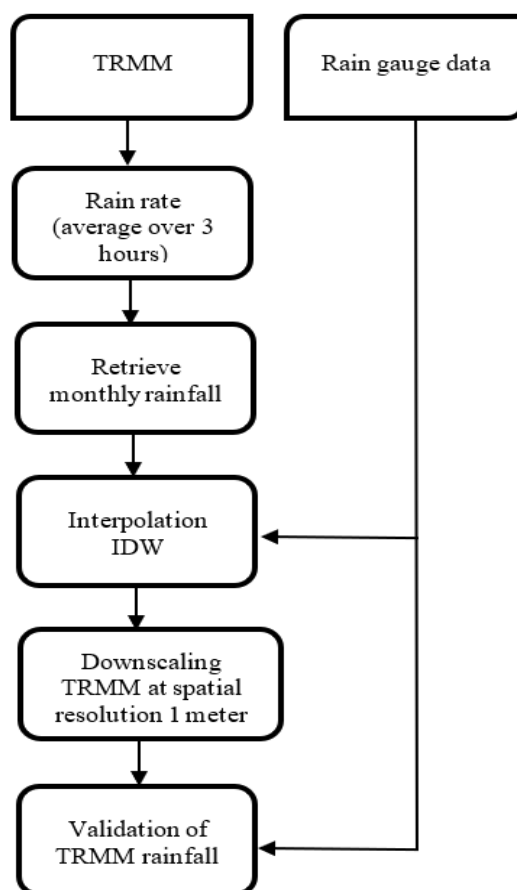


Figure 1: Flowchart processing of rainfall data

TRMM Multi Satellites

The TRMM Multi Satellites Precipitation Analysis (TMPA) presents the rainfall data. In this study, the hourly gross rainfall is downloaded from the official website <http://mirador.gsfc.nasa.gov> with a temporal resolution of three hours and spatial resolution 0.25 degrees. Hourly precipitation data is derived by summing up all sets of three hourly TRMM precipitation for one day and multiplied by days in a month. The data in the Hierarchy Data Format (HDF) provide information such as rainfall, relative error, and gauge relative weighting. The monthly data from March 2015 to March 2016 were acquired. Table 1 summarized the general description of the product. The spatial resolution of 5km was downscaled to 1m using IDW resampling method.

Table 1: Summary of the TRMM satellite data product

Satellite	Tropical Rainfall Measuring Mission
Data provider	Nasa Aeronautics and Space Administration (NASA)
Product name	3B42
Data format	HDF
Data coverage	4° 00' to 7° 00' N latitudes and 115° 20' and 119° 20' E longitudes
Spatial resolution	0.25 degrees
Date of data acquisition	March 2015 until March 2016

In order to derive the monthly basis rainfall (mm), the TRMM unit mm per hour is multiplied by 24, which represents 24 hours per day and multiplied by the number of days per month as described in equation 1.0 (TRMM Instruction Manual, 2005).

$$R_s = R_{TRMM} \cdot H_t \cdot D_m \tag{1.0}$$

where, R_s is the monthly satellite-based rainfall estimation; R_{TRMM} is a raw TRMM satellite data; H_t is a total of hours per day (set to the constant of 24), and D_m is the total day per month. The original spatial resolution of TRMM data is 5km, to standardise spatial resolution with other data, the downscaling processes were carried out. The IDW interpolation method was used to obtain a finer spatial resolution of 1m. Table 2 shows the location of the gauges used to downscale the TRMM data.

Table 2: The coordinate location for rain gauge within the study area

Name	Y	X
Danum	4.963457	117.802877
Rhino	4.9700401	117.808465
Baru	4.976347	117.812072
Tembok Gajah	4.973476	117.816282
Sandakan	5.899698	118.057375
Tawau	4.31122	118.121187

In -situ Gross Rainfall

Ground rainfall data for station Sandakan and Tawau provided by Meteorological Department of Malaysia, and ground data in Danum Valley was collected by researcher. For rainfall measurements, there are three manual rain gauges with a diameter of 11.6 ± 0.2 cm, located in an open area at a distance around 100m from

the plot and 20m from the forest boundary. The automatic rain gauge located at 903.77m from the plot area was used as a reference for daily rainfall. Rainfall volume collected was measured using a graduated cylinder with an accuracy of 1ml. The rainfall volume of each collector was determined using the equation in Hornberger et al. (2014). Figure 2 shows the location of three main rain gauges for gross rainfall located within the study plots.

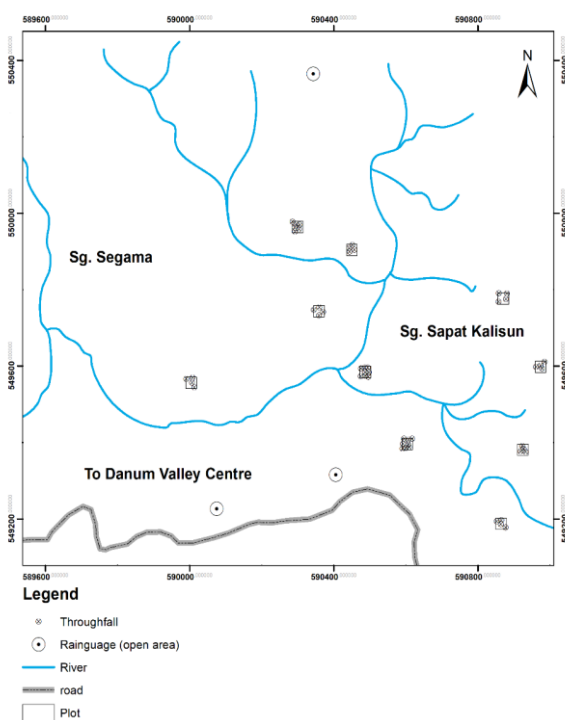


Figure 2: Map showing the location of main rain gauges

Downscaling Satellite Data

Monthly rainfall at 1m resolution was generated using IDW interpolation method in the ArcGIS software package. The TRMM data was downscaled from the original 5km resolution to a resolution of 1m. The original rainfall value of the TRMM data was retained. Merging the in-situ data to downscale the satellite data in the tropics is useful, such as the process done by Yatagai et al. (2014) and Mahmud et al. (2018).

The outcome of the spatial downscaling processes managed to produce a higher resolution of the TRMM data. Figure 3 (a) shows the raw satellite data, (b) first process is re-gridding the raw satellite data, and (c) re-calculating the

values of each pixel and combining them with the six rain gauges data for rainfall. The proposed downscaling method can be used to create high resolution rainfall maps in the highly dynamic hydro-meteorology status quo of humid tropics, with less complex computation and more reliable results (Mahmud et al., 2018).

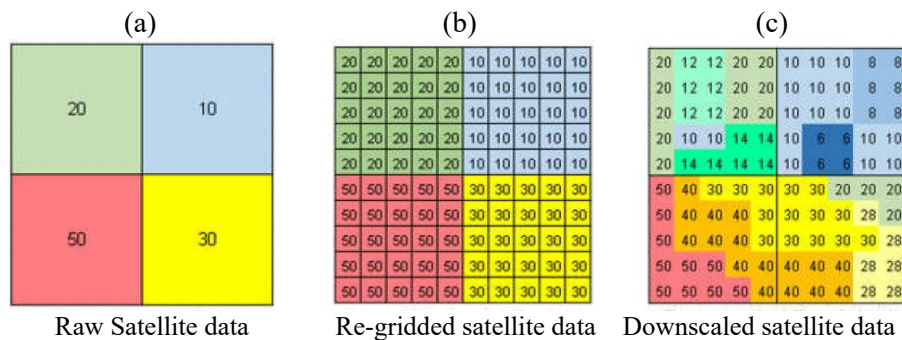


Figure 3: Flowchart processing of meteorological data
(Source: Mahmud et al., 2018)

RESULTS AND DISCUSSION

The Correlation Estimation Rainfall Interstation data with TRMM data

Rainfall has high spatial variability in both space and time. As a result, the measurement of daily rainfall has a constraint, especially in the study area. There is no automatic rain-gauge within the study area. Figure 4 presents the correlation of rainfall data collected by automatic gauges, manual gauge data, and TRMM data. Pg1 is rainfall data from the automatic gauge in Danum Centre; Pg2 is rainfall data from gauge 2; and Pg3 is rainfall data from gauge 3. The relationship between Pg1 and Pg2 with Pg3 data shows a high correlation with R^2 of 0.83 and 0.75, respectively. However, Pg3 has a low correlation with R^2 of 0.26. The variation of rainfall data from gauge 3 only corresponds to about 26% of the TRMM data, while the remaining 74% was due to spatial distribution that affected the amount of rainfall.

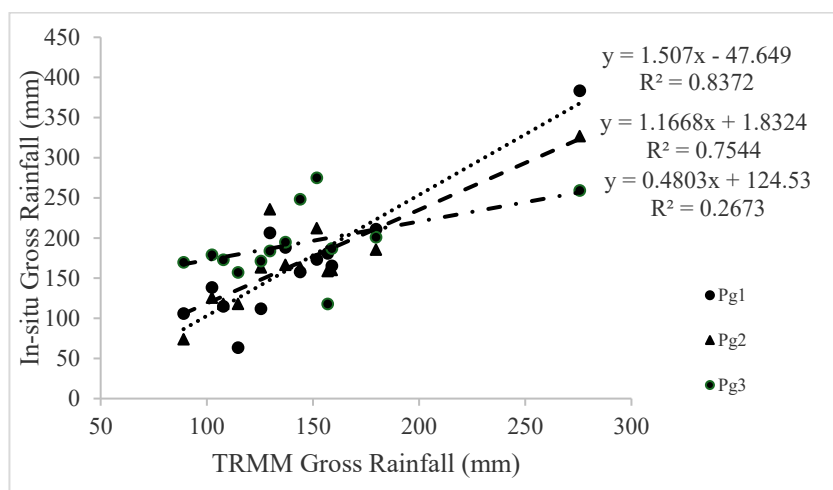


Figure 4: Correlation of rainfall data collected by automatic gauges, manual rain-gauges, and TRMM

The effect of Pg derived from TRMM data with a correlation coefficient of interstation rainfall gauges can be analysed using the Pearson correlation, as shown in Table 3. There is a significant correlation between the three rainfall gauges and TRMM data in the study area. The Pg from gauge 1 and TRMM data have the highest correlation, while the Pg from gauge 2 shows low correlation at $p > 0.01$. This suggests that, although the spatial distribution of rainfall distribution is significant, there is no difference between plots. Still, the conditions may be different when examining storms separately and it is essential to note that the data set from the manual gauges is obtained on the basis of the cumulative measure of several rainfall events. Therefore, there may be some possibility to overestimate or underestimate the rate of rainfall in manual gauges.

Table 3: Correlation coefficient of interstation rainfall gauges

		Pg1	Pg2	Pg3
Pg1	Pearson Correlation	0.901**		
	Sig. (2-tailed)	0.000		
Pg2	Pearson Correlation	0.520	0.599*	
	Sig. (2-tailed)	0.69	0.031	
TRMM	Pearson Correlation	0.915**	0.869	0.517
	Sig. (2-tailed)	0.000	0.00	0.070

** : Correlation is significant at the 0.01 level (2-tailed).

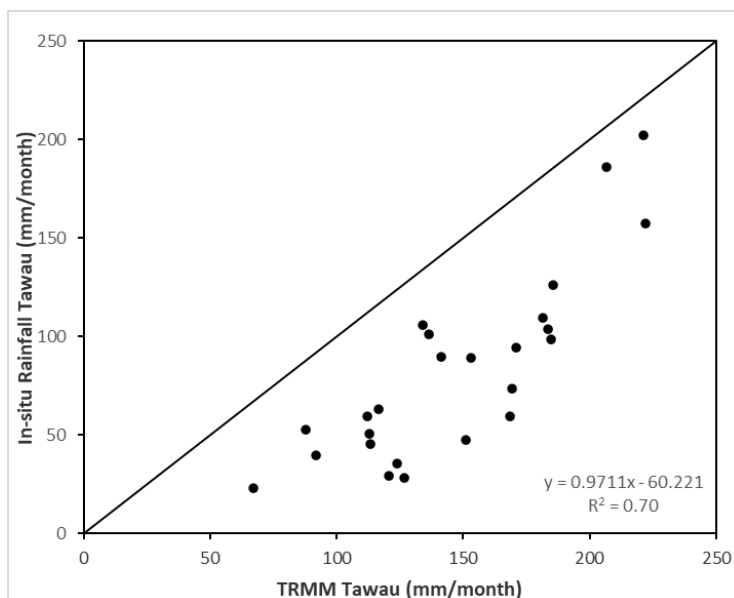
Validation on the TRMM Data Products

Figure 5 shows the correlation between TRMM satellite data and ground measurement. Based on linear regression, Tawau, Danum and Sandakan recorded R^2 with 0.70, 0.78, and 0.70, respectively. Overall, the R^2 for the three stations show a good correlation between satellite data and ground measurement with p-value (<0.0001). The lowest monthly rainfall recorded for Tawau, Sandakan, and Danum are 22.88mm, 33.74mm, and 82.34mm, respectively. While the highest monthly rainfall recorded for Tawau, Sandakan, and Danum are 331.62mm, 520.95mm, and 254.65mm, respectively.

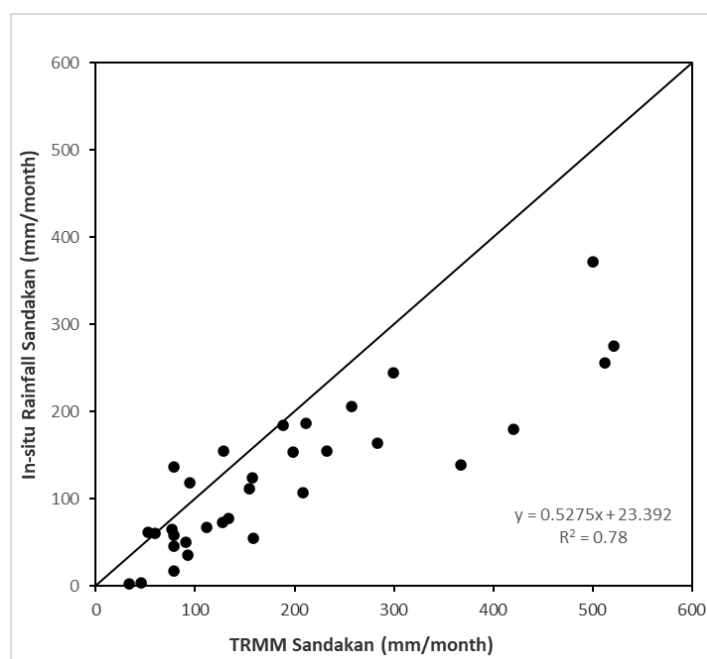
As can be seen, there are significant differences in the highest and lowest rainfall recorded by the station in Tawau and Sandakan with 58% and 37%, while Danum recorded a 20% difference. Spatial homogeneity at the regional scale in the temporal pattern within the three-station region relates to the effects of land-sea interaction in coastal regions (Johnson and Priegnitz, 1981) and the influence of various large-scale air flows (for instance equatorial easterlies and equatorial westerlies) in central and eastern Sabah (Kripalani and Kulkarni, 1998).

This shows the influences of strong maritime and local topographic variations at the local scale. Sandakan and Tawau are located near the South China Sea, while Danum is not affected by the maritime condition, but by the topographical terrain. According to Cosma, Richard and Miniscloux, (2002), topographic control of rainfall patterns is well understood on a scale of tens or hundreds of kilometres, while Sharon and Arazi (1997) proved that the topography also influences rainfall patterns on a very fine scale of several tens or hundreds metres. In addition, findings by Bidin and Chappell (2003) noted that there is high spatial variability in seasonal rainfall over only a few 100 metres, which will make it difficult for researchers to monitor reliable rainfall records.

Lindah Roziani Jamru, Adi Jafar, Mohammad Izuan Nadzri, Mohamad Pirdaus Yusoh, Fera Cleophas
Assessing Satellite Rainfall Accuracy in Dense Tropical Sabah East Coast Forest, Malaysia: A Cross
Validation of Downscaling Technique



(a)



(b)

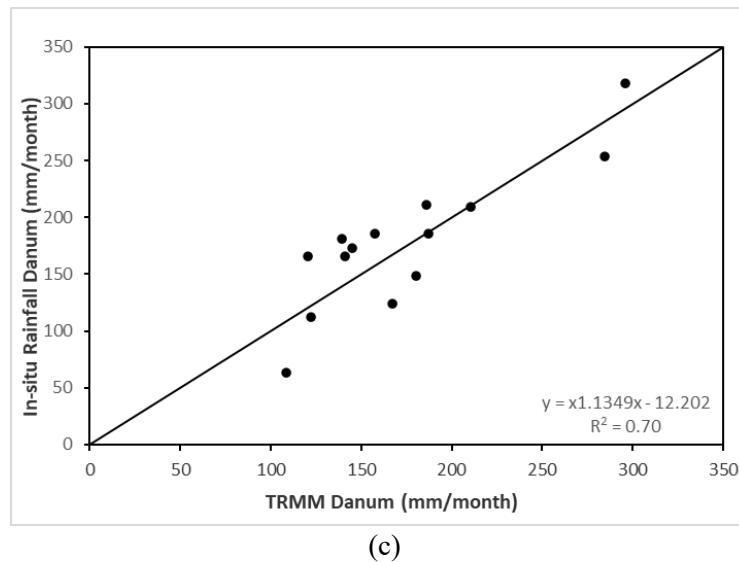


Figure 5: In-situ monthly rainfall against TRMM rainfall plotted on 1:1 line and the regression equation for stations (a) Tawau; (b) Sandakan; (c) Danum

As for the RMSE, Tawau, Sandakan, and Danum recorded errors of 69.25mm, 72.25mm, and 65.65mm, respectively. Therefore, the bias analysis results show that the Tawau station reported the highest overestimated bias with 64.47mm, while Danum reported the lowest bias with 0.29mm. Since the bias in the study area shows less than 5%, this presupposes that the variation of rainfall can be estimated directly from TRMM data, and the calibration may not always be necessary.

Based on Figure 6, the values of NSr for Tawau, Sandakan, and Danum are -1.193, 0.84, and 0.89, respectively. The NSr results, close to value 1, show that the accuracy of TRMM data compared to the rain-gauge data in Danum has a strong agreement. This is due to the downscaling method of IDW approach to satellite rainfall data using additional data from three manual rain-gauge within plots in Danum Valley capable of improving accuracy, compared to the Tawau and Sandakan stations. More importantly, the downscaling method has been able to provide fine spatial and increase the number of pixels in the study area. This suggests that the more station data we used to interpolate TRMM data, the more accurate it was. Overall, from the analysis data, there is a strong indicator that the quality of TRMM data varies within different regional environments and conditions, including local factors, such as wind, topography, and maritime influences, which have significant impacts.

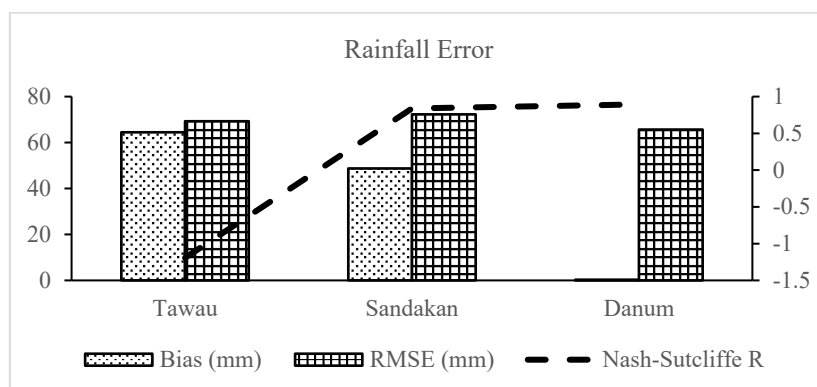


Figure 6: Precipitation errors of the stations in Tawau, Sandakan, and Danum

CONCLUSION

The use of remote sensing measurements to assess rainfall is a significant and relevant step in understanding the hydrological process in the watersheds. This study provides a basic guideline on how to monitor and evaluate rainfall using remote sensing observations. Many demonstrations on the use of remote sensing have been developed for the estimation and mapping of the spatial distribution of rainfall with a combination of field data. The collection of sufficient information on the spatial distribution of rainfall will need the installation of an additional ground station at high spatial coverage, which would be expensive for logistics. However, derived rainfall data from remote sensing data for monitoring can complement field data by providing consistent observations and minimize the costs.

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A COMPARATIVE STUDY ON BIOPHILIC PREFERENCES OF SCHOOL LEARNING SETTINGS: A CASE OF ELEMENTARY SCHOOLS IN ASIA

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Abstract

Countless studies have demonstrated evidence of the significance of nature in learning settings on children's performance globally. Children exposed to a learning setting based on nature tend to perform better than those in a typical classroom. Studies have also found that the current generation obtains indirect nature experiences through various e-learning platforms rather than experiencing nature directly in modern society. Recent studies found that an inconducive school design environment that does not fully support students' needs and preferences is one of the main reasons for this. Hence, this paper explores children's choices for biophilic elements in primary school design in three Asian countries: Malaysia, Indonesia, and Thailand. The online survey questionnaire was used as a qualitative method to collect the stipulated data. The results revealed that biophilic elements are highly favourable to the students from all three countries except for the different elements they preferred. In particular, the results found that planting elements within the school area are the biophilic element most preferred by students in Indonesia and Thailand. Meanwhile, students in Malaysia prefer animals (pets and birds). The data and results presented in the present study can be used as a general guideline, particularly in integrating nature as part of the future school design elements in Asian countries. Note that each design preference shows a different result based on each school's preferences in the three countries.

Keywords: School learning setting, Biophilic Elements, Preferences

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INTRODUCTION

Since the global COVID-19 pandemic, environmental disaster issues have been getting increasing attention from people worldwide. According to the latest Intergovernmental Panel on Climate Change (IPCC) report as of August 2021, climate change is currently at an irreversible and critical stage caused by reckless human activities (Kauffman, 2021). The Cable News Network (CNN) reported that countries across the globe have experienced intensified climate change, such as heavy rainfall, extreme global warming, and wildfires, including the coldest city in the world (Kottasová, 2021). Southeast Asian regions, including Malaysia, Thailand, and Indonesia, are also well-known as hotspots of climate-related disasters (Mall et al., 2018). Heavy floods and other extreme climate changes are among the environmental issues that result in a dramatic loss of public life due to unprecedented challenges, particularly in Southeast Asian countries, including Malaysia, Indonesia, and Thailand (Bernama, 2020; Bangkok Post, 2020; Davies, 2021a, 2021b, 2021c).

Moreover, school closures and damage, disruption of social and economic activities deterred new investments in flood-prone areas, as post-disaster psychological effects on children are the effects caused by environmental disasters in Southeast Asian countries (Abdul Rahman, 2014; Roosli et al., 2011; Bangkok Post, 2020) and in 2018, the New Straits Times (NST) reported that over 3,147 students could not attend classes in Pahang, Kelantan, Johor, Sarawak, and Terengganu, due to heavy flood issues. On the other hand, Indonesia has been experiencing environmental disasters since 2013 until now (The Star, 2018; Leung, 2020; Davies, 2021b). In 2020, a massive flash flood caused over 36000 people to be displaced, 66 people were found dead, and 19 schools were damaged due to the incident (Leung, 2020). In Country Report Thailand (2015), it is documented that approximately 95% of damage costs (US\$40 million) were incurred due to the flood disaster in 2011. Additionally, studies conducted by Abdul Rahman (2014) show that environmental disasters lead to several damages, including direct and indirect losses. Direct losses include losses due to injury or death and the cost of restoring the damage. Meanwhile, indirect losses include time, travel, and office operating losses.

As a result of the continuous environmental disaster, Asian cities are experiencing increased exposure to climate-related risks every year. Hence, several policies and efforts were introduced to strengthen the city's resilience and overcome the issues. Among these initiatives are launching the Sustainable Development Goals, the New Urban Agenda, the Sendai Framework for Disaster Risk Reduction, and the Paris Agreement, which aims for climate and disaster-resilient within cities (UNDDR, 2015). In a built environment, the uncontrolled environmental impact in most Southeast Asian countries is primarily due to an unresponsive school design environment (Aziz & Said, 2016). Hence, in this study, biophilic design approaches are suggested as having the potential to

overcome the issues of post-disaster schools in Asian countries and reduce the impact of environmental disasters. In 2011, the ASEAN Guidelines on Eco-Schools were formed as part of an effort within ASEAN countries to promote sustainable school concepts and practices throughout ASEAN. The guideline also encourages all ASEAN countries to strive for a sustainable school environment, including reducing environmental degradation and its impact on human well-being.

LITERATURE REVIEW

Children's Learning Approaches in Malaysia, Indonesia, and Thailand

Numerous research studies have acknowledged that environmental disasters in Asian countries have led to post-disaster psychological effects on children. Urban Heat Islands (UHI), heavy flash floods, landslides, and other ecological distress have drastically affected students' achievements and well-being (Nasir et al., 2012; Najafi et al., 2018). However, Mohamed et al. (2017) emphasised that children's health related to flood disasters has paid little attention these days. Hence, it can be suggested that natural elements are essential to enhance children's psychological and physiological well-being due to past traumatised events. This statement is supported by numerous studies that address the significant benefits of biophilic design implementation in urban spaces to people's restorative experience, decreasing mental distress, and increasing health and well-being (Berman et al., 2012; Walimbe & Chitgopkar, 2018).

However, research has indicated that most children's learning approaches in these three Asian countries are geared towards the indoors rather than the outdoors. In Indonesia, the traditional indoor learning classroom is still preferable to outdoor learning (Assa et al., 2021). Kullberg (2010) conducted studies over 12 years in southern Thailand schools and found that the most common teaching method used is recital or recital in indoor classrooms. In Malaysia, the design of outdoor learning has been found to not fully support a conducive learning environment from preschool up to the university level, including the needs and preferences of its users. Hence, these circumstances lead to low engagement and underutilised outdoor spaces among users (Aziz & Said, 2016). Underutilised outdoor spaces disconnect nature among schoolchildren in Asian countries. These factors are due to the unresponsive design of the outdoor learning environment and lack of exposure to the natural environment (Szczepanski, 2009; Kamaruzzaman et al., 2011; Mohidin et al., 2015; Assa et al., 2021).

Biophilic school design potential in an Asian school setting

Limited exposure to nature creates low attachment and awareness of children's ecosystem services and environmental values (Jeladze et al., 2017). Numerous studies have highlighted that connection to nature could positively influence

users' ecological concerns and responses to nature (Cheng & Monroe, 2010; Duerden & Witt, 2010; Collado et al., 2013; Zhang et al., 2014). Therefore, based on the discussion on the learning styles and practices in all three Asian countries, biophilic approaches are considered an essential design element to fill the gap and connect the existing learning culture and children's attachment to nature. The current attention to biophilic design, which integrates nature and natural elements into the built environment, has helped further connect us with nature. Moreover, a biophilic design helps increase environmental awareness among the young generation for a sustainable future. Biophilic design ideas create a strong attachment in children to the character through direct nature experience. Hence, more understanding of ecosystem services is obtained.

Biophilic design concept

Biophilic design studies have focused on various fields, such as workplaces, healthcare, and learning institutions. Recently, studies have examined the biophilic benefits of design for extreme climates (Parsaee et al., 2019), climate change (Africa et al., 2019), and, most recently, its restorative effect related to COVID-19 (Gillis, 2020). Biophilic design derived its concept from biophilia, an inherent human inclination to associate with nature. This concept was initially introduced by Wilson (1986), who suggested biophilia as an innate and positive human tendency and affiliation with the natural environment, allowing them to experience the benefits that facilitate human beings' development, adaptation, and survival. Even in the modern world, biophilia is part of an essential aspect of people's physical and mental health and well-being (Wilson, 1986; Kellert & Wilson, 1993; Kellert, 1997, 2012). The disconnection of the human and natural environment can delay a sustainable environment. The study of Simaika and Samways (2010) suggests biophilia as a process of inherent love towards nature that can be nurtured, developed, and experienced by anyone.

Biophilia aims to continue the culture-nature relationships of an individual's connection with nature (Kellert, 2018, 2016; Kellert et al., 2011). In another study by Kellert & Calabrese (2015), they believed that a biophilic design in the modern built environment is intended to offer suitable habitats for humans as biological organisms and advance people's health and well-being. Park and Lee (2019) defined biophilic design as an essential element that integrates and connects people and nature in the building and architectural environment where we live to induce positive changes towards nature. On the contrary, being disconnected from nature leads to ignorance of the natural environment and decreased emotional well-being (MacKerron & Mourato, 2013; White et al., 2013; Capaldi et al., 2014; Rai et al., 2020).

There are several theories related to biophilic design and the built environment. Based on the present study's key issues and concerns, the

Restorative Environmental Design (RED) theory is most suitable for this study context. The biophilic concept is part of the element in the RED approach. RED intends to recover and replenish human emotional resources and support people through stressful mental activities or environments with potential distractions (Kaplan, 1995).

Biophilic design approaches

The book *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life* outlines six main biophilic design elements and attributes that can be used as design guidelines (Table 1.0).

Table 1: Biophilic Design Elements and Their Corresponding Attributes

Biophilic design element	Attributes
Environmental features	Colour, Water, Air, Sunlight (Natural light), Plants, Animals, Natural materials, Views and vistas, Façade greening, Geology and landscape, Habitats, and ecosystems
Natural shapes and forms	Botanical motifs, Tree and columnar supports, Animal (mainly vertebrate) motifs, Shells and spirals, Egg, oval, and tubular forms, Arches, vaults, domes, Shapes resisting straight lines and right angles, Simulation of natural features, Biomorph, Geomorphology, Biomimicry
Natural patterns and processes	Sensory variability, Information richness, Age, change, and the patina of time, Growth and efflorescence, Central focal point, Patterned wholes, Bounded spaces, Transitional spaces, Linked series and chains, Integration of parts to wholes, Complementary contrasts, Dynamic balance and tension, Fractals, hierarchically organized ratios, and scales
Light and space	Natural light, Filtered and diffused light, Light and shadow, reflected light, Light pools, Warm light, Light as shape and form, Spaciousness, Spatial variability, Space as shape and form, Spatial harmony, Inside-outside spaces
Place-based relationships	Geographic connection to place, Historic connection to place, Ecological connection to place, Cultural connection to place, Indigenous materials, Landscape orientation, Landscape features that define building form, Landscape ecology, Integration of culture and ecology, Spirit of place, Avoiding place lessness
Evolved human-nature relationships	Prospect and refuge, Order and complexity, Curiosity and enticement, Change and metamorphosis, Security and protection, Mastery and control, Affection and attachment, Attraction and beauty, Exploration and discovery, Information and cognition, Fear and awe, Reverence and spirituality

Source: Kellert, S., R., Heerwagen, J., & Mador, M. (2011)

Recent studies by Browning, Ryan, and Clancy (2014) extended the biophilic design principle related to human response and the building environment. Nature in the space, Natural Analogue, and Nature of the area are three primary categories that reflect the other 14 patterns of biophilic design principles related to the connection between humans and the built environment (Table 1.1).

Table 2: Biophilic design patterns in improving health and well-being for the built environment.

Biophilic categories	Biophilic design patterns	Attributes
Nature in the Space	Visual Connection with Nature	View elements of nature, living systems, and natural processes.
	Nonvisual connection with nature	Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems, or natural processes
	Nonrhythmic sensory stimuli.	Stochastic and ephemeral connections with nature may be analysed statistically but may not be predicted precisely.
	Thermal and airflow variability.	Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
	Presence of water	A condition that enhances the experience of a place through seeing, hearing, or touching water.
	Connection with natural systems.	Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.
Natural Analogues	Dynamic and diffuse light.	Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
	Biomorphic Forms and Patterns	Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
	Material connection with nature.	Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place
Nature of the Space	Complexity and order	Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature
	Prospect	An unimpeded view over a distance, for surveillance and planning
	Refuge	A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.

Biophilic categories	Biophilic design patterns	Attributes
	Mystery	The promise of more information is achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
	Risk/Peril	An identifiable threat coupled with a reliable safeguard.

Source: Browning, Ryan, Clancy (2014)

METHODOLOGY

This study applied mixed methods, quantitative and qualitative. Only quantitative data from the survey questionnaire is presented in this paper. The survey questionnaire was formed and adapted from Kellert, Heerwagen, and Mador's (2011) studies on biophilic design, theory, and practices related to the building environment. This survey questionnaire's biophilic design elements and attributes were designed before the study scope. The survey was conducted online among five selected Thailand, Indonesia, and Malaysia schools. Sixty-six schoolchildren from *Sekolah Riyadlul Wardiyah* in Lombok and the School of Universe in Bogor were from Indonesia, and another sixty schoolchildren were from *Baan Don Tan* and *Baan Pha Gor Dam*, Chiang Rai, Thailand.

Meanwhile, 77 schoolchildren were from SK Kanchong Darat, Banting, Selangor, Malaysia. All male and female schoolchildren in this survey were between 9 and 12 years old. The school was selected because it had won the GPS Award for the Most Creative Landscape Categories.

Student's Preferences for Biophilic design elements for the learning setting

The survey design was divided into (6) sections. The first section asked about the children's feelings about the school design. The second section asked about the preferable school spaces. The third section asked their opinion about the school environment, particularly on play spaces, social spaces, and outdoor spaces within their school. Next, the fourth section asked about the classroom environment and the elements they wanted to add to the school design improvement. The last section asked about the student's preferences for having biophilic aspects as part of their school design. The children were asked to rate their preferences for those elements based on a four-point Likert scale of (1- very unlikely, 2- unlikely, 3-, and 4- very likely). Based on the earlier literature reviews, 15 biophilic elements were selected to suit the Asian primary school design context (Figure 1.0).

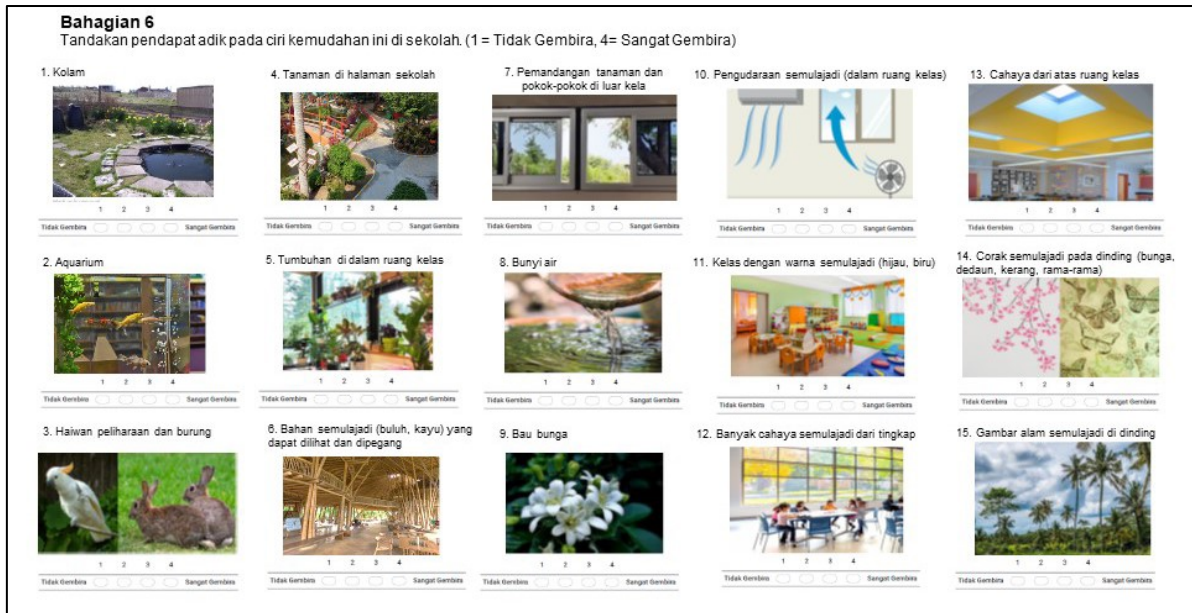


Figure 1: 15 biophilic design elements listed in the survey questionnaire. Source: (Authors, 2021)

FINDINGS AND RESULTS

The data were analysed using descriptive analysis in the Statistical Package of Social Science (SPSS) to identify the most preferred elements among children in three Asian countries (Thailand, Indonesia, and Malaysia). Table 1.3 below presents the results for each country.

Table 3: Results for each country on students' preferences for biophilic elements

Biophilic Theme	Feature	Overall rating					
		Thailand	R	Indonesia	R	Malaysia	R
Non-Visual connection	Natural materials (bamboo, wood) to see and touch	3.38	8	3.37	9	3.29	12
	Animals (pets and birds)	3.52	4	3.60	2	3.71	1
	Smell of flowers	3.23	10	3.29	11	3.52	5
	Plants inside the classrooms	3.53	3	3.41	7	3.33	11
Presence of water	Sound of water	3.52	4	3.39	8	3.48	6
Visual Connection	A pond	3.20	11	3.59	3	3.53	4
	An aquarium	3.47	5	3.41	7	3.57	3

Biophilic Theme	Feature	Overall rating					
		Thailand	R	Indonesia	R	Malaysia	R
	Plants in the school grounds	3.73	1	3.69	1	3.57	3
	View of the outside to see plants and trees	3.58	2	3.59	3	3.34	10
Light and space	Natural airflow (in classrooms)	3.42	7	3.56	4	3.62	2
	Lots of natural light from the windows	3.17	12	3.59	3	3.43	8
	Skylight in classrooms	3.34	9	3.44	6	3.38	9
Natural patterns	Classrooms with natural colours (green, blue)	3.47	5	3.54	5	3.44	7
	Patterns of natural plants or creatures on walls (flowers, leaves, shells, butterflies)	3.47	5	3.33	10	3.38	9
	Images of nature on the walls	3.14	13	3.26	12	3.38	9

*R= Rank

Non-visual connection

In this study, five items were measured under non-visual connection. The first item is natural materials (bamboo, wood). Table 1.3 indicates that school children from Malaysia scored this item with 3.29, 3.37, and Thailand 3.38. From the results, this item is the least preferred biophilia pattern among Malaysian school students compared to the other two countries. Browning, Ryan, and Clancy (2014) state that this biophilic design falls under non-visual connection. Non-visual connection involves other contacts with human senses except visual (Table 1.1). In this finding, the importance of touch involved touching natural materials (bamboo) within the school area. Most Malaysian students consider this biophilic design pattern the least preferred due to less direct experience with nature, particularly planting elements. Other studies on children's connectedness to the heart these days tested in 20 schools in Malaysia stated that children obtain indirect nature experiences through visuals such as movies, videos, and images more than direct experiences of nature (Mustapa, 2018). The direct experience involved connecting with nature through *haptic* (sense of touch).

Malaysian students preferred to have animals (pets and birds) as part of the biophilic elements in their school (3.71), as compared to Indonesia (3.60) and Thailand (3.52). Even though the first and second items involved similar senses

(*haptic*), the results indicate a massive gap in preference between these two items among Malaysian children. Hence, this is likely due to the negative feeling or response toward bamboo (*biophobia*). Unlike biophilia, biophobia refers to “the fear of living things and aversion, and alienation from nature (Simaika & Samways, 2010). For this paper, *biophobia* can be referred to as children’s affection towards certain types of natural elements (like or dislike). Additionally, the development of biophobic feelings may vary considering gender (Änggård, 2011), residential or school areas (Hinds & Sparks, 2008; Zhang et al., 2014; Mohamad Muslim et al., 2017), and cultural differences (Milfont, 2012).

On the other hand, out of the 15 items tested, Malaysian schoolchildren rated animals (pets and birds) as the most preferred elements that they wanted to have in their school (3.71), as compared to Indonesian (3.60) and Thailand (3.52). This is because children in Malaysia may have a high attachment to domestic animals, particularly birds, cats, rabbits, and chickens. Indeed, this statement is supported by Mustapa et al. (2020). The studies also evidence similar findings that most school children in Penang and Kedah had developed high attachments toward domestic animals. Moreover, having pets significantly impacted children’s attitudes toward animals’ presence (Prokop & Tunnicliffe, 2010) and their connection to nature-related experiences among Malaysian children (Muslim et al., 2019). According to Yamane et al. (2004), pet therapy, where companionship, petting, and feeling the fur of domesticated animals, is evidenced to have profound calming effects and develop environmental stewardship among children.

The third item under this category is the smell of flowers, where Malaysia scored 3.52, while 3.29 is the score given by Indonesian and 3.23 by Thailand. This survey item for this category involved olfactory stimuli (smell). Most Malaysian students tended to floral smells more than students from the other two countries. This is due to several reasons. During the observation conducted earlier, various types of flowers were planted at schools in Malaysia. Hence, the children were exposed to flowering plants within their school compound, and they positively accepted ornamental and scented plants. Meanwhile, in Thailand and Indonesia, the school design was observed to be similar. Studies also support the findings by Tomazic (2011) and Ballouard et al. (2012), which revealed that children’s favourable attitudes or interests in plants and animals are enhanced by observing and interacting with these elements.

On the other hand, plants inside the classrooms were rated at 3.33 among Malaysian schoolchildren, 3.41 among Indonesians, and 3.53 among Thai schoolchildren. The findings from Table 2.1 indicate that even though items 3 and 4 fall under the same categories, Malaysian students prefer olfactory (smell) stimuli more than haptic (touching) senses when planting elements. In the natural environment, different reasons bring different psychological effects to humans. Studies show that plants that produce pleasant smells help to calm or energise

people. Exposure to friendly scented plants positively impacts the healing process and human immune function (Kim et al., 2007; Li et al., 2012). Current studies also show that specific fragrance plants help calm nerves, improve health, and lower the risk of various diseases (Kim Grove, 2012). A survey by Mustapa et al. (2020) also demonstrated that most schoolchildren in Malaysia prefer ornamental and beautiful flowering plants.

Hence, while there are various biophilia approaches, both direct and indirect contact with nature should be introduced to increase environmental awareness and nature sensitivity among children for future benefits. Indeed, Lekies et al. (2015) also suggest that direct contact with nature can be the most effective way to grow environmental stewards and inject an emotional connection to nature conservation attitudes and behaviour. Moreover, it is worth emphasising that indirect nature experience is a fundamental learning approach that promotes biophilic design principles. Kellert and Calabrese (2015) highlighted that the biophilic design encourages an emotional attachment to settings and places. The biophilic principle promotes positive interactions between people and nature, encouraging an expanded sense of relationship and responsibility for human and natural communities.

The fact that Malaysian school students show a low tendency for direct contact and connection with planting elements is also due to inadequate exposure to outdoor gardening or planting elements compared to animals. This statement is supported by other studies conducted on the learning environment in Malaysia, which stated that nature-related subjects are taught through a visual and indirect relationship with nature instead of experiencing nature itself, for instance, through images and video recording (Spalie et al., 2011).

Presence of Water

The sound of water is part of the items measured in this study. The findings from Table 1.3 indicate that Thai students score the highest (3.52) as compared to Malaysian students (3.48) and Indonesian (3.39). The sound of water can be translated into different types of water elements. In biophilic design related to human experience, Biederman and Vessel (2006) and Alvarsson, Wiens, and Nilsson (2010) had evidence that the presence of water helps to improve concentration and memory restoration in terms of cognitive performance. Their studies also found that water elements help to reduce stress, increase calmness and tranquillity, and lower heart rate and blood pressure.

Meanwhile, other studies on moods and emotions found that sounds and the presence of water stimulate positive emotional responses in a biophilic design context (Barton & Pretty, 2010; White et al., 2010; Windhager et al., 2011; Jahneke et al., 2011). Moreover, in biophilic design studies, the presence of water elements also helps to improve concentration and memory restoration through natural and complex changes in visual stimuli. In addition, they enhance

perception and psychological and physiological reactions when several senses are stimulated (Alvarsson et al., 2010; Pheasant et al., 2010). Hence, water elements could be suggested as part of school design's indoor and outdoor elements. Water elements such as ponds or aquariums could enhance the children's connectedness with nature and sensitivity towards the water ecosystem. The presence of water elements could also act as part of the learning tools for specific subjects such as science and art.

Visual connection

In terms of the presence of a pond, Malaysian students scored (3.53), followed by Indonesian (3.59) and Thailand (3.20). Meanwhile, aquarium elements scored (3.57) among Malaysian school children, 3.41 among Indonesian, and 3.47 among Thailand participants. Most Thai (3.73) and Indonesian students (3.69) rated plants on school grounds as the most preferred elements, while Malaysia scored 3.57. Regarding views outside to see plants and trees, Malaysia scored 3.34 compared to Thailand (3.58) and Indonesia (3.59). Based on the results, Malaysian students tended to prefer having ponds and aquariums compared to Thailand and Indonesia. The findings of this study, also supported by other studies conducted by Salleh, Abdul Latip, and Abdul (2018) on outdoor learning in Malaysia, suggested that children prefer to learn via direct experience using their motor skills and senses of smell, hearing, sight, and touch. The studies indicated that water elements and mini kitchen gardens could be introduced as part of the design to expose children to the basic concept of living things within nature and their ecosystem. Direct experience in this finding refers to direct contact with natural elements, namely animals. Hence, it indicates that Malaysian school children are keener towards features that offer interaction with pets and fish than interacting with planting elements. Regarding planting elements, children from Malaysia prefer a visual connection in the school design rather than a non-visual connection.

Based on the supporting data from open-ended questions in this study, most of the students from Malaysia wanted to have the mini farm so that they could spend some time taking care of and getting in touch with their favourite animals, namely, rabbits, turtles, and birds. Meanwhile, some Indonesian schoolchildren also wanted animals in their school environment. According to Kellert, Heerwagen, and Mador (2011), a person who falls under this category is explorative, attracted to nature's beauty, and curious. Interestingly, Otto and Pensini (2017) found that environmental stewardship could be developed in traditional classroom settings; however, direct experience with nature had developed an emotional connection and a higher sensitivity toward the heart. The result indicates a 69% variance. Other studies found that direct nature experience by school children developed positive connections to nature (Cheng & Monroe, 2010; Duerden & Witt, 2010; Zhang et al., 2014). Therefore, it can be suggested

that children in Malaysia need more exposure to direct contact with nature, particularly with planting elements.

Malaysia's learning style and practices lack direct contact with nature, particularly in planting elements. Most of the learning styles in Malaysian primary schools are traditional or indoor learning; any nature-related subject is taught through visual and indirect relationships with nature instead of experiencing nature, for instance, through images and video recordings (Spalie et al., 2011). Referring to Table 1.3, it can be suggested that Malaysia school children show a lack of preferences for direct contact with planting elements, such as planting in the classroom and natural material (to touch and see), as compared to other factors, due to a lack of exposure on outdoor learning environment. The children prefer planting on school grounds rather than the presence of planting aspects in the classroom. Various studies related to the learning environment also provide evidence that direct and indirect experiences have different impacts on children's cognitive, educational performance, physical and social well-being (Selhub & Logan, 2014; Schneller et al., 2017; Mustapa, 2018; Walimbe & Chitgopkar, 2018).

Light and space

Under this category, Malaysian students rated natural airflow (in classrooms) as the second preferred element (3.62). Meanwhile, Thailand students rated natural airflow as the seventh most preferred (3.42) and ranked 4th by Indonesian students (3.56). Lots of natural light from the window was ranked 8th by Malaysian students (3.43), 3rd by Indonesian students (3.59), and 12th by Thai students (3.17). Skylights in classrooms were rated ninth by Malaysian (3.38), 6th by Indonesian (3.44), and 9th by Thai students (3.34). Based on the results from Table 1.3, it can be indicated that most Malaysian school students are more concerned about the outdoor classroom setting than the indoor classroom itself. These findings suggest that children in Malaysia show a high tendency toward the outdoor elements rather than the classroom design setting itself. In terms of natural airflow, the classroom's exposure to natural airflow is one of the essential measures for climate adaptation. Malaysia is a country that experiences heavy rainfall and flooding issues. Hence, moderate transformation to natural airflow and natural lighting can be suggested. On the other hand, extreme penetration or exposure to direct sunlight is not recommended (Moghaddami, 2019).

School designers need to gain the ability to find the balance between distributing unified and diffused lighting throughout the day to prevent too much glare, particularly when learning is taking place. Evidence has shown that humans prefer moderate levels of sensory variability, including light, sound, and temperature variation. An environment devoid of sensory stimulation and variability can lead to boredom and passivity. The study further indicates that changing thermal classroom conditions improved student performance. In

contrast, changes in ventilation velocity evoke positive comfort with no negative impact on cognitive function. According to Attention Restoration Theory, “soft fascination” elements such as light breezes or other natural movements can improve human concentration (Kaplan,1995).

Natural patterns

Three items were tested under natural patterns. Classrooms with natural colours (green, blue) scored 3.44 for Malaysian school children, followed by 3.54 for Indonesia and Thailand with 3.47. Patterns of wild plants or creatures on walls (flowers, leaves, shells, butterflies) scored 3.38 for Malaysians, 3.33 for Indonesian school children, and 3.47 for Thai school children. Meanwhile, the last item tested was images of nature on the walls, with 3.38 by Malaysian, 3.14 by Thailand, and 3.26 by Indonesian school students. Table 1.3 shows that children from Thailand and Indonesia prefer closer connections to natural elements than natural patterns. Surprisingly, Malaysian students prefer a natural direct contact with nature (non-visual relationship), particularly planting elements. However, the Malaysian students had shown a high tendency for direct contact (non-visual connection) with animals and pets, natural lighting, and water elements.

This study believes that the interior classroom influences children’s moods in the learning setting. Even though the score given is not as high as their tendency towards other biophilic design elements, it does not indicate that these biophilic elements should be left behind. Studies by Van et al. (2017) on the effects of classrooms with green wall designs on children’s performance and perception stated that green walls bring positive moods and perceptions among the students, where their performance on specific subjects tested also improved. The students were happy with the new classroom environment and requested that the green wall design be kept in the future. Instead of having indoor plants, green wall approaches could be suggested as part of the school design to expose children to the natural environment slowly. Recent research by McCullough, Martin, and Sajady (2018) on green wall implementation in the classroom has shown that the presence of green walls has inspired students with real-world thinking related to science, technology, engineering, art, and mathematics fields within the indoor learning environment.

Apart from its benefits on both children’s and teachers’ moods and psychological and physiological well-being, the results from various studies also confirmed an improvement in both indoor and outdoor temperature reduction as well as natural wind control tools using green wall design approaches (Safikhani et al., 2014; Perini, & Rosasco, 2016; Sudhakar et al., 2019; Tan et al., 2020).

CONCLUSION

Based on the findings discussed above, biophilic design patterns and elements are positively accepted in all three countries in the present study: Malaysia, Thailand, and Indonesia. In particular, the findings from each study vary differently in terms of biophilic preferences due to different cultures, learning settings, and backgrounds. Hence, the results of this study can help designers and educators provide a better learning environment for future generations. Learning is not just merely focusing on lesson planning and academic achievement; concern should also be given to spatial planning. A conducive learning environment, particularly the connection between indoor and outdoor design settings, and thermal comfort are essential aspects that should not be overlooked, considering their benefits on children's cognitive levels, brain functions, self-development, and psychological and physiological development. Hence, biophilic school design is a possible solution, especially in countries that experience continuous environmental disasters.

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**THE INTERRELATION BETWEEN SOCIO-CULTURAL ASPECTS
AND THE QUALITY OF PUBLIC OPEN SPACES IN ALMATY,
KAZAKHSTAN**

**ВЗАИМОСВЯЗЬ СОЦИАЛЬНО-КУЛЬТУРНЫХ АСПЕКТОВ И
УРОВНЯ КАЧЕСТВА ОТКРЫТЫХ ОБЩЕСТВЕННЫХ
ПРОСТРАНСТВ ГОРОДА АЛМАТЫ, КАЗАХСТАН**

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Abstract

This article investigates how socio-cultural factors impact the quality of public open spaces (POS) in Almaty. The study's relevance lies in the significant role public spaces play in local and citywide contexts, as well as in architectural and urban planning policies. Jan Gehl highlighted how urban environments and planning decisions shape city behaviour, emphasizing the global importance of urban space development. Jacobs developed methods to model social interactions with a focus on environmental safety, while Campbell explored social boundaries, and Lynch and Jacobs examined the socio-cultural aspects influencing POS formation. The research employs an interdisciplinary methodology, analysing Almaty's socio-cultural context, POS design, and functioning. Surveys among residents were conducted to gauge their perceptions of these spaces. The study spans urban planning, sociology, cultural studies, and landscape architecture, using both qualitative and quantitative methods, including photo documentation, sociological research, and mathematical modelling of selected POS sites. The findings reveal that the quality of POS in Almaty is influenced by their appeal to social groups, the availability of cultural events, and the levels of safety and comfort. These factors are crucial for creating inviting and functional public spaces. The study's results aim to guide future improvements in open public spaces, not only in Kazakhstan but also in other developing countries.

Keywords: public open spaces, socio-cultural aspects, Almaty, Kazakhstan

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Аннотация (Abstract)

В статье исследуется влияние социокультурных аспектов на качество открытых общественных пространств (ООП) Алматы, описываются социальные и культурные факторы, формирующие их. Актуальность исследования обусловлена ролью общественных пространств как на локальном и общегородском уровнях, так и в архитектурно-градостроительной политике, а также ее выходом на ведущие позиции. Ян Гейл подчеркивал, что городская среда и планировочные решения влияют на поведение и функционирование города, что подчеркивает глобальное значение развития городских пространств. Методики моделирования социальных взаимодействий с учетом безопасности среды разработаны Джейкобсом. Кемпбелл изучал социальные границы и дистанцию, а Линч и Джейкобс исследовали социокультурные аспекты формирования ООП. Методология исследования включала проведение анализа социокультурной ситуации в городе Алматы, изучение проектирования и функционирования открытых общественных пространств, а также опросы среди жителей города для выявления их мнения о качестве данных пространств и их использовании. Область исследования междисциплинарна и охватывает вопросы градостроительства, социологии, культурологии, ландшафтоведения, статистических данных и др. Цель исследования — выявить взаимосвязь между социокультурными аспектами и качеством ООП. Для достижения этой цели был проведен анализ текущей ситуации открытых озелененных пространств города Алматы, включающий фото-фиксацию, социологическое исследование, индикационные и количественные методы, методы математического моделирования. Анализ показал, что качество ООП в Алматы зависит от привлекательности для социальных групп, наличия культурных мероприятий, а также уровня безопасности и комфортности. Учет этих аспектов при проектировании и управлении ООП важен для создания комфортных и привлекательных мест. Результаты исследования будут способствовать будущему улучшению открытых общественных пространств в Казахстане и других развивающихся странах.

Ключевые слова: открытые общественные пространства, социально-культурные аспекты, Алматы, Казахстан

INTRODUCTION

here are different approaches to defining public open space. This article takes as a basis the definition according to the research report on public spaces of HABITAT III - about public space - includes all places of public property or public use that are open and available for use to all free of charge and without profit (Habitat III Research Reports, 2015). Thus, public open space (POS) is a place accessible to all people without restrictions, where they can freely gather, communicate and participate in public life, for example: streets, open spaces of parks, squares, embankments and other public facilities.

The objective of the study is to identify the relationship between sociocultural aspects and the quality of the architectural environment of public open spaces. Possible problems in studying this topic include insufficient knowledge of the issue, and as a result, the lack and unreliability of some data; difficulty in measuring sociocultural aspects and quality of the built environment. The purpose of this study is to empirically examine how public open spaces in the city of Almaty are used, and to compare the characteristics and problematic aspects of different types of public spaces. Specifically, this study points out differences in user behaviour across different types of POS through surveys, questionnaires, and visual analysis. In addition, observation makes it possible to empirically understand which elements of the environment and organizational techniques contribute to the ease of use of POS. The results obtained contribute to the improvement of public education and daily activities in Almaty, other cities of Kazakhstan, as well as other developing countries with similar social contexts.

LITERATURE REVIEW

To date, there are a number of works devoted to the problems of the relationship between socio-cultural aspects and the level of quality of public open spaces.

One of the key authors who investigated the relationship between socio-cultural aspects and the development of public spaces is Jane Jacobs. Her book "The Death and Life of Big American Cities" became a classic in the field of urban studies and offered a new perspective on urban planning, emphasizing the importance of taking into account socio-cultural characteristics to create high-quality public spaces (Jane Jacobs, "The Death and Life of Big American Cities").

Another well-known author who has researched this issue is Richard Sennett. His book *The Fall of Public Man: On the Social Psychology of Capitalism* examines the relationship between urban space, socio-cultural practices and the quality of life of citizens (Richard Sennett, "The Fall of Public Man: On the Social Psychology of Capitalism").

The work of researcher Kevin Lynch "The Image of the City" raises the question of the importance of visual perception of the urban environment and its

impact on the formation of a comfortable and convenient public space (Kevin Lynch "The Image of the City").

Theoretical works by V.L. Glazychev, K. Lynch, Z.N. Yargina, A.V. Krasheninnikov propose to study the architectural qualities of public spaces according to various indicators, and consider methods for modeling public spaces that are comfortable for people.

Specific techniques for modeling the space of social interaction, based on the criterion of environmental safety, are being developed by Jacobs D.

In the applied works of V.R. Vuchika, J. Jacobs, J. Geila, E. Penialosy, J. Speck and others, open public spaces are considered as the basis of the social life of the city.

Environmental behavior of people is considered in the works of A.A. Zhelnina, V.I. Iovleva, A. Yu. Lozhkina, A.L. Titova, M. Chernoushek, V.T. Shimko et al.

In general, the literature review shows that the development of public open spaces in Almaty depends on taking into account the socio-cultural characteristics, needs and preferences of its residents. Understanding these aspects will help to create a harmonious and comfortable space for the life and recreation of citizens.

In general, the literature review shows that the development of public open spaces in Almaty depends on taking into account the socio-cultural characteristics, needs and preferences of its residents. Understanding these aspects will help to create a harmonious and comfortable space for the life and recreation of citizens.

RESEARCH METHODOLOGY

This study applied document analysis of literary sources, scientific papers, sociological surveys, practical activities and statistical data of selected study locations. To further validate the output, an analysis of the current situation of three green open spaces in the city of Almaty was conducted, the selected POS were, Kok Tobe Recreation Park, Yuzhny Park and Gulder Park. The method includes photographic documentation, sociological research, indicator and quantitative methods, and mathematical modelling methods. The main criteria in the survey were environmental comfort, accessibility, versatility and safety.

ANALYSIS

Kazakhstan is a multinational state with a wide ethno—cultural, linguistic, religious, racial and national diversity. The Constitution of the Republic of Kazakhstan proclaims the country a democratic, secular, unitary state with a presidential form of government.



Figure 1: Age of the respondents

Source: <http://www.uzngos.uzsci.net/Map> of Central Asia

Kazakhstan has a sharply continental climate with warm summers and cold winters. Astana is the second coldest capital in the world after Ulaanbaatar. Precipitation varies between arid and semi-arid conditions, with winters being particularly dry.

Almaty (1867-1921 — Verniy) is a city of republican significance in Kazakhstan, the former capital of the Republic of Kazakhstan (until 1997), the former administrative center of the Almaty region (until 2001).

Almaty is the largest city and region of Kazakhstan in terms of population: 2 211 198 people lived in the city (as of October 2023). The climate of Almaty is continental and is characterized by the influence of mountain-valley circulation, which is especially evident in the northern part of the city, located directly in the transition zone of mountain slopes to the plain. The average long-term air temperature is +10 °C, the coldest month (January) is -4.7 °C, the warmest month (July) is +23.8 °C.

There are 211 park territories with a total area of 631.2 hectares in Almaty (for the period on May 2022). In addition, landscaping, repair and reconstruction of parks and squares are carried out annually (Tengrinews.kz, 2022).

Currently, there is considerable interest in the subject of public spaces all over the world. This interest is quite natural, given the increasing role of cities in the socio-economic life of most developed and developing countries. In Kazakhstan, unlike in other countries, where the processes of urbanization have been studied by specialists of various profiles for a long time and in various aspects, the processes have not yet found a comprehensive analysis, including in the aspect of studying the role of public spaces in urban development.

The construction, design and reconstruction of open public spaces in the cities of Kazakhstan are regulated by state standards in the field of architecture, urban planning and construction (CODE OF RULES OF the REPUBLIC OF KAZAKHSTAN 3.01-105-2013. Improvement of territories of settlements.).

The provision of green areas for common use in citywide and residential areas is regulated by the SNiP of the Republic of Kazakhstan 3.01-01-2008(СНиП РК 3.01-01-2008), where the norm for the largest, large and big cities, including Almaty, is 10m² per person (Table 1) (Urban planning, Layout and development of urban and rural communities, SNiP RK 3.01-01-2008).

Table 1: The area of green areas of common use

Source: Urban planning, Layout and development of urban and rural communities, SNiP RK 3.01-01-2008

Green common areas	Square of green areas (m ²) per person			
	The Largest, Large and Big Cities	Medium-Sized Cities	Small Towns	Rural Settlements
Citywide	10	7	8 (10)*	12
Residential areas	6	6	-	-

* The sizes for small towns with a population of up to 20 thousand people are shown in parentheses.

Notes.

1. For resort towns, the above standards for citywide green areas of common use should be increased, but not by more than 50%.
2. The area of green areas of common use in settlements may be reduced for semi-desert and desert areas by 20-30%, increased for steppe and forest-steppe by 10-20%.
3. In medium-sized, small towns and rural settlements surrounded by forests, in coastal zones of large rivers and reservoirs, the area of green areas of common use may be reduced, but not by more than 20%.

There have also been improvements in the interaction between citizens and local governments. An example of improvements is the Almaty Parks 2017 project. From January 28 to February 9, 2017, the Urban Studies Center held the first open urban workshop for the development of 22 draft designs of urban parks and squares. Architects, urbanists, landscape designers, sociologists, environmentalists, representatives of the creative community and simply caring citizens who wanted to contribute to the development of a comfortable life in the city took part in the discussion on the improvement of parks.

The Almaty City Hall also published the Almaty City Development Program until 2025 and Medium-term Prospects until 2030, which is aimed at creating a safe, comfortable city environment, sustainable economic growth, social sustainability and stability. The city must be prepared for emergencies such as accidents, catastrophes, diseases and natural disasters (avalanches, mudslides, landslides, heavy rains, spring and summer floods, hail, dangerous geophysical processes). Almaty, as a city located in a seismic zone, has a high risk of

earthquakes. In the event of a strong earthquake with an intensity of 9 points, the city may suffer significant damage and losses. To reduce damage, earthquake-resistant building codes, an early warning system, emergency measures to turn off gas and electricity supplies, stop railway transport and metro, and block dangerous processes are necessary.

Since July 2022, Almatygenplan has launched a survey survey "Citizen's Questionnaire" among Almaty residents to find out how Almaty residents live, how much time they spend on the road, what they want to change and how they are ready to participate in the development of the city. The intermediate results of the Citizen's Questionnaire were successfully used in the work on the project for the transformation of Rayymbek Avenue. At the start, the opinions and needs of residents of several districts at once, through which the highway runs, were studied.

CASE STUDIES

Kok Tobe Recreation Park

Kok-Tobe Hill (or Kok-Tube) is a popular attraction in Almaty, and one of the favorite vacation spots of the citizens. A small mountain, whose name translates as "Green Hill", is located on the southeastern outskirts of Almaty, and on its territory, there is a small amusement park, monuments, observation decks and the Almaty TV tower. There is a cable car on Kok-Tobe, and there is also a long winding highway. The height of the Kok-Tobe is 1130 meters above sea level, and 200 meters relative to the city of Almaty.

Initially, this place was called Verigina Gora, in honor of a rich merchant who built a house at its foot. In the 1960s, the leadership of the city of Almaty decided to turn the green hill into a place of rest, and work began on creating all the necessary infrastructure. In 1965, the lower station of the cable car was laid, and all work was completed in 1967, and on November 4 of the same year, the grand opening of the park took place.

The cable car was designed and built jointly with Georgian engineers who already had extensive experience in this industry. According to some reports, it was the first in the Central Asian region. The length of the cable car on Kok-Tobe is 1620 meters, and the cabins cover this distance in 6 minutes, gaining 250 meters of height at the same time. The cost of a round-trip ticket is 5000 tenge (11.25 USD), one-way ticket is 3000 tenge (6.7 USD).

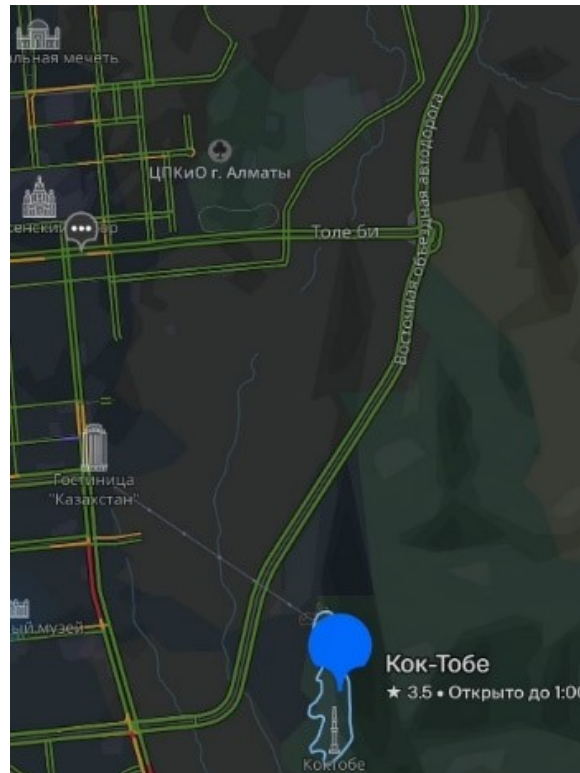


Figure 2: Situational scheme of the Kok-Tobe Recreation Park
Source: 2gis.kz

In 1978-1983, a 371.5-meter-high TV tower was built on Kok-Tobe, which at the time of commissioning was ranked 9th in the world in height (today 41st place). One of its main features is earthquake resistance – it can withstand an earthquake of 10 points. Unfortunately, the TV tower is closed to tourists due to safety concerns, although it has observation decks and a restaurant.

In 2007, a monument to The Beatles was unveiled on Kok-Tobe. The monument, made of bronze, is a popular local landmark. There are several speakers around the monument, from which the band's hits are constantly playing.

There are souvenir shops on Kok-Tobe, a Ferris wheel works, and there are several observation decks that overlook Almaty and the snowy peaks of the Zailiysky Alatau ridge. Also popular among tourists is the monument fountain "Alma" (Kazakh: "apple") in the form of an apple, the symbol of the city.

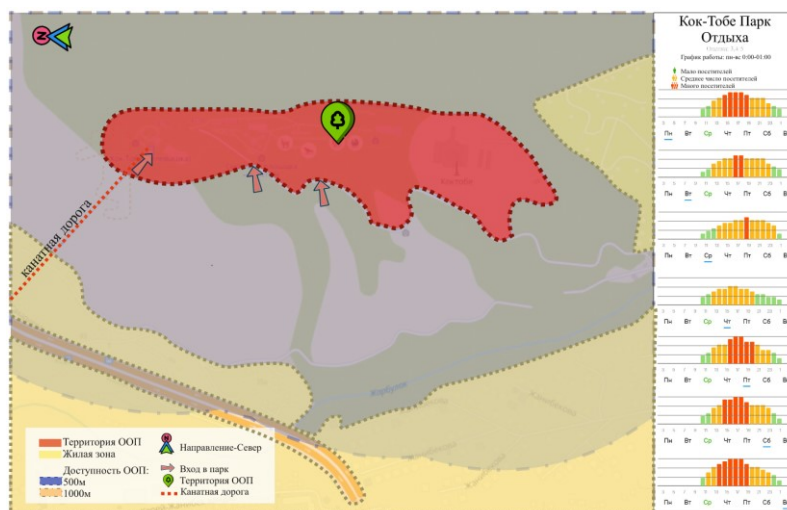


Figure 3: Situational scheme of the Kok-Tobe Recreation Park
 Source: Author's Survey

In addition to the rich nature surrounding the park, the positive and socially favourable moments noted during the tour were:

- i) Availability of bins in sufficient quantity along the entire road to the park;
- ii) Tourist information center near the nearest public transport stop to the park;
- iii) Security booth on the observation deck when climbing into the park;
- iv) Availability of a public toilet;
- v) Free entrance to the zoo with pets and wild animals;

The name of the park "Kok-Tobe" (Green Mountain) fully justifies itself, since the territory is quite landscaped, you can hear the singing of birds. Also, during the crawl, such disadvantages were noted as:

- i) There is no pedestrian road on the way to the park, when walking up to the park you need to walk along the roadway;
- ii) Lack of benches (only 2 places had benches, there were also none on the observation deck on the way to the park);
- iii) A large amount of commerce (despite the fact that entrance to the territory of the POS is free, most of the park is occupied by paid attractions, for which there is very low demand. Amusement park workers obsessively offer services);

- iv) Loud advertising and music (A negative feeling is created, the feeling of being not in a quiet park area, but at a busy fair due to the fact that there are many points around with different noise effects (music));
- v) Unpleasant odors near attractions bordering public toilets;
- vi) Not clear navigation in the park;
- vii) Poorly developed transport infrastructure (Expensive ascent by cable car, minibus, traffic jam at the entrance, and at the exit even more, which makes it difficult to leave);

These factors affect the attendance of the park. Currently, the place is popular mainly among tourists, residents of the city choose to visit the park mainly on weekends and holidays.

Yuzhny Park

Yuzhny Park (former name “Alumni Alley”) was founded in the 90s on the site of apple orchards next to Atakent on Zharokova St. between Khodzhanova St. and Baykadamova St. The park area is more than 14 hectares. More than 5000 trees grow on its territory.

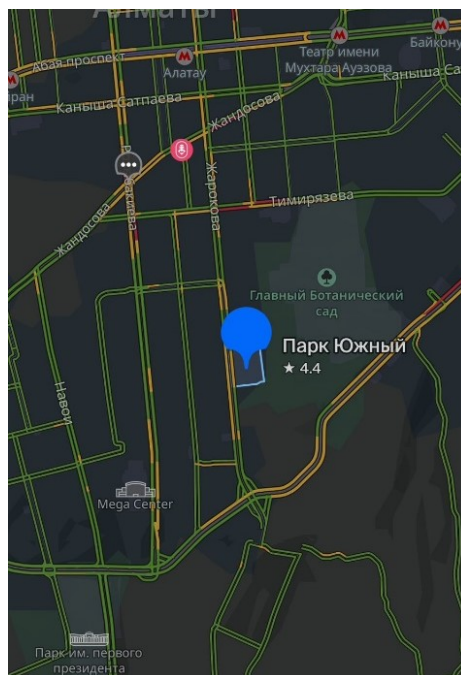


Figure 4: Situational scheme of the Yuzhny Park
Source: 2gis.kz



Figure 5: Situational scheme of the Yuzhny Park

Source: Author's Survey

For many years, the city authorities did not really deal with the park. The irrigation system collapsed, the asphalt on the paths fell into disrepair, there were not enough benches and bins, and they were also not in the best shape.

After the news of the upcoming reconstruction of the Yuzhny Park in 2018, which many people know as the "Alumni Alley", an initiative group, mainly consisting of residents of the Almagul microdistrict, wrote a letter addressed to the Mayor of Almaty, asking to review the reconstruction plan of the park (reconstruction project 2015). The citizens were invited to a meeting with developers, designers and employees of the City Hall.

The wishes of the residents were taken into account and adjustments were made. POS users expressed the opinion that the most important thing for the residents of this city and district is the living plantings.

As of 2015, there is no lighting or irrigation system in the territory. There are paths that residents and vacationers have trampled, according to the project, a sandy road was laid in such places, without compromising the ecology of the park. The main goal of the project was to create a comfortable urban environment. However, the reconstruction was delayed for two years. The initiative group continued monitoring the project, they demanded not to install a fence around the park and checked the work of the builders daily, made sure that the equipment did not harm the trees, so that the work took place strictly in accordance with the new project.

The positive and socially favourable moments noted during the tour of Yuzhny Park were:

- i) The presence of a police station on the territory of the park with patrolling officers;
- ii) The territory of the park is clean and well maintained;
- iii) There are a large number of playgrounds;
- iv) Urns, benches in sufficient quantity;
- v) There is a free-walking area for dogs;
- vi) There is a bike path and hiking trails;
- vii) Convenient access to the park from all adjacent streets;
- viii) Lack of fences;
- ix) Division by zones;

On the other hand, the disadvantage noted during the study of the park is the coverage of the bike path. Gravel used as a coating can damage the tires of the wheels.

It is worth noting the great work done by the initiative group “Let's Save Yuzhny Park” – this is an amazing and wonderful example that confirms the statement: “We are responsible for our beloved city!”.

Gulder Park

Gulder Park (translated from Kazakh as “Flowers”) is located near the PSC of the Zhetysu district of Almaty. The total area is 13.3 hectares. Basically, the park is a recreation place for residents of the Kulager neighborhood. In 2017, local initiatives of the city within the framework of the “Almaty Parks 2017” program revealed that the park can be accessed from four points, 71 benches, 72 urns are installed in the park, there are two children's and three sports grounds. It also turned out that visitors do not know the name, moreover, it does not correspond to reality – there were no flower beds in the park. The main problems noted in 2017 were:

- i) There is no entrance group;
- ii) The small architectural forms do not correspond to the concept of the park;
- iii) Spontaneous parking on the territory of the basketball field;
- iv) Lack of toilets, bike and treadmills, as well as poor navigation system in the park;
- v) Four benches and five urns are missing in the designated places.
- vi) Playgrounds do not have a special coating;
- vii) There is no inclusive infrastructure.

Restoration work was carried out in 2021-2022. From the reviews in the open access, it is noted that the park as a whole is a popular place for residents

to relax. There is a variety of entertainment for children and adults, well-groomed green spaces, benches and lighting. However, visitors pay attention to some problems, such as the presence of garbage, including syringes near benches and gazebos; lack of toilets; lack of hot drinks outlets and food boutiques; poor lighting, especially in the central part of the park.

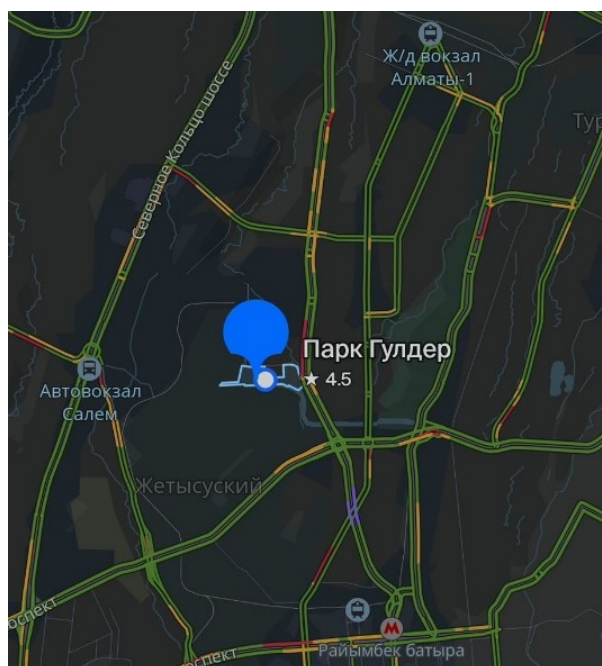


Figure 6: Situational scheme of the Gulder Park
Source: 2gis.kz

Thus, in order to further improve the condition of the park, attention should be paid to solving these problems and continuing to develop infrastructure and service for visitors. It is necessary to improve the control of order and safety in the park; provide public toilets, places with drinks and food for the convenience of visitors; improve lighting to increase the safety and comfort of evening rest.

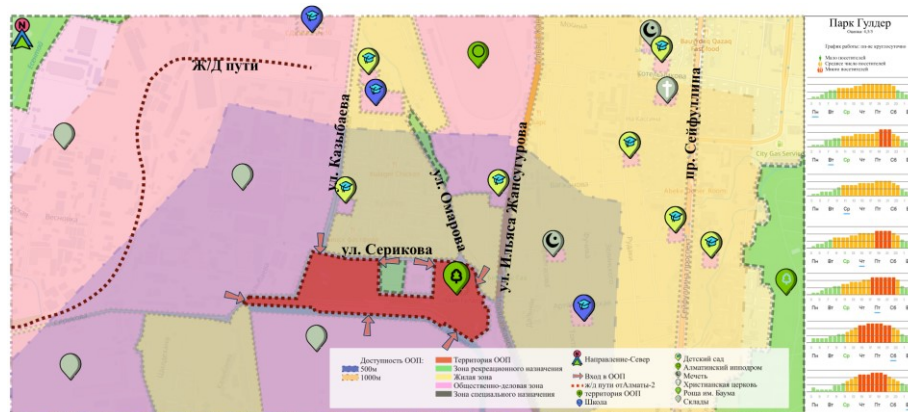


Figure 7: Situational scheme of the Gulder Park
Source: Author's Survey

The positive and socially favourable moments noted during the tour of Gulder Park were:

- i) Availability of a sufficient number of benches, there is a gazebo;
- ii) Availability of a stage for small events;
- iii) The territory of the park is quite landscaped;
- iv) At the time of the bypass, work was underway to restore the path to the park (during the work, the park continued to function without inconveniencing visitors);
- v) There is a public toilet;
- vi) Well-equipped playgrounds, skate court, sports ground, 3 football fields;
- vii) There is a potential for small business development (but it is poorly developed)

Result from the site visit had also identified disadvantages, such as:

- i) At the time of the study, there were a small number of people, which may indicate the unattractiveness of this POS;
- ii) Some tactile coverings on the paths for the visually impaired are being destroyed, despite the fact that the park was under reconstruction 2 years ago;
- iii) There are no signs and navigation markings in the park;
- iv) Broken equipment and sculptures that can be dangerous;
- v) The territory of the embankment adjacent to the park and part of it is in poor condition;

- vi) In most of the park, access to the embankment is blocked by a high fence;
- vii) In some places there is a low fence that does not carry any function;
- viii) The reconstruction of the park was carried out only in the adjacent territory to the akimat, therefore the benches are further in poor condition (broken, peeling paint)
- ix) There are no birdhouses and feeders, as in the POS, close to the central part of the city (despite the fact that there are squirrels and birds in the park);
- x) The boundaries of the park on maps in open sources differ, which creates inconveniences for visitors who are not familiar with the area, as well as the inability to determine the entrance to the park on the map.

It can be seen from the presented data that each of the parks has its own characteristics and unique features. Kok-Tobe Park is rich in nature, but suffers from a lot of commerce and loud advertising, which can scare away visitors. Yuzhny Park, on the other hand, is well equipped for family and children recreation, but has a subjective disadvantage in the form of a bike path cover. Gulder Park has great potential for small business development, but suffers from a lack of visitors, outdated equipment and problems with the waterfront area.

SURVEY ANALYSIS

A survey of citizens to assess the social aspects of the effectiveness of the functioning of public open spaces in Almaty, Kazakhstan

As part of the study, a survey of residents and visitors of the city was conducted, where the main evaluation criteria were self-determination and the feelings of the respondent. A total of 75 questionnaires were collected, which is a sufficient number with a margin of error of 10% (the minimum number of respondents per 2,000,000 inhabitants is 70 people). The survey was conditionally divided into 2 parts: demographic data, questions directly related to the public open spaces of the Almaty city. The questions regarding demographic data were to determine the age of the respondents, their gender identity, level of education, specialty, employment, marital status, area and duration of residence in Almaty. As part of the survey, questions were asked about the frequency of visits to the POS in the city, clarifying the most attractive spaces, assessing accessibility and convenience, identifying problems in functioning, timely response of local government and citizens to problems, determining the role of the POS in shaping the modern image of the city and the cultural life of citizens, the need to adapt the POS to the needs of specific social groups, determining factors for attracting more people to the POS and popularizing them.

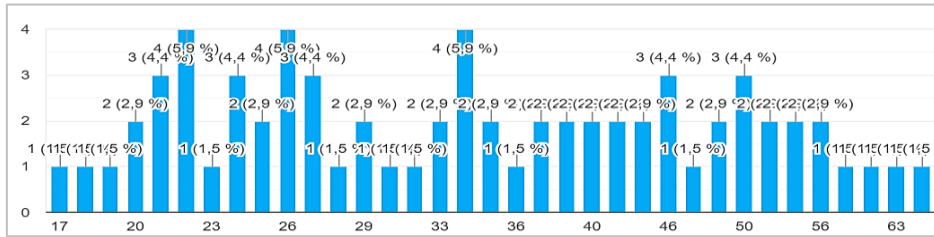


Figure 8: Age of the respondents

Source: Author's Survey

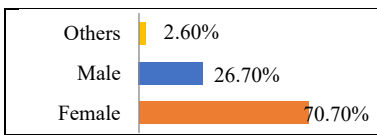


Figure 9: Gender identity

Source: Author's Survey

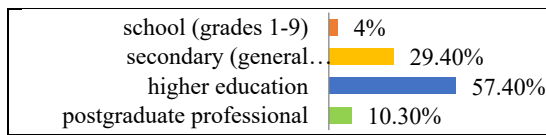


Figure 10: Level of education

Source: Author's Survey

15% of respondents have an education in architecture and urban planning, 7% in design, 5% engineers and builders, 5% in teaching.

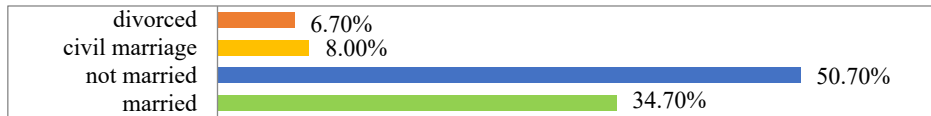


Figure 11: Marital status

Source: Author's Survey

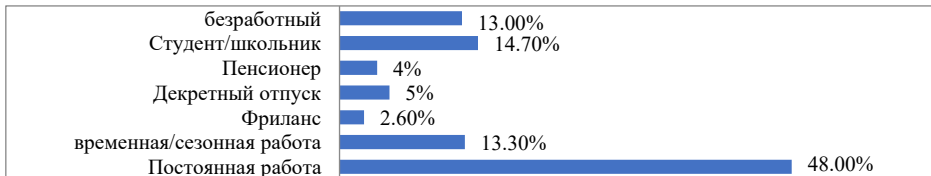


Figure 12: working hours

Source: Author's Survey

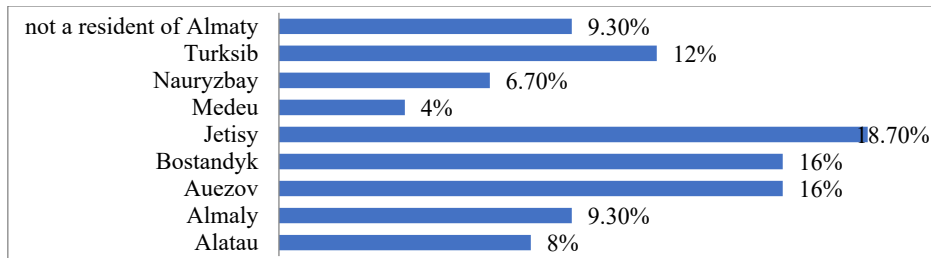


Figure 13: The area of residence in Almaty (district)

Source: Author's Survey

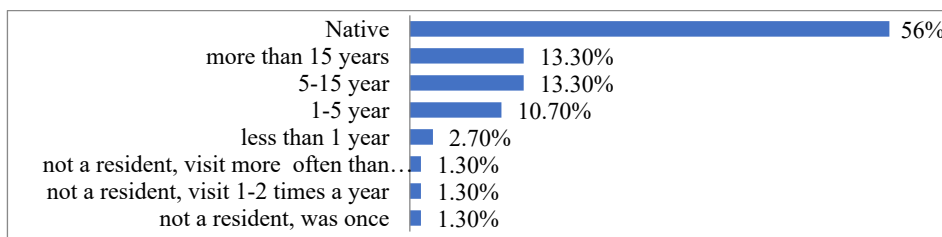


Figure 14: Period of residence in Almaty

Source: Author's Survey



Figure 15: Frequency of visits to open public spaces in Almaty

Source: Author's Survey

Milton Keynes classified open space according to the type of affiliation or structure in which parks and gardens include linear, district and local parks (Dennis Wakaba). This classification was adapted and formed the basis for the question of the attractiveness of the POS in the city of Almaty.

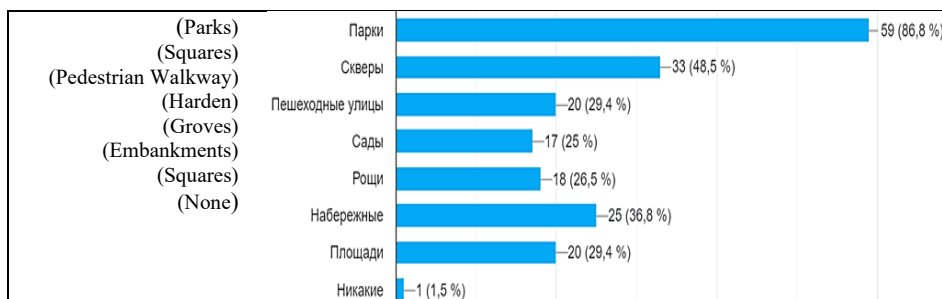


Figure 16: The most attractive POS in Almaty for recreation, leisure activities, meetings with friends, according to the typology

Source: Author's Survey

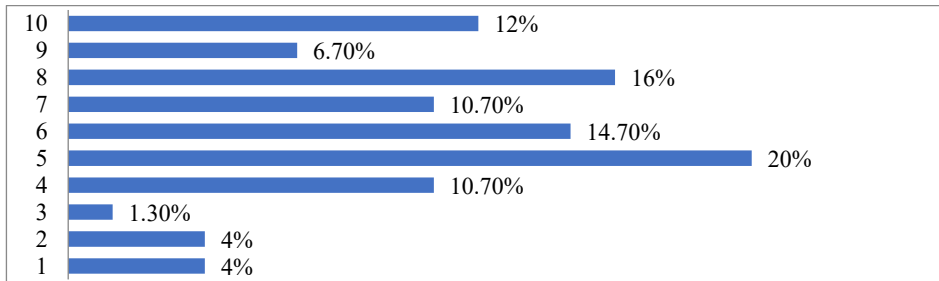


Figure 17: Accessibility and ease of use of POS in Almaty (on a scale of 1-10, where 1- does not correspond at all to accessibility and convenience, 10-fully correspond)

Source: Author's Survey

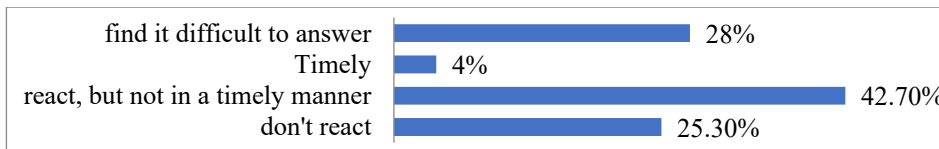


Figure 18: The opinion of the respondents on the issue of timely response to problems in the use of open public spaces by local governments and citizens

Source: Author's Survey

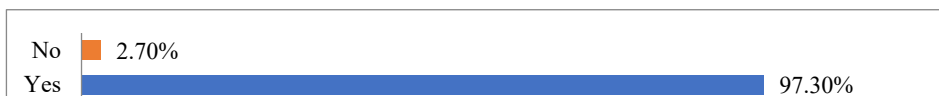


Figure 19: The opinion of the respondents regarding the need to adapt the POS to the needs of specific social groups, for example, children, youth, the elderly

Source: Author's Survey

DISCUSSION

In accordance to the presented data, majority of respondents are women (more than 70%), people with higher education (more than 70%), their age varies from 17 to 64 years (average age 35 years). Most of the respondents work full-time. Based on the typology presented, residents more often visit parks, squares and embankments.

Survey results were also able to conclude an estimated accessibility and usability of public spaces range from 4 to 10 points, which also pointed out that one of the causes for public open spaces dysfunction was due to the lack of connectivity between them and the untimely reaction of local governments. The majority of respondents believe that open public spaces play a significant role in shaping the modern image of the city and the cultural life of citizens. Respondents also express their opinion on the need to adapt public spaces to the needs of various social groups, such as children, youth and the elderly. This perceptive suggestion aims to attract more people to public spaces considering open space accessibility is proven to increase a space's popularity. Additionally, respondents

suggest providing more amenities, comfort, diverse content and additional social events. This survey outcome among respondents in Almaty open spaces is aligned with several literature and studies that promotes multi-level social indicators to be taken into the planning and design consideration.

These data show that socio-cultural aspects, such as the availability of safety, cleanliness, comfortable conditions for recreation and accessibility of cultural events, play an important role in creating high-quality open public spaces. It is important to take into account the opinions and needs of local residents when designing and updating parks to make them more attractive to visitors.

CONCLUSION

Based on the study, it follows that in order to attract more people to public spaces and increase their popularity, more amenities, comfort, diverse content and additional social events should be provided. The analysis of data collected in these three parks further identify that the main problems and advantages of each of them, which in turn will help to identify areas for improving the quality of public spaces in Almaty. The key factors of the recommendations may be improving infrastructure, ensuring safety and comfort of visits, supporting small businesses and holding cultural events to attract visitors. These social aspects affect the quality level of public open spaces, emphasizing cultural characteristics, meeting social needs, and providing psychological comfort.

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NOTES TO CONTRIBUTORS AND GUIDELINES FOR MANUSCRIPT SUBMISSION

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