COMMUNITY CONCERNS OF RIVER POLLUTION SPATIAL MODEL USING GEOGRAPHIC INFORMATION SYSTEM (GIS) IN IBAI RIVER, TERENGGANU

Wan Nor Azilawanie Tun Ismail[1], Aziz Amin[2], Mohd Khairul Amri Kamarudin[3], Asmawi Ibrahim[4] & Nik Sarina Nik Md Salleh[5]

[1,2,3,4] *Faculty of Applied Social Sciences,*
UNIVERSITI SULTAN ZAINAL ABIDIN, MALAYSIA
[5]*Faculty of Business and Management*
UNIVERSITI TEKNOLOGI MARA CAWANGAN KELANTAN, MALAYSIA

Abstract

Our nation has recently become quite concerned about the issue of environmental pollution, especially with the deterioration of river quality. The Department of Environment's monitoring efforts has revealed significant declines in the nation's river water quality. Focusing on all-encompassing and well-coordinated initiatives to improve the quality of life is essential for raising public awareness and fostering a sense of shared responsibility for the environment. The main objective of this study is to develop a spatial model using a Geographic Information System (GIS) for determining the level of knowledge, attitude, and behavior among Kampung Laut respondents toward the conservation of the Ibai River in Terengganu, Malaysia. This study applied a quantitative methodology and collected its data through a survey method. By using clustered sampling, 78 respondents in all were chosen. The study was conducted in the Ibai rivers, which Terengganu had classified as contaminated. The statistical package for social science (SPSS) version 21 was used to analyze the data descriptively and inferentially, while GIS was employed for the spatial model. The data were gathered via a questionnaire. The findings show that the level of knowledge was high and attitude was at a moderate level. Meanwhile, the findings depict that respondents' behavior in river conservation is low. The findings also show that knowledge and attitude did not correlate with environmental behavior. This study is critical and significant in ensuring the sustainability of the river. The stakeholders are also involved in this study's policy-making and efforts to address the problems of river pollution. The general public, regardless of age, can contribute to the ecosystem's well-being by teaching the next generation to cherish the environment, especially the rivers.

Keywords: Environmental Knowledge, Environmental attitude, Environmental behavior, River pollution, Geographic Information System (GIS)

---

[1] Lecturer at Universiti Sultan Zainal Abidin Email: azilawanieismail@unisza.edu.my

INTRODUCTION

Water is a very important gift of God to all living things on earth. In addition to meeting human needs, water is also an important basic resource for social and economic activities such as industrial activities, transportation, agriculture, and power generation.

However, various river pollution problems have existed in recent times as a result of human activities. This is also evident from the studies that have been conducted which show that various problems of water pollution cases have existed in recent times (Xu et al., 2022; Tirgar et al., 2020; Hua, 2019; Tuan Fauzan Tuan Omar et al., 2019; Kozaki et al., 2019; Md. Sadek Uddin Chowdhury et al., 2018; Ling et al., 2017; Lee et al., 2017; Poon et al., 2016). One of the most contentious cases involved the Kim Kim River in Johor, where reckless parties dumped chemicals into the river, affecting the health of more than 2000 people and forcing the closure of 111 schools (Yap et al., 2019; Rohman, 2019), and the Selangor River, where diesel oil contamination resulted in 1133 areas experiencing water disruption as a result of the incident (Khazi, 2019). The latest case is the pollution of the Petani River in Kedah which has lasted for the past 20 years and is now claimed to be more serious when the water turns black and smells bad. The activity of dumping rubbish and discharging the waste into ditches and rivers here is found to be intensifying (Zaid Mohd Noor, 2021).

This water crisis has made us aware of how serious the problem of water pollution is in our country. It also teaches us the value of protecting and conserving water supply sources, particularly rivers. Therefore, we can no longer treat it lightly, and all parties must begin acting seriously and efficiently to prevent a repeat of the same incident.

However, according to a report on environmental quality, river water quality as measured by the Water Quality Index has improved in 2020. The proportion of rivers that are considered to be clean has significantly improved to 66% in 2020 from 61% in 2019. By 2020, only 5% of rivers will be considered to be contaminated, down from 9% in 2019. (Department of Environment Malaysia, 2020). The improvement in river water quality is due to the closure of business premises such as workshops, restaurants, and commercial centers during the period of the Movement Control Order which helps rivers across the state to return clean.

This demonstrates unequivocally that human action, whether directly or indirectly, contributes to environmental concerns. The need to create a more environmentally conscious society is especially vital given that the impact of the environment on humans is global and that the preservation and care of ecosystems are essential to the quality of life of both the present and future generations (Sahrir et al., 2022). Accordingly, it is an obligation to conserve water resources in terms of quality and quantity before they are destroyed.

Therefore, the issue of river pollution must be given serious attention and controlled to a minimum. This is due to the fact that water is a source of life, and if this supply becomes so contaminated that humans are unable to use it, this indirectly reduces the source of human existence. Day by day, if the pollution situation of this river worsens, then humans consciously or unconsciously have poisoned themselves. Thus, the important points emphasized in this study are in terms of knowledge, attitudes, and behavior of the local community in addressing the issue of river pollution to ensure the more holistic well-being of the community.

LITERATURE REVIEW
Environmental Knowledge
According to Mohammad Affendy Omardin & Nazirah Zainul Abidin (2014), acquiring environmental knowledge is a lifelong learning process to foster environmental awareness at all societal levels as well as knowledge, skills, and a commitment to making decisions that have an impact on the environment either directly or indirectly. Applying environmental knowledge in society is crucial since it is the basis for sustainability (Tucker & Izadpanahi, 2017; Noor Azizah Samsudin & Zanaton H. Iksan, 2015 and Ainul Marziana M. Mahidin & Suhardi Maulan, 2012).

Theoretically, as one's knowledge of the environment increases, this will influence a positive attitude toward the environment. The ability to create good practices in how community members interact with the environment depends on the information being accompanied by a high level of awareness (Nor Kalsum Mohd Isa, 2016 & Gifford, 2014). Therefore, knowledge and awareness must be applied together especially in the younger generation through formal or informal education.

Environmental Attitude
In the environmental balance crisis, individual attitudes are crucial. Individuals who are positive toward the environment will apply such attitudes in daily life (Paco & Lavrador, 2017). Some negative attitudes such as greed, selfishness, and materialism are basic human weaknesses towards destroying the environment arbitrarily. Greed is the biggest enemy of the environment. In the fervor for financial gain, laws are disregarded, legal loopholes are exploited, and risks are not considered (Ibrahim Kamoo, 2000). They will also be willing to toss things away or contaminate the environment without feeling guilty or embarrassed due to their negligent attitude toward keeping cleanliness in the environment. Numerous environmental problems need to be addressed at the individual level where an individual is required to develop attitudes that will guide them to pro-environmental behaviors (Asmawati Desa et al., 2011). A person should be given

knowledge and information about ecological problems that require fast action in order to improve one's attitude (Paco & Lavrador, 2017).

Environmental Behavior
Any action taken by a person to assist or enhance the benefit of others is referred to as behavior (Sahrir et al., 2022; Morren & Grinstein, 2016). Past studies on behavior have shown differences in findings on the level of awareness and practice of the environment. A study conducted by Siti Mazwin Kamaruddin et al. (2016) showed that the community is aware of various problems related to the environment. However, their level of involvement is low. Similarly, in a study conducted by Mohammad Affendy Omardin & Nazirah Zainul Abidin (2014) where more than 75% of respondents indicated that they have a high level of concern for the environment but, the level of environmental practice is moderate. The findings are in line with the study conducted by Noor Azizah Samsudin & Zanaton H. Iksan (2015) where society is beginning to be aware and more sensitive to environmental issues. However, the awareness to be involved in overcoming the problem is still too low. Fatma Sadik and Semra Sadik (2014) claim that having awareness and knowledge does not always entail acting on what one knows. Evidence suggests that knowledge does not always convert into action.

According to Laurens (2012), a person's behavior toward the environment should be influenced by their feelings and beliefs about the environment as well as their pro-environmental acts. According to Laily Hj. Paim et al. (2013), it's critical to first pinpoint the precise behaviors that need to be altered in order to better shape behavior. This makes it simpler to carry it out, more effective, and makes it simpler to evaluate the success of the change program. For these specified behaviors to change from being just instructed to becoming habits, constant attention must be given to them. This is because repetition and reinforcement strategies can create habits.

In conclusion, raising people's awareness of and affection for the environment is one of the crucial measures for ensuring that it is protected by all parties. Additionally, action must be consistently encouraged because it is human behavior that determines how society affects the environment, and increased awareness will result in a change in activity.

RESEARCH DESIGN
This study uses a cross-sectional survey study design where the survey data is collected only once from the respondents. Survey research is the most popular and most widely used research design in the social sciences. To accomplish the study's goals, this research used a quantitative research methodology.

Questionnaires are the tool used to test environmental knowledge, environmental attitude, and environmental behavior. All three of the study's constructs were intended to be measured by the structured self-administered questionnaire. The communities in the Terengganu state river area that are considered to be contaminated are the subject of this study. The community that has been chosen is Kampung Laut, which is close to the Ibai River. Cluster sampling was used to randomly choose 78 respondents overall. This study focuses on local communities living near rivers because the destruction of ecosystems in river areas is often associated with those that are usually from waste disposal activities in the form of solids, liquids, and sewage. Data is analyzed descriptively and inferentially using the Statistical Package for Social Sciences (SPSS) version 21 while the spatial model used GIS. A geographic Information System is defined as a system for capturing, storing, examining, integrating, manipulating, analyzing, and displaying space-related data guided to the earth (Ang, 2015). The development of spatial model was developed to identify the level of knowledge, attitude, and behavior of the local community in Kampung Laut towards the conservation of the Ibai River whether high or otherwise.

ANALYSIS AND DISCUSSION
Environmental Knowledge Spatial Model
The spatial model showed the pattern of the mean values of the level of environmental knowledge in Kampung Laut. The areas are covered with the 3 colors representing the level of knowledge at a low (red), moderate (yellow), and high level (green). The minimal mean score value is below 2.999, which is categorized as a low level in Table 2 and Figure 1. Afterward, the intermediate level with a mean score value ranging from 3.001 to 5.999. Additionally, high level with a mean value of 6.000. With a percentage of 51.3%, respondents' overall understanding of topics relating to river conservation is quite strong. A moderate level of expertise is possessed by the remaining 48.7% of respondents.

Table 2: Distribution of Determination Mean Score of Knowledge Level

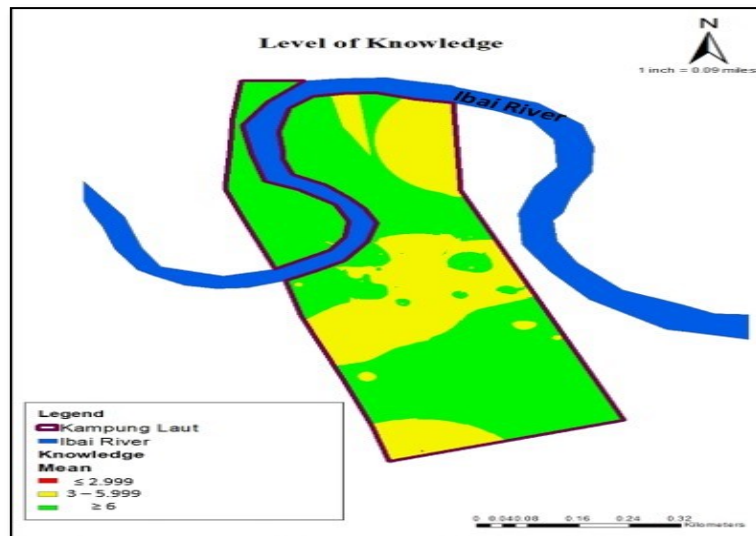| Mean value	Level	Percentage (%)
≤ 2.999	Low	0
3.000 – 5.999	Moderate	48.7
≥ 6.000	High	51.3

Figure 1: The Level of Environmental Knowledge Spatial Model in Kampung Laut, Terengganu, Malaysia

The result shows that the respondents have good knowledge and understanding related to river conservation issues to ensure river sustainability. This may be due to the development of information technology (IT) nowadays making respondents IT literate and can access information and knowledge about the environment anytime and anywhere. In addition, sources of information and knowledge on the environment are easily available coupled with the role of the mass media which provides extensive coverage of environmental issues.

A high level of knowledge will typically motivate respondents to act appropriately (Paco & Lavrador, 2017). An understanding of environmental care is important because it can help maintain environmental sustainability. This is because the aspect of knowledge is a guide to society in making decisions.

Environmental Attitude Spatial Model
The spatial model showed the pattern of the mean values of the level of environmental attitude in Kampung Laut. The areas are covered with the 3 colors representing the level of attitude at a low (red), moderate (orange), and high level (yellow). Based on Table 3 and Figure 2, the minimum mean score value is below 2.999 classified as a low level. Afterward, the intermediate level with a mean score value ranging from 3.001 to 5.999. Additionally, high level with a mean value of 6.000. With a percentage of 57.7%, respondents' attitudes toward concerns of river protection are generally at a moderate level. The remaining

48.7% of respondents have a moderate level of knowledge. The results also showed that 39.7% of respondents had attitudes at a high level while 2.6% of respondents had attitudes at a low level.

Table 3: Distribution of Determination Mean Score of Attitude Level

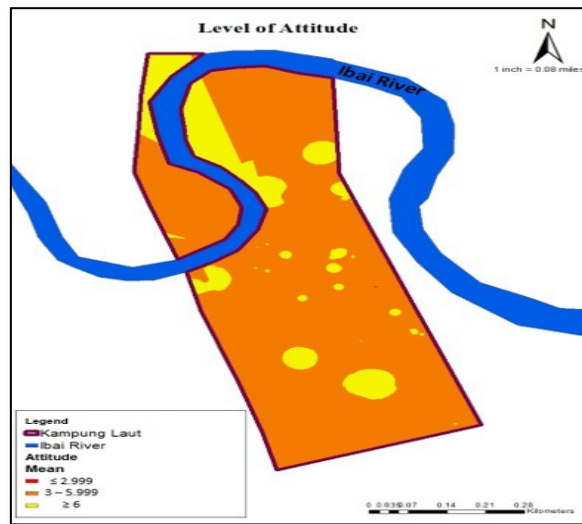| Mean value	Level	Percentage (%)
≤ 2.999	Low	2.6
3.000 – 5.999	Moderate	57.7
≥ 6.000	High	39.7

Figure 2: The Level of Environmental Attitude Spatial Model in Kampung Laut, Terengganu, Malaysia

This indicates that respondents exhibit less good attitudes or behaviors toward river conservation. The indifference of the community such as dumping garbage evenly is the main cause of river pollution. The attitude of the respondents on issues related to the conservation of the river and its care is important to know so that the strategy adopted will get to generate maximum involvement of all parties. In turn, responsible societal attitudes will have a positive impact on the environment and quality of life (Tucker & Izadpanahi, 2017).

Environmental Behavior Spatial Model
The spatial model showed the pattern of the mean values of the level of environmental behavior in Kampung Laut. The areas are covered with the 3

colors representing the level of knowledge at a low (red), moderate (yellow), and high level (green). The minimal mean score value is below 2.999, which is categorized as a low level in Table 4 and Figure 3. Afterward, the intermediate level with a mean score value ranging from 3.001 to 5.999. Additionally, high level with a mean value of 6.000. According to the data as a whole, 65.4% of respondents' behavior toward river conservation is at a low level. 34.6% of respondents, according to the findings, exhibited moderate behavior.

Table 4: Distribution of Determination Mean Score of Behavior Level

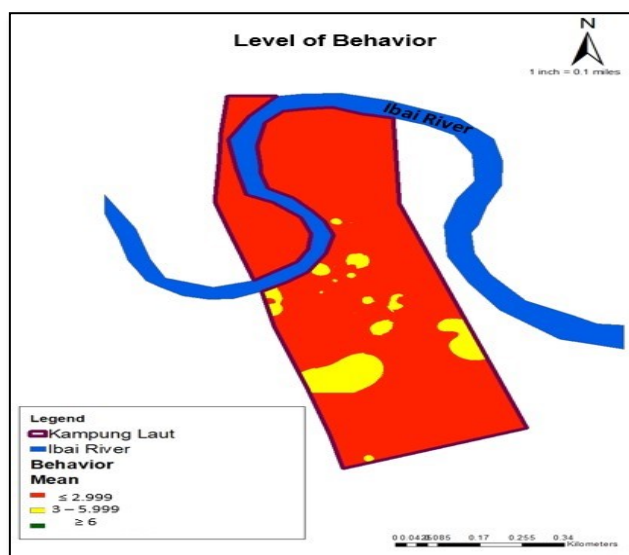| Mean value	Level	Percentage (%)
≤ 2.999	Low	65.4
3.000 – 5.999	Moderate	34.6
≥ 6.000	High	0

Figure 3: The Level of Environmental Behavior Spatial Model in Kampung Laut, Terengganu, Malaysia

The results of these findings show that respondents do not behave well in river conservation. Detailed analysis showed that respondents lacked support in terms of making financial contributions to river conservation. The analysis also showed that respondents did not show interest and lacked awareness in discussing issues related to river conservation. In addition, respondents also do not tend to be involved in organizing activities to address the issue of river pollution.

This indicates that the various approaches and efforts to preserve and conserve the environment held at present have not been able to foster consistent behavior in environmental care. Many believe that river pollution should not have happened, yet their actions are not in line with their thinking. They do not try to make something to symbolize their appreciation for the environment.

The Relationship of Knowledge and Attitudes Towards Environmental Behavior

Correlation tests were conducted to determine the relationship between the two variables. It aims to obtain a significant correlation between the two variables. Table 5 shows the results of the analysis of the relationship between knowledge and attitudes toward respondents' behavior on river conservation. Knowledge and attitude showed did not correlate with environmental behavior because the p-value was above the alpha value of 0.05. This result shows that knowledge and attitudes are seen as unable to influence the way a person behaves. This is because individuals will act as if they know about things that need to be done. It can be concluded that the high level of knowledge within the local community does not have a strong impact on river conservation behavior. This means that even if they have a high level of knowledge about environmental conservation, they will not necessarily adopt environmentally friendly behaviors in their daily lives (Ismail & Amin, 2020).

Table 5: Correlation Between Knowledge and Attitude with Environmental Behavior

Variables	Environmental Behavior	
	Pearson Correlation (r)	**p**
Environmental Knowledge	-.149	.194
Environmental Attitude	.106	.356

CONCLUSION

The destruction and manipulation of the environment due to irresponsible human activities seem to be difficult to curb. Human activities have been recognized to have a significant impact on the environment, especially in terms of pollution. One of the problems with environmental change that is directly tied to daily life and health is the issue of reducing river water quality. Humans should understand that some ecological environments are fragile and vulnerable. Man's attitude that changes the environment dominantly to affect the balance of nature is one of the factors that exacerbate the disaster. A sustainable river ecosystem depends on the community's knowledge, attitude, involvement, and comprehension of the negative impacts of one person's actions. Thus, understanding ecosystems needs to be widely promoted. It is time for the community to put the importance of the

environment, especially the river as the main agenda in their lives and strive to save this invaluable property from further destruction. Individuals play a role in raising public awareness that these ecosystems function in interconnectedness. The well-being of the river can only be achieved if all levels of society play their respective roles responsibly.

REFERENCES
Ainul Marziana M. Mahidin, & Suhardi Maulan. (2012). Understanding children preferences of natural environment as a start for environmental sustainability. *Procedia - Social and Behavioral Sciences*, 38, 324–333.

Asmawati Desa, Nor Ba'yah Abd Kadir, & Fatimah Yusooff. (2011). A study on the knowledge, attitudes, awareness status and behaviour concerning solid waste management. *Procedia - Social and Behavioral Sciences*, 18, 643–648.

Department of Environment Malaysia. (2020). Environmental Quality Report. Retrieved from https://enviro2.doe.gov.my/ekmc/digital-content/laporan-kualiti-alam-sekeliling-environmental-quality-report-2020/

Fatma Sadik, & Semra Sadik. (2014). A study on environmental knowledge and attitudes of teacher candidates. *Procedia - Social and Behavioral Sciences*, 116, 2379–2385.

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology, 65*(17), 541–79.

Hua, A. K. (2019). Applied structural equation model in sustainable development of water resources management. *Journal of Water and Land Development, 42*(VII–IX), 83–90.

Ibrahim Kamoo. (2000). Antara tuntutan pembangunan dan pemuliharaan alam sekitar: Suatu pertentangan? In Abu Bakar Abdul Majeed & Abu Bakar Yang (Eds.), Pengurusan Bijak Alam Sekitar (pp. 43–66). Kuala Lumpur: Institut Kefahaman Islam Malaysia.

Ismail, W. N. A. T., & Amin, A. (2020). Examining the relationship between factors influencing environmental behavior among polluted river communities. *International Journal of Advanced Science and Technology, 29*(7s), 479–487.

Khazi, H. (2019). Pencemaran sumber air: LUAS terus pantau situasi di Sungai Selangor. Berita Harian Online. Retrieved from https://www.bharian.com.my/berita/kes/2019/07/587897/pencemaran-sumber-air-luas-terus-pantau-situasi-di-sungai-selangor

Kozaki, D., Norhasmira Idayu Harun, Chong, C. H., Murni Hayati Esraruddin, Nor Atiah Yunus, Aini Syazana Derahman, Mashitah M. Yusoff. (2019). Identification of polluted sites in four major rivers in Kuantan , Malaysia based on water chemistry estimates of aquatic microbial activity. *Sustainability (Switzerland), 11*(3813), 1–19.

Laily Hj. Paim, Mumtazah Othman, Ahmad Hariza Hashim, Sharifah Azizah Haron, Syuhaily Osman, & Jariah Masud. (2013). Membudayakan penggunaan lestari. Selangor: Persatuan Ekonomi Pengguna dan Keluarga Malaysia (MACFEA).

Laurens, J. M. (2012). Changing Behavior and Environment in a Community-Based Program of the Riverside Community. *Procedia - Social and Behavioral Sciences*, 36, 372–382.

Lee, I., Hwang, H., Lee, J., Yu, N., Yun, J., & Kim, H. (2017). Modeling approach to evaluation of environmental impacts on river water quality: A case study with Galing River, Kuantan, Pahang, Malaysia. *Ecological Modelling*, 353, 167–173.

Ling, T. Y., Soo, C. L., Phan, T. P., Nyanti, L., Sim, S. F., & Grinang, J. (2017). Assessment of water quality of Batang Rajang at Pelagus area, Sarawak, Malaysia. *Sains Malaysiana, 46*(3), 401–411.

Md. Sadek Uddin Chowdhury, Faridah Othman, Wan Zurina Wan Jaafar, Nuzaima Che Mood, & Md. Ibrahim Adham. (2018). Assessment of pollution and improvement measure of water quality parameters using scenarios modeling for Sungai Selangor Basin. *Sains Malaysiana, 47*(3), 457–469.

Mohammad Affendy Omardin, & Nazirah Zainul Abidin. (2014). Konsep dan amalan kesedaran terhadap isu-isu alam sekitar di peringkat awalan projek pembinaan melalui fasa pengurusan nilai. In Social Sciences Postgraduate International Seminar (SSPIS) 2014 (pp. 173–194).

Morren, M., & Grinstein, A. (2016). Explaining environmental behavior across borders: A meta-analysis. *Journal of Environmental Psychology*, 1–55.

Noor Azizah Samsudin & Zanaton H. Iksan. (2015). Kesedaran Alam Sekitar Melalui Aplikasi Kendiri Alam Sekitar (KAKAS). *Jurnal Personalia Pelajar, 18*(2), 31–44.

Nor Kalsum Mohd Isa. (2016). Pengetahuan, sikap dan tingkah laku pelajar UPSI terhadap prinsip-prinsip kampus lestari. *Jurnal Perspektif, 8*(1), 29–41.

Paco, A., & Lavrador, T. (2017). Environmental knowledge and attitudes and behaviours towards energy consumption. *Journal of Environmental Management*, 197, 384–392.

Poon, W. C., Herath, G., Sarker, A., Masuda, T., & Kada, R. (2016). River and fish pollution in Malaysia: A green ergonomics perspective. *Applied Ergonomics*, 57, 80–93.

Rohman, M. A. P. (2019). Semua 111 sekolah di Pasir Gudang diarah tutup. Berita Harian. Retrieved from https://www.bharian.com.my/berita/nasional/2019/03/540647/semua-111-sekolah-di-pasir-gudang-diarah-tutup

Sahrir, S., Ponrahono, Z., & Sharaai, A. H. (2022). Modelling the community adaptive behaviour towards air pollution: A confirmatory factor analysis with pls-sem. *Planning Malaysia*, 20.

Sahrir, S., Yalçınkaya, N. M., & Say, N. (2022). Exploring risk perception and intention to improve the air quality. *Planning Malaysia*, 20.

Siti Mazwin Kamaruddin, Puziah Ahmad, & Norsyamira Alwee. (2016). Community awareness on environmental management through Local Agenda 21 (LA21). *Procedia - Social and Behavioral Sciences*, 222, 729–737.

Tirgar, A., Aghalari, Z., Sillanpää, M. et al. (2020). A glance at one decade of water pollution research in Iranian environmental health journals. *International Journal of Food Contamination 7(*2).

Tuan Fauzan Tuan Omar, Ahmad Zaharin Aris, Fatimah Md. Yusoff, & Shuhaimi Mustafa. (2019). Occurrence and level of emerging organic contaminant in fish and mollusk from Klang River estuary, Malaysia and assessment on human health risk. Environmental Pollution, 763–773.

Tucker, R., & Izadpanahi, P. (2017). Live green, think green: Sustainable school architecture and children's environmental attitudes and behaviors. Journal of Environmental Psychology, 51, 209–216.

Xu, H., Qiang Gao, & Yuan, B. (2022). Analysis and identification of pollution sources of comprehensive river water quality: Evidence from two river basins in China. Ecological Indicators, 135, 1–13.

Zaid Mohd Noor. (2021, May 10). Pencemaran Sungai Petani semakin serius. Utusan Malaysia Online. Retrieved from https://www.utusan.com.my/nasional/2021/05/pencemaran-sungai-petani-semakin-serius/