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APPLICATION OF GIS IN SPATIAL MODEL DEVELOPMENT OF ATTITUDE RESIDENTS TOWARDS RIVER POLLUTION: A CASE STUDY OF THE TERENGGANU RIVER BASIN, MALAYSIA

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Abstract

Like any other country, Malaysia also faces environmental issues and should not be separated from the threat of water quality deterioration that contributes to river pollution. River pollution occurs due to the community's irresponsible attitude that ignores its importance as a life source. This study aims to develop a spatial model of attitude towards river pollution using GIS. This study used a survey method, which is purposive sampling through questionnaires, involving 396 respondents. The findings were analyzed using XLSTAT to obtain the mean value. GIS was then applied to implement buffer analysis and spatial analysis. The Attitude model was then successfully developed. The study's findings show that the number of people living in Kampung Menerung and Kampung Lubuk Periuk is low. A moderate level of attitude is represented by the people living in Kampung Pasir Pelatar, Kampung Jenagur, Kuala Berang, Kampung Lerek, Kampung Tanggul, Kampung Kuala Ping, Kampung Pelong, Kampung Payung, and Kampung Merbau Menyusut. Next, the findings show the high level of attitude is represented by people living in Kampung Langkap, Kampung Sungai Tong, Bandar Kuala Terengganu, Kampung Seberang Takir, Chabang Tiga, Lapangan Terbang Sultan Mahmud, Manir, Kampung Peradung, Kampung Kuala Jeneris, Kampung Kuala Tajin, and Kampung Kuala Telemong. The study results show that GIS usage is the best approach to assist decision-making for the stakeholders. Therefore, future studies should focus on various variables, including environmental awareness, environmental concerns, environmental values, environmental practices, and involve GIS in solving environmental issues.

Keywords: Attitude, River Pollution, GIS, Terengganu River Basin, Malaysia

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INTRODUCTION

Like any other country, Malaysia also faces environmental issues and should not be separated from the threat of water quality deterioration that contributes to river pollution (Abdullah, 2004). According to Ma'arof & Hua (2015) and Mohd Khairul Amri Kamarudin et al. (2015), river pollution is dissolved chemicals in river water that threaten life. Based on a report released by the Department of Environment (DOE) in 2017, it was found that there are 51 polluted rivers in Malaysia. One of them is the Kim Kim River, located in Johor, due to irresponsible people's disposal of toxic waste, which has negatively impacted people's lives, water quality, aquatic life, and national administration (Utusan, 2019).

The damage that occurred in the environment resulted from the increase in population, which demands development. As a result of this irresponsible attitude, the people are categorized as the major contributors to environmental problems (Wan Nor Azilawanie Tun Ismail & Aziz Amin, 2020; Hanafiah et al., 2019; Yaakob & Moris, 2012; Jaafar et al., 2010). A study conducted by previous researchers proved that the Malaysian public attitude toward the environment is still low (Wan Nor Azilawanie Tun Ismail & Aziz Amin, 2020a and Jamilah Ahmad et al., 2011).

According to the Department of Irrigation and Drainage (DIS) (2016), Sungai Hiliran, part of the Terengganu River Basin, has been contaminated because of commercial activities. Based on the studies conducted by Suratman, Sailan, Hee, & Latif (2015), the average water quality index value in the Terengganu River Basin was approximately 71.5% to 94.6%, which is classified as slightly polluted to clean (Mohd et al., 2019; Wahab et al., 2019; Nalado et al., 2017). While the Terengganu River Basin has been contaminated, it still can be preserved in various ways (Nur Usani Anuar et al., 2019). The limited capacity to solve environmental problems has created various conferences at multiple levels, such as Stockholm Conference in 1972, Tbilisi in 1976, etc.

The Malaysian Plan also emphasizes environmental management at the local level. Therefore, the community's well-being can be achieved easily if activities emphasize the importance of the environment, as a clean environment requires continuous preservation efforts from various parties (Rasdi et al., 2022; Azinuddin et al., 2022). However, although various efforts have been made, human activities that destroy the environment's quality have increased and continue to put the environment seriously (Sahrir et al., 2022). Therefore, this article aims to develop a spatial model of attitude toward river pollution.

LITERATURE REVIEW

According to Petty & Brinol (2010), attitude is an expression of what people like or dislike, support or disprove, positive or negative views of individuals, objects,

and events. At the beginning of 1960, sociologists and environmental researchers introduced studies related to environmental attitudes, Yu (2014), who also studied social psychology (Mostafa, 2007). In this case, environmental attitudes were shaped by individual beliefs and values that ultimately shape verbal commitment, actual commitment, motivation, and intention to act (Zareie & Navimipour, 2016).

The scale widely used to measure human attitudes toward the environment is called the new environmental paradigm, known as the new ecological paradigm, founded by Dunlap & Van Liere's in 1978 (Dunlap et al., 2000; McIntyre & Milfont, 2015). The concept of a new environmental paradigm focuses on the belief that humans can easily damage the environmental balance, that there is a lack of several individuals capable enough to protect the environment, and that humans have the right to control the environment (Dunlap et al., 2000; Lundmark, 2007). Thus, this scale is a basis for developing attitudes to be shaped into pro-environmental behaviors (Dunlap et al., 2000).

METHOD

This study involved 22 areas that are located around the Terengganu River Basin. Areas of study involved four districts, namely Hulu Terengganu, Setiu, Kuala Terengganu, and Kuala Nerus. This study used non-probability sampling by applying the purposive sampling technique. Data collection was conducted through the survey method using a questionnaire as an instrument. A total of 396 respondents participated in this study.

In this study, two analytical methods were used, which are Statistical Software for Excel 2014 (XlStat2014) and ArcMap or ArcGis 10.2, a Geographic Information System (GIS) application. XLSTAT was used to analyze attitudes by using descriptive statistics to obtain mean values. GIS was applied to implement buffer analysis and spatial analysis. Before both analyses were carried out, data for each studied location were collected using the Global Positioning System (GPS). The coordinates obtained from the GPS were based on the coordinate system Latitude and Longitude. After identifying the areas of study located along the Terengganu River Basin, the areas' coordinates were then marked on Google Earth. Using Google Earth, screen digitizing was performed in point, line, and polygon to build a data point for each study area identified. Data built into Google Earth was then converted into the Keyhole Markup Language (KML) format, then transferred into GIS.

In this study, the GIS function was to interpolate the mean data of attitude scores to form spatial models. The space interpolation process was then performed using the Inverse Distance Weighting (IDW) technique to produce a spatial model based on the mean score. Spatial interpolation techniques are an

attribute estimation process with the value of the data recorded by generating new data values (Siti Haslina et al., 2018).

Based on the buffer analysis, residents must live no less than 500 meters from the riverbank. The 500 meters were specified because people living near the riverbank area within the range contributed to the pollution. For spatial analysis, the database involved an overall mean of attitude at each study location, while the geographic base involved the map of the Terengganu River Basin's surroundings. Figure 1 shows the Terengganu River Basin's map.

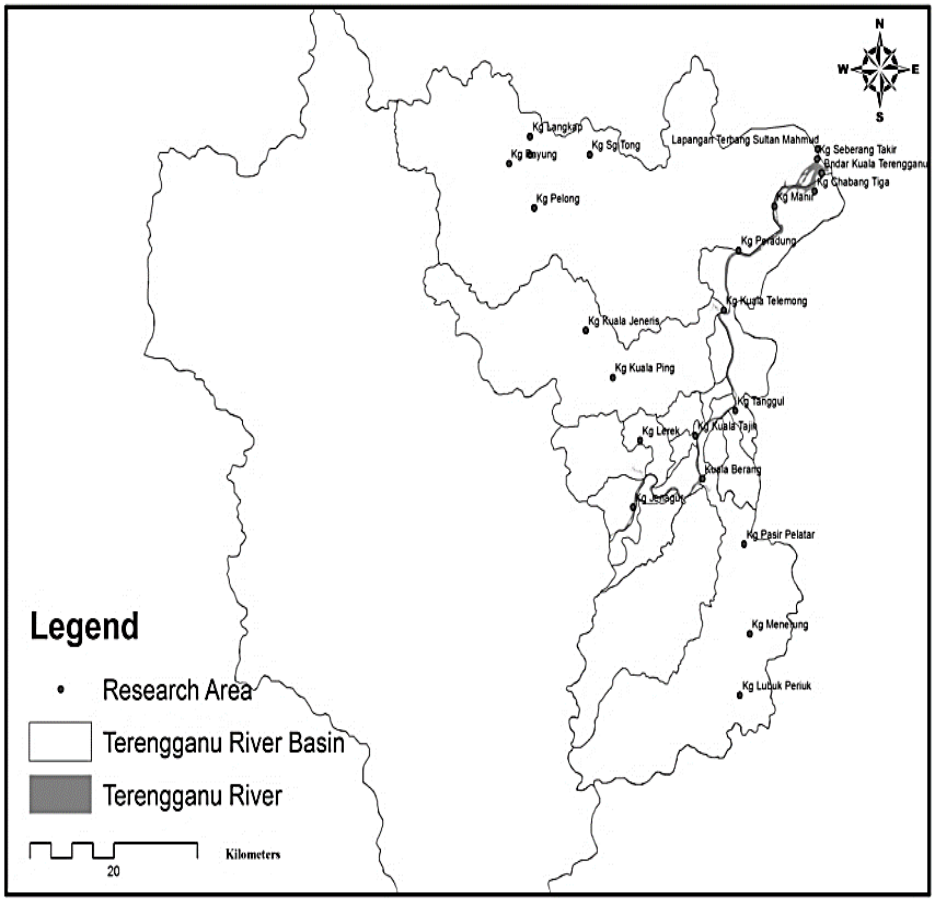

Figure 1: Terengganu River Basin Map
Source: (Norshahida Akma Alias, 2020)

RESULT AND DISCUSSION

Table 1 shows the mean scores for the attitude variables and the mean value obtained from the study areas.

Table 1: Mean Score of Attitude Towards River Pollution.

No.	Areas of Study	Mean Value
1	Kg Kuala Jeneris	5.110
2	Kg Kuala Ping	4.908
3	Kg Lerek	4.857
4	Kg Kuala Tajin	5.188
5	Kuala Berang	4.678
6	Kg Pasir Pelatar	4.796
7	Kg Tanggul	5.093
8	Kg Kuala Telemong	5.087
9	Kg Menerung	3.952
10	Kg Lubuk Periuk	3.904
11	Kg Jenagur	4.586
12	Kg Seberang Takir	5.153
13	Lapangan Terbang Sultan Mahmud	5.097
14	Bndar Kuala Terengganu	5.596
15	Chabang 3	5.676
16	Manir	5.514
17	Kg Peradung	5.195
18	Kg Pelong	4.686
19	Kg Langkap	5.387
20	Merbau Menyusut	4.702
21	Kg Sg Tong	5.485
22	Kg Payung	4.809

Source: (Norshahida Akma Alias, 2020)

The model was developed based on the data from the mean score of attitude variables toward river pollution. The findings show that population distribution based on each study's attitude level can be differed according to the color distribution.

Three colors were produced in the spatial model, and the colors represent each level of attitude, as shown in Figure 2. The results from the map show that the attitude level measurement scales representing the lowest values are (3.90-4.49), the medium values (4.49-5.08), and the high values (5.08-5.67). The results of the attitude towards river pollution at the Terengganu River Basin are described in Figure 2.

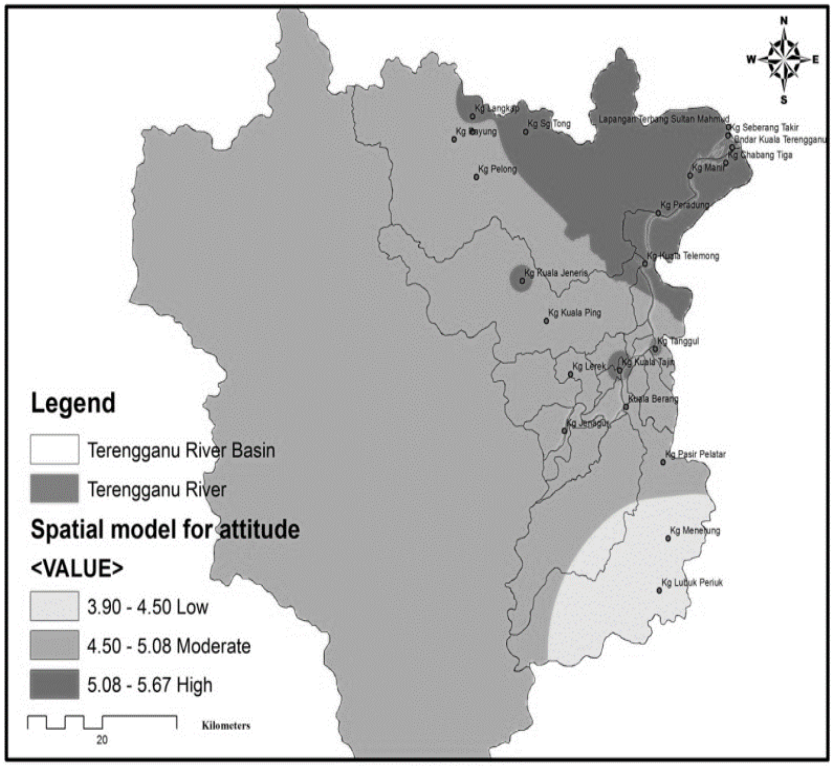

Figure 2: Spatial Model for Attitudes Toward River Pollution
Source: (Norshahida Akma Alias, 2020)

The study's findings show that the number of people living in Kampung Menerung and Kampung Lubuk Periuk is low, which parallels the studies conducted by (Jamilah Ahmad et al., 2011; Tamby Subahan Mohd Meerah, Lilia Halim, & Nadeson, 2010). The findings show the locations of the study were in the rural areas in Hulu Terengganu District. Environmental education can be an intervention that can change society to have environmental knowledge. Therefore, knowledge can help improve understanding, thus fostering awareness and changing people's attitudes toward a more sustainable life (Bakar, Osman, & Hitam, 2020).

The findings show that a moderate level of attitude was represented by people living in Kampung Pasir Pelatar, Kampung Jenagur, Kuala Berang, Kampung Lerek, Kampung Tanggul, Kampung Kuala Ping, Kampung Pelong, Kampung Payung and Kampung Merbau Menyusut. The findings parallel with studies conducted by (Abun & Aguot, 2017; Ali, 2015; Patial, 2016). The results show that people in this area were still sensitive toward river pollution issues.

According to Mahadi & Yusof (2003), people are more susceptible to environmental issues when the problem occurs in their environment. When they become aware of the problem, efforts to conserve the environment will be taken to prevent water quality, aquatic life, and human life. Therefore, environmental campaigns are one of the alternatives that can help people better understand river pollution. Thus, the government, non-governmental organizations and others should organize the campaign to educate and bring awareness to the community about the importance of river conservation.

Lastly, the findings show the high level of attitude is represented by people living in Kampung Langkap, Kampung Sungai Tong, Bandar Kuala Terengganu, Kampung Seberang Takir, Chabang Tiga, Lapangan Terbang Sultan Mahmud, Manir, Kampung Peradung, Kampung Kuala Jeneris, Kampung Kuala Tajin, and Kampung Kuala Telemong. The findings parallel with studies conducted by (Abun & Aguot, 2017; Arbaat, Norshariani, & Sharifah Intan Sharina, 2010; Bozoglu, Bilgic, Topuz, & Ardali, 2016; Majumder, 2019; Shahzadi, Hussain, Afzal, & Gillani, 2018; Sultana, Hossen, & Khatun, 2017). Community involvement is vital to those who have a direct impact on environmental issues. Community cooperation can address river pollution because commitment shown through community involvement can contribute to the formation of a positive attitude towards river pollution. Thus, the participation of various parties is essential in raising environmental concerns.

CONCLUSION

Residents who live near the river should be responsible for maintaining the river environment. Efforts to keep the river clean are not only focused on them but also on each individual's responsibility. The findings show that there were two areas with low levels of attitude. With the use of GIS technology combined with environmental elements, it should be highlighted that it can help stakeholders decide.

This result allows the Department of Environment (DOE), the Department of Irrigation and Drainage (DID), and the university needs to find a solution to improve awareness, especially for Kampung Menerung dan Kampung Lubuk Periuk. This study focuses on the elements of attitudes that can influence river pollution. Therefore, future studies need to focus on various variables, including environmental awareness, environmental concerns, environmental values, and environmental practices. They should also involve using GIS in solving environmental issues as these aspects are essential indicators that can contribute to the formation of environmental sustainability.

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