

Community-Based Mangrove Forest Management Sustainability: The Case of Some Asian Countries

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Abstract: *This study presented the various cases of community-based mangrove forest management in the Philippines and other parts of Asia. It shows the comparison of the community-based mangrove management systems. Some areas focusing on their practices that are suitable to the physical condition of location, culture, and socio-economic characteristics. Some are applying strategies learned from the other areas. The experiences show that management systems that are contextual and/or suitable to the location are likely to be sustainable. Mangrove forest management by the local community is a vital instrument to attain sustainability. However, there is no assurance that the mangrove forest management by the community is sustainable, especially resource extraction, tourism activities, and aquaculture are present. Community-based mangrove forest management needs evaluation of sustainability using applicable criteria and indicators contextual to the area.*

Keywords: Community-based Mangrove Forest Management, Evaluation of Sustainability, applicable criteria and indicators

1. Introduction

Mangrove forest provides a variety of ecosystem services which includes protection of coastal communities against disasters (e.g., storm, flood, strong wind, etc.), provision of critical habitats for several faunas, and storage of vast amounts of carbon (UNU-INWEH, 2016). It supports terrestrial animals, marine animals, and humans (Carter et al., 2015). Also, it can provide lumber and firewood, but they also provide indirect benefits. The indirect benefits include their capacity to regulate wave energy and serve as buffers against flood, storm, and strong wind (Daupan, 2016), their capacity to filter the water from sediments upon flowing to the ocean to avoid water pollution and contamination (Hema & Indira Devi, 2013). Mangrove firewood, but also provide indirect benefits. The indirect benefits include their capacity to regulate wave energy and serve as buffers against flood, storm, and strong wind (Daupan, 2016), their capacity to filter the water from sediments upon flowing to the ocean to avoid water pollution and contamination (Hema & Indira Devi, 2013).

Mangrove Forest Management by the coastal community is a crucial mechanism to achieve sustainability in the management of the mangrove ecosystem (Datta et al., 2012). Communities from different places in Asia are involved in the management of mangrove forests for the protection and utilization of resources. There are different strategies adopted by the community as part of their management system. Sustainability of management system is crucial to provide long term direct and indirect benefits as well as in the next generations.

Mangrove Forest and Its Importance

Mangrove forests are significant tropical forests that grow at the edge of the land and sea, which stabilize coastlines, protect communities from storms, provide critical habitats for many animals, and store vast amounts of carbon (UNU-INWEH, 2016). It supports several forms of life, including terrestrial animals, marine animals, and humans (Carter et al., 2015). It is also used as a source of lumber and

firewood, but they also provide indirect benefits. These include their ability to absorb wave energy and serve as buffers against storms (Daupan, 2016), their ability to filter the water from sediments before flowing unto the sea (Hema & Indira Devi, 2015), a natural habitat for birds and marine life forms, including its function as nurseries and spawning grounds for aquatic life forms such as shrimp and milkfish and a source of food for marine fauna through the detritus food chain (Daupan, 2016). The Philippines shelters at least 40 species belonging to 14 families of around 54 true mangrove species worldwide, which provides not only derived products and services as benefits but also cultural influence, as many towns derived their names from mangrove species. Estimates of production and value of mangrove fisheries (on a per ha per year basis) are 13-756 kg and US\$91-5,292 penaeid shrimp, 13-64 kg, and US\$39-352 mud crab, 257-900 kg and US\$475-713 fish, 500-979 kg and US\$140-274 mollusks (Maneja, 2006). Mangroves in India are spread over an area of 4,66,156 hectares (in 5700 km coastal line) occupying 0.14 percentage of the geographical location of the country with 3.1 percent of the global and 8 percent of the Asian mangrove coverage (FSI, 2011). Mangroves in Kerala are spread mainly in the districts of Kannur, Ernakulam, and Kasargode. Even the scanty presence of mangroves in the other districts plays essential ecological functions and an economic role in the local economy. Mangroves of Kollam (Ashramam) and Kottayam (Kumarakom) have a prominent place in the tourism map of Kerala. Mangroves of Kumarakom (Kottayam), Mangalavanam (Cochin) and Kadalundi (Kozhikode) are the hot spots of birds, especially migratory birds (Hema & Indira Devi, 2015).

In the case of North Sumatra, Indonesia, mangrove ecotourism was implemented as an alternative livelihood to the community as part of the community-based mangrove management strategies which provided economic welfare to the community, including the upland inhabitants (Basyuni et al., 2018). In their management, upland ecosystems and upland communities are directly part of their sustainable mangrove management. In the case of mangrove forests in

Damas Beach, Trenggalek, Indonesia, mangrove forests are useful to the local community for their subsistence by providing fishes, timber, and others (Purwanti et al., 2018). In the case of Matang mangrove reserve in Malaysia, the local community is dependent on mangroves by providing charcoals and timber as well as aquatic products (Martínez-espinoza et al., 2020).

Sustaining the livelihood of the local community, proper regulation, and plans in the utilization of mangrove resources and direct participation of the local community are essential for the effectiveness and sustainability of mangrove management for sustainable use of ecosystem services (Damastuti & Groot, 2017). In the case of Kerala, India, the respondents expressed their willingness to contribute towards the conservation of mangroves both in cash and kind (cash payment and manual participation as labor and as a volunteer in awareness programs) and in combination. On average, 50 percent of the stakeholders expressed their willingness to contribute towards conservation efforts. About 15 percent of residents, fishers and the general public and one-fourth of the paddy farmers were not willing to contribute, either cash or kind. This may be due to the situation of competition between paddy cultivation and prevailing mangroves in specific areas like Ezhome and Chengal (Kannur). Some of the residents opined that it was the responsibility of the government to conserve the natural ecosystems. Few among the general public observed that those deriving direct benefits from the mangroves were to be taxed rather than the population at large. The low economic status may also be a reason that restricts their willingness to pay (Hema & Indira Devi, 2015). Based on Pascal & Bulu (2013), in the case of Crab Bay, Vanuatu, the mangrove ecosystem of about 136.5 hectares have produced in 2012 of Vt 53 million (US \$ 586,000) comprised between Vt 36 million and Vt 70 million. In Eratap, Vanuatu, the mangrove area of about 31.2 ha was estimated to produce a value of Vt 24 million (US\$ 266,000) annually with a minimum of Vt 17 million and a maximum amount of Vt 31 million. For comparison between sites, this is equivalent to Vt 386,000 per year per hectare in Crab bay and Vt 786,000 per year per hectare in Eratap. In Crab bay, the principal ecosystem services in economic terms are the value of carbon sequestered, the proteins from subsistence fishery, commercial fishing, and wood extraction. On the other hand, the principal ecosystem services in Eratap are carbon sequestered, revenues from tourism linked to mangroves. The avoided cost from coastal protection against floods, proteins for subsistence fishery for a total of 85% value, commercial fishing, wood extraction, and recreative fishery (Pascal & Bulu, 2013).

Also, mangroves are very beneficial to social groups in the case of Crab Bay and Eratap in Vanuatu, such as fishermen of the commercial artisanal fishery, local families for whom fishing in the mangrove. It is a source of regular protein (160 households in Crab bay and 80 households in Eratap, local families benefiting from firewood and construction materials (150 households in Crab bay and 45 in Eratap), tourism Entrepreneurs in Eratap proposing mangrove tourism, real estate owners protected from coastal flooding as well as plantation owners. Also, the global community to benefit from carbon sequestration and biodiversity, tourism

entrepreneurs in Eratap whose businesses, depends on the quality of water of the lagoon as well as beach formation and with a total of 800 people depend on one or more of the mangrove ecosystem services in Crab bay and 400 in Eratap (Pascal & Bulu, 2013).

Deterioration of Mangrove Forest

For the past decades, there has been a huge decrease in areas occupied by mangrove trees in the Philippines. At present, the mangrove forest cover in the country is estimated at 310,593 hectares (DENR, 2015), having dwindled from 450,000 ha in 1918 (Naz, 2013). This significant loss of mangrove forests can be attributed to anthropogenic activities, especially to the conversion of mangrove forests to fishponds or aquaculture and clear-cutting for timber production (Carter et al., 2015). Based on Morales et al. (2014), aside from aquaculture, tourism activities can destroy mangrove forests. From 1973 to 2002, a total of 62,834.34 hectares of mangrove forest areas across the country were issued with Fishpond Lease Agreements (FLAs) by the Bureau of Fisheries and Aquatic Resources (BFAR), consequently converting these forests into fishponds (Naz, 2013). Fish production will rapidly decline due to uncontrolled and continuous mangrove deforestation, and if there are no proper management and restoration programs (Carter et al., 2015).

Out of the total land area of 1.485 million hectares of Palawan, 4.4% or 63,532 hectares is saturated with mangroves, and it is considered the highest in the country. This presents a significant increase in the province's mangrove cover, as compared to 3.34% in 1992, 3.35% in 1998, and 4.0% in 2005, with an approximate increase rate of 700 hectares/year (PCSD, 2015). In line with the rising awareness of the importance of mangroves, government-funded and large-scale international development assistance programs have focused on mangrove replanting or rehabilitation not only in Palawan but also in other parts of the country. However, with the current rate of development in the province, as well as the expansion of its tourism industry, pressures caused by the people's demand will continue to threaten Palawan's mangrove forests (Primavera & Esteban, 2008). In Catanduanes Island, the Bicol region, the mangrove area was degrading due to tourism development by the construction of structures and the increasing number of tourists in the area. (Morales et al., 2014). In the case of Tarut bay, Saudi Arabia, mangrove areas were highly deteriorated due to the pollution caused by factories, littering, and land reclamation. For 39 years, there was a decline of 59.93% in the mangrove area due to high exposure to many environmental and human pressures such as urban encroachment, pollution, and land reclamation (Almasheer, 2013). Another case of mangrove deterioration is in the Sundarban mangrove forest in Bangladesh, in which the livelihood of the people is highly dependent. They engaged in aquaculture (fish and shrimp production) that deforest the mangrove area. The rapidly expanding shrimp industry drives the people to degrade the mangrove. Besides, the poaching of wildlife that is living in the mangrove area serves as another form of livelihood (Rahman et al., 2010).

Mangrove Forest Security and Livelihood

Mangrove forest sustainability does not only depend on continuous planting but through the involvement of the community in the management. The local community can directly affect the mangrove forest due to easy access to the area (Daupan, 2016). Also, the cooperation of the local and national government with the local community is more efficient in securing the mangrove conservation due to the complexity of the mangrove ecosystem (Carter et al., 2015). Livelihood is the main reason for utilizing the mangrove forest by the people, which may lead to degradation without proper management. The livelihood of the people that use mangrove forests is aquaculture, charcoal production, timber production, tourism, etc. Aside from fuel and timber, it also provides food to the people through fish production (Hema & Indira, 2015). Urbanization and development activities are another enormous pressure to the mangrove forest due to utilization of timber and land-use changes, but through mitigating actions like restoration and rehabilitation through a community-based approach, mangroves will revive (Dale et al., 2014). There are four management options to protect the mangrove forests: community-based management, public management, private management, and public-private partnership. Community-based management is the local communities that depend on the mangrove ecosystem for their livelihood, forming democratic institutional form to manage the resource. Public administration is a situation in which the state takes ownership rights over the resources and manages the resources and provides user rights to communities who depend on the system of livelihood while private management is with private ownership rights and private management of the resource as per the owner preferences. The public-private partnership is an institutional form in which private ownership/ user rights are protected, and the state takes an active role in the management through an institutional way where there are representatives from both private owners and government (Hema & Indira, 2015).

Community-based forest management can sustain livelihood without degrading the mangroves forest like in the case of Sri Lanka, the mangrove forest is being used by the local people as livelihood through ecotourism and getting resources such as fishes and shrimps. The locale people are conserving the mangroves, and at the same time, they can get their daily needs to survive (Ratnayake, 2013). This case is similar to mangrove forests that manage by local people in Catanduanes, Philippines, in which the mangrove area is engaged in ecotourism. The ecotourism activities are being handled by the local community, aside from management. They can generate income in this undertaking without cutting the mangrove forest (Morales et al., 2014). Ecotourism is also present in the mangrove forest in Barangay Talokgangan, Banate, Ilo-ilo, Philippines. The local people are managing the mangrove forest and also serve as their livelihood through ecotourism. Aside from income from ecotourism, they can also generate income from fish production (Bagsit & Jimenez, 2012).

Community-Based and Family-Based Mangrove Forest Management

Community-Based Mangrove Forest Management (CBFM) is an essential instrument to attain sustainability in the

management of natural resources like mangrove forests (Datta et al., 2012) (Pokharel et al., 2014). It is highly recommended by both academia and governing agencies as a sustainable approach for managing the mangrove forest (Datta et al., 2012). Unfortunately, there is no assurance that every community-based forest management undertaking is sustainable (Garcia & Lescuyer, 2008). In this case, evaluating the sustainability of CBFM is a practical approach for the proper management of natural resources (Pokharel et al., 2014). For instance, there is some ongoing Community-Based Forest Management in Palawan, one of these is in the Mangrove Forest of Tagpait, Aborlan. However, based on the study of Regoniel & Pacañot (2012), since this is not part of the mangrove reserve of Palawan, cutting of mangrove is allowed by their organization, Tagpait Coastal Development Association (TACDA) for every member. The use of mangroves is only for housing lumber needs as well as aquaculture (shrimps, crabs, and fishes). Also, the cutting of mangroves by people from other places or adjacent barangays is also a significant problem in the area. Currently, the mangrove uses by the local community through tourism activities as the primary source of income (Dela Peña et al., 2013).

In the case of Damas Beach, Trenggalek, Indonesia, mangrove forest is being managed by the local community and government (co-management) that encourages the participation of the community in the management (Purwanti et al., 2018). In the case of North Sumatra, Indonesia, the mangrove forest is being managed by the local community, and mangrove ecotourism was implemented as a strategy for sustainable management of mangrove particularly on improving ecological, social, and economic dimensions including the local community from upland (Basyuni et al., 2018). In their management, upland ecosystems and upland communities are directly part of their sustainable mangrove management. In the case of Matang mangrove reserve in Malaysia, mangrove provides charcoals and timber to the local community as one of the sources of their income (Martínez-espínosa et al., 2020).

A community-based mangrove forest management approach should be developed based on the socio-economic conditions and habits of the local community (Arfan & Taufieq, 2018). The upland community and the indigenous cultural community should be involved in the management as a ridge to reef approach, like in the case of mangrove forest management of local communities in South Sulawesi, Indonesia. Collaborative mangrove forest management of the concerned communities and institutions and the opportunity for alternative livelihood are crucial to attaining sustainability (Martínez-espínosa et al., 2020). Also, mangrove forest management should be integrated that covers not only the coastal ecosystem but also the terrestrial ecosystem since these ecosystems are directly connected as well as all the communities involved including the indigenous people (Kusmana, 2017).

In the case of Pedada, Ajuy, Ilo-ilo, based on the study of Daupan (2016), their mangrove forests are being managed by the collaboration of the Local Government Unit and the organization of fisherfolks. Most of the local people are engaged in fishing as a source of their income. These

mangrove areas use as eco-park for tourism purposes. Tourism activities serve as another form of livelihood of the people—the community members trained on tour guiding. In Pedada, the fisherfolks registered as a PO in 2003 under Presidential Decree No. 441. During this time, all members were only men. They formed into a PO because of the need for empowerment and obtaining sustainable income sources. This PO is called the *Barangay Pedada Fisherfolk Association* (BPFA), which started with 95 members. From the time that they formed until 2008, this PO had no mangrove-related activities, and the members just joined LGU-initiated coastal clean-up drives and vegetable gardening. Many of the members left and sought jobs in other places because of not meeting the expected sustained income source. In 2009, BPFA got reorganized by the assistance of an environmental NGO that helped the group apply for CBFMA, and not yet approved until recently. This PO then opened its membership to women and grew to have a total of 289 members in 2015 (114 women and 175 men). To be a member of BPFA, the organization requires that the individual is under legal, a resident of Pedada, should pay a membership fee of 50 Php and a monthly due of 5 Php, and that there should be no more than three members per family. In terms of the collection of resources such as crabs and shells, it is open for all community members, but they need to follow the 3-month rule for harvesting, which is every purok will harvest alternately every three months (Daupan, 2016).

Based on Buffle et al. (2011), Da Loc, Vietnam, has a mangrove area that is being managed by the community with the cooperation of the local government. The site is considered as a protected area by the state. Most of the community members are protecting the mangrove forest through the planting of mangroves and free from cutting. They are protecting mangroves as an adaptation strategy against storms through the improvement of the awareness of the people, improvement of the quality and quantity of mangroves by replanting and providing nursery and mangrove care, and improvement of the livelihood to increase the adaptive capacity of the communities against extreme events. In terms of livelihood improvement, they provide livelihood benefits and institutional change through enhancing the understanding of the local communities and authorities about community-based management, improving the communication between local communities and leaders, improving communication between leaders and women and establishment and implementation of group benefit sharing.

In the case of mangrove forests in Damas Beach, Trenggalek, Indonesia, the status of management is unsustainable because the ecological dimensions fall under fairly sustainable. Then, the economic, social, legal, and institutional category falls under a less sustainable category due to the conversion of mangroves into coconut plantation based on the study of Purwanti et al. (2018). In the case of North Sumatra, Indonesia, mangrove ecotourism was adopted as a mechanism for sustainable management of mangroves, particularly on improving ecological, social, and economic dimensions, including the local community from upland (Basyuni et al., 2018). In their management, upland ecosystems and upland communities are directly part of their sustainable mangrove management. In the case of

Matang mangrove reserve in Malaysia, the local community is aware that mangrove provides charcoals and timber but not knowledgeable on other services like carbon sequestration, which serves as a barrier for sustainability (Martinez-Espinosa et al., 2020).

Camara et al. (2011) stated the case of community-based mangrove management in WunBaik, Rakhine State, Myanmar. The community restored the 5 acres of denuded mangrove through replanting in which the community raised the seedlings to their nursery. Their livelihood is very dependent on mangroves, which drive them to protect the mangrove areas that led to the restoration of another 25 acres. This case was similar to the case of Kalpitiya, Sri Lanka, in which the livelihood of the community is highly dependent on the mangrove forest. The primary purpose of the organization is to restore the mangrove forest after the hit of a tsunami in 1994. Ecotourism is the primary undertaking in the mangrove forest to serve as a livelihood. However, due to the lack of continuous economic benefits of the local people, the mangrove forest serves as their source of income that leads to adverse effects (Ratnayake, 2013).

Another case of mangrove forest management is in Nabitasan, Leganes, in the province of Ilo-ilo based on the study of Daupan (2016). It is a 15-Ha of mangrove eco-park that is part of the 187 Ha of mangrove cover in the Municipality of Leganes. This area used to be an abandoned and underutilized fishpond that was reclaimed by the municipality. Rehabilitation of the site began in 2009 in partnership with NGOs and local schools. A total of 1,712 seedlings were planted during that year, and the total planted seedlings up to date are about 54,000. It is mainly managed by the Municipal Environment and Natural Resource Office (MENRO) with the help of the local community. The area is also used for ecotourism as an eco-park, which is open for tourists, but the access of resources is very much limited even to the members of the community. The management prohibits the cutting of mangroves, grazing of animals, and gathering of shells. In case of violation, they are required to plant mangrove trees depend on the extent of damage as a penalty (Daupan 2016).

In the case of Barangay Talokgangan, Banate, Ilo-ilo, Philippines, the mangrove forest is managed by the Talokgangan Concerned Citizens Association (TaCCAs), a peoples' organization that composed of the local community. It was established in 1997, and the majority of the members were men, but by 2010 most of the members of TaCCAs were women. Most members now are over 50 years of age, have elementary education, and have been residents since birth. The local community joined the TaCCAs to help their community, to benefit from government projects, to organize as a group, and to have other sources of income. Some of the benefits the respondents enjoyed from the mangrove replanting included protection from strong waves during typhoons, the stability of the soil where their houses stood, and monetary incentives from selling mangrove seedlings. Some of the issues encountered by the members included lack of support from other community members, lack of funds, and conflict

within the household over time devoted to the work (Bagsit & Jimenez, 2012).

Based on Daupan (2016), Dolores, Nueva Valencia, Guimaras has a mangrove forest that is being managed by the organization of fisherfolks in the community called KAMAMADO. It was registered in 1999 with total members of 210 to address the decline in fish catch of the fisher. It currently co-manages the 17-Ha of mangrove forest in their locality called Basiao Cove. This group applied for CBFMA in 2002, which got approved in 2009. Before 2002, the area was privately owned by businessmen who are not locals to the site. These businessmen owned the land since 1985 and used it as a fishpond. It was in 2002 that the fishpond lease agreement (FLA) of these businessmen expired. That time KAMAMADO started to apply for CBFMA, which took time because of the lengthy legal process of transferring the area under FLA back to DENR and finally to the PO. Basiao Cove is also included under the 67-Ha of Marine Protected Area (MPA). The community members engaged in the management through mangrove planting and coastal clean-up. The area is also used for ecotourism as an eco-park, which is an additional source of income for the community (Daupan 2016).

Gender Role in Mangrove Forest Management of Community

The role of women in the management of mangrove forests is very crucial. They will be very helpful concerning planning. They are more influential to their children about the management of mangroves (Khadka & Vacik, 2011). Women provide additional income for the household through active participation (Daupan, 2016). In the case of Da Loc, Vietnam, women are organizing activities that promote awareness on the protection of mangroves to their children, husband, relatives, neighbors, or people from other communities (Buffle et al., 2011). In Tagpait, Aborlan, Palawan, women are responsible for gleaning activities within the mangrove areas for both household consumption and selling purpose, which serves as additional household income (Regoniel & Pacañot, 2012). Aside from gleaning, women are preparing local food as one of their tourism products that help as an extra income to the community Dela Peña et al., 2013). In the case of Barangay Talokgangan, Banate, Ilo-ilo, there is a peoples' organization, Talokgangan Concerned Citizens Association (TaCCAs), which primarily managed the mangrove area. When they started in the year 1997, most of the members are men, while in the year 2010, most are women. Women's participation is mostly in the planning process, during meetings, nursery development, and maintenance and mangrove protection.

On the other hand, men were involved in the construction and maintenance of fences in the mangrove area (Bagsit & Jimenez, 2012). In community-based resource management in Siquijor, Philippines, they formulated a peoples' organization named Maite Resource Development Association (MRDA), which was established in the year 2009. The women are directly involved in the management in which they are part of planning and meetings. They are also part of mangrove restoration to increase fish production in which fishing is the primary livelihood (Clabots, 2013).

Mangrove Forest Management Impacts

Based on Regoniel & Pacañot (2012), the mangrove afforested area in Tagpait, Aborlan, Palawan is solely managed by the Indigenous Cultural Community, but the cutting of mangroves is allowed that hinders to increase the mangrove area. Based on Daupan (2016), Pedada, Ajuy, Ilo-ilo used to have the forest that was undervalued by the local communities where the people would often go-to for cutting mangroves that are then used as a fuel source. They also have stray animals that also feed on the mangroves, and outsiders can also access to gather shells from this *barangay*. During this time, management was entirely under the National Government through DENR and DA. The community noted a decline in fish catch since the 1970s, and fishes are slowly increasing in abundance since the time the PO started taking part in management and conservation. When seminars on mangrove forests ecosystem services and mangrove taxonomy began in 2008, the local communities began to realize the importance of mangroves.

In another case in Nabitasan, based on Daupan (2016), the lack of ordinance on mangroves wandering around the mangrove area that had parts of it converted to fishponds in the early 1970s. The municipality also owned all mangrove areas unless under FLA. Recently, there were no more stray animals roaming around Nabitasan Mangrove Eco-park, and the people also stopped cutting mangroves because of local ordinances. The community also noted an increase in the mangrove abundance since 2009. Although many locals were aware of the ecosystem services provided by mangroves, many did not participate in mangrove forest activities.

On the other case, the Basiao Cove of Dolores was previously a privately operated fishpond from 1985 to 2002. During those times, fisherfolks were unhappy with the lack of fish catch. The operated fishpond used to be closed and people feared entering the area because of fear of being shot with a gun. The communities used to uproot big mangrove trees around the privately-owned fishpond to gather oysters and shells. Now fishing and shell gleaning are completely prohibited, but people still do it illegally. There is no executive order by the mayor yet regarding the prohibition of banning so the PO members and LGU officers could do nothing with the fisherfolks who continue to fish. Many community members do not collaborate with or take part in the membership of the PO because they feel that their fishing rights are violated. The PO members are hopeful that fish diversity will once again rise (Daupan 2016). The management of community-based resource management in Siquijor, Philippines, by a peoples' organization named Maite Resource Development Association (MRDA) was successful due to the collaboration of the community with the help of the local government. Their fisheries were improved by increasing their fish catch (Clabots, 2013). The management of the Sundarban mangrove forest in Bangladesh was not successful due to the over-extraction of resources as their main livelihood. The management allowed the aquaculture (fish and shrimp production) that deforest the mangrove area. The rapidly expanding shrimp industry drives the people to degrade the mangrove. The poaching of wildlife that is living in the mangrove did not successfully address by the management (Rahman et al.,

2010). Also, the management of mangrove forests in Barangay Talokgangan, Banate, Ilo-ilo is successful due to the active collaboration of the local community, peoples' organizations, and local government. It is primarily managed by a peoples' organization, Talokgangan Concerned Citizens Association (TaCCAs). The livelihood of the people highly depends on mangroves that leads to so much concern of the people, which is one of the avenues to attain sustainability (Bagsit & Jimenez, 2012). In the case of mangrove management in Sri Lanka, their reasons for conserving the mangrove forest are to serve as a buffer for a storm in the area, to mitigate coastal erosion, to increase fish production, and to provide an ecotourism site. The local community is managing the mangrove area, and at the same time, they are using for ecotourism as one of their livelihoods. Even though they are doing steps to manage the mangroves, but due to their livelihood, the mangrove forest is at risk (Ratnayake, 2013).

Sustainable Mangrove Forest Management

The United Nations Conference on Environment and Development (UNCED) was the largest intergovernmental gathering that seriously addressed the goal of advancing sustainable development (Martella & Smaczniak, 2012). The conference produced Agenda 21, which is composed of different sections like conservation and management of resources for development with some subsections: combating deforestation, preservation of biological diversity, protection of oceans and coastal areas, and others (UNCED, 1992). The UNCED provided a sustainable management framework that focuses on social equity, economic viability, and environmental protection that will serve as a guide of different countries or institutions in sustainable resource management like mangroves (see Figure 1). The Philippines, as part of UNCED, adopted the sustainable management framework in different programs and policies. For instance, Executive Order 263, otherwise known as "Adopting Community-Based Forest Management as the National Strategy to Ensure the Sustainable Development of the Country's Forestlands Resources and Providing Mechanisms for its Implementation," which was implemented in 1995 as the national strategy to achieve sustainable forestry and social justice.



Figure 1: Sustainable management framework by the UNCED, 1992

The sustainability of community-based mangrove forest management can be possible by developing a management approach based on the socio-economic conditions and habits of the local community and ridge to the reef (Arfan & Taufieq, 2018). The upland community and the indigenous cultural community play an essential role in achieving sustainability, and they should be involved in the management as a ridge to reef approach. Collaborative mangrove forest management of the concerned communities and institutions and the opportunity for alternative livelihood are crucial to attaining sustainability (Martínez-espínosa et al., 2020). Also, mangrove forest management should be integrated that covers not only the coastal ecosystem but also the terrestrial ecosystem since these ecosystems are directly connected as well as all the communities involved including the indigenous people (Kusmana, 2017). Also, sustaining the livelihood of the local community, proper regulation, and plans in the utilization of mangrove resources and direct participation of the local community are essential for the sustainability of mangrove management for sustainable use of ecosystem services (Damastuti & Groot, 2017).

Evaluation of Sustainability of Mangrove Forest Management Systems

Different activities can degrade mangrove forests. Tourism Activity can cause the degradation of natural resources without sustainable strategies (Khanom et al., 2011), and aquaculture can cause the degradation of mangrove forests (Rahman et al., 2010). In the situation of both areas, it is very crucial to evaluate its sustainability of mangrove forest management systems for the proper management of the mangrove forest and other resources therein.

Evaluation of the sustainability of mangrove forest management systems can be done using Criteria and Indicators. ITTO (2005) provided seven criteria: Enabling Conditions for sustainable forest management, Extent, and Condition of Forest. Forest Ecosystem Health, Forest Production, Biological Diversity, Soil, and Water Protection, and Economic, Social and Cultural Aspects. Each criterion has indicators that can be answered through scoring (quantitative approach) from 1 to 3 in which scores of 1, 2, and 3 stand for low, fair, and reasonable, respectively (Pokharel et al., 2014).

2. Conclusion

Mangrove forests are highly beneficial tropical forests that support several forms of life, including life on land, life on the water, and humans. It stabilizes coastlines, protects communities from storms, provides critical habitats for many animals, sources of food and material, and stores vast amounts of carbon and others. Mangrove forest management by the local community is a vital instrument to attain sustainability. However, there is no assurance that the mangrove forest management by the community is sustainable, especially resource extraction, tourism activities, and aquasilviculture are present.

The evaluation of the sustainability of the mangrove forest management system is a useful mechanism for sustainable mangrove forest management. In Indonesia, evaluation of

the sustainability of mangrove management was adopted as their planning and management tool for its sustainability. In the mangrove forest in Damas Beach, Trenggalek, Indonesia, the status of management is unsustainable because the ecological dimensions fall under fairly sustainable. Also, the economic, social, legal and institutional category falls under less sustainable category due to the conversion of mangroves into coconut plantation based on the study of Purwanti et al. (2018). In the case of North Sumatra, Indonesia, mangrove ecotourism was adopted as a mechanism for sustainable management of mangroves, particularly on improving ecological, social, and economic dimensions, including the local community from upland (Basyuni et al., 2018). In their management, upland ecosystems and upland communities are directly part of their sustainable mangrove management. In the case of Matang mangrove reserve in Malaysia, the local community is aware that mangrove provides charcoals and timber but not knowledgeable on other services like carbon sequestration, which serves as a barrier for sustainability (Martinez-Espinosa et al., 2020).

3. Recommendations

- Periodic evaluation and monitoring of the mangrove management system using the applicable criteria and indicators by the community through the support of the local government, academe, and others. This will help to address their weakness in the capacity for planning and periodic monitoring and evaluation.
- The government should initiate and encourage the evaluation and monitoring of the mangrove management system using the applicable criteria and indicator in community-based mangrove management in other areas in the country that is usable by the community. This will help to evaluate the status of the sustainability of mangrove management for each criterion of sustainable management.
- Academic institutions and government with the LGU may support the community in the implementation of the evaluation and monitoring of the mangrove management system using the applicable criteria and indicators by providing workshops, relevant training, technical and financial supports.
- The weakness of each community in sustainable mangrove management should be improved. Their weaknesses are funding, capacity for planning and management, forest product industry, and implementation of strategies for sustainable mangrove management. Both government and non-government agencies may provide relevant actions by providing financial support, planning workshops, monitoring and evaluation workshops, training on efficient forest product industry and market, and others.

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