

Conservation and Preservation for Endangered Mangrove Species: Comprehensive Case Study of Swamp Forest on North Coast Area of Malaysia

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Abstract

Mangrove forests are special type of coastal ecosystem characterized by their adaptations that enable plants to thrive in saline soil. Despite accounting for only about 1% of global forest coverage, mangroves are keystone ecosystems that provide a variety of critical ecological processes and environmental services. In recent years, there has been a considerable increase in interest in mangrove biodiversity. The lack of community-based organizations (CBO) on the awareness of conservation has a direct negative impact on endangered species. The aim of this is to analyze the conservation and preservation for mangrove in north coast area of Malaysia. Qualitative method was used to collect and analyzed the data, and supported with observations. The findings showed that mangrove conservation project in Kilim and Acheh River rivers are participated by the different stakeholders such as local government units (LGU), NGOs (PiFWA and Koperasi Komuniti Kampung Kilim Langkawi Berhad and Koperasi Nelayan Sungai Kubang Badak Langkawi Berhad), as well as a local community composed of fishermen, gleaners and business operator (travel agent). Those stakeholders are playing different role depend on their capacities. This study proves that mangrove forests are important for coastal area in Malaysia, and conservation efforts are needed to protect it. This finding also can be applied in other area. The contribution and participation of all parties also need for any conservation activities. The funding is crucial for supporting the sustainability of conservation program because some parts of conservation need it to be built such infrastructure or material for conservation.

Keywords: conversation; preservation; rehabilitation; mangrove restoration; endangered species

Introduction

Mangroves are one of endangered ecosystems in all around the world. Fatimah and Zhang (2017) acknowledge that more than 35 % of the global mangrove area was lost between 1980 and 2000. As a result, the global mangrove area fell from 19.8 to 14.7 million ha in 2012. According to estimates, the rate of decline of mangroves is even greater than that of inland tropical forests and coral reefs. Approximately half of the region's total mangrove area has been lost in Southeast Asia, accounting for 15.4% of the global mangrove area lost between 1996 and 2010 (Abdillah *et al.*, 2020).

At the end of 2006, it was estimated that the mangrove forests' total area in Peninsular Malaysia is estimated to be 107,802 ha, of which 82,091 ha was damage. Accordingly, it has been gazetted as

Permanent Reserved Forests (PRFs). The state of Perak possesses the largest mangrove reserves (Matang), followed by Johor (South Johor) as well as Selangor (Kelang). Next, small patches of mangrove forests are discovered along the rocky shores, specifically Pangkor Island (Perak), Port Dickson (Negeri Sembilan) and Pulau Langkawi (Kedah).

In a broader sense, mangroves have a significant impact on the global carbon cycle and climate change. Recent initiatives have increased global society's awareness of and concern for climate change, particularly global warming. Through corporate social responsibility (CSR) programs, the current study seeks to investigate and comprehend community-based organizations' awareness of the conservation and rehabilitation of endangered mangrove species. Besides, it further considered the effect of the previously implemented CSR practice on the resilience of mangrove restoration projects. This

study utilized two mangrove restorations on a conservation project to explain the progress activities of community-based organizations' awareness of environmental sustainability, especially for mangroves in coastal areas. The project was chosen with different nature of economic activities as per the case presented in areas of Kilim Geoforest Parks (tourism base community activities, high population density) and Nibong Tebal Seberang Perai Utara (fishery and high population density). Apart from that, the detail of the conservation project based on community base organization activities that stimulate engagement among the agencies to support their CSR program. It is argued that this study can enhance creativity to develop new conservation and rehabilitation future project by attracting more NGOs, private organizations and government agencies highly involved with such CSR activities.

In this study, this issue is formulated by an optimal restoration problem from the standpoint of a local community, considering trade-offs with current livelihood options such as fishing, agriculture, and tourism activities that will contribute to mangrove degradation for the long term if the proper monitoring is not conducted. Moreover, when determining the appropriate amount of restoration, the local community considers the possibility of future loss of recovered mangroves and the resulting impact on carbon credits collected. Lastly, the model is used to help save a small area of mangroves in the northern part of Malaysia, which is the perfect place for the research to be done.

Materials and Methods

The current study site location was selected at Sungai Acheh River, Nibong Tebal Seberang Perai Utara, Penang, (5.4129° N, 100.4412° E) 24.8 ha and Kilim River Geoforest Figure1, Langkawi Kedah (4.354 ha), Malaysia Figure 2. The mangrove ecotourism area of Kilim River Geoforest Park Langkawi Island, Kedah, was chosen as the model of successful mangrove deterioration and focused on rehabilitation through replanting mangroves and developing experimental nurseries for mangrove seedlings of different species. Both research areas are in Malaysia's Langkawi Island's north-eastern half, between longitudes 99° 48' and 99° 55' E and latitudes 6° 29' and 6° 23' N. The 478-square-kilometre Kilim Geoforest Park contains greenish mangrove swamps, limestone cave tunnels, mangrove forest, a limestone formation, the Kilim River, narrow valleys, and a diverse array of species (Hikmah *et al.*, 2013; Matthew *et al.*, 2019). Halim *et al.* (2019) reported the decreasing number of mangroves at Langkawi from 2005–2017. The mangrove area in 2005 was 557.69 ha, and the mangrove area in 2017 was approximately 552.06

ha. From 2005 to 2017, total declining areas were 5.63 ha, with Kilim areas being around 2.03 hectares (Halim *et al.*, 2019). Meanwhile, since 1982, almost 42% of mangroves have disappeared due to conversion to urban development and agriculture in Penang coastal. As of 2017, less than 1,050 ha of mangrove forest were all that was left as of 2017, which took up only 1% of the total land area in Penang (Latiff, 2012). The data number of mangrove tree indicate that is not healthy for future mangrove rehabilitation. In additional, stakeholder awareness more beneficial to the future mangrove conservation.

Research scope

The impact of a mangrove conservation and rehabilitation project on community and other stakeholder involvement in coastal areas was the subject of this study. Maintaining and rebuilding mangrove resources requires community participation. Conservation and rehabilitation are defined more broadly in this study in order to be more sustainable for community-based well-being. The importance of preserving mangroves is examined here through four pillars: community participation, education awareness, social income production, and stakeholder role. As a result, the current project is built and conceptualised around these four primary pillars. Figure 3 depicts the conceptual framework for conservation programmes based on four pillars from a community base in the northern region's coastal areas.

Community engagement

With conservation project aims to promote community-based in combination with mangrove conservation through a carefully designed program that benefits communities, key mangrove species, and ecologically significant habitats. The project also aims to promote integrated community landscape conservation, facilitate policy discussions to strengthen replanting policies, and build the capacity of the Government to implement community-based mangrove and conservation project.

The long-term goal of community engagement or participation in conservation projects is for them to become self-sustaining and maintained by the community (Rasanjali *et al.*, 2021). To do this, the conservation initiative attempts to mitigate community felt costs by developing self-managed ecotourism and sustainable livelihood assistance. Activities are carried out in such a way that economic, social, and aesthetic requirements, cultural integrity, biological diversity, and life support systems are all met in a harmonious manner.

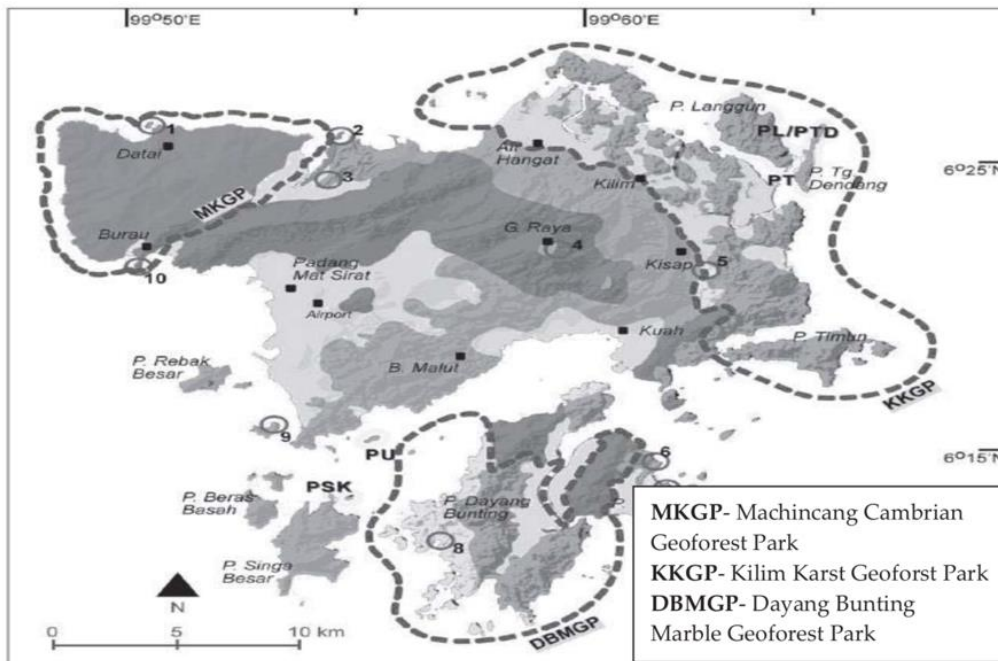


Figure 1: Location map of Kilim Karst Geoforest Parks (KKGP). Source: Sapari et al. (2013)



Figure 2. Sources: Southern, Seberang Perai Land and District Penang, Kuala Sungai Acheh River PiFWA 2019

Education awareness and outreach

In June of 2017, non-governmental organizations (NGO) started holding educational programs about environmental conservation, replanting or restoration, and seeding for the youth. They are holding the restoration program for school curriculum activities, including kindergarten, high

school, and university students. Whiles, the advancement of education in both initiatives remains dependent on non-governmental organizations (NGOs) and government agencies founded on cultural beliefs. The purpose of the educational project is to place an emphasis on environmental education programs with the intention of empowering children to become community ambassadors. This will be

accomplished by ensuring that children's knowledge of environmental and conservation issues, as imparted in the classroom, is widely accepted throughout the community. In the year 2020, NGOs developed an environmental education program by facilitating workshops and training sessions on the significance of conserving wildlife habitats and restoring mangrove species. Students need to have a strong sense that they are contributing members of their communities and are actively engaged in discussions about environmental issues for environmental literacy to be effectively taught to them (Baroody and Diamond, 2012; Poimenidis *et al.*, 2022). Since the year 2019, there have been over 20 different programs that invite participation from students attending high schools, colleges, and universities both locally and internationally.

Society income sustainability

Aquaculture, fisheries and ecotourism area main economic activities for this coastal community. The literature notes that human anthropogenic will contribute to the environmental damages. However, previous study stated that needs to ensure long term economic sustainability of projects. CSR project mixed record with economic success. As a result, community leaders decided to begin aiding local communities in the implementation of sustainable livelihood program as a means of offsetting the costs

associated with complying with more stringent land use plans and new community ordinances. These projects for sustainable livelihood included things like increasing sustainable agricultural production with farmer's and women's groups, harvesting sustainable oysters, and ecotourism. All the economic activities such will sustainably the community livelihood and well-being.

Stakeholder role

Stakeholder role to involve in conservation mangrove projects refers to attracting support of diverse participants as well as increasing their capacity to improve effectiveness (Seva *et al.*, 2022). There are two types of stakeholders in mangroves: direct and indirect users. According to them, direct users are those who exploit the mangrove forest directly, whereas indirect users are those who do not have direct contact with the mangrove forest and do not exploit it directly (Savaya and Spiro, 2011). Malaysia facing same difficulty, despite narratives that often center around the program's use of smallholders implying it must participatory. Besides, most of the conservation project have been managed from the top-down (Chinseu *et al.*, 2022; Hodgson *et al.*, 2022). Thus, undeniable the functions of stakeholder as a key person in implementing and controlling the conservation performance.

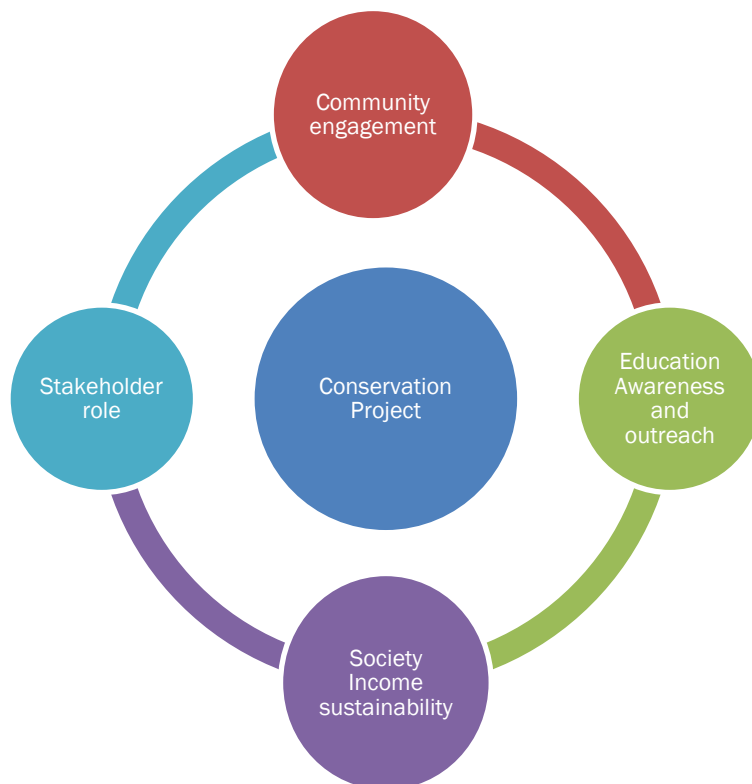


Figure 3: Conceptual framework for conservation project

Data collection

This study has performed observational monitoring of primary indicators essential to examine the performance of rehabilitation or restoration projects' aims and objectives, as well as to guide decision-making and adaptive management. The researcher utilized a classic anthropological approach (Goffman, 1967) to analyze the consequences for the project organizer mitigate mangrove and coastal degradation, restoration project members, the participation through face-to-face interviews and observations of their mangrove site. To allow for the potential influence of restoration mangrove activities and site conditions on their rehabilitation and conservation practices, community involvement, and success of mangrove restoration, two different areas were selected for investigation (Figure 2 and 3.). Kilim Geoforest Parks (tourism base community activities, high population density) and Nibong Tebal Seberang Perai Utara (fishery and high population density). The interview and observation were conducted from November 2021 to February 2022 via in-depth expert interviews to acquire data on the threat factors affecting the conservation and rehabilitation in both projects. Four groups are participating in the conservation project. Participation observation involves studying actions and behavior, which is combined with direct observation, participation in group activities and informal interviews or conservation with the research subject (Bernard, 2006; Newing *et al.*, 2011).

Based on the research's scope, which was limited to particular geological and environmental protection concerns, expert and professional involvement in Langkawi and Penang, Acheh River at Nibong Tebal Seberang Perai Utara management was the ideal group to interview than the general population. This is due to the fact that the conservation and management element was fairly difficult and technical. According to Curtis *et al.* (2000), the issue of qualitative research validity pertains to the sample/respondents who should give credible descriptions/explanations. As a result, competent professionals with knowledge of Langkawi were chosen as the group to gather valuable and valid data. In the in-depth expert interviews, the experts were implored regarding Langkawi's conservation, management challenges, as well as issues. The form of the question was subdivided into a few sections by relating to indicators and characteristics of the Geopark. In addition, the topics include general knowledge about the Geopark and Geoforest Park, as well as conservation challenges and issues.

The interview took place from December 2021 to March 2022. Twenty-two individuals or families participating in the mangrove restoration three were interviews. Participation was connected by phone

call, regarding their participating in the CSR project. Respondents were divided into four main profiles: students, agencies, NGO's and residents. The interview was conducted by an individually according to comprehensive interview method described and theories by (Heath and Cowley, 2004; Charmaz, 2006). The interviews will take around 1h 15 min on average (30min⁻¹ h). Most of them (n=22) took place at respondents' project sites. All the interviews were recorded and transcribed. After 18 interviews, we reach saturation as the last interviews did not contribute discovering anything (Strauss, 1987; Clayton and Opatow, 2003).

Data analysis

Thematic analysis is used to code the data to develop a systematic technique of analysis. The data was effectively controlled. Thematic analysis is a qualitative analytics method for identifying, analyzing, and reporting patterns (themes) in data. According to Braun and Clarke (2006), the analytics is arranged to describe the data set in detail and is interpreted in several areas related to the research issue. Evidence from numerous sources is then classified and organized into larger themes. Furthermore, Braun and Clarke (2006) recognize that the themes that collect meaningful data from interview transcripts must answer the study questions and represent the patterned responses within the produced data set. The variables in this study's themes/categories are the factors that form community to involve with project. The extracts are quoted verbatim, without editing, to preserve the genuine significance and veracity of the participant opinions.

Results and Discussion

All the respondents showed a general interest in mangrove conservation project, matter. The most significant findings related to this study is that the growing number of community-based engagement with conservation project in these areas. Participating in Mangrove Conservation projects, specifically in repeat observation of program. Three significant factors contribute to the successful creation of the conservation project: (1) community's engagement, (n=4), (2) Education awareness (n=7), (3) society income sustainability (n=9) and (4) stakeholder role (n=6). Considering community-based and stakeholders' participation in conservation project, all the interviewees stated that they are fully encouraged by one another to engage in the process conservation activities. The findings showed that mangrove conservation project in Kilim and Acheh River rivers are participated by the different stakeholders such as local government units (LGU), NGOs (PiFWA and *Koperasi Komuniti* (Community Cooperation) Kampung Kilim Langkawi Berhad and

Koperasi Nelayan (Fisherman Cooperation) Sungai Kubang Badak Langkawi Berhad), as well as a local community composed of fishermen, gleaners and business operator (travel agent).

Fishermen also indicated their active involvement in replanting mangrove. For instance, one comment. Theme 1- Community engagement Respondent 13: "We are group of fishery community who should be responsible for mangrove conservation because we have directly exploited marine and mangrove resources as our main income generation in order to sustain our economic well-being". Another response from Fishermen Theme 2- Education Awareness and Outreach. Respondent 5: "I always make time to participate with the replanting mangrove at the plant areas that a deforestation. Most of the replanting project I participate especially with school children".

Comment from women respondent Theme 3- Society Income Sustainability. Respondents 8: "We were enthusiastically encouraging by community leader to used sources from mangrove as our community product and to commercialist in knowledge sharing as well as a community income generation". Response from agencies that involve with conservation project. Theme 4- Stakeholder role Respondent 11: "I represent as an agency who directly involve with mangrove conservation responsible to strengthen the mangrove restoration and conservation policies and always give support for research rehabilitation work".

According to the findings of this study, community members and other stakeholders are very committed to conservation program. Generally, mangrove restoration projects (include state sponsor and international projects) implemented in Malaysia have contributed to an increase in mangrove areas. In this paper, it is estimated that from 2018 to 2021 about 1 million mangrove trees was planted in Malaysia. As a result, at Table 1, demonstrates that the initiative has been growing mangrove restoration plants in deteriorated regions since 2018. Economic activities are the primary threats to mangrove survival rates at both sites. Population growth, fast urbanization, and industrialization, as well as unsustainable land use and land conversion, particularly in coastal areas for shrimp and fish farming, infrastructure, and tourism, have all contributed to mangrove degradation in the northern region. On the Acheh River, 350,000 trees have been planned since 2011. Meanwhile, on 60 acres of land, 114,198 mangrove seedlings have been planted. Furthermore, their nurseries can house 25-30 thousand mangrove seeds. However, in comparison to the Acheh River, where the community base was created in 2009, Kilim is still progressing slowly in the

replanting effort of mangrove trees, with approximately 13,500 mangroves planted over the river and coastal areas. Besides, selecting species unsuitable to site condition also leads to failure of mangrove restoration project (Alam *et al.*, 2022; Khairany *et al.*, 2022). Moreover, other reason leading to failure of mangrove restoration programs is the lack of incentive for long term management (Seva *et al.*, 2022). This current project is all about recruiting volunteers from students, towns, and organizations to assist design and operate their program while making the volunteers feel like they belong and are thankful for nature.

As a result of the findings as per Table 2, several conclusions were drawn on the problems and obstacles that ought to be given priority in subsequent study. It is quite clear that the local CBOs establishment has improved the quality of life for individuals as well as for the community in the surrounding areas. In addition to having access to a wide range of information and abilities, the local communities are also given new roles in the management and conservation of mangroves. Incentives can be gained through participating in active mangrove program. Participating in replanting mangroves and other activities associated to the protection of mangroves makes local communities feel like they have a stronger connection to their natural surroundings. In addition to this, it inspires people to have a positive attitude toward the management of mangroves and the utilization of mangrove resources. As local communities take care of and maintain the areas, they develop a greater respect for such sites.

The present study has focused attention on the crucial awareness of conservation and rehabilitation projects for endangered mangrove species in north coast areas of Malaysia among the community-based organization (CBO). Numerous variables have been identified as impeding the successful application of mangrove conservation recommendations, according to researchers. Initially, observation from both projects suggested that there is maybe a link between community base organization awareness is the main contribution to the success of the project and even difference in their economic activities. Furthermore, the engagement and involvement of non-governmental organizations (NGOs) and local government agencies will bring conservation and rehabilitation of mangroves to become more priority in sustainable agendas.

Future threats

The findings from this study also highlight the obstacles element should be managed. There are the challenges faced by Community Mangrove Restoration Project as below:

Climate change: Rising global temperatures have a serious impact on the quality of the environment. An increase in temperature coincides with an increase in carbon dioxide (CO₂) released into the atmosphere (Arifanti, 2020). Mangrove forests can serve as long-term carbon (C) absorbers, capturing up to four times more than rainforests. Mangrove ecosystems have the capacity to absorb CO₂ and store 40% more C compared to dryland forest ecosystems. The amount of C deposited in mangrove ecosystems is 50 times faster than in dryland tropical forests.

Funding: Most countries, especially in areas with communities with high dependence on mangrove ecosystems, have given priority to mangrove forest financing. Coastal ecologists, national and international NGOs, governments, community-based organizations and coastal communities play an important part in mangrove

restoration and conservation initiatives. Through partnerships and collaborations among these key players, the successful implementation of mangrove restoration and restoration projects is possible. Nowadays, local NGOs and CBOs working with government agencies in mangrove conservation are no longer uncommon. Such synergies often contribute to collective action and positive outcomes. In addition, financial support from international funding agencies, bilateral donors, and government agencies in the form of grants or concession contracts is essential to the success of efforts for mangrove conservation.

In recent years, the CBO has carried out many mangrove replanting activities as part of the national mangrove replanting program in coastal areas through funding from the Peninsular Malaysia Forestry Department (FDPM). For example, mangrove management in Sabah has received greater attention

Table 1. Nursery place, nursery mangrove seed, conservation and rehabilitation project and total number of mangrove replanting (2018-2021).

Project site	Total of Nursery Place	Conservation project	Nursery of mangrove seed	Total number of mangrove trees
Kilim Langkawi	13	25	35,000	13,500
Acheh River Penang	2	48	100,000	35,000

Table 2. Summary of project the best practice issues and challenges and improvement

Site	Reasons for mangrove losses	Best Practices	Issues and Challenges	Lessons learned
Kilim	Conversion to aquaculture pond, construction material conversion land to tourism used.	<ul style="list-style-type: none"> • Adoption of community-based engagement, and ecological mangrove restoration at degraded coastal environments. • No aquaculture farms in mangrove areas • More focusing tourism industry than aquaculture. 	<ul style="list-style-type: none"> • Percentage of survival rate quite lower in plantations due wrong choices of species for planting. • A lot of trips of speed boat around mangrove areas to carry tourist / passenger. 	<ul style="list-style-type: none"> • Need to harmonized mangrove plantation policies and institution to assist in promoting effective sustainable management and rehabilitation. • Lab test and sciences-based process is a prerequisite for rehabilitation.
Acheh River	Conversion to aquaculture, pond, fishery, industrial development land used	<ul style="list-style-type: none"> • Integration of aquaculture with rehabilitation for local community income generation. • Community engagement replanting and restoration mangrove. • Education training center for mangrove awareness. 	<ul style="list-style-type: none"> • Limited studies that asses the cause of degradation and insufficient communication of results. • Policy gap on requiring feasibility assessment, monitoring and enforcement through multi-disciplinary approach. 	<ul style="list-style-type: none"> • Need for integrate approach to mangrove rehabilitation, including knowledge based planting methods. • Socialize mobilization • Livelihood support, strengthen protection policies and provides more support for research and rehabilitation works.

since the Sumatra Tsunami disaster in 2004 (Musa *et al.*, 2020). Since that tragic episode, the Federal and State Governments have provided full support by providing the necessary funding for mangrove rehabilitation programs.

Conservation management: Poor integration of environmental policy in overall policymaking results in ineffectiveness, especially in the existing government agencies that do not promote economic development and hinder nature conservation (Latiff, 2012). Local and provincial levels face political pressures that require immediate action to allow for changes in land use versus national authorities. When agencies start reforestation for rehabilitation initiatives, technical policy mistakes frequently happen. Legal uncertainty over the land title is frequently caused by the intersection of marine and all-encompassing resources in mangrove forests. In addition, government agencies may provide long-term leases or concessions to commercial industries like tourism and shrimp farming, which can lead to unsustainable land use.

Land use urban development: Land cover conversion for infrastructure and urban development has been common in shallow-sloping intertidal environments. At regional scales, urban development may not be the significant cause of mangrove loss. Still, it can be a crucial driver in specific regions, such as the southeast coast of Gurney Penang in the late twentieth century. Penang has also lost large amounts of mangroves and related mudflats due to urban expansion.

Pollution: Upstream industrial and agricultural activity, as well as land-use patterns, contribute to pollution in estuaries and rivers. In addition, sediments from the expanding town of Sungai Acheh River, as well as sections of the free trade zone industry at Bayan Lepas, poured into the mangrove areas, turning the muddy sediments sandy.

Aquaculture: During the second part of the twentieth century, mangrove deforestation was mostly caused by inshore aquaculture for fish and shellfish production. Fish and prawn cultures have proven more profitable in the long run, particularly for export markets. Mangroves in Kilim and Acheh River River has been severely depleted due to aquaculture. The growth and expansion of the aquaculture industry in Langkawi had been cautioned against by Fauzi *et al.* (2017).

Conclusions

The three groups of stakeholders, composed of the LGU, NGOs, and local community, have varying levels of awareness of the mangrove resources,

and conservation practices. This is also affected (positively and negatively) by the perceived values they put on mangrove resources. The higher the involvement in conservation practices such as NGOs and LGU, the greater their desire to reduce the negative impact on mangrove resources. On the contrary, the local community with lower awareness of conservation practices considered the mangrove tree, which they can use for fuel and dye for bark, to have the highest value. The results indicated harmonizing the awareness of the three important stakeholders of the conservation measures enhances everyone in the community. It benefits both the direct and indirect ecosystem as well as the services that mangroves can provide. Furthermore, depending on the economic activities in specific regions of the mangrove site, the design of the program and implementation may differ. Moreover, if an outside organization offers financial and logical assistance, it is inaccurate to claim that empowering the local community to protect the environment has produced positive results. Another crucial lesson gained is the need to combine CBO awareness and capacity building with restoration efforts. The contribution and participation from all practices are need for Mangrove conservation program with their own capacities.

Acknowledgement

This work was supported by the Kolej Universiti Islam Perlis (KUIPs), Langkawi Department Authority (LADA), Penang Inshore Fisherman Welfare Association (PiFWA), Komuniti Kampung Kilim Langkawi Berhad and Koperasi Nelayan Sungai Kubang Badak Langkawi Berhad. Project funding was self-funded grant

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