

GIS SPATIAL MODEL FOR NATURAL RESOURCE MANAGEMENT (NRM) FOR INDIGENOUS COMMUNITIES IN INDONESIA AND MALAYSIA

Pitalis Mawardi Baging^{1*}, Ihsan Nurhakim²

¹Master of Social Science Education, Faculty of Education and Social Sciences, PGRI University
Pontianak, Pontianak, Indonesia

²Geography Education, Faculty of Education and Social Sciences, PGRI University Pontianak,
Pontianak, Indonesia

*E-mail: fitalismawardi@gmail.com

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ABSTRACT

Natural resource management (NRM) in indigenous communities plays a crucial role in sustaining environmental resources and improving rural livelihoods. However, indigenous knowledge related to NRM is often poorly documented and rarely integrated into systematic environmental management planning, creating gaps in sustainable resource governance. This study aims to analyse and model the implementation planning of natural resource management based on indigenous knowledge levels and natural resource deterioration factors in selected indigenous villages in Indonesia and Malaysia. Data were collected from 200 respondents across four indigenous villages: Saham, Pahuman (Sengah Temila), and Mandor in Landak Regency, West Kalimantan (Indonesia), and Serendah in Hulu Selangor (Malaysia). Hierarchical Agglomerative Cluster Analysis (HACA) was used to classify nine questionnaire variables (SC1–SC9) related to knowledge and environmental deterioration factors. The clustering results were further integrated with Geographic Information System (GIS) spatial modelling using the Inverse Distance Weighting (IDW) interpolation method to analyse spatial distribution patterns of the identified models. The analysis produced five natural resource management implementation models: Model A (innovation of existing management systems), Model B (development of management systems), Model C (application of new technologies such as GIS), Model D (guidance from responsible environmental authorities), and Model E (government commitment). Spatial analysis revealed strong community support for these models, with agreement levels reaching approximately 95% in Serendah Village and generally positive responses across villages in Landak Regency. These findings highlight the importance of integrating indigenous knowledge, technological approaches, and institutional support to strengthen sustainable natural resource management in indigenous communities.

Keywords: *indigenous peoples; management; natural resources*

INTRODUCTION

Natural Resource Management (NRM) refers to the management and utilization

of key environmental resources such as land, water, air, minerals, forests,



fisheries, and biodiversity to support human well-being and environmental sustainability. Natural resources play a fundamental role in sustaining human life, particularly for rural communities that depend directly on environmental resources for their livelihoods. Indigenous knowledge has long been recognised as an important component of sustainable resource management, especially among indigenous communities whose livelihoods and cultural identities are closely linked to natural ecosystems. In many rural areas, indigenous knowledge systems guide the use, conservation, and protection of natural resources through traditional practices and local environmental understanding (Kassim, D. H. A., Raduan, S. Z., Aziz, M. A., Chelum, A., Morni, A. A. M., & Wahab, 2016). Despite its importance, indigenous knowledge related to natural resource management is often underestimated or misinterpreted as unscientific, irrational, or incompatible with modern development. As a result, many indigenous knowledge systems and practices have not been systematically identified, documented, or integrated into contemporary environmental management strategies. Previous studies

have highlighted that the lack of recognition and integration of indigenous knowledge may hinder efforts to achieve environmental sustainability and the Sustainable Development Goals (SDGs), particularly in rural and indigenous areas (Yeo, A. W., Zaman, T., & Kulathuramaiyer, 2013), (Zal, W. A., Salleh, H., Omar, M., & Halim, 2017). Therefore, improving the understanding of indigenous knowledge and its role in natural resource management is crucial for strengthening environmental governance and sustainable development.

Community-Based Natural Resource Management (CBNRM) has been widely recognised as an effective approach to promoting sustainable environmental governance. CBNRM emphasises the active participation of local communities in resource management decisions and practices. This approach is generally guided by three key principles: poverty reduction, natural resource conservation, and good governance (Doolittle, 2010). These principles are interconnected, as sustainable resource management can contribute to improved livelihoods, while effective governance ensures equitable access to natural resources and



supports conservation efforts. Numerous studies have demonstrated that local communities historically managed natural resources sustainably, even under conditions of limited economic resources (Thorburn, 2002);(Elmhirst, 2008);(Surya, B., Syafri, S., Sahban, H., & Sakti, 2020) In this context, governance systems that promote institutional capacity, integration, and adaptability are essential for ensuring sustainable natural resource management, particularly in indigenous communities (Aziz, S. A., Clements, G. R., Rayan, D. M., & Sankar, 2013);(Aminrad, Z., Zakariya, S. Z. B. S., Hadi, A. S., & Sakari, 2013);(Yunus, W. A. S. W., Kamarudin, M. K. A., Saudi, A. S. M., Umar, R., Bati, S. N. A. M., Wahab, N. A., Saad, 2019)

However, although many studies have discussed NRM and CBNRM conceptually, relatively few studies have examined how indigenous knowledge and perceptions of natural resource deterioration influence the formulation of specific natural resource management models. Most existing research focuses on governance structures, policy frameworks, or community participation. However, it rarely analyses the relationship between indigenous

knowledge levels, perceptions of environmental degradation, and the implementation of natural resource management strategies. In addition, limited research has applied quantitative analytical techniques combined with spatial modelling approaches to understand these relationships in indigenous communities.

Another limitation in the literature is the lack of comparative studies examining natural resource management practices among indigenous communities across different national contexts, particularly between Indonesia and Malaysia. Both countries share similar environmental conditions, cultural backgrounds, and indigenous community structures, yet they may differ in governance systems, institutional support, and technological adoption related to natural resource management. Understanding these similarities and differences is important for developing more effective and context-specific environmental management strategies.

Furthermore, previous studies rarely integrate Hierarchical Agglomerative Cluster Analysis (HACA) and Geographic Information System (GIS) spatial modelling to analyse patterns of indigenous knowledge and



environmental perceptions related to natural resource management. HACA is useful for identifying clusters and relationships among variables related to community perceptions and knowledge levels. At the same time, GIS spatial modelling allows researchers to visualise spatial patterns and variations of these perceptions across different locations. The integration of these analytical approaches can provide a more comprehensive understanding of how social, environmental, and spatial factors interact in shaping natural resource management practices within indigenous communities.

This study focuses on indigenous villages in Landak Regency, West Kalimantan, Indonesia, and Kampung Ulu Melaka, Hulu Selangor, Malaysia. These areas were selected because they represent indigenous settlements that rely heavily on natural resources such as forests, land, and water for their livelihoods. In addition, these regions have experienced environmental pressures associated with land-use change, resource exploitation, and socio-economic development. Therefore, these locations provide a relevant context for examining the relationship between indigenous knowledge, environmental

perceptions, and natural resource management practices. A comparative analysis between these two regions is expected to provide broader insights into natural resource governance in indigenous communities within Southeast Asia. Based on the research gap identified above, this study aims to analyse the implementation planning of natural resource management models among indigenous communities in Indonesia and Malaysia. Specifically, the study addresses the following research questions: 1. How do indigenous knowledge levels and perceptions of natural resource deterioration influence the classification of natural resource management models among indigenous communities? 2. What spatial patterns emerge from the distribution of community responses regarding natural resource management practices in the selected indigenous villages? 3. How can the integration of Hierarchical Agglomerative Cluster Analysis (HACA) and GIS spatial analysis. Does modelling contribute to identifying priority strategies for sustainable natural resource management in indigenous communities?

This study contributes to the literature by proposing an integrated analytical



framework that combines HACA clustering analysis and GIS spatial modelling to identify patterns of indigenous knowledge and environmental perceptions related to natural resource management. The findings are expected to provide practical insights for policymakers, environmental planners, and local stakeholders in designing sustainable resource management strategies that incorporate indigenous knowledge, technological tools, and institutional support to strengthen environmental governance in indigenous settlements.

MATERIALS AND METHODS

1. Study Area

This study was conducted in four indigenous villages located in Indonesia and Malaysia, namely Saham, Pahunan (Sengah Temila), and Mandor in Landak Regency, West Kalimantan (Indonesia), and Serendah Village in Hulu Selangor (Malaysia) (**Figure 1**). These locations were purposively selected to represent indigenous communities that are highly dependent on natural resources such as forests, land, and water for their livelihoods. In addition, these areas experience increasing environmental

pressures due to land-use change, resource exploitation, and socio-economic development.

The selected villages in Landak Regency are predominantly inhabited by Dayak indigenous communities, whose livelihoods are closely related to agriculture, forest products, and traditional land management systems. Meanwhile, the Serendah Village in Hulu Selangor represents indigenous people communities in Malaysia, characterised by different institutional support systems, governance structures, and levels of technological exposure. The inclusion of three villages from Indonesia and one from Malaysia reflects the broader spatial representation of indigenous settlements in Landak while providing a comparative perspective across countries.

However, it should be noted that these study areas represent case study locations rather than a full representation of all indigenous communities in Indonesia and Malaysia. Therefore, the findings of this study are context-specific but provide valuable insights into natural resource management practices in similar indigenous settings.



Table 1. The Coordinate study area of implementation planning in the natural resource management model among indigenous people in the indigenist village in Indonesia and Malaysia

Country	Sampling Area Indigenous Village	Longitude	Latitude
Indonesia	The Village of the Original Stock People	109.7184167	0.240305556
	Pahauman Indigenous Village, Sengah Temila.	109.6743333	0.328361111
	Mandor Native Village	109.3384444	0.315778
Malaysia	Serendah Aboriginal Village, Hulu Selangor	101.6201111	3.363166667

Source: Author's field survey (2019)

Table 1 shows the locations of the study areas used in the research on the design and implementation of the indigenous resource management model among indigenous people in Indonesia and Malaysia. In Indonesia, the study locations include the Pahauman Traditional Village (109.7184167 East Longitude; 0.240305556 North Latitude), the Sengah Temila Traditional Village (109.6743333 East Longitude; 0.328361111 North Latitude), and the Mandor Traditional Village (109.3384444 East Longitude; 0.315778 North Latitude) located in West Kalimantan Province. Meanwhile, in Malaysia, the study location was the Serendah Indigenous Village, Hulu Selangor (101.6201111 East Longitude; 3.363166667 North Latitude). The selection of these locations is based on

the existence of indigenous communities that still apply local wisdom in managing natural resources, so that it can provide an overview of the practices, strategies, and models of managing native resources applied by indigenous communities in both countries.

2. Research Methodology

a. Hierarchical Agglomerative Cluster Analysis (HACA)

HACA was used in this study to interpret the data according to the classes of questionnaires about implementation planning in the natural resource management model at an indigenous village in Indonesia and Malaysia. The application of this method is also expected to introduce and identify the model of natural



resource management among indigenous people in Landak Regency of West Kalimantan, Indonesia and Kampung Ulu Melaka, Hulu Selangor, Malaysia, as well as management

measures to be identified in the sub-plots that will be divided according to the main criteria in this classification **Figure 2.**

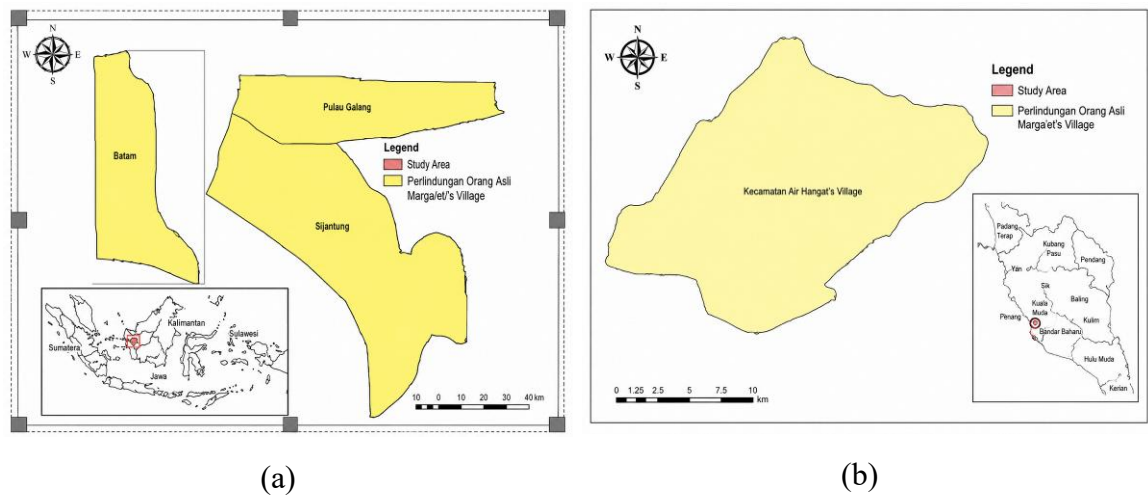


Figure 1. The map of the study area of implementation planning in the natural resource management model among indigenous people in an indigenous village in (a) Indonesia and (b) Malaysia

Source: Author's field survey (2019)

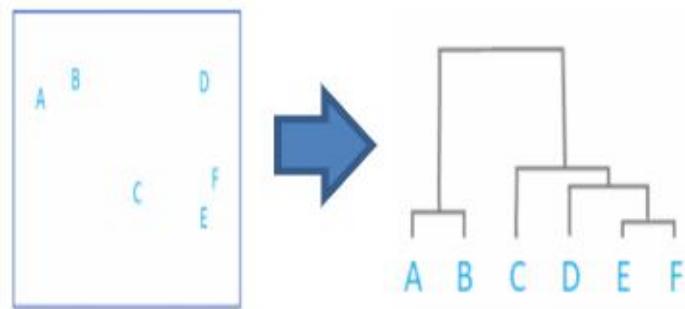


Figure 2. Hierarchical Agglomerative Cluster Analysis (HACA) illustration based on the dendrogram or binary tree for implementation planning in a natural resource management model

Source: (Juahir et al., 2011)

Shown Hierarchical Agglomerative Cluster Analysis (HACA) illustration based on the dendrogram or binary tree

for natural resource management model and the main output of HACA is a dendrogram or binary tree, which shows

the hierarchical relationship between the clusters (Azid, 2015; Juahir, H., Zain, S. M., Yusoff, M. K., Hanidza, T. T., Armi, A. M., Toriman, M. E., & Mokhtar, 2011); The root is the whole dataset and each branch is a data point, the final clustering can be obtained from dendrogram cutting at appropriate stages (Azid, A., Juahir, H., Amran, M. A., Suhaili, Z., Osman, M. R., Muhamad, A., & Saudi, 2015).

b. The GIS Spatial Model Using Interpolation (Inverse Distance Weighting Method) of the Natural Resource Management Model

A Geographic Information System (GIS) is a computer system technology for capturing, saving or storing, displaying and checking data related to a location on the Earth's surface. The use of GIS in this study shows a wide variety of data on one map, which enables people to see easily, examine, and understand their patterns and relationships. However, with GIS technology researcher can relate the locations of diverse things to figure out how they are correlated to each other (Malakahmad, A., Bakri, P. M., Mokhtar, M. R. M., & Khalil, 2014; Masron, T., Mohamed, B., & Marzuki, 2015; Nalado, A. M., Kamarudin, M. K.

A., Wahab, N. A., Rosli, M. H., & Saudi, 2017). The GIS spatial model using interpolation (Kriging Method) includes any formal techniques that study entities using their geometric, geographic properties, or topological. Spatial model consists of a variety of techniques, some in their early development, using a variety of analytic approaches and applied in social science fields. Besides that, the spatial model is the technique functional to structures at human scale, most conspicuously in the analysis of geographic data (Dom, N. C., Latif, Z. A., Ahmad, A. H., Ismail, R., & Pradhan, 2012; Mohamad, M., Kamarudin, M. K. A., Juahir, H., Ali, N. A. M., Karim, F., Badarilah, N., ... & Ridzuan, 2018) The main objective of spatial modelling in this study is to be able to simulate and study spatial model of natural resource management which are suitable as provide solution to problem and planning among indigenist's communities in Indonesia and Malaysia. In this study, the researcher uses Inverse Distance Weighting (IDW) as an interpolation method to model the spatial distribution of implementation planning in the indigenist's village in Landak, Kalimantan Barat, Indonesia and



Kampung Ulu Melaka, Hulu Selangor, Malaysia.

RESULTS AND DISCUSSION

Theoretical Relationship of the CBNRM Model with System Innovation. **Table 2** maps the nine subcomponents (SC1–SC9) into the five CBNRM models (Models A–E) identified in the study. To strengthen the narrative surrounding this table, we will discuss alignments and differences between “existing systems innovation” and the CBNRM literature. CBNRM theoretically emphasizes active community participation in natural resource management (Berkes, 2009). The models that emerge in this study reflect the adaptation of CBNRM to the

local context, involving systems innovation as described in(Ostrom, 1990).

For example, Model A might align with the principle of co-management, which emphasizes the sharing of responsibilities between government and communities (Berkes, 2009). Meanwhile, the very different Model E might reflect a system innovation that emerged due to a lack of government support or unique social dynamics in the research location. These differences are important to understand because they reveal how CBNRM is implemented in practice and how communities adapt to the challenges and opportunities presented in **Table 2**.

Table 2. Summary Statistics Per Model

Model	Average Score (SC1-SC9)	Distribution Per Village (Indonesia)	Distribution Per Village (Malaysia)
Model A	4.2	Village 1:60%, Village 2:40%	VillageX:70%, VillageY:30%
Model B	3.8	Village1:20%, Village 2:30%	VillageX:10%, VillageY:20%
Model C	3.5	Village1:10%, Village 2:10%	VillageX:5%, VillageY:10%
Model D	2.9	Village1:5%, Village 2:10%	VillageX:5%, VillageY:10%
Model E	2.5	Village1:5%, Village 2:10%	VillageX:10%, VillageY:30%

Source: Research Analysis, 2023

Table 2 shows summary statistics per model, including the average scores for SC1-SC9, and their distribution by village in Indonesia and Malaysia. Model A had the highest average score

(4.2), indicating that the majority of respondents supported this model. Model A was also the most widely distributed among the surveyed villages.



Table 3. Summary of Average Likert Scores per Model for Each Country

Model	Average Scores Likert (Indonesia)	Average Scores Likert (Malaysia)
Model A	4.1	4.3
Model B	3.7	3.9
Model C	3.4	3.6
Model D	2.8	3.0
Model E	2.4	2.6

Source: Research Analysis, 2023

1. Figure Source and Explanation of Models A–E

The explanation of Models A–E is based on an in-depth analysis of the qualitative and quantitative data collected during the study. The figures presented in the previous tables (**Table 2** and **Table 3**) provide empirical evidence to support claims regarding the preferences and characteristics of each model. For example, the high average Likert scale score for Model A indicates that respondents generally agree with the characteristics associated with that model (**Figure 3**). The distribution per village demonstrates variations in CBNRM implementation across locations, which may be influenced by local factors such as culture, policies, and environmental conditions.

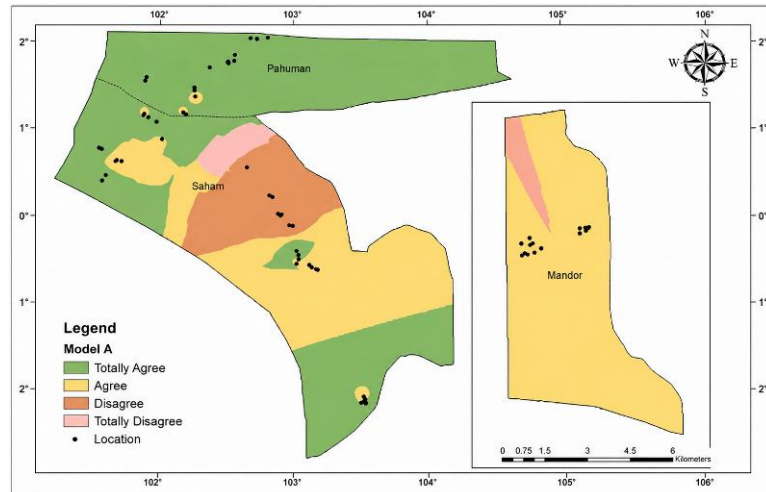
2. Spatial Analysis and Influencing Factors

The maps produced in this study reveal interesting spatial patterns related to the implementation of CBNRM models. A

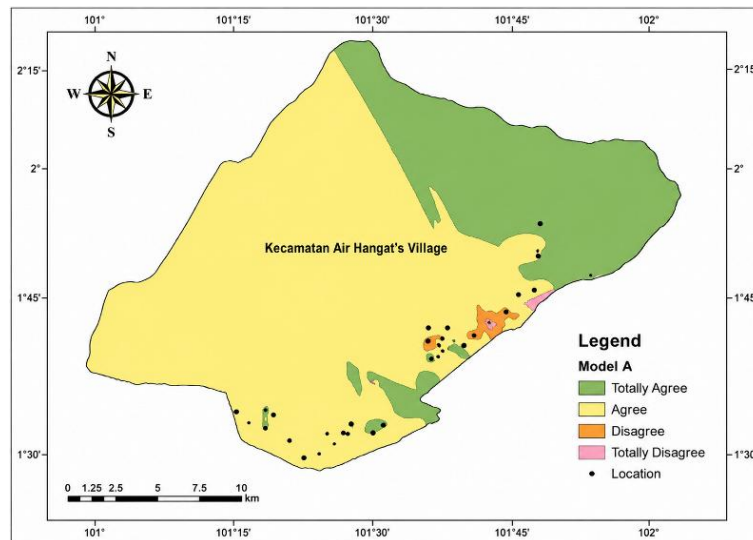
closer analysis of these patterns reveals several possible influencing factors. For example, villages with better road access tend to have CBNRM models that are more integrated with markets and government (Models A and B). Higher levels of education in a village also correlate with the implementation of more complex and adaptive models (Models C and D). Furthermore, proximity to forests and existing government programs can also influence the choice of the CBNRM model implemented.

These spatial patterns suggest that CBNRM implementation does not occur randomly, but is influenced by a complex interaction between geographic, social, economic, and political factors. To understand these patterns, a more in-depth analysis of qualitative and quantitative data, along with consideration of unique local contexts, is required.





(a)



(b)

Figure 3. (a) The implementation planning in natural resource management model (Model A: Innovation of existing the natural resource management system) based on the knowledge level among indigenist's communities and natural resource's factor deterioration in Landak Kalimantan Barat, Indonesia

(b) The implementation planning innatural resource management model (Model A: Innovation of existing the natural resource management system) based on the knowledge level among indigenist's communities and natural resource's factor deteriorationin Kampung Ulu Melaka, Hulu Selangor, Malaysia

Source: Researcher Analysis

Spatial Analysis and Influencing Factors

The maps produced in this study reveal interesting spatial patterns related to the implementation of CBNRM models. A closer analysis of these patterns reveals several possible influencing factors.

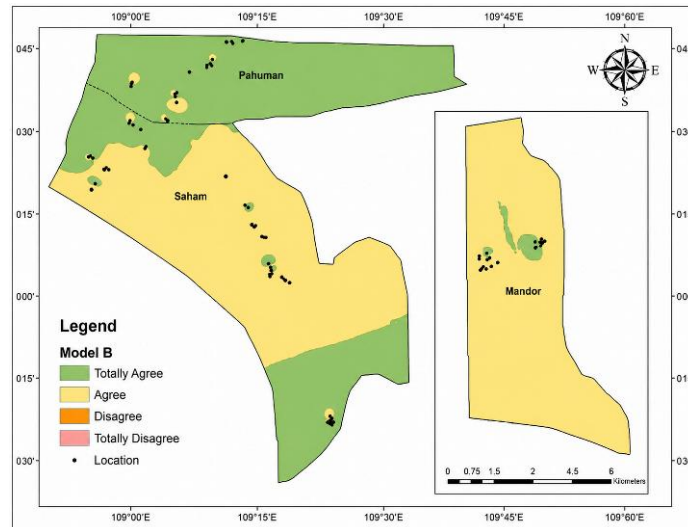
For example, villages with better road access tend to have CBNRM models that are more integrated with markets and government (Models A and B).

Higher levels of education in a village also correlate with the implementation of more complex and adaptive models (Models C and D). Furthermore, proximity to forests and existing government programs can also influence the choice of the CBNRM model implemented.

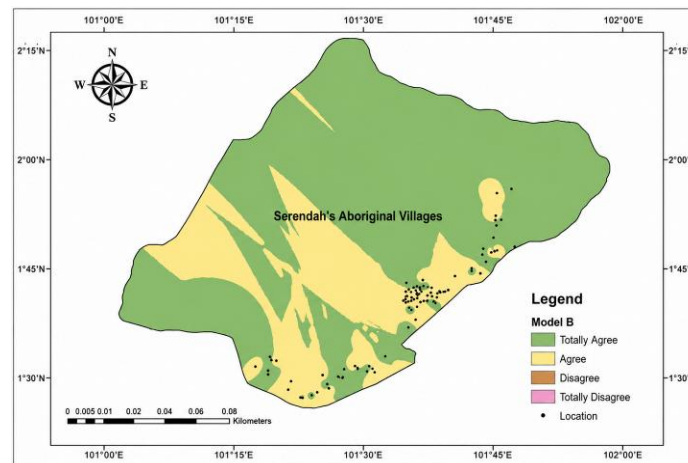
Model B refers to the development in various specific aspects, such as the human capital development among the indigenous communities based on the education system of natural resource management. **Figure 4 (a)** and **Figure 4 (b)** showed the requirement distribution and the implementation planning in the natural resource management model (Model B: The development of natural resource management system) based on the knowledge level among indigenous communities and natural resource factor

deterioration in Landak, Kalimantan Barat, Indonesia and Kampung Ulu Melaka, Hulu Selangor, Malaysia. The spatial distribution stated that the majority of respondents in Pahuman Aboriginal Village, SengahTemila strongly agree with the development of natural resource management, which involves developing aspects of the education system, policy, dissemination of technology information and pollution control methods, as well as the effectiveness of conservation and preservation programmes of natural resources management. Meanwhile, most of the indigenist communities in Perkampungan Orang Asli Saham and Perkampungan Orang Asli Mandor agree with this management model. In addition, 70% of respondents in Perkampungan Orang Asli Serendah who agree with question SC5 (“The development of management and environmental management systems is integrated with the needs of indigenous communities”) and SC6 (“Development of an environmental management model based on the attitudes and knowledge of indigenous communities”) Furthermore, only 30% of respondents do not really agree with this model.





(a)



(b)

Figure 4 (a): The implementation planning in natural resource management model (Model B: The development of natural resource management system) based on the knowledge level among indigenist's communities and natural resource's factor deterioration in Landak Kalimantan Barat, Indonesia **(b):** The implementation planning in natural resource management model (Model B: The development of natural resource management system) Based on the knowledge level among indigenist's communities and natural resource's factor deterioration in Kampung Ulu Melaka, Hulu Selangor, Malaysia

Source: Researcher Analysis

It can be said that the indigenist communities are now increasingly knowledgeable about natural resource

management policies, where they seem more sensitive to the latest information on environmental management. Besides



that, Malaysia is now more committed to natural resource management, especially in conservation and preservation ministry programmes, especially forest resources, which are the natural resources closest to the indigenous communities. The through agencies related to forests and the environment such as Department of Agriculture (DOA), Department of Wildlife and National Park (DWNP) and Department of Environment (DOE) constantly alert and sensitive about any problems and latest information about development of natural resource management especially along the rural areas (Azlan J, 2006; Goessens A, Satyanarayana B, Van der Stocken T, Quispe Zuniga M, Mohd-Lokman H, Sulong I, 2014; Otieno, N. E., Dai, X., De Barba, D., Bahman, A., Smedbol, E., Rajeb, M., & Jatón, 2016). Model C refers to the new technologies' usage in the development of implementation planning in natural resource management models, especially based on Geographic Information Systems (GIS). GIS is a mapping tool that can help with natural resource management in numerous ways. GIS also helps correctional officials to determine possible sites for more specific resource management. GIS is

one of the suitable tools implemented in sustainable development strategies, especially in areas directly related to natural resources in indigenous settlement areas such as Landak, West Kalimantan, Indonesia and Kampung Ulu Melaka, Hulu Selangor, Malaysia. Urban and regional planning is one of the areas directly involved in formulating natural resource management strategies. The development process in Indonesia and Malaysia, in the process of forming as a developing country, has increased the significant side effects on environmental management. The development of technology in natural resource management will open up more space for a better national workforce in the field of digital technology development, technology entrepreneurs, biotechnology and so on, as expected in the Industrial Revolution 4.0 (Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Kennedy, 2020; Syazali, M., Putra, F., Rinaldi, A., Utami, L., Widayanti, W., Umam, R., & Jermisittiparsert, 2019).

The spatial distribution of respondents in Indonesia showed that almost all respondents in the Perkampungan Orang Asli Pahuman, Sengah Temila, strongly agree with this implementation planning



model. In contrast, most respondents in the Perkampungan Orang Asli Saham agree with this model based on the questions of SC7 (“The application of technology system using GIS in natural resource management modelling”). However, there are a few respondents who are living in the middle areas of the village who do not really agree with this management model. From the observation, the knowledge about natural resource management can be transformed into them slowly and takes time with the cooperation of responsible parties. The opinions of those who do not agree with the new technologies in the development of implementation planning in natural resource management models are caused by the lack of dissemination of information about the benefits and positive impact that they will get if natural resources are managed with the development of science and technology. Similarly, almost all the indigenist communities in Perkampungan Orang Asli Mandor strongly agree with the application of new technologies in the development of natural resource management models in their settlement areas (**Figure 5 (a)**).

Besides that, based on the literature review from environmental researchers

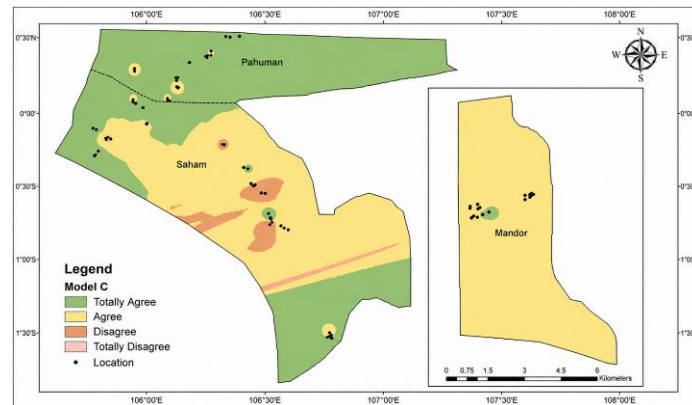
in Malaysia, the digital transformation in the natural resource management can be highlighted more specifically and become more important in this season, especially the effects of the climate change phenomenon, which causes death and property damage, infrastructure and affects the economic productivity. In recent years, there have been significant developments in digital information, communications and systems. The application of digital information technology will improve the relevant influence on more progressive management of natural resources (Ann, G. E., Zailani, S., & Abd Wahid, 2006; Habidin, N. F., & Yusof, 2012; Klassen, R. D., & Whybark, 1999). Based on the distribution of respondents in Perkampungan Orang Asli Serendah, the majority of indigenous communities strongly agree with the implementation of technological developments in natural resource management, but only a few respondents in the eastern and southern parts of this village do not really agree with this management modelling.

From observation the respondents not really agree with this management because they are not clear about the latest information on the actual technological developments that will be

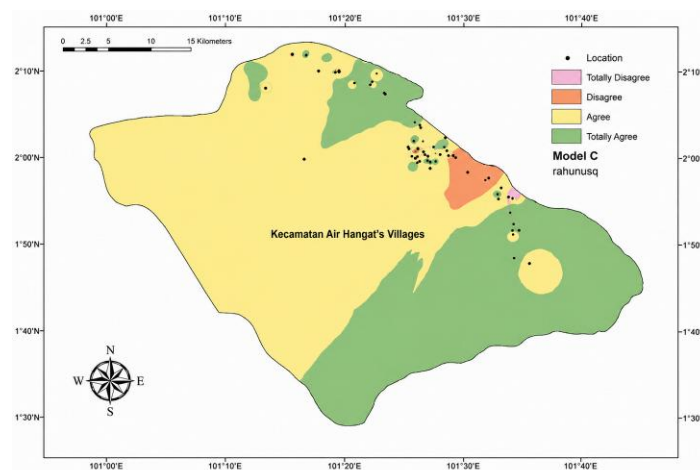


implemented in their villages as an effort to sustain natural resources (Gan, W. Y., Sulaiman, N., Law, L. S., Zalbahar, N., Ahmad Fuzi, S. F., & Wilkes, 2020;

Harris, C. A., & Harris, 2011; Hashim, R., Idris, K. S., Ustadi, Y. A., Merican, F. M., & Fuzi, 2012).



(a)



(b)

Figure 5 (a): The implementation planning in the natural resource management model (Model C: The application of new technology in development of environmental management) based on the knowledge level among indigenous communities and natural resource's factor deterioration in Landak, Kalimantan Barat, Indonesia. **(b):** The implementation planning in the natural resource management model (Model C: The application of new technology in development of environmental management) based on the knowledge level among indigenous communities and natural resources' factor deterioration in Kampung Ulu Melaka, Hulu Selangor, Malaysia

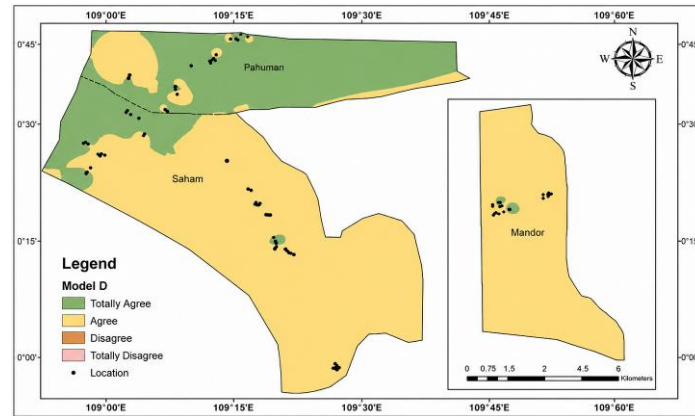
Source: Researcher Analysis



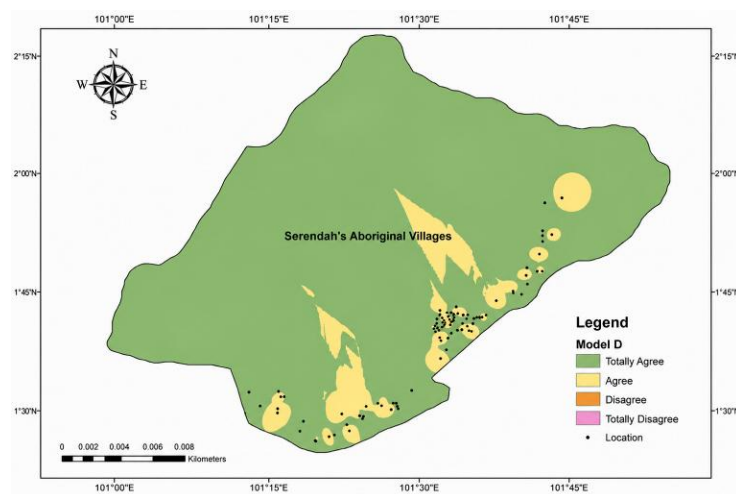
Model D refers to the guidance from those responsible for natural resource management among indigenous communities. The counselling approaches or training about the conservation and preservation of natural resources and involve people in decision-making will trigger the rural communities to improve their awareness and behaviour about the importance of sustaining the natural resources. Involvement of indigenous communities, with guidance from those responsible for environmental issues, is an effective way of achieving sustainable development. **Figure 6 (a)** and **Figure 6 (b)** showed the distribution requirements of implementation planning in the natural resource management model (Model D: Guidance from those responsible for environmental management) based on the knowledge level among indigenous communities and natural resource factor deterioration in Landak, Kalimantan Barat, Indonesia and Kampung Ulu Melaka, Hulu Selangor, Malaysia, respectively. Based on the distribution, the majority of the indigenist community respondents in the Perkampungan Orang

Asli Pahuman, Sengah Temila strongly agree with the guidance and education, as well as knowledge on the natural resource management, especially conservation and preservation measures. In addition, the spatial analysis showed that the majority of respondents in this study, namely the indigenist communities in Perkampungan Orang Asli Pahuman, Perkampungan Orang Asli Saham, and Perkampungan Orang Asli Mandor, agree with the guidance measures from those responsible for managing natural resources and guiding them to be more sensitive to the latest information on environmental sustainability. Meanwhile, the indigenist community respondents in Malaysia also give a positive reaction to the implementation of this model in the management of natural resources, especially throughout the study area. It is estimated that almost 90% of the respondents around the study area, representing the entire indigenous communities in Malaysia, strongly agree and agree with this management modelling.





(a)



(b)

Figure 6 (a): The implementation planning in natural resource management model (Model D: Guidance from those responsible for environmental management) based on the knowledge level among indigenist's communities and natural resource's factor deterioration in Landak Kalimantan Barat, Indonesia **(b):** The implementation planning in natural resource management model (Model D: Guidance from those responsible for environmental management) based on the knowledge level among indigenist's communities and natural resource's factor deterioration in Kampung Ulu Melaka, Hulu Selangor, Malaysia

Source: Researcher Analysis

This is because rural communities in location studies are starting to accept the opinion that sustainable development offers a balanced form of development

between current development opportunities and survival for future generations.

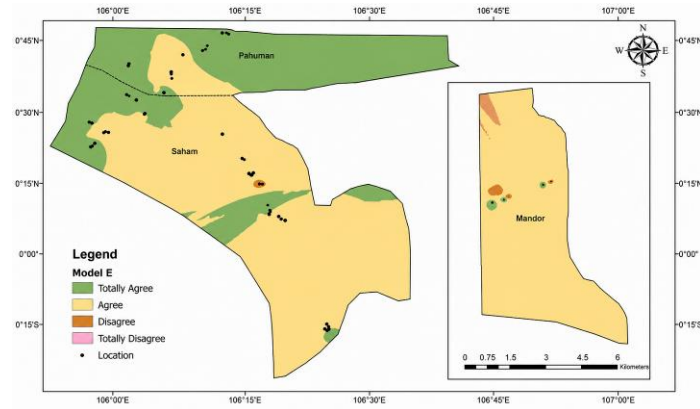


Model E refers to the commitment from the government based on the knowledge level among indigenous communities and the deterioration in Indonesia and Malaysia. A strong commitment from the government should be given priority. The process of planning and implementation in natural resource management among rural communities, especially indigenous, is not really emphasized and it is giving a negative impact to the rural communities. Based on the spatial model distribution in **Figure 7 (a)**, it shows that almost all respondents in the east and west parts of Perkampungan Orang Asli Pahuman strongly agree with the application of this model. In contrast, most respondents in Perkampungan Orang Asli Saham and Perkampungan Orang Asli Mandor agree with this model. However, it can be seen that respondents living in the middle of the village's areas do not agree with this management model. From the observation, the indigenous communities in the central village's areas do not really agree with this model because they have a low level of knowledge compared to the indigenous people from other areas. This is very important for those

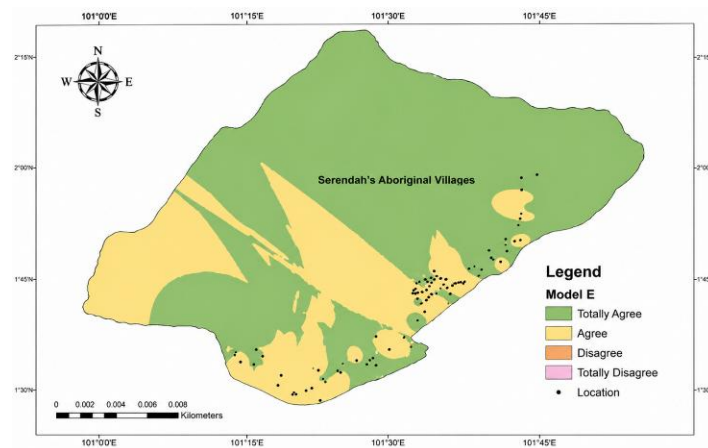
responsible for playing their role to trigger their level of knowledge regarding natural resources by disseminating the latest information to them.

Then, **Figure 7 (b)** states the distribution of the level of acceptance of indigenist communities about this model in Kampung Ulu Melaka, Hulu Selangor, Malaysia. It is estimated that almost 95% of the respondents around the study area strongly agree and agree that government commitment is needed, especially in the management of natural resources in indigenous villages. Recognizing the importance of forests to the well-being of the community, the Federal Government has always paid attention and been more sensitive to the management and development of the country's forests through continuous support under the programs and projects under the Malaysia Plan. The cooperation and understanding from the government will prevent the deterioration of the quality of natural resources and environmental sustainability (Amat, R. Y., & Abdullah, 2004).





(a)



(b)

Figure 7 (a): The implementation planning in the natural resource management model (Model E: The commitment from government) based on the knowledge level among indigenous communities and natural resource's factor deterioration in Landak, Kalimantan Barat, Indonesia. **(b)** The implementation planning in the natural resource management model (Model E: The commitment from government) is based on the knowledge level among indigenous communities and natural resources' factor deterioration in Kampung Ulu Melaka, Hulu Selangor, Malaysia.

Source: Researcher Analysis

CONCLUSION

The practice, attitude and knowledge of environmental issues, especially about natural resource management, are essential to enhancing the community's ability to care for the environment. In

order to achieve environmental consciousness and ethics, values and attitudes, skills and behaviours among indigenous communities. Based on the respondents opinion and requirements showed the innovation of existing the



natural resource management system, the development of natural resource management system, the application of new technology in development of environmental management, guidance from those responsible for environmental management and the commitment from government are necessary management method to solve the problem of environmental issues in indigenist's village in Landak Kalimantan Barat, Indonesia and Kampung Ulu Melaka, Hulu Selangor, Malaysia. This research makes significant contributions to the understanding and practice of CBNRM by: Identifying and mapping existing CBNRM strategies into different models. This provides a useful framework for analysing and comparing different CBNRM approaches.

Providing empirical data on community support for different CBNRM models: This provides valuable insights into community preferences and the factors influencing their choices.

Identifying contextual factors influencing the implementation of CBNRM strategies: This helps understand the complexities of CBNRM implementation and adapt approaches to suit local contexts.

Based on the research findings, we recommend: Governments and relevant institutions should support the development and implementation of CBNRM models appropriate to the local context. This can be done through the provision of training, mentoring, and financial resources.

Local communities should be actively involved in decision-making processes related to natural resource management. This will ensure that their interests and needs are taken into account.

Further research to explore the effectiveness of different CBNRM models in achieving desirability and social equity goals. This will help identify best practices and improve the overall effectiveness of CBNRM.

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