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GIS-BASED SPATIAL MODELLING TO ENHANCE TOURISM RESILIENCE AND CONSERVATION FOR SUSTAINABLE LEADERSHIP IN COASTAL COMMUNITIES

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Abstract

This study aims to create a spatial model for sustainable leadership in coastal communities to improve both tourism resilience and conservation efforts in those areas. The idea of this study stemmed from the need to better understand the importance of sustainable leadership in developing coastal communities and tourism. 366 respondents from the coastal areas in Kuala Terengganu and Marang answered the questionnaire. The statistical tool and geographical information system (GIS) were used to analyse the data. The findings show that critical thinking abilities, ethical and moral skills, and community involvement in tourism development have significant positive effects on sustainable leadership, making them vital elements in driving sustainable leadership forward. Cluster analysis groups the five sustainable leadership practices into three categories. Apart from certain domains like critical thinking, ethical and moral concerns, and sustainable leadership, the spatial analysis results show that sustainable leadership practices are typically strong in Kuala Terengganu and Marang. GIS analysis reveals a high density of sustainable leadership practices in coastal communities across different scales. The application of statistical analysis coupled with GIS can effectively identify the sustainable leadership that leaders in coastal areas adhere to.

***Keywords**:* Coastal Community, GIS, Spatial Model, Sustainable Leadership, Tourism

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INTRODUCTION

GIS has been welcomed as a crucial instrument for problem-solving and decision-making in many academic fields (Fazillah et al., 2018). GIS technology reveals geographic patterns that are not visible in traditional statistics by displaying data on the easily understandable maps (Toriman et al., 2015). GIS can be used for a variety of purposes, including in many fields of environmental management. Theoretically, GIS could also be used as a synthesizing tool for the management of interventions aiming at effective management. Furthermore, the development of GIS-based simulation models improves the accuracy with which environmental and planning problems are solved (Wang et al., 2019). A great deal of research places a strong emphasis on geographic visualization, which makes use of GIS tools to effectively present data and depict patterns.

Sustainable leadership is an innovative leadership strategy that improves organizational performance by addressing current and future environmental, economic, and social goals. Sustainable leadership is necessary in managing sustainability, of which is a constantly expanding and demanding area inside an organization, as its development is based on three pillars; social, economic and environmental factors (Abdullah et al., 2024; Abdullah et al., 2024). To achieve sustainability, leaders must be able to foster long-lasting behaviours in their communities and institutions, which will in turn stimulate economic growth (Iqbal et al., 2020). In 2003, Andy Hargreaves and Fink established the leadership strategy known as "Sustainable Leadership" (Phing & Karuppannan, 2022). Sustainable leadership is an effective leadership approach capable of influencing the entire organization as well as external groups to collaborate in order to achieve desired outcomes (Iqbal & Piwowar-Sulej, 2022).

RESEARCH PROBLEM AND LITERATURE REVIEW

Since sustainable development was first introduced into the field of organizational management by the Brundtland committee, the idea of sustainable leadership has evolved (Dzimińska et al., 2020). The existing body of knowledge on sustainable practices, sustainability principles and environmental leadership suggests that these leadership styles play an important role in achieving sustainability goals to attain long-term success of striking a balance between social responsibility and economic achievement (Suriyankietkaew et al., 2022). There is not a single, thorough definition of sustainable leadership in the body of current literature. The assessment does, however, draw attention to a number of important issues, such as the need for social and environmental responsibility, organizational preservation, shared accountability, moral and ethical behaviour, continuous development, and the impact of organizational culture on sustainability objectives (Boeske, 2023). Research on sustainable leadership has come a long way in the last few years with an abundance of study on sustainable

leadership in the literature, most of which focuses on studies conducted in the field of education (Liao, 2022). The concept of sustainable leadership just keeps evolving over time. Consequently, the attributes of sustainable leadership differ according to the particular role the leader plays within the company. Developing the operationalization of sustainable leadership presents future research opportunities across various contexts. This involves creating diverse theories tailored to the specific direction and context of each study.

Therefore, sustainable leadership is crucial in enhancing the quality of tourism development in coastal communities and realizing sustainability visions. Sustainable leadership in coastal communities and tourism entails good resource management and stewardship, both natural and human, to maintain the long-term viability and resilience of coastal destinations while still benefiting local communities. An effective sustainable leadership guides the vision and direction of tourism endeavours, ensuring that they match the community's needs and goals while simultaneously encouraging environmentally friendly practices. A series of research have indicated that GIS can be used as an analytical platform for studying tourism trends. Avdimiotis et al. (2006) used GIS applications as tools for tourism planning and education in Chalkidiki after discovering that coastal areas experience demand from May to October, peaking particularly in July and August, based on the analysis of tourism flows in various other regions. Foreign tourists are found to stay longer than domestic tourists, with Greek vacationers peaking between May and October while foreigners arrive steadily throughout the year. Chalkidiki is also discovered to primarily attract middle-class Central European tourists who prefer scheduled tour packages. In another study by Jovanović and Njeguš (2008) on the tourism potential of the Cajetina and Nova Varos municipalities, GIS was also continuously used, both theoretically and technically, providing tourism information in an integrated manner and being of immense benefit not only to the region but to Serbia as a whole. Another study by Rosa-Jiménez et al. (2016) presents a technique of using spatial data to map a mature destination in Benalmádena, Spain. The study concludes that the evolution in the destination's appeal from sun and beach to sun and water, the emergence of tourism hotspots, and the discovery of the public areas is what attracts the visitors the most.

Through GIS, this study seeks to identify the spatial distribution of sustainable leadership practices in the coastal communities and tourism in the study area and correlate the location data with the features. Spatial modelling of sustainable leadership and the identification of effective practices by leaders are essential for organizing and controlling changes in the environment, economy, society and population at different geographic dimensions (Alshuwaikhat & Aina, 2006; Avdimiotis et al., 2006). In Malaysia, Terengganu is regarded as an affluent state, mostly because of its copious marine resources. These resources

have helped Malaysia become one of the world's most popular travel destinations, and have promoted its economic growth, raising the living standards for the coastal communities (Masud et al., 2017). This study aims to identify the role of sustainable leadership practices in coastal communities and tourism in Kuala Terengganu and Marang, two districts in Terengganu. To that end, a suitable questionnaire was developed to explore the geospatial distribution of sustainable leadership practices in the study area. Spatial model allows more accurate and informative decision-making to assist sustainable leadership in managing changes and development within the coastal communities and the tourism sector.

RESEARCH METHODOLOGY

Study Area

This study was conducted in two districts (Marang and Kuala Terengganu) in Terengganu, Malaysia (Figure 1). The study area is located along the shore of the South China Sea. The coordinates are 5.3302 N, 103.1408 E for Kuala Terengganu and 5.207053 N, 103.205299 E for Marang. Marang district is located adjacent and 20 km from Kuala Terengganu. Historically, coastal towns have been filled with people who work as coastal fishermen. These areas were selected because they are located on the coastline and have currently been popular tourist destinations.

Research Design

The study used a quantitative research design, with questionnaires serving as the main methodological instrument for gathering data. This methodology has been proven effective since it enables the examination of sustainable leadership through the lens of societal perspectives. This approach allowed quantitative data collected from coastal communities in the research region to be consistently monitored and evaluated, making it easier to identify and investigate relevant issues. A pilot study was carried out by the researchers to verify the validity and reliability of the questionnaire items before conducting the actual study. The questionnaire used for this study is divided into six parts; Socio-demography, A, B, C, D and E, and contains 25 items on a 5-point Likert scale ranging from "strongly agree (5)" to "strongly disagree (1)".

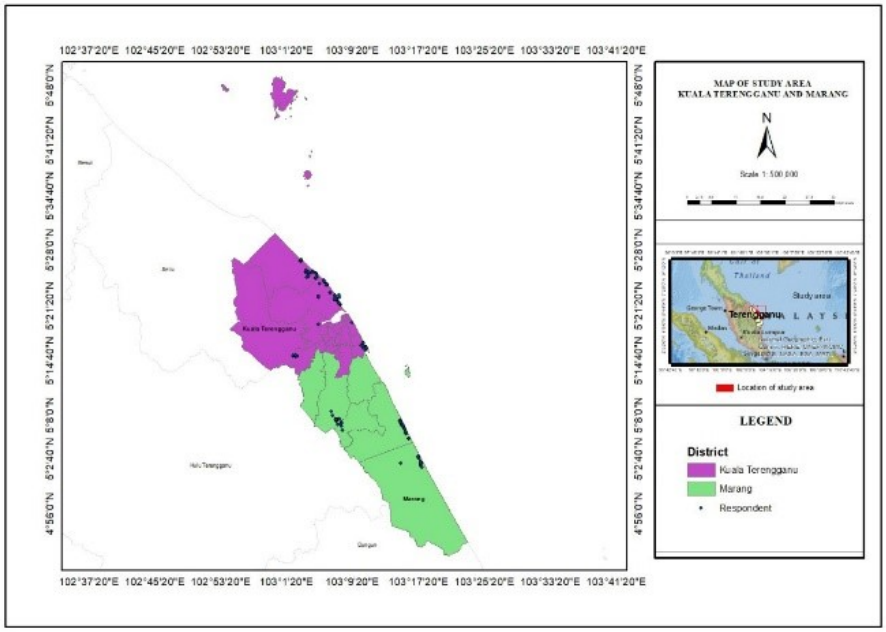

Figure 1: Map of Study Area, Showing the Location of Kuala Terengganu and Marang

Data Collection

Data collection for this study includes the creation of printed questionnaires, which were distributed to coastal communities in Kuala Terengganu and Marang by research assistants. Purposive sampling was used to select specific residents for questionnaire distribution. Notably, this method is a non-probability sampling technique. The questionnaire is divided into six sections, one for collecting the respondents' demographic information and others for identifying variables connected to sustainable leadership. In total, 366 survey questionnaires were distributed to coastal villages throughout the study area. Based on a preliminary study of 25 items assessed among 30 coastal residents in Kuala Terengganu, which does not include the data from the actual study's participants, the Cronbach's Alpha value is 0.782, with the range of all items between 0.753 and 0.793. The Terengganu topography map was digitized using ArcGIS 10. Once the pertinent portions of the map were extracted, the study regions were chosen using the "Select by Attribute" feature. During the process of gathering data, the GPS coordinates of the respondents were recorded. These coordinates were subsequently combined with the data gathered to create the attribute table for further process.

Data Analysis

The non-spatial data collected from the questionnaire surveys was re-entered into Microsoft Excel using sorting and coding techniques. The coded data were then analysed using the Statistical Package for Social Sciences (SPSS) version 26 for further statistical insights. It was used to run the following tests: Cronbach's alpha coefficient, general descriptive statistics, frequencies to assess the data, and representing the distribution and concentration of participant responses. Subsequently, the data was further analysed using the non-parametric tests, which are the Mann-Whitney test (U-test) and the Kruskal-Wallis H test. Multiple linear regression (MLR) was applied as well in this study to justify the relationship between the sustainable leadership practices with sustainable leadership itself. Using Ward's approach with squared Euclidean distances, Hierarchical Agglomerative Cluster Analysis (HACA) was performed on the standardized data.

The purpose of this investigation is to identify the differences between the coastal communities' sustainable leadership variables. A dendrogram was utilized to visually represent the results of the Cluster Analysis (CA) and provide insight into the homogeneity levels of the clusters (Fazillah et al., 2017). XLSTAT 2007 Microsoft statistical add-in was used to carry out the HACA procedure. Lastly, the GIS Arc Map 10.1 software was used to conduct graphical analyses aimed at identifying the spatial distribution of each sustainable leadership practice in the area. The interpolation method used was IDW (Inverse Distance Weighted) because of its excellent accuracy (Xu et al., 2020). The IDW approach, which assumes that anticipated values are comparable to those of neighbouring observation locations, is a simple yet efficient interpolation technique (Biswas et al., 2020). The IDW is a popular mathematical and geostatistical interpolation technique that is often used to predict target attributes. To calculate cell values, it uses a linearly weighted mixture of sample points (Yang et al., 2020).

ANALYSIS AND DISCUSSION

Socio-Demographic Profiles of The Respondents

366 respondents from coastal communities participated in this study. Descriptive frequencies were then used to evaluate the data. The respondents ranged in age of 25 – 34 (22.1%). The study involved about equal numbers of men (52.7%) and women (47.3%). Based on the participants' educational backgrounds, 89.3% had completed high school or a higher level of education. Additionally, the results reveal that the majority of the households (47.5%) have an average monthly income of below than RM1,500, while only 6.8% of them have a monthly income of more than RM4,500. It is also found that most households in the coastal areas generate income through a variety of occupations.

A Manne-Whitney test revealed a significant gender difference in responses to sustainable leadership practices. Males prefer that their leader have better communication skills ($z = -7.441$, $p = < 0.001$), critical thinking ($z = -3.553$, $p = < 0.001$), ethical and moral behaviour ($z = -3.254$, $p = 0.001$), sustainable leadership ($z = -1.972$, $p = 0.49$) and community involvement ($z = -5.053$, $p = < 0.001$), as compared to females. Next, to examine if there is a significant difference between sociodemographic factors of respondents which encompasses multiple classifications and sustainable leadership practices, Kruskal–Wallis H test was used. The Kruskal-Wallis H test was conducted on age, marital status, education level, occupation and monthly income. Out of the five sustainable leadership practices, the findings of the Kruskal–Wallis H test show that, there was a statistically significant difference among the four sustainable leadership practices according to these five sociodemographic factors (p value > 0.05), except for one particular practice (critical thinking) which did not differ regardless of the respondents' marital status, occupation and household income (p value > 0.05).

Sustainable Leadership Accelerators

MLR was employed to investigate the relationship of each sustainable leadership practice to the dependent variable (sustainable leadership). This enables the understanding of how each variable contributes to the larger construct of sustainable leadership. Table 1 shows an examination of the relationship between the constituents of sustainable leadership (communication skills, critical thinking skills, and ethical and moral behaviour) and the dependent variable of sustainable leadership. The findings confirm that the studied model is statistically significant ($sig = 0.000$; $F = 498.965$). The results indicate that critical thinking skills, ethical and moral behaviour, and community involvement in tourism development exert a significant positive impact on sustainable leadership, that they consequently act as the accelerators for sustainable leadership. Conversely, there is no support for communication skills, suggesting that it does not exert any statistically significant effect on sustainable leadership.

In this study, three variables meet the entry requirement to be included in the equation (critical thinking skills, ethical and moral behaviour, and community involvement in tourism development) with significant values of $p < 0.005$. The model's degree of predicting the dependent variable was found to be $R = 0.742$. The R-square of 0.551 implies that the three predictor variables make up about 55.1% of sustainable leadership, with ethical and moral behaviour shows the highest coefficients in multiple linear regressions, followed by critical thinking skills, community involvement in tourism development, and communication skills. These coefficients suggest that the model predicts the

dependent variable with a certain degree of skills or practices. Based on the multiple regression analysis results, the regression equation obtained is as below:

$$SL = 0.677 - 0.015\,\text{CS} + 0.311\,\text{CTS} + 0.425\,\text{EMS} + 0.117\,\text{CITD}$$

- *SL: Sustainable leadership
- CTS: communication skills
- EMS: ethical and moral skills
- CITD: community involvement in tourism development

Table 1: Coefficients for results of the multiple linear regression analysis for the dependent variable sustainable leadership

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	0.677	0.083		8.120	0.000
Communication skills	-0.015	0.015	-0.019	-0.982	0.326
Critical thinking skills	0.311	0.017	0.355	17.835	**0.000**
Ethical and moral skills	0.425	0.018	**0.448**	23.471	**0.000**
Community involvement in tourism development	0.117	0.015	0.153	8.068	**0.000**

Note: Dependent variable: sustainable leadership, *p < 0.05.

Similarities and the Grouping of Sustainable Leadership Practices

Cluster analysis was applied to the sustainable leadership practices according to the homogeneity of the observation, as stated in the questionnaire, to study the variation of sustainable leadership practices in the study area based on their similarity levels. When combining all the data from the two districts, the results show that the sustainable leadership practices are diversified into three significant groups in the hierarchical dendrogram at (Dlink /Dmax) × 100 (Figure 2).

In cluster 1, there are three variables that are clustered together, viz., critical thinking skills, ethical and moral behaviour, and sustainable leadership. These three variables are grouped together due to their similarities in emphasising on critical thinking-based decision-making as well as the effectiveness in ethical ideals and principles, in the context of leading and managing resources with sustainability as a goal. This cluster could be explained by its direction of

handling complexity and creating successful strategies; critical thinking requires analytical approaches and problem-solving techniques, while moral and ethical behaviour produces value-based and responsible decision-making that is advantageous to all parties involved. To promote resilience, adaptation, and ongoing development in tourism practices, sustainable leadership combines a strategic vision, evidence-based policies, and a balanced approach to economic, social and environmental goals. Researchers have discovered that sustainable leadership increases overall organizational effectiveness (Sezgin Nartgün et al., 2020), considerably improves environmental performance (Javed et al., 2021), and has a beneficial impact on organizational sustainability (Iqbal et al., 2020).

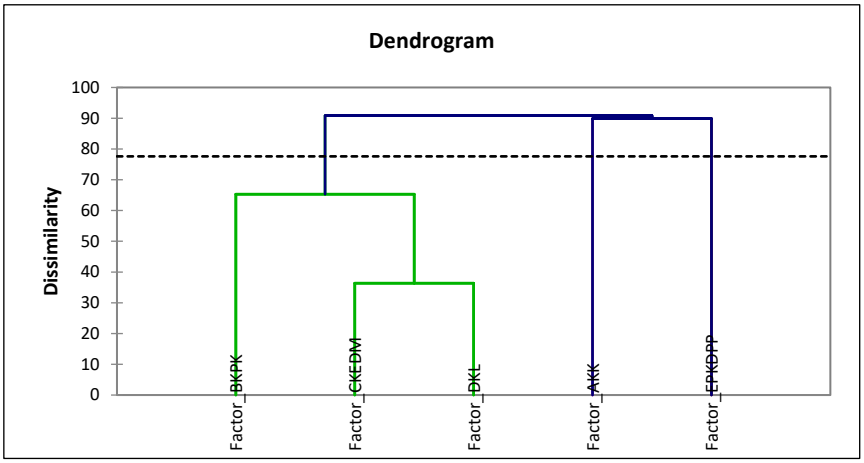

Figure 2: Sustainable Leadership practices dendrograms combining two districts

Cluster 2 demonstrates the importance of communication skills for sustainable leadership, which could boost self-efficacy. As a result, leaders are more equipped to inspire their communities, overcome challenges, and implement sustainable practices with assurance. This strategy contributes to the long-term profitability and sustainability of the tourism industry by improving organizational efficiency and guaranteeing a positive and sustainable experience for visitors. According to Armani et al. (2020), a leader who sets an example through their conduct and words will cause a ripple effect, which can influence the behaviour of others around them as well. Hanh (2023) asserts that proficient communication is a prerequisite for proactive community engagement, cultivation of trust and respect, and optimization of production. MacDonald and Shriberg (2016) also support this, claiming that communication skills are the most important skills in sustainable leadership.

Cluster 3 demonstrates the community's involvement in tourism development, which depends on its leader. It requires a deep commitment to the

well-being of others, and creating an environment conducive to the development of strength, resilience and vitality. It takes a holistic approach, focusing on human connections and ethical ideals to promote environmental and community concerns (Armani et al., 2020). In the context of the sustainability leadership criteria, cluster analysis can provide insights based on common traits. Furthermore, leaders can select ways or strategies appropriate to their situations from the peculiarities of various sets of criteria.

Spatial Distribution Pattern of Sustainable Leadership Practices

The five identified sustainable leadership practices in coastal communities and tourism were mapped spatially using the GIS mapping technique. This study demonstrates how the spatial model is able to group the distribution of sustainable leadership practices appropriately. This distribution visually represents the analysis results by focusing on regional variations and pinpointing the hotspots for these practices within the study area, as seen in Figure 3. From Figure 3 (a) to (e), it is clear that only two types of sustainable practices (communication skills and community involvement in tourism development) would indicate how good the leader is, without any disagreeing response from the respondents. The need for clear communication emphasizes the importance of these sustainable leadership practices. Enhanced communication between leaders and communities indicates a stronger understanding in their interaction, allowing leaders to deliver directives more easily (Bush et al., 2021). Leaders in the tourism industry who possess strong communication skills will be able to attract stakeholders, properly communicate sustainability goals, and create a collaborative environment. Responses vary merely from "strongly agree" to "agree " and mostly come from those living along the Marang shore and at the centre of Kuala Terengganu (for communication skills), and the southern part of Marang and the northern region of Kuala Terengganu (for both communication skills and community involvement in tourism development).

The community involvement in tourism boosts the tourism by providing unique cultural and historical contributions, creating local job possibilities, and encouraging entrepreneurship, hence reducing poverty and raising living standards (Ndivo & Cantoni, 2016). Nyaupane et al. (2006) highlighted that community involvement might as well promote environmentally conscious behaviour and the preservation of natural and cultural resources by coordinating tourism development with regional needs and sustainability objectives. Communities that are involved are also more prepared to adjust to changes in the industry, resulting in long-term sustainability and resilience. The three types of sustainable leadership practices (critical thinking, moral and ethical behaviour, and sustainable leadership skills) receive varying levels of responses, ranging from strongly agree to disagree. In terms of ethical and moral behaviour,

it was found that the majority of people in Marang and Kuala Terengganu strongly agree with the policies of their leaders, with very few expresses disagreement. Sustainable leadership, which covers the ability to attract stakeholders, socialize and be transparent, is fundamentally based on ethical behaviour. It is difficult to define ethical behaviour, but in order to safeguard and maintain their businesses, managers, especially those who are short-term goal-oriented, must operate with moral integrity and openness (Boeske, 2023). Suriyankietkaew et al (2022) also suggest that by highlighting virtues like restraint, caution, respect for one another and creativity, sustainable leadership will encourage the top management team to embrace sustainable practices. Hence, attaining sustainability across organisations actually depends on the integration of moral and ethical norms.

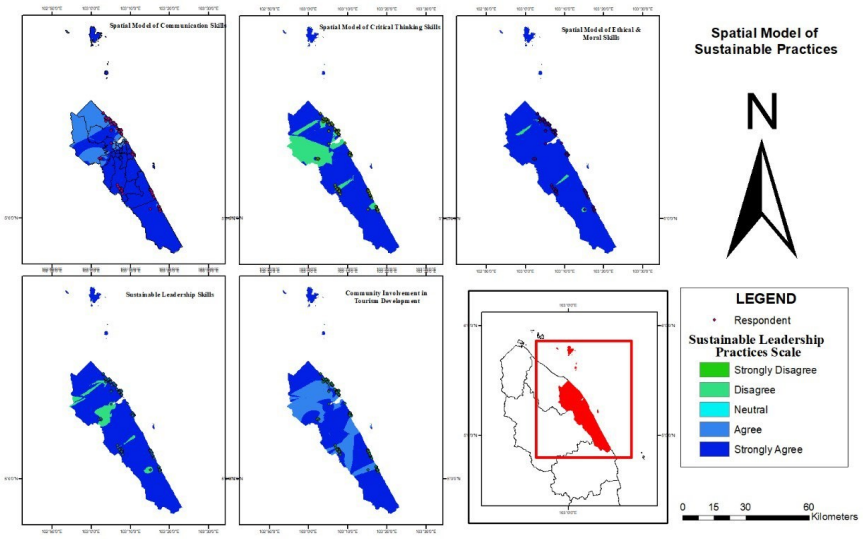

Figure 3: distribution of sustainable leadership practices in Kuala Terengganu and Marang (a) communication skills, (b) critical thinking, (c) ethical and moral skills, (d) sustainable leadership, and (e) community involvement in tourism development

High concentration (hotspots) and low concentration (cold spots) of sustainable leadership practices were found in areas specified by the interpolation technique. These variations in leadership philosophies between different coastal regions and tourism-related industries reveal to us the areas where leaders lack these practices as well as the areas where sustainable leadership is more common. By using the spatial model, it becomes clear on which locations should the strategic planning and policy making be stressed on. In a study by Wulung et al. (2021), who developed a spatial model for geotourism clusters in Bandung City,

Indonesia, it is used as a planning tool for tourism destinations, allowing for the integration of natural, social and economic environmental development while assuring its protection. This concept is especially useful given the long-term nature of tourism planning. In addition, policymakers and stakeholders can make evidence-based decisions to increase the sustainability within the coastal communities and tourism by using the insights collected from the geographical distribution maps. In line with the study by Al shawabkeh et al. (2023), this study would help to protect cultural and natural heritage places by offering the decision-makers a model along with a number of recommendations on how to achieve it.

Furthermore, comparing various locations can help find excellent practices and serve as a baseline for other regions to effectively implement sustainable leadership strategies. Examining the spatial distribution of sustainable leadership practices yields comprehensive insights that are necessary to advance sustainability in coastal communities and tourism. This strategy encourages focused interventions and well-informed decision-making while improving the overall effectiveness of sustainable leadership initiatives. The spatial model for the five sustainable leadership practices suggests that Marang leaders exhibit more sustainable leadership qualities than Kuala Terengganu leaders. Besides, it can be clearly seen that all sustainable leadership practices in coastal areas are better compared to those further inlands. Coastal areas are very desirable for tourism. Thus, in order to maximize these regions' potential for tourism, sustainable leadership is crucial. The spatial distribution pattern of sustainable leadership practices, when evaluated, indicates that leaders in coastal towns do employ sustainable leadership practices effectively.

CONCLUSION

Based on the MLR statistics for the dependent variable, this study examines the statistical relevance of the four independent factors in the standard model in determining the sustainable leadership score. The outcome demonstrates that moral and ethical behaviour, as well as community involvement in tourism development, significantly improve sustainable leadership and serve as key drivers of sustainable leadership advancement. Effective leadership is required to ensure that the coastal tourism development satisfies the current requirements while also laying the groundwork for resilient, inclusive, and sustainable tourism practices that benefit both current and future generations. The spatial analysis by GIS is practical and advantageous for formulating theories and identifying the areas that require attention. In order to build a database system of sustainable leadership, this study presents a visualization of the data that makes use of GIS features.

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