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"Warning in Spaces: Blending Heritage, Nature and Design"

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The Impacts of the Mangrove Ecosystem: A Case Study at Kampung Menteri, Kuala Sepetang

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Abstract

Kuala Sepetang is one of the sites that the Perak State is famous for because of its coastal heritage for “The Matang Mangrove” located along the Perak State Coastline. The Kuala Sepetang mangrove ecosystem is home to the largest protected and most accessible mangrove reserve in Peninsular Malaysia. From this ecosystem, the research focuses on Kampung Menteri, Kuala Sepetang. The research considers the socio-economic activities and conservation of mangroves providing ecosystem services that protect shorelines, and support biodiversity in relation to the eco. This study examines the ecological and socio-economic significance of the Kuala Sepetang mangrove ecosystem through three key objectives, to evaluate the key ecological functions of the mangrove ecosystem, to evaluating the socio-economic contributions of mangroves to local livelihoods through fishing, forestry, and ecotourism activities and to analyze community perceptions and adaptive strategies toward mangrove conservation and resource utilization. The research uses a mixed-methods design which combines field observations with socio-economic surveys based on questionnaires, which aims at delineating how the resources in the community are being used, the conservation practices being employed, and the community’s perceived level of threat to the resources. The results showed a high level of community awareness and positive views toward mangrove conservation, with strong emphasis on active community participation as a key adaptive strategy for sustainable mangrove management.

Keyword: Kampung Menteri, Ecotourism, Ecological, Socioeconomic, Sustainable

INTRODUCTION

The mangrove ecosystems of the coasts are known to have a multifaceted contribution to ecological processes and human well-being worldwide. These forests grow between the land and the sea, acting as a natural barrier and support system for the environment (Rössler et al., 2022). They help protect shorelines from erosion, store carbon, provide breeding and nursery areas for fish and crabs, and support many species of plants and animals. Besides their ecological value, mangroves also benefit local communities by providing resources, supporting tourism and education, and helping people earn a living through fishing and forestry (Lee et al., 2025).

Mangroves provide important and valuable goods and services to communities, at different spatial and temporal scales. Local communities concentrated to the mangroves are depended either directly or indirectly to the ecosystem for their livelihood activities. The change of the mangrove ecosystem affects (both direct and indirect) the services that are provided by the mangroves to the locals (Getzner & Islam,

2020). The change also affects their source of livelihood or socioeconomic development (Getzner & Islam, 2020). In a similar vein, the International Union for Conservation of Nature (IUCN, 2021) emphasizes mangroves as one of the most endangered yet vital ecosystems, stressing their contribution to community resilience, biodiversity conservation, and catastrophe risk reduction (Ihinegbu et al., 2023).

In the state of Perak, Malaysia, the Matang Mangrove Forest Reserve spans approximately 40,466 ha and is managed by the Perak State Forestry Department (formerly the Perak Forestry Department) under a long-standing sustainable management regime (Zhou et al., 2025). This reserve is recognised as one of the best-managed mangrove ecosystems in Malaysia and arguably in the world (Zhou et al., 2025). This research focuses on the mangrove ecosystem at Kampung Menteri, Kuala Sepetang with the intention of integrating ecological and social perspectives.

Particularly, the study aims to achieve the following objectives: (1) to evaluate the key ecological functions of the mangrove ecosystem (2) to determine the socio-economic benefits derived from the local livelihood activities of the mangroves such as fishing, forestry, and ecotourism; (3) to determine the community's attitude and adaptive strategies towards the conservation of mangrove systems and the utilization of its resources. By dealing with all the three combined aspects of ecosystem, socio-economic and community, this study will assist in understanding the role of natural ecosystems in the overall well-being of people in fine-tuning the sustainable utilization of the mangrove of Kampung Menteri.

This paper places local results of the study within the context of larger sustainability frameworks at the global, national, and corporate levels. The conservation of these mangrove ecosystems improves the attainment of the United Nations Sustainable Development Goals (SDG 14 (Life Below Water) & SDG 15 (Life on Land & SDG 13 (Climate Action) and directly improves food security and alleviates poverty. The ecosystem provides protection to the coast, stores carbon, and supports various livelihoods which is a testimony to how local actions can achieve global sustainability objectives. From the business perspective, the Environmental, Social, and Governance (ESG) framework encourages the incorporation of mangrove restoration and sustainable resource utilization in the operations of companies.

LITERATURE REVIEW

Socioeconomic Roles: Fisheries, Timber, and Ecotourism

The coastal areas of Malaysia depend on mangroves because these ecosystems support their economic activities through fishing and timber harvesting and tourism operations. The area of Kuala Sepetang demonstrates these functions through its established firefly tourism industry and sustainable charcoal production system (Umzarulazijo Umar et al., 2024). The current research gap exists because no study has combined ecological assessments with measurements of how these industries generate economic value for residents in local communities. The research investigates community dependence on forestry and tourism and fisheries through quantitative methods while using ecological data from Umzarulazijo Umar et al. (2024).

Community Perceptions and Conservation Awareness

The Malaysian communities have received growing academic attention regarding their opinions about mangroves during the previous five years. Research conducted in Kuala Langat and Penang showed that

people who understand mangrove advantages tend to join conservation efforts (Rahim et al., 2022). The local dependence on mangrove resources creates management challenges because people need to use these resources for their livelihood which results in conflicts between resource use and conservation needs so participatory methods must be used to sustainably manage these resources (Ismail et al., 2021).

Biodiversity and Firefly Habitat

Research in Malaysia shows that mangroves are home to diverse wildlife, including the firefly species *Pteroptyx tener*, which has become the backbone of a growing ecotourism industry (Saiful et al., 2019). While firefly tourism draws significant numbers of visitors to Kuala Sepetang, we still don't have enough research connecting how mangrove vegetation and water conditions affect firefly populations especially as tourism continues to grow. This study aims to assess biodiversity indicators like fireflies and aquatic life to better understand how the ecosystem supports both the local ecology and the tourism industry that depends on it.

Ecological Functions: Shoreline Protection and Sediment Dynamics

Mangroves act as natural wave breakers, protecting coastlines from erosion and keeping them stable (Kamaludin et al., 2019). Research in Perak has shown that sediment quality and water flow patterns are crucial for keeping mangroves healthy (Ismail et al., 2020). While we understand these roles generally across the region, we're missing specific data for Kuala Sepetang—particularly how coastal protection and sediment conditions vary between different mangrove zones. This project will address that gap by combining coastline measurements and sediment samples to figure out just how well the mangroves in Kuala Sepetang are protecting the coast. (Saharudin et al., 2024)

RESEARCH METHODOLOGY

This study uses a mixed-method approach, combining both quantitative and qualitative techniques to assess the ecological and socioeconomic importance of Kuala Sepetang's mangrove ecosystem. The quantitative side involves measuring community perceptions through structured questionnaires, while the qualitative side relies on direct site observations to capture environmental conditions, community activities, and evidence of how mangroves are being used or conserved.

Study Area

The study will be conducted in the Kampung Menteri Kuala Sepetang, Perak. The site is also famous due to its near with the Mangrove Forest of Kuala Sepetang, one of the largest and most sustainably managed mangrove ecosystems in Peninsular Malaysia. with high biodiversity, traditional charcoal industry, and firefly ecotourism, which makes it the best place to evaluate ecological functions and community perceptions.

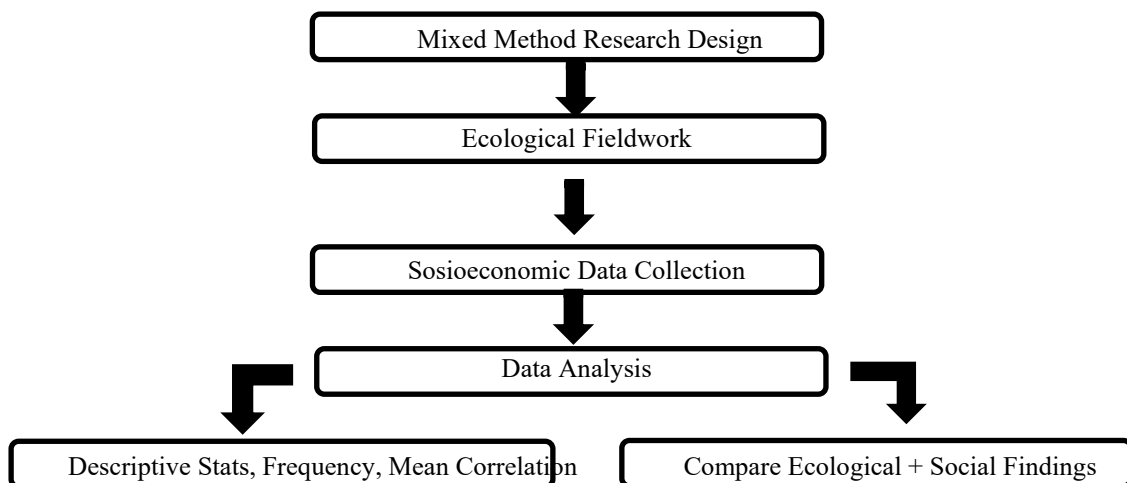


Figure 1. Location Plan (right) and Key Plan (left) of Kampung Menteri Kuala Sepetang, Perak.
(Source : Google Map, 2024)

Data Collection

The questionnaire survey will be conducted with local households, fishers, forestry workers, and tourism operators in Kuala Sepetang to gather information about their awareness, reliance on, and attitudes toward mangrove resources. The questionnaire has six sections: (1) respondent demographics; (2) perceptions of ecological functions like shoreline protection, biodiversity, and carbon storage; (3) how much their livelihoods depend on mangroves; (4) awareness of conservation programs; (5) willingness to participate in conservation activities; and (6) overall perceptions of mangrove importance. Respondents will rate their level of agreement using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Stratified random sampling will be used to select a total of 120-150 respondents to represent various livelihood groups.

The SPSS (version 28) will be used to analyze quantitative data to generate descriptive statistics (frequency, percentage, mean) to test the relationships between variables. The interpretation of observation data will be based on the descriptive qualitative analysis, which will identify the main patterns and on-site conditions that will either confirm or contradict the community perceptions. This study offers a comprehensive picture of the ecological and social functioning of the Kuala Sepetang mangrove ecosystem, which is based on the combination of survey and observational results, to facilitate sustainable management and conservation planning.



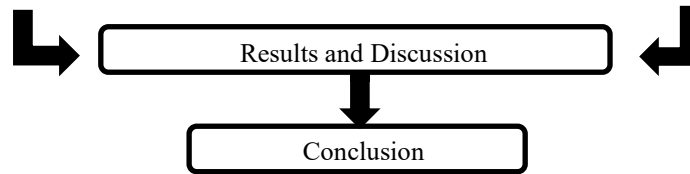


Figure 2. Showcases the research methodology employed and the flow of processes involved.
(Source : Author, 2025)

ANALYSIS AND DISCUSSION

The analysis will be a combination of questionnaire and site observation findings to give a complete picture of the mangrove ecosystem in Kampung Menteri, Kuala Sepetang. This section will provide the data analysis of 50 respondents who took part in the survey. The questionnaire data, which was analyzed in SPSS, shows trends in community awareness, perception, and reliance on mangroves as livelihoods. Site observations are used to support these results, which in turn to confirm the existence of the human activities that relies on the mangrove forest.

Respondent 's Background

The respondent profile includes information about gender, age, occupation, and how long they've lived in Kuala Sepetang. Table 1 presents the demographic characteristics of the 50 participants in this study. The gender distribution shows that most respondents were female (62.0%), while males made up 38.0%. Regarding age, young adults formed the largest group at 46.0%, followed by working adults (20.0%), mature adults (18.0%), and middle-aged adults (16.0%).

For occupation, more than half of the participants were residents (54.0%), demonstrating strong local representation in the study area. Tourism operators made up 18.0%, those involved in various business activities accounted for 12.0%, individuals engaged in fisheries represented 10.0%, and forestry or charcoal workers comprised 6.0%. As for length of residence in Kuala Sepetang, the largest group had lived in the area for over 10 years (36.0%), while equal proportions had stayed less than 5 years (32.0%) and between 5 to 10 years (32.0%).

Table 1. The respondent's profiles participated in the study

Attribute	Frequency	%
Gender		
Male	19	38.0
Female	31	62.0
Age		
Young adults	23	46.0
Working Adults	10	20.0
Mid Adults	8	16.0
Matured Adults	9	18.0
Occupation		
Fisheries	5	10.0
Forestry/Charcoal worker	3	6.0
Tourism operator	9	18.0
Resident	27	54.0
Others (Business)	6	12.0

Residency in Kuala Sepetang

<5 years	16	32.0
5-10 years	16	32.0
>10 years	18	36.0

Note : N = 50

(Source : Author,2025)

Ecological Functions of Mangrove Ecosystems to the Community

The achievement of Research Objective 1, which aims to assess the ecological functions of mangrove ecosystems for the community, is strongly supported by connecting respondent background characteristics with their levels of awareness, visitation patterns, and perceptions of mangrove functions. The respondent profile shows that a large proportion of participants are long-term residents of Kuala Sepetang, with 36.0% having lived in the area for more than ten years, while more than half are local residents by occupation. This long-term and direct exposure to the mangrove environment provides a strong foundation for hands-on knowledge and understanding of mangrove ecological functions.

This background is reflected in the high levels of awareness shown in Figure 3, where respondents across all age groups showed strong understanding of mangrove roles, particularly among young and working-age adults. The widespread awareness across different age groups suggests that knowledge of mangrove ecological functions is not limited to a single demographic group but is shared within the community through daily interaction, education, and lived experience. In addition, Figure 4 shows that local residents and livelihood-related groups, such as tourism operators and fisheries workers, are the most frequent visitors to mangrove areas. This frequent visitation shows continuous engagement with the mangrove ecosystem, reinforcing practical understanding of its ecological roles beyond just theoretical knowledge.

Figure 3. Public understanding about the roles of mangrove.

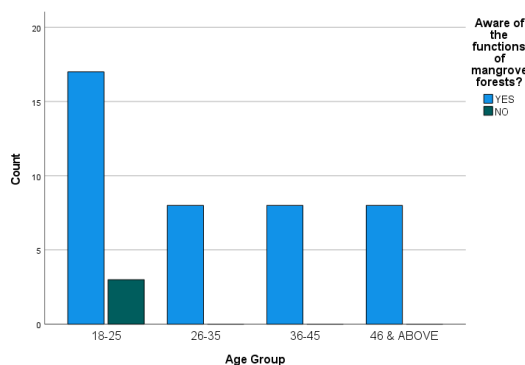
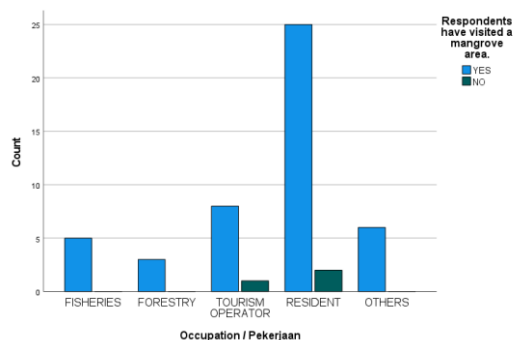


Figure 4. Visitation of respondents to the mangrove areas.



(Source : Author,2025)

These patterns of awareness and interaction are further supported by the perception results presented in Table 2. The community showed strong agreement with key ecological functions of mangroves, including coastal protection ($M = 4.46$), providing habitat for marine species ($M = 4.46$), attracting biodiversity such as fireflies and birds ($M = 4.56$), and regulating climate through air quality improvement ($M = 4.48$). The consistently high mean values show that respondents not only recognize but also strongly value the

ecological services provided by mangroves. When connected to respondent background data, these findings suggest that individuals who live, work, and regularly interact with mangrove environments have a well-informed understanding of how mangroves function as natural coastal defenses, biodiversity reservoirs, and environmental regulators.

Table 2. The respondent's perceptions towards Mangrove Forest

Understanding of the Function of Mangrove Forest	Community Knowledge of Mangrove Forest					Mean
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Mangrove forests as natural coastal protection	0 (0%)	1 (2.0%)	2 (4.0%)	21 (42.0%)	26 (52.0%)	4.46 (High)
Mangrove forests that provide habitat	1 (2.0%)	0 (0%)	2 (4.0%)	23 (46.0%)	25 (50.0%)	4.46 (High)
Mangrove wildlife (fireflies and birds) attracts visitors and tourists	0 (0%)	1 (2.0%)	3 (6.0%)	14 (14.0%)	32 (64.0%)	4.56 (High)
Improving air quality and reduce climate change impact	0 (0%)	1 (2.0%)	1 (2.0%)	22 (44.0%)	26 (52.0%)	4.48 (High)
Mangroves benefit the community	0 (0%)	0	4 (8.0%)	20 (40.0%)	26 (52.0%)	4.44 (High)
Mangroves support fisheries in this area.	0 (0%)	1 (2.0%)	5 (10.0%)	16 (32.0%)	28 (56.0%)	4.44 (High)
Mangrove tourism supports household and community income.	1 (2.0%)	0 (0%)	5 (10.0%)	23 (46.0%)	21 (42.0%)	4.26 (High)

Source : Author,(2025)

Overall, combining respondent background, awareness levels, visitation behavior, and perception data shows that the local community of Kampung Menteri has a clear and comprehensive understanding of mangrove ecological functions. This combination of demographic experience and perceptual evidence confirms that Research Objective 1 has been successfully achieved, as the ecological importance of mangrove ecosystems is both recognized and experienced by the community in their daily lives.

Socio-Economic Contributions of Mangroves to Local Livelihoods

The second research objective aims to evaluate the socio-economic contributions of mangrove ecosystems to local livelihoods in Kampung Menteri, Kuala Sepetang. This objective is effectively addressed by integrating findings from Section D (Resource Use & Livelihood Dependence) and Section E (Conservation Awareness & Community Participation) of the questionnaire, as both sections collectively reflect how mangroves support income generation while shaping community involvement and

sustainability awareness.

The clustered chart comparing Section D (Resource Use and Livelihood Dependence) and Section E (Conservation Awareness and Community Participation) shows a clear and consistent relationship between economic reliance on mangrove ecosystems and community commitment to their conservation. Results from Section D show high levels of agreement across all livelihood-related indicators, including household dependence on mangroves, fisheries support, forestry and charcoal production, and tourism-based income. These consistently high agreement levels indicate that mangrove ecosystems serve as a crucial socio-economic foundation for the Kampung Menteri community, supporting income generation, food security, and employment opportunities.

Similarly, Section E reveals strong agreement levels for conservation awareness, perceived effectiveness of management, and community willingness to participate in mangrove protection activities. The high agreement for statements related to community involvement and willingness to engage in conservation efforts suggests that economic dependence on mangroves is closely connected to a sense of responsibility toward sustaining these resources. When viewed together in the clustered chart, the similar strength of responses across both sections highlights that communities benefiting economically from mangrove ecosystems are more likely to support and participate in conservation initiatives.

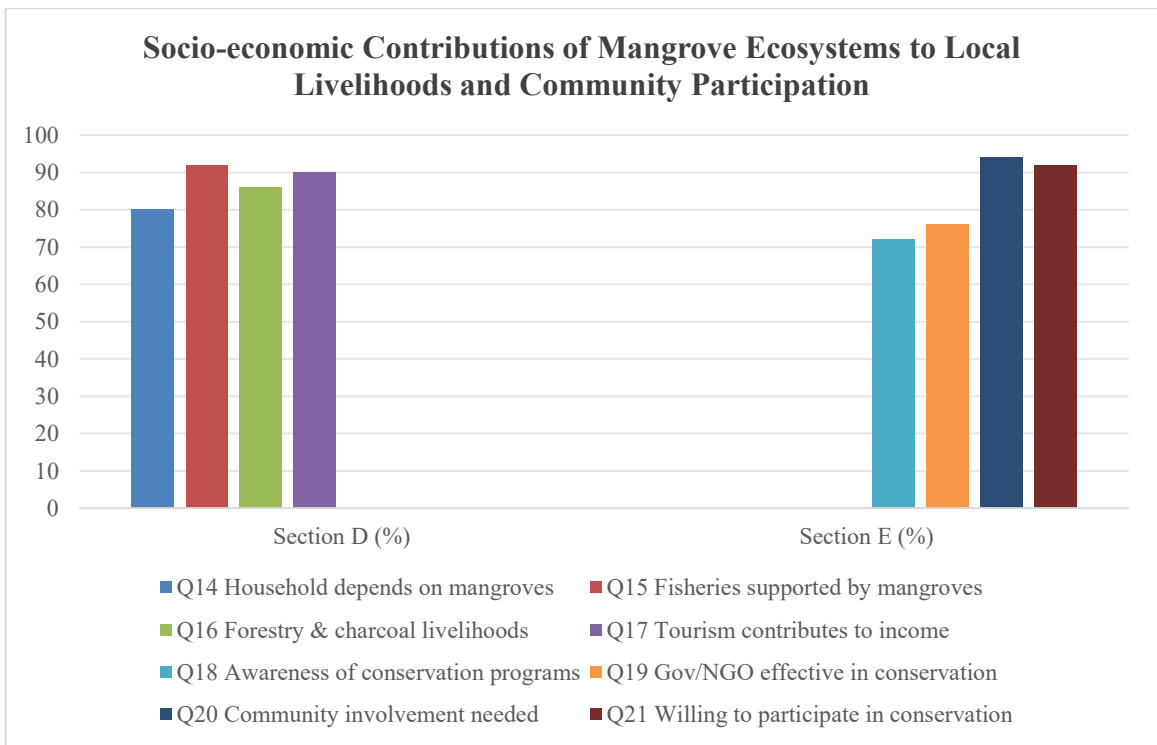


Figure 5. Socio-Economic Contributions of Mangrove Ecosystems to Local Livelihoods and Community Participation
(Source : Author, 2025)

The images presented complement the clustered chart results by visually showing the socio-economic activities that depend on mangrove ecosystems in Kampung Menturi, thereby reinforcing the quantitative findings from Sections D and E. Figure 5(a) shows small-scale trading activities conducted by local residents near residential

and riverfront areas. These informal economic activities often involve selling mangrove-related products and marine resources, showing how mangrove ecosystems support diverse livelihood opportunities beyond direct resource extraction. Figure 5(b) shows the sale of dried fish, a common livelihood activity within the local community. The processing and sale of dried fish highlight the importance of mangrove ecosystems in supporting fisheries resources that enable small-scale trading. Figure 5(c) shows a mangrove viewing activity, representing ecotourism practices such as guided tours and environmental observation. This activity demonstrates the socio-economic contribution of mangrove ecosystems through tourism, where natural landscapes and biodiversity attract visitors and generate alternative income sources.



Figure 5(a). Dried Fish Sales



Figure 5(b). Small-Scale Local Trading
(Source : Author, 2025)



Figure 5(c): Ecotourism Activity

In conclusion, the findings confirm that the mangrove ecosystem in Kampung Menteri plays a significant role in supporting local livelihoods through fisheries, small-scale trading, forestry-related activities, and ecotourism. The consistently high agreement levels shown in the clustered chart, supported by visual evidence of socio-economic activities, show strong community dependence on mangrove resources for income and food security.

Community Perceptions and Adaptive Strategies Toward Mangrove Conservation and Resource Utilization

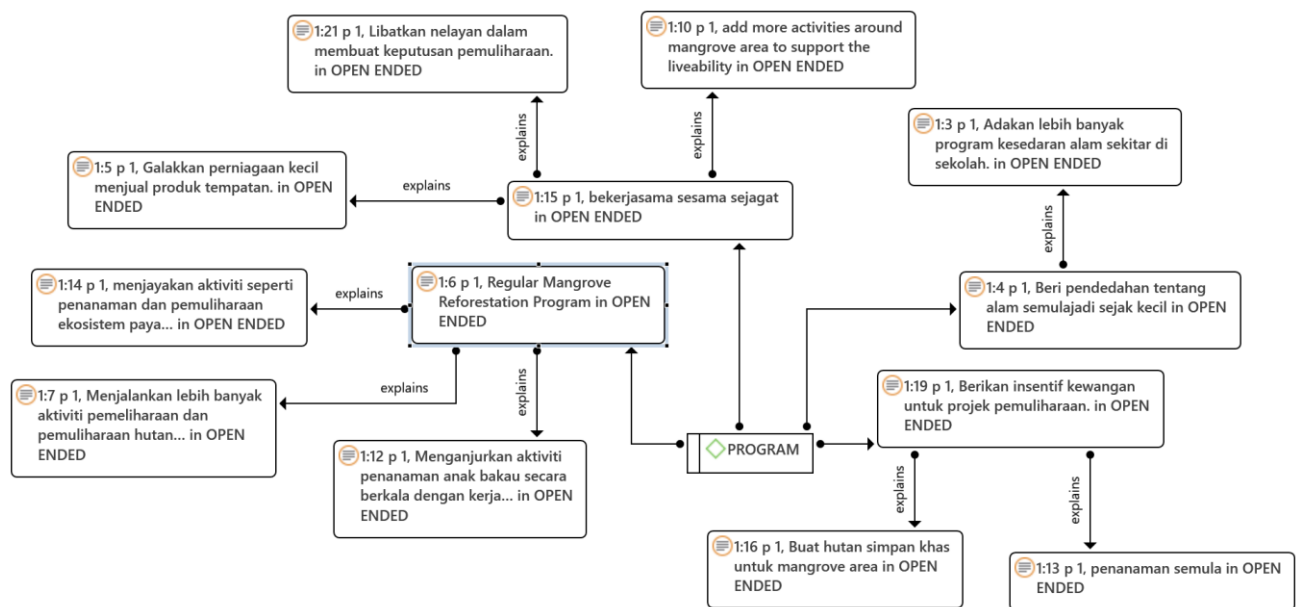
For the third objective, the open-ended questionnaire responses were analyzed to gain deeper understanding of community perceptions, experiences, and suggestions about the mangrove ecosystem at Kampung Menteri, Kuala Sepetang. Unlike closed-ended questions, the open-ended responses gave respondents the freedom to express their views on the ecological importance of mangroves, how mangroves support their livelihoods, existing challenges, and what conservation measures they would recommend.

The strong emphasis on community involvement, replanting programs, and environmental cleanliness shown in Figures 6 and 7 can be explained by respondents' close daily interaction with the mangrove environment in Kampung Menteri. As reflected in the open-ended responses analyzed using Atlas.ti, many respondents directly depend on mangrove ecosystems for their livelihoods, including fisheries, small-scale trading, and tourism-related activities. This direct dependence increases awareness of the impacts of mangrove degradation, motivating respondents to prioritize conservation actions that can protect both

ecological functions and income sources.

In Figure 6, the frequent mention of mangrove replanting, restoration programs, and education initiatives shows that respondents see conservation as a proactive and collective responsibility rather than just a government-led effort. This perception is likely shaped by their long-term residency and repeated exposure to environmental changes, such as shoreline erosion, declining fish catches, or habitat disturbance. As a result, respondents tend to prefer practical, visible actions—such as tree planting and habitat restoration—that they believe can directly improve ecosystem health and ensure the continuity of mangrove-related livelihoods.

Figure 6. Keywords (Program) of analysis using Atlas Ti



(Source : Author,2025)

Similarly, the strong focus on environmental cleanliness highlighted in Figure 7 reflects lived experiences with pollution in mangrove areas. Respondents often mentioned waste accumulation, especially plastic waste trapped around mangrove roots and along riverbanks. These concerns are likely shaped by firsthand observations of how pollution affects water quality, fish numbers, and the overall appearance of mangrove areas, which in turn influences fishing productivity and tourism appeal. The emphasis on cleanliness therefore shows an understanding that poor waste management poses immediate risks to both ecological functions and socio-economic activities supported by mangroves.

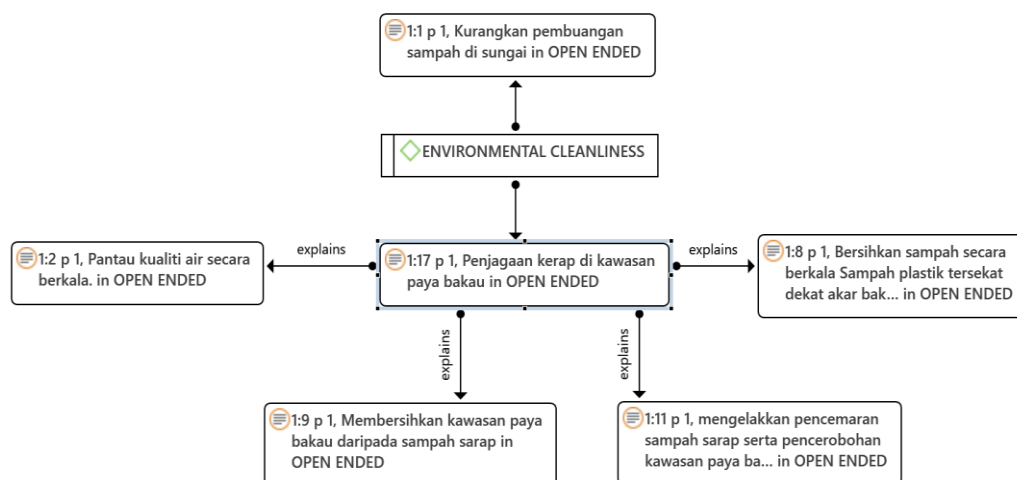


Figure 7. Keywords (Environmental Cleanliness) of analysis using Atlas Ti
(Source : Author,2025)

Overall, the patterns seen in Figures 6 and 7 suggest that respondents' opinions are based on practical experience rather than abstract environmental awareness. Their views reflect an adaptive response to local environmental conditions, where conservation strategies such as replanting, community participation, and pollution control are seen as necessary steps to sustain mangrove ecosystems and the livelihoods that depend on them. This explains why most respondents consistently stressed these themes, reinforcing the connection between ecological health, socio-economic security, and community-driven mangrove management.

In addition to the questionnaire survey, site observation was conducted to support the analysis by providing firsthand insights into the actual site conditions. This approach helped strengthen the interpretation of the questionnaire findings and ensure consistency between what respondents perceived and the real characteristics of the site.

The documented from the figure 8, riverfront jetty areas and small-scale boat activities show how local livelihoods, transportation, and daily economic practices are closely tied to the mangrove environment. This direct dependence explains why respondents strongly stressed the need for organized conservation programs, community participation, and mangrove restoration initiatives, as any degradation of the mangrove ecosystem would immediately affect their income sources and living conditions. In addition, the presence of riverside housing located close to mangrove vegetation highlights the close spatial relationship between residential areas and the mangrove ecosystem, reinforcing respondents' concerns about environmental cleanliness and waste management.

The risk of pollution from daily activities and boat operations further explains why respondents consistently linked effective mangrove conservation with cleanliness, water quality monitoring, and pollution control. Overall, these site observations confirm that community perceptions reflected in Figures 6 and 7 are shaped by lived experience, where livelihood security, environmental quality, and ecosystem health are closely connected. This combination of visual evidence and qualitative responses strengthens the interpretation of adaptive strategies toward sustainable mangrove management in Kampung Menteri.



Figure 8. Documented site condition of the area.
(Source : Author,2025)

DISCUSSION

This study shows that the mangrove ecosystem in Kampung Menteri, Kuala Sepetang functions as an integrated ecological and socio-economic system that directly supports community well-being. The findings show that high levels of awareness and positive views toward mangrove functions are closely connected to the community's long-term interaction with and dependence on the mangrove environment. Unlike abstract environmental knowledge, respondents' understanding is largely based on experience, shaped by daily livelihood activities, living near mangroves, and directly observing environmental changes.

The discussion of Research Objective 1 reveals that strong community recognition of mangrove ecological functions such as coastal protection, biodiversity support, and climate regulation is shaped by frequent interaction with mangrove areas. Long-term residents and livelihood groups, including fisheries and tourism operators, showed consistent awareness and visitation patterns, suggesting that continuous exposure strengthens ecological understanding. This supports the idea that community-based experience plays a crucial role in reinforcing environmental awareness and appreciation of ecosystem services.

Regarding Research Objective 2, the findings confirm that mangroves make significant socio-economic contributions to local livelihoods. High agreement levels related to fisheries support, small-scale trading, forestry activities, and tourism income show that mangrove ecosystems serve as an economic backbone for the Kampung Menteri community. Importantly, the clustered analysis shows that strong livelihood dependence is accompanied by high conservation awareness and willingness to participate in protection activities. This relationship suggests that economic reliance on mangroves encourages a sense of stewardship, as community members recognize that maintaining mangrove health is essential for securing income and food security.

The discussion of Research Objective 3 highlights that community perceptions and adaptive strategies are shaped by real environmental challenges observed on-site. Concerns about waste accumulation, water quality, and pollution reflect lived experiences with environmental degradation in mangrove areas. Respondents' emphasis on replanting programs, environmental cleanliness, and community involvement shows a preference for practical and visible conservation actions that can deliver immediate ecological and socio-economic benefits. This suggests that the community sees conservation not as a separate environmental agenda but as a necessary strategy to protect livelihoods and living conditions. Overall, the findings suggest that effective mangrove management in Kampung Menteri requires an integrated approach that combines ecological conservation, livelihood sustainability, and active community participation. The strong connection between ecological awareness, economic dependence, and conservation willingness highlights the potential for community-driven mangrove management to achieve long-term sustainability.

RECOMMENDATION

Based on the findings and discussion, several recommendations are proposed to strengthen sustainable mangrove management and enhance socio-economic benefits for the Kampung Menteri community. Community-based conservation programs should be formalized and supported through regular mangrove replanting, monitoring, and maintenance activities that actively involve local residents, particularly fishermen, tourism operators, and long-term residents. Environmental cleanliness and waste management should also be prioritized by improving waste disposal facilities, organizing regular clean-up initiatives, and integrating public education on pollution control into conservation programs. In addition, sustainable livelihood diversification should be encouraged through support for value-added seafood products, eco-friendly tourism, and small-scale entrepreneurship to reduce pressure on mangrove resources. Continuous environmental education, especially for younger generations and new residents, is essential to maintain conservation awareness over time. Finally, stronger coordination among government agencies, non-governmental organizations, and local communities is needed to ensure that mangrove management strategies are effective, inclusive, and aligned with local socio-economic conditions.

CONCLUSION

This study examined the ecological, socio-economic, and community aspects of the mangrove ecosystem in Kampung Menteri, Kuala Sepetang using a mixed-methods approach that combined questionnaire surveys and site observations. The findings confirm that mangrove ecosystems function as vital natural systems that support coastal protection, biodiversity conservation, and climate regulation, while also sustaining local livelihoods and community well-being. These results support existing research that highlights mangroves as multifunctional ecosystems providing both ecological services and socio-economic benefits to coastal communities (Getzner & Islam, 2020; Lee et al., 2025).

Overall, this research highlights the interconnected relationship between mangrove ecosystems and the social, economic, and environmental resilience of Kampung Menteri. Protecting and sustainably managing mangrove ecosystems is therefore crucial not only for ecological stability but also for safeguarding local livelihoods and community resilience. The study supports the need for integrated, community-driven mangrove management strategies that align with national conservation goals and global sustainability frameworks, including the Sustainable Development Goals related to climate action, life below water, and life on land (IUCN, 2021; Rössler et al., 2022).

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