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## People's initiatives on mangrove management in Dipaculao, Aurora, Philippines

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### Abstract

People's initiative in managing mangrove refers to the involvement of local communities in planning, implementing, and monitoring mangrove restoration and conservation activities. It has been successful in many nations throughout the world to involve people in managing mangrove forests. This study assessed the community's level of knowledge, awareness, as well as the practices used by the environmental agency and locals in managing mangrove forest that can be used to attain sustainable management. This study used both qualitative and quantitative methods relying on quantitative survey data and qualitative information gathered from the key informant interview respondents. Mangroves are important for preventing erosion, maintaining water quality, and reducing pollution; mangroves also provide a source of income and nourishment for the community, protecting them from natural disasters. The study found that the respondents were aware of the importance of mangroves in terms of wildling/seedling collection, planting, monitoring/protection, and its role in ecological and economic aspects. Further studies are recommended to assess the drivers and barriers of community participation and engagement in mangrove management, assess policy enforcement, and explore the perceptions and preferences of the community regarding guidance and support.

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## Introduction

Ecosystems benefit human welfare in two ways. First is the raw materials for all economic production are provided by the systemic basic elements of ecosystems—the plants, animals, minerals, soils, land, and water, among others. Furthermore, ecosystems offer additional life-sustaining roles as well as other valuable services, which are mostly important for human well-being and in all practical terms (Farley *et al.*, 2009). Mangroves are important for coastal fisheries, aquaculture, and commercial fisheries, providing nursery grounds and habitats. Mangroves, as forested wetland habitat, provide a variety of ecosystem services. Mangroves are that flourish in areas with salty water near the sea (Kulkarni, 2018) in a wide range of substrates such as clay, loam, peat, sand, coral rubble, rock, and some near sea grass beds (Goloran, Laurence, Glenn, & Tricia, 2020). The mangrove is referred to be the “rainforest of the sea”, and like the upland rainforest, it supports the coastlines economically and ecologically. Alcohol, medications, tannin, lumber, and building materials can all be found in mangroves (Mangrove Forests in the Philippines – the Maritime Review, 2017). Mangroves provide a barrier to protect coastal areas from storm and flood devastation, influencing human behavior and environmental management (Utami, Susiloningtyas, & Handayani, 2018).

The community-based approach was praised as a long-term strategy for protecting and restoring mangroves to their former glory. A sustainable management of mangrove should be community-based where LGUs, DENR, and nongovernmental organizations must work together to conserve and manage the mangrove forest along the Philippine coastline (Primavera *et al.*, 2004). Aurora province has 430 hectares of mangrove (Cañada, 2020) and a portion of it can be found in Dipaculao. Mangrove forests in Aurora are being managed to raise environmental awareness and support global reforestation efforts, restoration of lost forests, repair of damaged ecosystems, and mitigation of climate change. Moreover, Aurora's coastal area supports a diverse range of marine and fish species, mangroves, sea urchins, and marine turtles (Department of Environment and Natural Resources-Central Luzon, 2021).

The national government established the Community-Based Forest Management (CBFM) Program in an effort to engage and educate communities in the management process. The program which is still active today generates CBFM Agreement between local communities, regional government, and the national government to protect, manage, and maintain mangrove forest in compliance with sustainable development principles (Pulhin *et al.*, 2008). Community-Based Mangrove Management (CBMM) is suitable since it decentralizes management functions, particularly to resource dependent locals who have a greater stake in the protection and conservation of ecosystem (Gevaña, Camacho, & Pulhin, 2018). It has been successful in many nations throughout the world to involve people in managing forests. Active cooperation between the government, non-government groups, financial agencies, research and academic institutions, and most crucially, local populations or the stakeholders are essential to ensuring the sustainable and successful rehabilitation of mangroves (Camacho *et al.*, 2020). This study was conducted to assess the community's knowledge and awareness, as well as the practices used by the environmental agency and locals in managing mangrove forests, which can be used to attain sustainable mangrove management.

## Material and methods

### Research Design

This research used descriptive type applying both qualitative and quantitative methods. The researcher used cluster sampling in selecting the respondents. The study relied primarily on quantitative survey data with qualitative information gathered from the key informant interviews, participants' observation, and interactions with respondents.

### Research Locale

This study was conducted in Brgy. Lobbot, Dipaculao, Aurora, where the mangrove forest resides. Lobbot is a barangay in the Aurora province's municipality of Dipaculao. It is situated on the island of Luzon at approximately 15.8589 North and 121.5443 East. At these coordinates, the elevation is estimated to be 11.8

meters or 38.7 feet above mean sea level. Barangay Lobbot has a total household population of 622 based on the 2020 Census and accounted for 1.88% of Dipaculao's total population (Lobbot, Dipaculao, Aurora Profile PhilAtlas, 2020). It is one of the 25 barangays of Dipaculao, which is a coastal municipality with a land area of 361.64 square kilometres or 139.63 square miles.

*Research Instrument*

A self-developed questionnaire with both closed and open-ended questions was used to conduct the survey. The researchers also employed a semi-structured interview guide. All questions were standardized so that every respondent will see the similar items; questionnaires were administered in person utilizing paper and a pen.

*Procedure of the Study*

This research complied with the following procedure of gathering the data: (i) planning and conceptualization of questions that was used in gathering the necessary data needed for the study; (ii) Data Gathering; permission from the barangay chieftain, LGU, and MENRO was sought; a survey questionnaire was given to the respondents in order to gather the necessary data; (iii) Analysis of the gathered data; data collected was presented and analyzed in a descriptive form; and (iv) interpretation of the result, including discussion, conclusion, and recommendation.

*Data Analysis*

Descriptive analysis is a particular technique that are primarily used to assess, describe, and summarize gathered data in a logical, significant, and effective manner (Vetter, 2017). The researcher computed for weighted mean in tabulating gathered data for the survey checklist questionnaire. The hereunder scale was used to interpret the weighted mean. Furthermore, the researcher used Collaizi's method in interpretation and assumptions that were drawn based on the findings of the interview.

Scale Range	Verbal Interpretation
3.51 - 4.00	Very Familiar (VF)
2.51 - 3.50	Familiar (F)
1.51 - 2.50	Not Familiar (NF)
1.00 - 1.50	Very Unfamiliar (VUF)

**Result and discussion**

*Result*

*Level of knowledge of community in managing mangrove forest*

*Wildling Collection*

**Table 1.** Wildling collection.

Wildling Collection	WM	VI
1. The wildling or seedling to be collected should not exceed 40cm (10-30cm).	3.21	F
2. The capture of wildling should be done during the peak of fruiting.	3.34	F
3. One is the manual way of getting the wildling from the trees which includes taking care not to damage its fruits and flowers.	3.52	VF
4. Wildlings or germinated seeds are collected from large trees where there is a natural seedling.	3.55	VF
5. Some are collected by climbing the tree, or by getting under the leaves and branches that cover the ground.	3.21	F
6. Collection is usually carried out in the months of June-August after flowering in the months of April-May.	3.03	F
GRAND MEAN	3.31	F

Table 1 presents the level of knowledge of the community in managing mangrove forest in terms of collecting wildlings or seedlings. It contains 6 statements, the weighted mean and its verbal interpretation. As can be seen from the table, a grand mean 3.31 was obtained which is verbally interpreted as familiar who means that the communities were aware of the practices in collecting wildlings or seedlings. This can be explained by the fact that the community has been practicing the wildling collection for a very long time. Furthermore, statement number 4 gained the highest weighted mean of 3.55 which means that locals were *very familiar* of wildlings or germinated seeds were being collected from large trees where there is a natural seedling. This could be verified through the simple fact tha the community has an immense amount of information and experience regarding how to collect the seeds of mangrove trees, which are found growing throughout tropical and subtropical coastlines.

Meanwhile, statement number 6 attained the lowest weighted mean of 3.03 which means that locals were impartially familiar of the collection of wildlings that usually carried out in the month of June – August after flowering in the months of April – May, considering that the locals have some experience and knowledge about the month of harvesting seedsof mangrove, but not sufficiently prefer it or possess a strong opinion about it. According to Schmitt & Duke (2015), having enough knowledge on collecting mangrove is vital for it can help to avoid common mistakes and problems in mangrove planting, such as planting in inappropriate locations, using poor quality seeds, or neglecting maintenance and protection. Knowing that almost all of the mangrove species have unique fruiting peak seasons, it is of the utmost importance to be aware of when each mangrove species' seedlings production its highest point. Preparing for the direct planting of seedlings must consider their peak fall, in the meantime (Mohale *et al.*, 2023).

Young mangrove plants known as “wildlings” are those that develop naturally in mudflats or along riverbanks; they are also easily able to be carefully dug up and moved to a suitable location where they can grow and prosper. In order to avoid disturbing the plants and their roots and to assure their survival and growth after planting, collecting mangrove wildlings requires the right knowledge and abilities (Miguel, 2019).

*Mangrove Planting*

**Table 2.** Mangrove planting.

Wildling Collection	WM	VI
1. Mangroves are usually planted in rows.	3.76	VF
2. The planting of mangroves should be 1 meter apart and 2 meters between each row or row.	3.31	F
3. Planting will be from the beach or inland towards the sea.	3.45	F
4. Planting potted wildlings in mud or previously prepared holes should have a depth of 6 cm.	3.24	F
5. Mangroves are usually cultivated and live in muddy soil, but they can also grow in sand, peat, and coral rock.	3.41	F
<b>GRAND MEAN</b>	<b>3.43</b>	<b>F</b>

Table 2 presents the community’s level of knowledge in managing mangrove forest in terms of planting. It contains 5 statements, the weighted mean and its verbal interpretation. As can be seen from the table, grand mean obtained 3.43 which are verbally interpreted as *familiar*; this means that the communities were aware with how to properly plant a mangrove seedling or wildling. The community has been planting mangroves for a long time, thus they are familiar with the basics of mangrove planting that aids in clarifying this. Furthermore, statement number 1 gained the highest weighted mean of 3.76 which means that locals are *very familiar* or highly aware of planting mangrove in a row. The reason for this is likely clarified through the community’s years of experience and knowledge with regard to how to arrange mangrove seedlings in a linear pattern as a result of their years of practice.

Meanwhile, statement number 4 attained the lowest weighted mean of 3.24 and is verbally interpreted as *familiar* which means that the community are just aware of planting potted wildlings in mud or the previously prepared holes should have a 6cm depth, considering that the locals have several experiences about planting potted seedlings, but not adequately have a preference of it or have a strong view about it. Community knowledge on planting mangrove wildlings is vital as it fosters a sense of ownership and responsibility; it also enables the use of locally available and adapted mangrove species, which may have higher survival, and growth rates then introduced or exotic species (Kentish, 2022). According to Quevedo, Uchiyama, & Kohsaka (2019), community knowledge on planting mangrove helps in raising.

*Monitoring and Protection*

Table 3 presents the community’s level of knowledge in managing mangrove forest in terms of monitoring/protection practices. It contains 3 statements, the weighted mean and its verbal interpretation. As can be seen from the table, grand mean obtained 3.57 which verbally interpreted as *very familiar*, which means that community are highly aware with the practices that should be done in

terms of monitoring and protecting the mangrove forest. This can be described by the information that aside from practicing methods of mangrove management, the community has a good understanding of the importance of monitoring the mangroves. Furthermore, statement number 1 gained the highest weighted mean of 3.62 which means that the community are *very familiar* on regular patrolling in mangrove forest conducted by the locals, LGU, NGO, or school groups to monitor the growth of seedlings/crops. On the other hand, statement number 2 attained the lowest weighted mean of 3.52 with a verbal interpretation also of *very familiar*.

**Table 3.** Monitoring and protection.

Monitoring and Protection	WM	VI
1. Regular patrolling of mangroves are conducted by the community, LGU, NGO, or school group to monitor the growth of seedlings/crops.	3.62	VF
2. Performs cleaning or removal of debris (plastic/garbage/litter, dead plants) that may hinder mangrove growth.	3.52	VF
3. Avoid cutting its branches and not tying boats to the tree itself.	3.59	VF
GRAND MEAN	3.57	VF

This means that the community are highly aware of cleaning or removing of waste or debris that may hinder mangrove growth since the community has been doing it since then. Monitoring and replacing those that did not survive is essential for sustainable management and for NGOs, governments, and researchers to evaluate plant growth and survival (Chan & Baba, 2009). According to the State of the World's Mangrove (2021), monitoring and protecting mangrove forest provides many benefits to the environment and to people, through these practices we can enhance the resilience of both nature and people to different threats.

*Ecological and economic importance of mangrove ecosystem*

*Ecological Importance*

Table 4 shows that the community's awareness of the importance of mangroves in an ecological manner. It contains 4 statements, the weighted mean and its

verbal interpretation. The grand mean obtained 3.69 which is verbally interpreted as *very familiar* which implies that the community is highly aware of the importance of the mangrove in terms of ecological aspects. This can be described by the statement that the community was getting benefits from the mangrove forest such as being a coastal stabilizer, natural barriers, fisheries supporter, and habitat provider for plants and animals. Furthermore, statement number 4 gained the highest weighted mean of 3.79 which means that the community is very familiar of the services offered by the mangrove forest such as habitat for fish, crabs, shrimps, even birds, and other animals such as turtles and alligators. In addition, statement number 2 and 3 attained the lowest weighted mean of 3.66 and still interpreted as *very familiar*. Nevertheless, the community is quite aware that mangroves help prevent soil erosion, maintains water quality, and reduce pollution. Mangroves play an ecologically significant role in the upkeep and development of the soil as well as serving as a reservoir for the tertiary absorption of waste. Mangroves prevent erosion and excessive coastline shifting by trapping sediments, which helps to develop new land (Acanto, 2016).

**Table 4.** Ecological importance of mangrove ecosystem.

Ecological Importance of Mangroves	WM	VI
1. Mangroves protect the environment by protecting coastal areas and communities from storms, high waves, tidal currents and typhoons.	3.76	VF
2. Mangroves help prevent soil erosion.	3.66	VF
3. Mangroves maintain water quality and reduce pollution.	3.66	VF
4. It serves as a habitat for fish, crabs, shrimps, even birds, and other animals such as turtles and alligators.	3.79	VF
GRAND MEAN	3.69	VF

Plants' root systems help to keep the substrate hard, which contributes to the coast's long-term stability. Numerous food fish and shellfish can be found in the ecosystem, and they frequently stimulate and draw in other species of wildlife. They also serve as breeding sites and nurseries (Kathiresan, 2012). Being highly aware of all the ecological aspect of mangroves, one can better understand their value and importance to

the overall health of our planet and support their conservation restoration efforts (Bing, 2023).

*Economic Importance*

**Table 5.** Economic importance of mangrove ecosystem.

Economic Importance of Mangroves	WM	VI
1. Mangroves are a source of livelihood such as firewood, shellfish and fish, medicinal plants, poles, timber collection, even housing materials.	3.10	F
2. Fish, shrimp and firewood are the main mangrove products that provide income and needs of the locals in the community.	3.55	VF
3. It enhances the extensive commercial fisheries of the adjacent coastal waters through a spawning ground for fish, shrimp and crab.	3.76	VF
GRAND MEAN	3.47	F

Table 5 shows the community awareness on the importance of mangroves in economic aspect. It contains 3 statements, the weighted mean and its verbal interpretation. The table above presents the grand mean that obtained 3.47 which is verbally interpreted as *familiar*; this means that the communities are familiar with the entirety of its economic importance profitable to them. This can be explained by the fact that aside from commercial fishing and being a source of their livelihood, the communities were harvesting oysters, crabs, shrimp, fish and shellfish that makes an income. Furthermore, statement number 3 gained the highest weighted mean of 3.76 which means locals are *very familiar* or fully aware that mangrove forest enhances the extensive commercial fisheries of the adjacent coastal waters through a spawning ground for fish, shrimp, and crabs. Meanwhile, statement number 1 attained the lowest weighted mean of 3.10 and interpreted as *familiar*. This implies that the community are quiet aware of mangroves as the source of livelihood, such as firewood, shellfish and fish, medicinal plants, poles, timber collection, and even housing materials. According to Acanto (2016), local communities benefited economically from the nipa, firewood, and use of nipa fruit as fillings that

were gathered from the mangrove environment, it also provides a unique habitat for animals, a breeding ground for unique species of flora and fauna. The mangrove environment has played an important role in fostering local economic growth and can help coastal towns develop more effectively while upholding global ideals. According to UN Environmental Programme (UNEP), mangroves support fisheries and aquaculture, safeguard the shore, provide opportunities for tourism and recreation, and help to slow down climate change, hence recognizing and appreciating the numerous economic advantages and values that mangroves offer to individuals and society is necessary in order to understand the economic significance of mangroves.

*Management Strategies Offered and Conducted by the Community in Managing Mangrove Ecosystem*

Table 6 shows the summary of formulated meanings and themes of the significant statements on the activities for mangroves as stated by the respondents.

**Table 6.** Summary of formulated meanings and themes.

- Summary of Formulated Meanings (Activities)	Themes
- Getting planting materials (wildlings) directly and with rod to submerge them	
- Minimum of 2 to 2 sacks of wildlings are being planted every tree planting activity	Mangrove tree planting and
- Active involvement and participation of community stakeholders such as barangay authorities, local community, youth volunteers, students, riders, and fishing community	nurturing activities
- Planting begins at six to seven o'clock in the morning	
- Initiative by barangay officials, and actively supported and participated by community stakeholders	Clean-up drives and monitoring activities
- Sacks, brooms, and bolo, are the tools used by the community in clean-up drive	
- Wastes collected include plastic bottles, twigs, and dried leaves	
- Clean-up drive depends on the schedule in barangays.	

The community continues planting and maintaining the mangrove since it protects them from natural disasters considering that they live on the coastal area. Furthermore, it profits the residents or the community through oysters, crabs, shrimp, fish, shellfish, and other seafood. It is a source of income and nourishment for them. Anyone active in establishing and maintaining mangroves can reap the benefits. According to Team (2022), planting mangrove trees is a crucial activity that can support the restoration and preservation of mangrove ecosystem, which are beneficial to both the environment and people; by providing habitat for a wide variety of plants and animals including endangered species, planting mangrove trees helps improve biodiversity. Planting mangrove trees reduces climate change as they store more carbon per area than any other terrestrial ecosystem; by providing a food source, nursery environments, and an improvement in water quality for many fish and shellfish species that are consumed or traded by people, it also supports fisheries and aquaculture; by lessening the effects of storm surges, waves, tides, and tsunamis on coastal towns and infrastructure, mangrove tree planting protects the shoreline. According to Miguel (2019), it can also give local and indigenous people chances for economic generation, education, tourism, recreation, and spiritual connection. Furthermore, using technical or manual methods, individuals or experts can clean the mangrove forest. To prevent destroying the mangroves or upsetting the fauna, it is necessary to abide by a few rules. Some of these rules are to choose the right time to clean the mangroves, appropriate tools in collecting debris, avoid cutting, pulling, or digging their roots, and to respect the wildling, as well as to educate others about the importance of cleaning mangroves (Bing, 2023).

In Community-Based Mangrove Management (CBMM) initiatives, planting mangrove trees is a regular activity with the goal of re-establishing degraded mangrove regions and enhancing the ecological services they offer. Another activity that enhances the health and survival of the mangroves is

a mangrove cleanup drive, which helps to remove waste and pollutants from the coastal area. Local communities, governmental bodies, nongovernmental organizations, and other stakeholders who have an interest in protecting and managing the mangrove resources collaborate and participate in both activities. CBMM programs can help the mangroves and the people who depend on them in both ecological and social ways by tying these activities together.

### **Conclusion**

Based from the result of the study, the respondents were aware on managing the mangroves in terms of wildling/seedling collection, planting, and monitoring /protection. However, community's knowledge on these aspects can be enhanced for more effective sustainable management on mangroves. The respondents were also aware of its significant role in ecological and economic aspect as it contributes to multiple policy objectives not only for sustainable development but also related to biodiversity conservation and climate change adaptation and mitigation. The respondents also stated in an interview the activities for mangroves such as tree planting and clean-up drive participated by the barangay authorities, local community, volunteers, students, and anyone who wants to engage on the said activity. On the other hand, the community noted that the LGU and MENRO have poor intervention for sustainable management of the mangroves forest, the resources within the area of mangroves, and the regular activity for the mangroves.

### **Recommendation(S)**

Based on the findings of the study, and the conclusion drawn, furthered prospective with the study are hereby recommended:

Assess the drivers and barriers of community participation and engagement in mangrove management, such as knowledge, attitude, beliefs, norms, values and institutions. Assess the policy enforcement and participation in mangrove management for the ecological and economic well-being of the community and the mangrove ecosystem. Explore the perception and preferences of the

community regarding the guidance and support needed from the Local Government Unit.

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