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ANTICIPATING LOCAL ACCEPTANCE OF SOLAR FARM DEVELOPMENT IN BATANG KALI, SELANGOR, MALAYSIA: ASSESSING POTENTIAL IMPACTS

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Abstract

To restructure the country's economy towards a high-value economy, the government has placed the transition to a green economy as one of the main targets of its economic restructuring efforts. This transition will create a significant positive impact on every level of society, in addition to guaranteeing the continuity of the country's energy. Nonetheless, every planned development must minimise its impacts on the communities that it will affect. The main objective of this study is to explore the impact of solar farm development on a local community in the dimension of sustainability. This study employed a quantitative research methodology to evaluate the level of impact that the community may experience. The study's primary findings revealed that the community involved in the proposed development project would be significantly affected, both positively and negatively, across social, environmental, and economic dimensions. The community anticipated that the solar renewable energy generation would have a significant positive impact, and the establishment of a solar-based community would improve the quality of life. The implications of this study will facilitate policy makers, decision makers and practitioners in developing solar farms in a sustainable manner while safeguarding the interests of local communities.

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INTRODUCTION

Sustainable Development Goals (SDG) 7 is a global energy goal that includes three main objectives: guaranteeing universal, affordable, and dependable access to modern energy services, significantly increasing the proportion of renewable energy (RE) in the world. Moreover, energy plays a crucial role in achieving all SDGs, including alleviating poverty and hunger, improving healthcare and education, promoting gender equality, ensuring access to clean water and sanitation, driving economic growth, fostering full and productive employment, reducing inequalities, encouraging sustainable production and consumption, and building sustainable cities and communities (United Nations, 2021). As the energy industry advances, the production of clean, efficient, and low-carbon energy focusses on renewable energy production. However, in Malaysia's energy industry, fossil fuel generation continues to dominate the national installed capacity mix. Malaysia's percentage of renewable energy remains below the world and regional averages. In 2020, RE made up 23% of the national installed power capacity, compared to the global average of 37% and the Southeast Asia regional average of 30%. Malaysia must accelerate renewable energy deployment to meet climate targets. This can be achieved by strengthening existing programmes, introducing new approaches, and future-proofing electricity market regulations and industry practices (SEDA, 2021). Solar energy is one of the renewable energy sources, where the use of solar photovoltaics (PV) can generate electricity for the benefit of the country's energy production. The main idea of solar PV is the conversion of sunlight into electricity. The use of PV technology in conjunction with mini grids allow for the generation of electricity and its distribution throughout the country. The decreasing cost of solar panels has made power not only more affordable but also more accessible to a broader population. As a result, solar PV installations have expanded significantly in Malaysia (Vaka et al., 2020).

While the expansion of the PV projects has positively impacted energy production, it is equally important to assess potential negative impacts to ensure the well-being of local communities. According to PLANMalaysia (2023), the quality of life and well-being of the community must be prioritised in the pursuit of economic progress. A nation's prosperity is linked to societal well-being, which encompasses all aspects of life including economics, living standards, health, and safety. If certain areas of development are ignored, the quality of life will suffer. Against this backdrop, this paper aims to investigate the anticipated impacts of a proposed solar farm development project on the local community of Batang Kali, Selangor, Malaysia.

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LITERATURE REVIEW

Sustainability Concept and Sustainability Variables for Solar Farm Development

Sustainability has been a major conceptual paradigm for urban development since 1987 when the call for sustainable development gained traction. The World Commission on Environment and Development (WCED) presented sustainable development in the Brundtland report, also known as Our Common Future. The purpose was to launch a global agenda to tackle the degradation of social and ecological ecosystems, which has intensified since the Industrial Revolution (Taiwo et al., 2021). According to Ozili (2022), sustainability can be defined as the capacity to allocate resources to economic and non-economic activities responsibly to attain specific social, economic, and environmental goals. There are three interwoven subjects of sustainability that describe how our world's environmental, economic, and social components interact. These circles are linked concepts that, when combined, can provide a firm foundation for key decision-making activities. Examples of such decisions include land use planning, project management, building design and construction, and even legislation (Wanamaker, 2022). Figure 1 illustrates three pillars that serve as the foundation for sustainability: economy, society, and environment. The figure also depicts the connection between the three pillars.

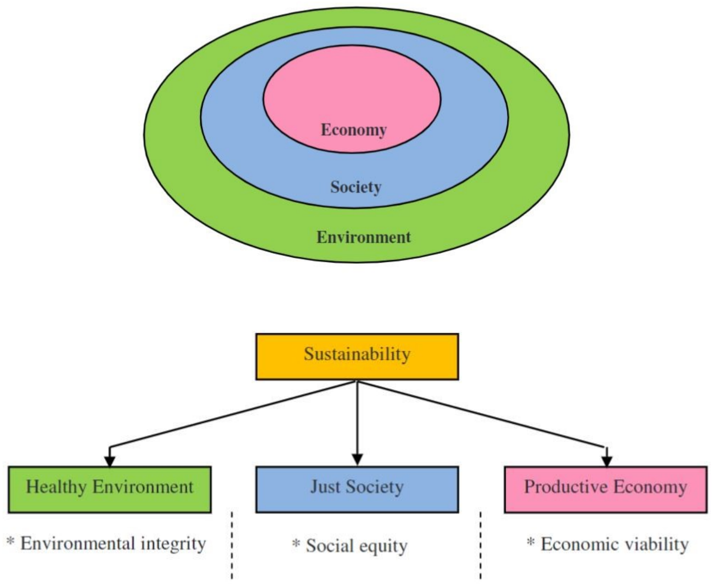

Figure 1: The Three Pillars of Sustainability
Source: Abu-Goukh et al. (2013)

The three pillars of sustainability are thought to be highly significant, particularly in the context of research for the development of sustainable solar farms. Therefore, to evaluate the impact of solar farm development on the local community from this sustainability perspective, an important group of variables was identified based on the literature from previous studies on the development of solar projects. The following are the dimensions and variables that are important for this study (refer to Table 1):

Table 1: Sustainability Dimensions and Variables for Solar Farm Development

Dimensions	Variables
Social Sustainability	Accessibility to facilities
	Safety and health
	Road and traffic risk
	Quality of life
	Cultural values & norms
Environmental Sustainability	Land use change and conservation
	Noise and solar glaring
	Air and water quality
	Carbon emissions and climate change
Economic Sustainability	Efficiency and reliability of the energy system
	Effects on business opportunities and productive diversification of the area
	Economic benefits for local community
	Employment in renewable energy sector
	Improvement of property value
	Advancement of surrounding development

Source: Adapted from Gupta (2001); Modotti et al. (2015); Mutatkar (2017); Roddis et al. (2018); Lassio et al. (2021); Hamed et al. (2022); PLANMalaysia (2023)

Local Community Acceptance of Renewable Energy Developments

According to Yiridoe (2014), the development of new renewable energy technology requires social acceptance. Lack of social acceptance among local population can hinder the adoption of renewable energy in a country. Renewal energy transitions have had both positive and negative impacts on equity and community cohesion. The current change is influenced by complicated authority and experience matrices among major stakeholders and actors. To address the needs of local communities, governance structures and organisational formats should be participatory, inclusive, and reflective of their lived experiences (Lennon et al., 2019). Based on previous research on the development of solar farms in developed nations, the researchers discovered that local support for utility-scale solar was highly influenced by perceived positive outcomes, such as employment growth and improved property value. They also discovered that, contrary to previous research, place-based beliefs (e.g., level of agreement regarding whether the place they lived was beautiful, had a great community of people, etc.) and perceived negative impacts had no significant influence on

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support for utility-scale solar when controlling for other factors, such as perceived positive impacts. Other characteristics, such as perceived severity of climate change and the belief that solar development would reduce property value, were not significant predictors of local acceptance. These findings indicated that the anticipated individual and community benefits of a local solar power system are particularly significant influences on local acceptability (Scovell et al., 2024). Additionally, Bishoge et al. (2020) found that involving the community at all levels of a project leads to increased legitimacy, community ownership, and reduced conflicts during implementation, resulting in community acceptance. Other relevant components of community acceptance that may result in project resistance or lack of support include failing to consider the political context as well as local perceptions of economic, social, and environmental impacts when planning and implementing the project. All these elements are necessary for project sustainability (Tsoeu-Ntokoane et al., 2024).

STUDY AREA

According to the Selangor Structure Plan 2035, Batang Kali, Selangor, Malaysia is included in category 1 of development priority area, which includes growth centres outside the Greater KL urban hub, such as Kuala Selangor, Banting - Telok Panglima Garang, Batang Kali, Bernam Jaya and Sabak Bernam. In addition, under the MP31 policy, the development of green technologies in the energy and water supply sectors, as well as in building, waste management and transport systems, will be promoted and facilitated. There is a special initiative to promote the use of environmentally friendly power generation technologies and the use of RE, especially solar energy, as an alternative to conventional electricity systems (PLANMalaysia Selangor, 2017). Specifically, an open tender programme for solar developers has been placed under the Sustainable Energy Development Authority (SEDA) to promote the development of solar farms to support the transition towards clean and green energy.

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Figure 2: Study Area: Batang Kali, Selangor, Malaysia

Figure 2 shows a 61-acre oil palm agricultural land proposed for solar farm development by a solar developer. The site is being evaluated to assess its feasibility and anticipated impact of the development before the proposal is fully implemented as a future development.

METHODOLOGY

This study employed a quantitative approach, using a questionnaire designed based on sustainability dimensions and variables. Primary data were collected through a survey of households using physical and online questionnaires. Data from the questionnaires were then analysed to assess the social impact of the proposed development. It was found that within the Zone of Influence (ZOI) of one (1) kilometre from the proposed site, there were 165 residential units: 36 units in Kampung Idaman, 107 units in Perumahan Sime Darby Ladang Tennamaram (A), and 22 units in Perumahan Sime Darby Ladang Tennamaram (B). From the sample size calculation using formulas from Rea and Parker (1997) with a confidence level of 95%, it was determined that the number of housing sample units required for this study was 116. For data analysis and storage, SPSS software was used. Each impact variable in this study was subsequently evaluated using measures of central tendency and the severity of impact based on the

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median value categorised by the sustainability dimensions (refer to Table 2 below). This analysis focuses on the anticipated impact on the local community once the solar farm project is completed and becomes operational.

Table 2: Levels of Impact Severity Used in the Study

Severity of Impact						
Scale	No Impact	Very Little	Minor	Moderate	High	Very High
Score	0	1	2	3	4	5

Source: PLANMalaysia (2017)

DATA ANALYSIS AND FINDINGS

A.Social Sustainability Dimension

As indicated in Table 3 and Figure 2 below, six (6) variables were tested to assess the severity of the expected impact on the local community from the social sustainability dimension. The most significant expected positive impact was observed in variable SDV 2, with a mean score of 4.48. However, variable SDV 1 was rated unsatisfactory, with a mean score of 2.03. Regarding anticipated negative impacts, variable SDV 3 had the highest mean score of 3.96, followed by SDV 5 (1.75), SDV 6 (1.55), and SDV 4 (1.28).

The analysis revealed that SDV 1 had very little impact on the accessibility of facilities from the perspective of the local community. However, the improvement of the quality of life was expected to have a very high level of impact, with the formation solar-based communities anticipated in the future. Regarding the negative impact, the local community anticipated that the development of this solar farm would lead to overcrowding by foreigners within the local community (SDV 3), which was assessed at a high impact level.

Table 3: Dimensions, Variables and Impact Types for Social Sustainability

Dimension	Variable		Impact
Social Sustainability	*SDV 1*	Solar farm development will create and improve accessibility to the facilities around the neighbourhood.	*Positive*
	SDV 2	The quality of life will increase with the formation of a solar-based community.	*Positive*
	SDV 3	Solar farm development will overpopulate the local community with foreigners.	*Negative*
	SDV 4	Solar farm development will cause social problems which can disrupt cultural values and societal norms.	*Negative*
	SDV 5	The safety of the population will be affected (crime, road accident, natural disaster, neighbourhood safety etc.).	*Negative*
	SDV 6	Health problems and infectious diseases will increase due to solar farm development.	*Negative*

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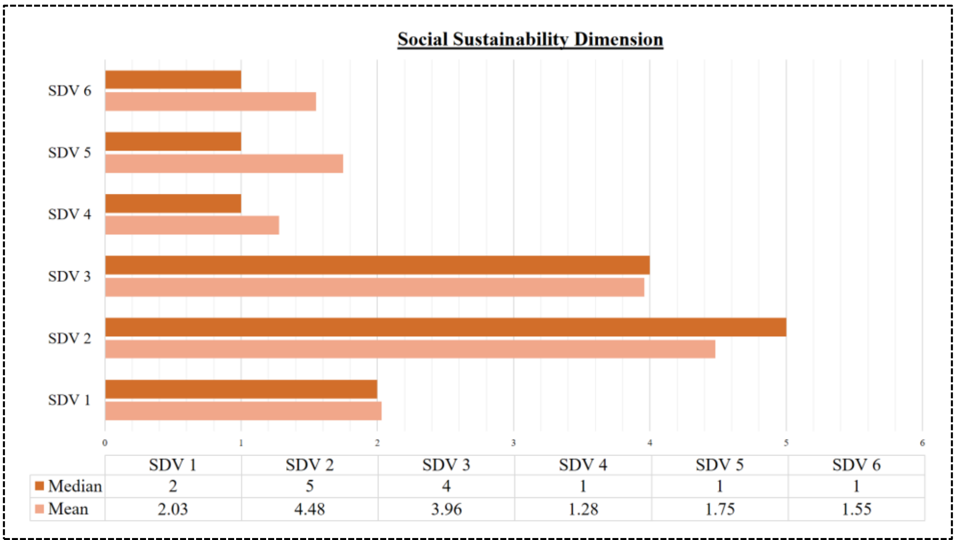

Figure 2: Result of Social Sustainability Dimension According to Local Community

B.Environmental Sustainability Dimension

EDV 1 had the highest anticipated positive impact in the environmental dimension, with a mean score of 4.22. On the other hand, EDV 2 had the highest predicted negative impact, with a mean score (3.53), followed by EDV 3 (3.14), EDV 5 (3.09), and EDV 4 (2.72). Figure 3 shows that, based on the median score for this dimension, the level of impact was high to moderate. For the expected positive impact in general, the local community expected that the solar farm development would have a good impact on the environment, particularly in reducing carbon emissions compared to conventional methods in energy production. In addition, they foresaw negative impacts on land use, with this development likely to result in future land use conflicts. They anticipated that the conversion of agricultural land to infrastructure would undoubtedly have an impact on development in the surrounding area, particularly in neighbourhoods near the proposed site. This was followed by other environmental impacts, such as influence on land degradation, habitat loss, noise, air, and water quality, and the impact of solar glare.

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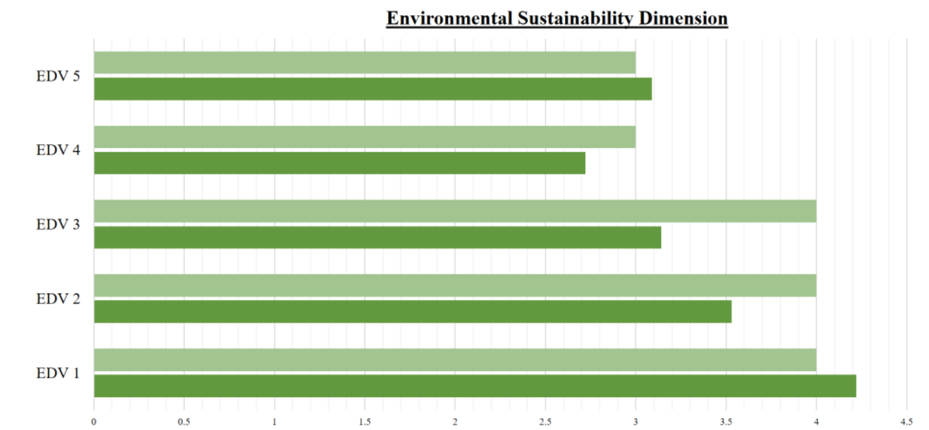
Table 4: Dimensions, Variables and Impact Types for Environmental Sustainability

Dimension	Variable		Impact
Environmental Sustainability	*EDV 1*	Solar farm development will reduce carbon emissions compared to conventional energy use.	*Positive*
	EDV 2	Solar farm development will cause land use conflicts.	*Negative*
	EDV 3	Solar farm development will cause land degradation and habitat loss.	*Negative*
	EDV 4	Solar farm operation will cause solar glaring.	*Negative*
	EDV 5	Solar farm development will have a significant impact on noise, air and water quality.	*Negative*



	EDV 1	EDV 2	EDV 3	EDV 4	EDV 5
Median	4	4	4	3	3
Mean	4.22	3.53	3.14	2.72	3.09

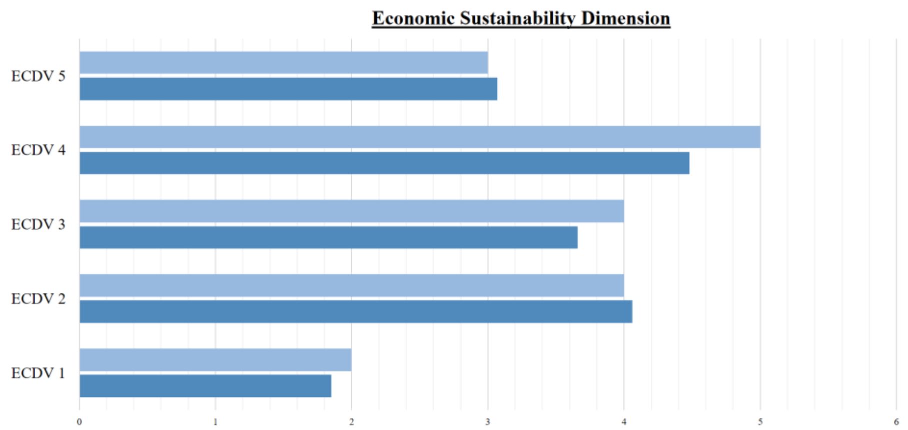
Figure 3: Result of Environmental Sustainability Dimension According to Local Community

C.Economic Sustainability Dimension

All the economic sustainability impacts were positive. Table 5 and Figure 4 show that the variables with the highest mean score were ECDV 4 (4.48) and ECDV 2 (4.06). These were followed by ECDV 3 (3.66), ECDV 5 (3.07), and ECDV 1 (1.85). A noteworthy result regarding this economic dimension is the anticipated high impact from solar farm development, which would help the local community by generating sustainable energy. Another significant impact concerned the development of surrounding neighbourhood. The local community believed solar farm development would accelerate the development of the surrounding neighbourhood. However, the local community did not expect the solar farm development to create job prospects for them; they believed this variable would have a minor impact.

Table 5: Dimensions, Variables and Impact Types for Economic Sustainability

Dimension	Variable		Impact
Economic Sustainability	*ECDV 1*	Solar farm development will provide employment opportunities to the local community.	*Positive*
	ECDV 2	Solar farm development will advance the development of the surrounding area.	*Positive*
	ECDV 3	Solar farm development will improve the socio-economy of the local community.	*Positive*
	ECDV 4	Solar farm development will benefit the community with renewable energy generation.	*Positive*
	ECDV 5	Solar farm development will increase property value.	*Positive*



	ECDV 1	ECDV 2	ECDV 3	ECDV 4	ECDV 5
Median	2	4	4	5	3
Mean	1.85	4.06	3.66	4.48	3.07

Figure 4: Result of Economic Sustainability Dimension According to Local Community

DISCUSSION

The main outcome of this study was derived from the social dimension, where the local community expected their quality of life to be boosted as a result of the development of a solar-powered community. They believed that the development of this solar farm would improve the environment by lowering carbon emissions compared to conventional energy production. In terms of the economic dimension, the community anticipated that the surrounding development would accelerate, as would the socioeconomic development of the local population, who would profit from the RE generation. However, negative effects were also expected to occur in each dimension and measured variable. The local community's attention was specifically focused on the impact of an overpopulation of foreigners, land use conflicts, land degradation and habitat

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loss. This indicates that the local community had a deep awareness of sustainability in terms of the importance of protecting the environment. The findings also indicate that each dimension and variable is essential in protecting the community's interest in the proposed development in a sustainable manner. Consequently, the findings could assist policymakers and developers in considering appropriate mitigation measures for minimising the impact on the community, particularly for solar development projects. Furthermore, research associated with the development of solar farms, especially in Malaysia, is considered to be less thorough than in developed nations that utilised solar energy as their main energy production. As confirmed by a study conducted by Sahid et al. (2021), promoting solar energy generation has led to multiple challenges, particularly in terms of solar farm development, which is still in its early stages and lacks sufficient guidance. This study also serves as the foundation for solar farm development projects by assessing their impacts on the local community as well as contributing to the body of knowledge and practices of impact assessment practitioners specifically in managing solar farm development within the local context.

CONCLUSION

Malaysia's energy sector requires significant support at all levels of stakeholders in infrastructure development. RE is an endeavour that contributes to the achievement of national energy development goals and strategies while also moving the country towards energy efficiency and low carbon emissions. However, dealing with the impact on the local community in a sustainable manner is vital to the project's development and defines its success factor. The development of solar farms based on project size also has a significant impact on the local community and surrounding environment. In contrast to this case study, the development of large-scale projects is expected to generate a greater impact.

Although the approach taken in this study is quantitative, a qualitative method may also assist in the deeper meaning and interpretation of issues, particularly in analysing the impact on the community and stakeholders involved in solar farm development. This study recommends that further research be conducted, particularly in urban planning and project management, to ensure that solar farm project development mechanisms are sustainable and comprehensive.

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