

COMMUNITY STAKEHOLDERS' KNOWLEDGE AND AWARENESS OF THE ECOLOGICAL AND SOCIO-ECONOMIC USES OF MANGROVES IN CALATAGAN, BATANGAS, PHILIPPINES

Mario A. CUDIAMAT^{1,*}, Maria Luisa A. VALDEZ²

¹University of the Philippines Rural High School, College of Arts and Sciences,
University of the Philippines Los Baños, Laguna, Philippines

²College of Arts and Sciences, Batangas State University ARASOF-Nasugbu, Philippines

Abstract

Mangrove forests are a complex assemblage of flora that plays significant roles in the sustainability of human and environmental well-being for numerous reasons. However, a lot of mangrove forests have been converted for other purposes and uses in the past years. Limited knowledge about unsustainable aquaculture, coastal infrastructure, urban development, pollution, and overexploitation of mangrove timber resources has led to the loss of mangroves globally. Thus, to address these challenges regarding the insufficiency of mangrove and conservation-related knowledge and awareness, this study was conducted to identify the community stakeholders' knowledge and awareness as regards the ecological and socio-economic uses of mangroves in the fringing mangrove forest in Barangay Kilitisan, Calatagan, Batangas, Philippines. The study employed the mixed method of research and the purposive sampling technique with the interview, focused group discussion (FGD), and survey questionnaire as the data gathering instruments. The respondents of the study include 20 fisherfolks who served as key informants purposively chosen from the barangay. The findings of the study revealed that the stakeholder's knowledge of mangrove taxonomy and biology was evident. They have moderate ecological and socio-economic awareness as regards the uses of mangroves. There is a significant difference in the level of awareness according to sex while no significant difference was noted in terms of educational attainment and monthly income; extension projects and activities may be recommended to scale up sustainability initiatives of the mangrove forest in Barangay Kilitisan, Calatagan, Batangas and calls for collaboration among the local government officials and stakeholders in redefining and strengthening the sustainability initiatives for the fringing mangrove forest to preserve ecological balance and to reduce the ongoing deterioration of other associated marine resources.

Keywords: Mangroves; Fringing Forest; MAU Index; Status of knowledge; Awareness; Ecological; Socio-economic uses; Marine resources

Introduction

Mangroves reflect a multiple-use ecosystem providing a wide range of products and services [1] for the sustainable well-being of the environment and community. They are marine plants that can survive in varying degrees of salinity in coastal environments [2] and can grow in a variety of depths of salt water, with their roots sticking up out of the mud, with fish, crustaceans, and a host of other species living between their tree trunks [3]. Likewise, they can sequester up to four times more carbon dioxide by area than upland terrestrial forests [4]. They

* Corresponding author: macudiamat@up.edu.ph

are a highly valuable ecosystem that provides essential goods and services which contribute to the livelihoods, well-being, and security of the coastal communities [5]. Moreover, mangroves play an important role in sustaining human and environmental well-being as well as in reducing the vulnerability of coastal communities [6, 7].

Mangrove forests are complex assemblages of macroscopic floral species [8] in nature. They also play an important role in the sustainability of human and environmental well-being for numerous reasons [9]. Besides being a major source of supply specifically marine products such as fish, shrimp, crab, and cockles, it also has an important role in the hydrological cycle and in the mitigation sector as a natural protector of the environment from natural disasters such as the monsoon wind, tsunami, and erosion [10].

Although mangrove is an important heritage and supports local communities in their food supply, safety, and health, the mangrove area development and land conversion of other sectors continue [11]. The report of the United Nations Environment Program (UNEP) shows that despite the benefits of mangroves that are estimated at US\$33-57.000 per hectare, they are being degraded, lost, or poorly restored at an alarming rate [12]. Some of the threats to mangrove biodiversity loss are triggered by weak institutional arrangements, legislation, and management [13]. Additionally, poverty and inequity issues within the communities that depend on the mangroves often result in further overexploitation of the dwindling resources.

In the past years, a lot of mangrove forests have been converted for other purposes and uses. Unsustainable aquaculture, coastal infrastructure, urban development, pollution, and overexploitation of mangrove timber resources have led to the loss of mangroves globally [14-16]. Human impacts also contribute to scaling down the ability of mangrove forests to withstand other environmental challenges such as coastal erosion, storms, and typhoons as well as sea level rise [17].

Nowadays, more attention is given to sustainable management of the remaining forests sustainably and the restoration of the degraded ones [18]. To address this issue, there have been many reforestation and rehabilitation programs for mangrove restoration in the Philippines [19] [20]. One of the commonly practiced rehabilitation strategies across the country is community-based management which is involved in coastal resources management [21]. Local people of the Philippines have actively planted and managed mangrove forests entirely on their own initiative. A community-based action has positive outcomes for the environmental conservation of mangroves [22]. Studies also show that among the reforestation projects that were implemented, community involvement is identified as the key factor for success [2, 23, 24].

In community-based mangrove forest management, education is considered the main factor to determine the understanding of the communities to create a positive perception of mangrove forests among local stakeholders [7]. Gender, age, years of residence, and proximity of mangrove areas play significant roles in public perception of sustainable mangrove conservation programs [24]. It was recommended that a more vigorous and sustainable community education awareness program be included in mangrove restoration to inform the community stakeholders about the roles and potential benefits of mangroves and the roles community members can play in the mangrove conservation program [25]. In addition, knowledge of the biology and ecology of mangroves will help in the sustainable management and conservation of the forest [26].

However, many of these rehabilitation efforts through community-based conservation failed due to various technical, social, and institutional concerns [20]. One of these is the lack of awareness and very poor knowledge of mangroves and management [27]. Similarly, insufficient knowledge about the economic and ecological value of mangrove ecosystems is considered a major driver causing the decline in the number of mangroves [28]. Likewise, the local community is still doubtful as regards mangrove forest conservation [7].

To address these gaps and challenges on the insufficiency of mangrove and conservation-related knowledge, familiarity as regards the biology, socio-economic, and

political or institutional aspects of mangrove management is imperative in any resource management program. Furthermore, this research aimed to assess the knowledge and awareness of community stakeholders on mangroves to scale up the Community-Based Coastal Resources Management Sustainability Initiatives in Barangay Kilitisan, Calatagan and Batangas.

Statement of the Problem

This study aimed to identify the community stakeholders' status of knowledge and awareness as regards the ecological and socio-economic uses of mangroves in Calatagan, Batangas, Philippines.

Specifically, it sought to answer the following questions:

1. What is the profile of the community stakeholders in Barangay Kilitisan, Calatagan, Batangas in terms of:
 - a. Gender;
 - b. Educational level and
 - c. Monthly income?
2. What is the community stakeholders' status of knowledge relative to mangroves in Barangay Kilitisan, Calatagan, Batangas?
3. To what extent is the ecological and socio-economic awareness of the community stakeholders as regards the uses of mangroves?
4. Is there a significant difference between the extent of stakeholders' awareness about the uses of mangroves based on their demographic profile?
5. What extension activities to scale up the Community-Based Coastal Resources Management Sustainability Initiatives in Barangay Kilitisan, Calatagan, Batangas may be proposed?

Hypothesis

The null hypothesis was tested at a 0.05 level of significance.

There is no significant difference between the extent of stakeholders' awareness on mangroves based on their demographic profile.

Scope, Delimitation and Limitation of the Study

The present study focused on determining the community stakeholders' status of knowledge and awareness as regards the ecological and socio-economic uses of mangroves in the fringing mangrove forest in Barangay Kilitisan, Calatagan, Batangas, Philippines. The study employed the mixed method of research and the purposive sampling technique with the interview, focused group discussion (FGD), and survey questionnaire as the data gathering instruments. The respondents of the study include 20 fisherfolks who served as key informants purposively chosen from the barangay.

Significance of the Study

The relevance of this study is underscored in terms of its implication for a number of beneficiaries. For the local community leaders and development planners, this paper may serve as baseline data in conceptualizing and implementing their developmental policies, priorities, programs, and projects to ensure the conservation of mangrove resources in the identified study areas. This may help them realize the necessity of capitalizing on enhanced cost-effective assessments of these areas, in order to better understand the trade-off that is made when development threatens the mangrove nursery areas and the ecological services they provide. Likewise, this research may help the community stakeholders in strengthening their knowledge and awareness on mangrove biology and ecology towards better and sustainable mangrove management. This study may also be valuable for academic managers in the sense that the paper may help them update the local government units as regards the current status of the mangrove forest in order to enhance their understanding of the significance of coordinating and sharing information about mangrove forests to create a larger network through the support of the community. This study will help answer some essential inquiries on how the ecosystems function, the real impact of human activities on them, and what can be done to effectively

mitigate against the loss and degradation of these habitats in order to convince policymakers and the public that the protection of mangrove nurseries is of paramount importance. Finally, this paper may be used as a frame of reference by future researchers who want to conduct more studies about mangroves, the environment, and environmental stewardship.

Experimental part

Study Area

Figure 1 shows the area under study, taken from the modified Map of the region.

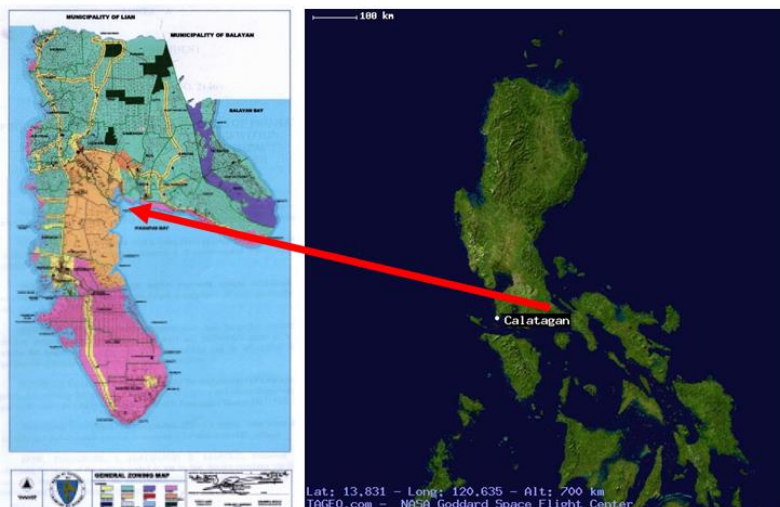


Fig. 1. Modified Map of Calatagan, Batangas in Luzon Island, Philippines

Calatagan, Batangas is renowned as the corridor of the world's center of center of marine shore fish biodiversity, the Verde Island Passage [29]. The Calatagan Mangrove Forest Conservation Park (CMFCP) is situated in Barangay Kilitisan, Calatagan, Batangas, and is locally known as "Ang Pulo." This is a community-managed Marine Protected Area (MPA) managed by a local organization named the Pro-mangrove Alliance and Implementing Team and Arm as Kilitisan's Advocates of Nature (PALITAKAN) [30]. PALITAKAN is the community stakeholders specifically fishermen, farmers, gleaners, women, youth, volunteers from non-government organizations, and the academe who, not only is affected by, but can also directly affect the actions of their organization. However, for the purpose of this research, the fringing mangrove forest in Barangay Kilitisan was the focus of the study since there exist no studies and mangrove conservation initiatives conducted yet in the said study area compared to the overwashed mangrove forest under the CMFCP.

Research Design

This study employed the mixed methods research design. A mixed methods research design is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative research and methods in a single study to understand a research problem [31]. This method applies prominently on the account that it assessed the knowledge and awareness of the stakeholders on their mangrove forest ecosystem. An interview and a focused group discussion (FGD) were conducted to document the knowledge of the stakeholders as regards the mangrove species in the study area. A survey questionnaire using the developed Mangrove Awareness and Uses (MAU) Index tool was used to determine the extent of ecological and socio-economic awareness of the respondents on mangrove forests.

Participants of the Study

Purposive sampling was utilized in this study. It is a non-probability sampling that is used to select the respondents based on the characteristics of a population and the objective of the study. Twenty (20) key informants (7 males and 13 females) served as the respondents of the study who are into gleaning and post-harvest fisheries activities in Barangay Kilitisan, Calatagan, Batangas.

Data Collection

Prior to the data gathering, a letter of request to conduct the study was sent to the Barangay Chairperson of Barangay Kilitisan, Calatagan, Batangas. Upon approval of the permit to conduct the study, informed consent was presented to the respondents requesting them to be part of the study. To ensure that the consent was freely given and fully informed, the researchers took note of the following: that the participants understood all the relevant information about the research activity; that they are competent to give consent; that they are not under threat, duress, or inducements; and that they can withdraw at any time of the study.

With reference to the qualitative data gathering techniques, the study employed the interview, focused group discussion (FGD), and survey using a questionnaire. As regards the interview information sheet, the researchers ensured that the participants have read and understood the information sheet; that the sheet contains the title of the study; a terse summary of what they expect to achieve in their research; the background information including the purpose of the study; what is involved in the study including how any data will be used; the details of any risks; and the information on the right to withdraw from the study. On the other hand, the FGD was divided into two sessions: Session 1 which lasted for one hour was composed of 7 men while Session 2 was composed of 13 women. During the FGD the respondents were interviewed as regards the number of species they can identify based on the picture analysis activities relative to the local names and scientific names and their knowledge about the ecology of mangroves.

Since the study made use of the mixed method research design, qualitative data such as local and scientific names of the mangrove species were gathered based on the taxonomical and botanical descriptions of the respondents. The picture analysis activity was held thru the description and images from the Field Guide of *Primavera et al.* [32].

For the quantitative data, the survey tool was utilized using the MAU index. The MAU index is composed of three parts: Part I focused on the demographic profile of the respondents specifically the sex, educational attainment, and monthly income of the respondents; Part II highlighted the respondents' ecological awareness of the uses of mangroves hinged on items focusing on the biology, ecology, and taxonomy of mangrove forest; and Part III concentrated on the respondents' socio-economic awareness as regards the uses of mangroves anchored on their social and economic contributions to the coastal community and the society in general.

Data Analysis

For the Quantitative Data Analysis, the frequency, percentage, mean, standard deviation, and rank were used to describe the demographic profile of the respondents and the extent of awareness of the respondents on mangroves. Non-parametric Mann-Whitney U test and Kruskal-Wallis H test were used to test if there is a significant difference in the extent of awareness of the respondents based on their profile variables. These statistical tests were used due to the limited sample size and non-normal distribution of the data which was determined using the Shapiro-Wilk test. All statistical analyses were performed using the PAST software version 4.03.

On the other hand, for the Qualitative Data Analysis, the researchers examined the meaningful and symbolic content of the qualitative data. Qualitative Data Analysis is the range of processes and procedures whereby one moves from the qualitative data that have been collected into some form of explanation, understanding, or interpretation of the people and situations one is investigating. The said analysis is usually based on an interpretative

philosophy. The process of Qualitative Data Analysis usually involves two things, writing and the identification of the themes (Online QDA Website, 2015) [33]. Both qualitative and quantitative analysis involves labeling and coding all of the data in order that similarities and differences can be recognized. (Libweb.surrey.ac.uk Website, 2017) [34].

Results and discussion

The profile of community stakeholders in the Calatagan Mangrove Forest Conservation Park is presented in Table 1.

Table 1. Demographic Profile of the Stakeholders

Demographic Profile	Frequency (n)	Percentage (%)
Sex		
Male	7	35
Female	13	65
Total	20	100
Educational Attainment		
High School Undergraduate	5	25
High School Graduate	9	45
College Undergraduate	5	25
College Graduate	1	5
Total	20	100
Monthly Income (in peso, Php)		
1-5,000	11	55
5,001-10,000	9	45
Total	20	100

Table 1 presents the demographic profile of the stakeholders. It can be gleaned from the table that the majority (65 percent) of the stakeholders are composed of women; most of the (45 percent) are high school graduates, and most of them have a monthly income that ranges from Php 1.00 to 10,000.00. This finding could be attributed to the fact that many of the stakeholders depend only on mangrove-related livelihoods and another alternative livelihood such as farming, fishing, vending, and gleaning mollusks or sea cucumbers.

The following summarizes stakeholders' knowledge of the marginal mangrove forest in Barangay Kilitisan, Calatagan and Batangas.

Based on the interviews and Focused Group Discussions (FGDs) conducted among the community stakeholders relative to mangrove taxonomy, ecology and biology, all 20 respondents were able to identify the mangroves based on their local names. The following local names of mangrove species were cited by the stakeholders namely: *pagatpat*, *kalapinay*, *bakawang babae*, *bakawang lalaki*, *bakawang bato*, *pototan*, *buta-buta* and *lapis-lapis*. With reference to their scientific names, only 14 respondents were able to identify the mangrove species confidently.

Nine out of the twelve species present were identified by the stakeholders through the picture analysis activity namely: *Avicennia marina* (kalapinay), *Bruguiera cylindrica* (pototan), *Ceriops zippeliana* (lapis-lapis), *Ceriops tagal* (lapis-lapis), *Excoecaria agallocha* (buta-buta), *Rhizophora apiculata* (bakawang lalaki), *Rhizophora mucronata* (bakawang babae), *Rhizophora stylosa* (bakawang bato), and *Sonneratia alba* (pagatpat). The other three species shown to the participants were located easily by the respondents in the study site using the descriptions and images from the field guide of *Primavera et al.* [32]. These species were the *Aegiceras corniculatum*, *Lumnitzera racemosa* and *Xylocarpus granatum* species.

In terms of the ecology and habitat of mangroves, the respondents showed the clustering of species such as *Rhizophora spp.* in more muddy areas of the site while the *S. alba* and *A. marina* were identified as seaward mangroves that thrive in the sandy substrates.

The degree of ecological and socio-economic awareness of the respondents regarding the uses of mangroves is presented in Table 2.

Table 2. Ecological Awareness of the Respondents as regards the Uses of Mangroves

Indicators	Mean \pm Standard Deviation	Verbal Rating	Rank
1. Mangroves protect coastal communities from storm surge and strong winds.	3.75 \pm 0.44	High Awareness	1
2. Mangroves serve as habitats and nurseries to marine animals.	3.60 \pm 0.60	High Awareness	2
3. Mangroves prevent erosion and siltation.	3.30 \pm 0.57	High Awareness	3
4. Mangroves are plants in the marine ecosystem.	2.75 \pm 0.91	Moderate Awareness	4.5
5. There are 12 species of mangroves in the <i>Ang Pulo</i> .	2.75 \pm 0.91	Moderate Awareness	4.5
6. People living in coastal areas with mangroves are protected from sea level rise.	2.70 \pm 0.73	Moderate Awareness	6
7. Sudden Sea level rise in coastal areas can be reduced by mangrove conservation.	2.65 \pm 1.27	Moderate Awareness	7
8. Mangroves help in nutrient recycling.	2.50 \pm 1.00	Low Awareness	8
9. Mangroves can sequester carbon dioxide from the atmosphere.	2.20 \pm 1.11	Low Awareness	9
Grand Mean	2.91	Moderate Awareness	

Using the Mangrove Awareness and Uses (MAU) Index, data show that the respondents are highly aware that mangroves protect coastal communities from storm surges and strong winds. This indicator ranked first with a mean and S.D. of 3.75 \pm 0.44. This could be attributed to the respondents' cognizance that mangroves reduce damage from storm surges and strong winds on the account that they provide substantial protection to properties, even relatively far away from the coast and mangroves of Barangay Kilitisan. This finding supports the study of *Das and Crépin* [35], which states that mangroves can protect lives and property from storms by buffering the impacts of storm surges.

Moreover, the data confirm that the respondents are highly aware that mangroves serve as habitats and nurseries for marine animals. This indicator ranked second with a mean and S.D. of 3.60 \pm 0.60. This could be ascribed to the respondents' knowledge that the robust productivity of flora and fauna in mangrove ecosystems makes the marshes in their barangay an important ecological unit that links mangroves to terrestrial and marine habitats. This finding is in consonance with the study of *Paillon et. al.* [36], which underscores that mangroves serve as nursery sites for a diversity of marine and estuarine species, including coral reef fishes and invertebrates, leading to the high abundance of these organisms in the creeks, pools, and inlets of mangrove forests.

Likewise, the data show that the respondents are highly aware that mangroves prevent erosion and siltation. This indicator ranked third with a mean and S.D. of 3.30 \pm 0.57. This could be credited to the respondents' understanding that mangroves stabilize the coastlines by controlling erosion and facilitating sediment deposition. This finding is in contrast with the cross-sectional analysis of *Das* [37], which highlights that mangrove plantation did not decrease erosion, not even after normalizing the coastline changes by the length of the coastline and

using controls for physical and anthropogenic features of the *tehsils*, an administrative unit under a district.

On the other hand, the respondents have low awareness as regards the idea that mangroves help in nutrient recycling. This could be ascribed to the respondents' inadequate knowledge about the nature of nutrient recycling within the mangrove forest and how mangroves serve as either sink to adjacent coastal waters or a nutrient source. This indicator ranked eighth with a mean and S.D. of 2.50 ± 1.00 . This finding runs parallel with the study of *Twilley and Day* [38], which underscores the patterns in nutrient recycling that may influence the productivity of mangrove communities, as well as the exchange of nutrients at the boundary of mangroves. The said study also noted that depending on the nature of nutrient recycling within the forest, mangroves may serve as either a nutrient source or sink to adjacent coastal waters.

Similarly, the respondents have low awareness relative to the concept that mangroves can sequester carbon dioxide from the atmosphere. This indicator ranked ninth with a mean and S.D. of 2.20 ± 1.11 . This could be attributed to the respondents' inadequate understanding that mangroves can cut off carbon dioxide from the atmosphere. This finding concurs with the study of *Erickson-Davis* [39], which highlights that mangrove soil held around 6.4 billion metric tons of carbon in 2000. This is dramatically higher than previous estimates that pegged the carbon content of mangroves both soil and biomass at around 4.19 billion metric tons. The results also indicate that between 2000 and 2015, up to 122 million tons of this carbon was released due to mangrove forest loss.

To sum up, Table 2 revealed that the respondents have high awareness relative to Indicators 1, 2 and 3: that mangroves protect coastal communities from storm surge and strong winds; that mangroves serve as habitats and nurseries to marine animals; and that mangroves prevent erosion and siltation. Conversely, the respondents have low awareness as regards Indicators 8 and 9, which shows that mangroves can help in nutrient recycling and in sequestering carbon dioxide from the atmosphere. The table also showed that four out of nine indicators recorded a grand mean of 2.91 with a verbal rating of "Moderate Awareness." It can be construed that there is a moderate level of awareness among the respondents with reference to ecological awareness as regards the uses of mangroves.

Table 3. Social and Economic Awareness of the Respondents as regards the Uses of Mangroves

Indicators	Mean ± Standard Deviation	Verbal Rating	Rank
1. Destruction of mangrove forests results in low fishery production.	3.60±0.62	High Awareness	1
2. Conserving mangroves build camaraderie and volunteerism.	3.50±.61	High Awareness	2
3. Mangrove conservation can increase community participation.	3.30±0.54	Moderate Awareness	3
4. Mangroves indirectly provide food.	3.00±1.10	Moderate Awareness	4
5. Mangroves can be a source of tourism.	2.90±0.61	Moderate Awareness	5
6. Mangroves provide livelihood and income to the community.	2.70±0.80	Moderate Awareness	6
7. Mangrove areas can be used for aquaculture activities.	2.50±.78	Moderate Awareness	7
8. Mangroves can be a source of pharmaceuticals and medicine.	2.20±0.83	Low Awareness	8
9. People cut mangrove trees to be used as firewood and as construction material.	2.15±0.75	Low Awareness	9
Grand average	2.98	Moderate awareness	

Using the Mangrove Awareness and Uses (MAU) Index, data show that the respondents are highly aware that the destruction of mangrove forests results in low fishery production. This

indicator ranked first with a mean and S.D. of 3.6 ± 0.62 . This could be ascribed to the respondents' cognizance that the destruction of the mangrove forests in Barangay Kilitisan may lead to low fishery production. This finding runs parallel with the study of *Mirera* [40], which states that fish and sediment fauna are the natural resources that are affected by disturbances in the mangrove ecosystem. Significantly higher fish abundance, biomass and mean length were observed in forested habitats compared to un-forested habitats.

Furthermore, the data confirm that the respondents are highly aware that conserving mangroves build camaraderie and volunteerism. This indicator ranked second with a mean and S.D. of $3.5 \pm .61$. This finding could be attributed to the respondents' high understanding relative to the significance of empowering the residents not only to become vanguards for sustainable development for the environment but also in fostering camaraderie and volunteerism through the mangrove conservation. This finding concurs with the study of *Garcia et. al.* [41], which states that in many cases, volunteerism or 'non-paid planting' provides a better approach to increasing local awareness, commitment, and sense of ownership in pursuing mangrove rehabilitation. Rehabilitation sites can also be developed as a learning venue for more stakeholders to appreciate the value of mangrove conservation.

On the other hand, the respondents have low awareness relative to the benefit that mangroves can be a source of pharmaceuticals and medicine. This indicator ranked eighth with a mean and S.D. of 2.2 ± 0.83 . This could be ascribed to the respondents' inadequate understanding that different mangrove plants possess diverse pharmaceutical and medicinal properties. This finding supports the study of *Abeyasinghe* [42], which evaluated the antibacterial activity of medicinal mangrove plants using different solvents such as chloroform, ethyl acetate, ethanol, and sterilized water in order to get maximum compound(s) from the different plant materials and screening them in vitro for antibacterial activity.

Likewise, the respondents have low awareness that people cut mangrove trees to be used as firewood and as construction material. This indicator ranked ninth with a mean and S.D. of 2.15 ± 0.75 . This could be credited to the respondents' limited attention as regards mangrove wood harvesting for cooking fuel and as construction materials. This finding is in line with the study of *Rasquinha and Mishra* [43], which investigated the impact of small-scale fuelwood harvesting practices on mangrove forest structure, composition, regeneration, and biomass and carbon stocks in a protected area on the east coast of India. The study also cited that as harvesting is selective, mainly for cooking fuel demands, integrated management plans are required to accommodate the local cultural and economic needs of the communities in this region.

To sum up, Table 3 revealed that the respondents have high awareness relative to Indicators 1 and 2: that the destruction of mangrove forests results in low fishery production and that conserving mangroves build camaraderie and volunteerism. Conversely, the respondents have low awareness as regards Indicators 8 and 9: that mangroves can be a source of pharmaceuticals and medicine and that people cut mangrove trees to be used as firewood and as construction material. The table also showed that five out of nine indicators recorded a grand mean of 2.98 with a verbal rating of "Moderate Awareness." It can be interpreted that there is a moderate level of awareness among the respondents with reference to social and economic knowledge as regards the uses of mangroves.

The difference test between the ecological and socio-economic awareness of the respondents regarding the uses of mangroves and their demographic profile has the data presented in Table 3.

Table 4 presents the test of the difference between the stakeholders' extent of ecological and socio-economic awareness of mangroves according to their demographic profile. The *p*-value method was utilized based on the results of the statistical analyses using the Mann-Whitney U test (sex and monthly income) and the Kruskal-Wallis H test (educational attainment). A *p*-value of 0.0423 was obtained for the sex profile, which means that there is a

significant difference in the extent of awareness between the male and female stakeholders. Hence, the null hypothesis is rejected. Furthermore, the females have a higher awareness of the ecological and socio-economic uses of mangroves compared to men as supported by the Table’s mean rank of 8.13. This finding could be attributed to the fact that there were many knowledgeable female stakeholders compared to the men. In a study conducted by *Tejada and Cauilan* [24], there exists a significant difference between the extent of participation in mangrove conservation and maintenance activities when the respondents were grouped according to sex while knowledge of mangrove conservation was not significantly different.

Table 4. Test of Difference between the Stakeholders’ Extent of Ecological and Socio-Economic Awareness as regards the Uses of Mangroves and their Demographic Profile

Profile Variables	Test Statistic	p-values*	Decision
Sex**	Mann-Whitney U test	0.0423	Reject H_0
Educational Attainment	Kruskal-Wallis H test	0.1097	Fail to reject H_0
Monthly Income	Mann-Whitney U test	0.2622	Fail to reject H_0

*Significant at $p \leq 0.05$

**Mean rank for women = 8.13; Men = 2.38

However, there are no significant differences between the level of ecological and socio-economic awareness among the stakeholders in terms and their educational attainment and monthly income. This is supported by the p -values of 0.1097 and 0.2622 respectively, thus it fails to reject the null hypothesis. This implies that regardless of educational attainment and monthly income, the extent of awareness is comparable and therefore almost the same among the male and female stakeholders. This finding is in contrast with the study of *Lopez-Hoffman et al.* [44], which found sharp differences in the perceptions and practices of older, more experienced versus younger, less experienced mangrove wood harvesters in Venezuela. The same is true for Kenyan mangrove users, as those with greater experience were better able than others to identify forest vegetation decline [45].

In the following are presented a series of community outreach projects through the expansion of mangrove sustainability initiatives in Barangay Kilitisan, Calatagan and Batangas.

It is significant to note that as knowledgeable as the community stakeholders in Barangay Kilitisan in Calatagan, Batangas is sometimes found to be, it is notable that stakeholders in the mangrove forest under study are sometimes found to act in ways that were inconsistent with their knowledge and behavior. This gap between knowledge and behavior, also referred to as ‘cognitive dissonance’ is manifested by most of the respondents in diverse degrees and is often caused by conflicting interests or incentives. Thus, knowledge of mangrove use should not be assumed to always guide the behavior of local stakeholders as regards resource use, economic incentives, property rights, and participation are also likely to influence such behavior.

To strengthen the mangrove awareness and knowledge of the stakeholders, the following extension projects and activities may be implemented: i) Continuous capacity building and empowerment of the local community through training on biology, ecology, and taxonomy of mangroves; ii) mainstreaming gender and development in mangrove conservation to continuously empower women in coastal resources management; and iii) conduct of workshop and mentoring activities to stakeholders about principles of mangrove conservation, planning, monitoring and evaluation of reforestation programs and other conservation-related activities.

Conclusions

The findings of the study revealed that the stakeholders’ knowledge of mangrove taxonomy and biology was evident. They have moderate ecological and socioeconomic awareness as regards the uses of mangroves. There is a significant difference in the level of

awareness according to sex while no significant difference was noted in terms of educational attainment and monthly income; and that extension projects and activities may be recommended to scale up sustainability initiatives of the mangrove forest in Barangay Kilitisan, Calatagan, Batangas and calls for collaboration among the local government officials and stakeholders in redefining and strengthening the sustainability initiatives for the fringing mangrove forest to preserve ecological balance and to reduce the ongoing deterioration of their marine biodiversity.

Acknowledgments

The researchers express their deepest gratitude to the management of the Calatagan Mangrove Forest Conservation Park headed by Ms. Lucena E. Duman, the Chairperson of the PALITAKAN, for giving them permission to conduct the survey in the mangrove forest and among the stakeholders of the community-based organization. Likewise, they are also grateful to the Department of Fisheries and Aquatic Sciences for the opportunity granted to conduct this research. Special thanks are extended to Dr. Enrico M. Dalangin, the Chancellor of the Batangas State University ARASOF- Nasugbu and to Prof. Froilan G. Destreza, the Vice Chancellor for Research and Extension, for their support in the fisheries and aquatic sciences education and research.

References

- [1] K.K. Kwan, L.F. Leong, V.C. Chong, A. Sasekumar, *Resource Valuation of Kuala Selangor Mangrove Forest, Mangrove and Coastal Environment of Selangor*, Institute of Ocean and Earth Science, University of Malaya, Kuala Lumpur, 2005, pp. 261-282.
- [2] K. Dinesh, E.R. Chinchu, M.T. Geeji, *Attitude and perception of local inhabitants towards mangrove ecosystems*, **Journal of Extension Education**, **29**(4), 2017, pp.5984-5987. DOI: <https://doi.org/10.26725/JEE.2017.4.29.5984-5987>.
- [3] * * *, **Mangroves and Coastal Ecosystems**, International Union for Conservation of Nature, 2021. Retrieved from: <https://www.iucn.org/theme/marine-and-polar/our-work/climate-change-and-ocean/mangroves-and-coastal-ecosystems>.
- [4] D.C. Donato, J.B. Kauffman, D. Murdiyarso, S. Kurnianto, M. Stidham, M. Kanninen, (2011). *Mangroves among the most carbon-rich forests in the tropics*, **Nature Geoscience**, **4**(5), 2011, pp. 293–297. DOI: 10.1038/ngeo1123.
- [5] N. Duke, J. Bochove, **The Importance of Mangroves to People**. UNEP.Cambridge, Uk, 2014, pp.128.
- [6] R. Badola, S. Barthwal, S.A. Hussain, *Attitudes of local communities towards conservation of mangrove forests: A case study from the east coast of India*, **Estuarine Coastal Shelf Science**, **96**, 2012, pp. 188-196.
- [7] M.I. Sawairnathan, I.N. Halimoon, *Assessment of the local communities' knowledge on mangrove ecology*, **International Journal of Human Capital Urban Management**, **2**(2): 2017, pp. 123-138. DOI:10.22034/ijheum.2017.02.02.004.
- [8] Z.N. Feka, *Sustainable management of mangrove forests in West Africa: A new policy perspective?* **Ocean Coast Management**, **116**, 2015, pp. 341-352.
- [9] R. Badola, S. Barthwal, S.A. Hussain, *Attitudes of local communities towards conservation of mangrove forests: A case study from the east coast of India*, **Estuarine Coastal and Shelf Science**, **96** 2012, pp. 188-196. DOI10.1016/j.ecss.2011.11.016.
- [10] M.S.H. Othman, H. Shalwahid, **A Preliminary Economic Valuation of Wetland Plant Species in Peninsular Malaysia**, AWB Report No 67d, Asian Wetland Bureau/ WWFM Kuala Lumpur.

- [11] A. Latiff, *Conservation strategies for endangered mangrove swamp forests in Malaysia*, **Pakistan Journal of Botany**, **44**, 2012, pp. 27-36. [https://www.pakbs.org/pjbot/PDFs/44\(SI2\)/05.pdf](https://www.pakbs.org/pjbot/PDFs/44(SI2)/05.pdf).
- [12] J. van Bochove, E. Sullivan, T. Nakamura (Editor), **The Importance of Mangroves to People: A Call to Action**, United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, 2014. <https://www.unep-wcmc.org/resources-and-data/the-importance-of-mangroves-to-people--a-call-to-action>.
- [13] J.H. Primavera, *Development and conservation of Philippine mangroves: Institutional issues*, **Ecological Economics**, **35**(1), 2000, pp. 91-106. DOI:10.1016/S0921-8009(00)00170-1.
- [14] A.K. Duraiappah, S. Naeem, T. Agardy, N.J. Ash, H.D. Cooper, S. Díaz, D.P. Faith, G. Mace, J.A. McNeely, H.A. Mooney, A.A. Oteng-Yeboah, H.M. Pereira, S. Polasky, C.C. Prip, W.V. Reid, C. Samper, P.J. Schei, R. Scholes, F. Schutysen, A. Van Jaarsveld (Editors), **Ecosystems and Human Well-being: Biodiversity Synthesis**, Island Press, Washington, District of Columbia, 2005, 100p.
- [15] C. Giri, E. Ochieng, L.L. Tieszen, Z. Zhu, A. Singh, T. Loveland, J. Masek, N. Duke, *Status and distribution of mangrove forests of the world using earth observation satellite data*, **Global Ecology and Biogeography** **23**, 2010, pp. 154-159. DOI: <https://doi.org/10.1111/j.1466-8238.2010.00584.x>.
- [16] J.C. Ellison, *Vulnerability assessment of mangroves to climate change and sea-level rise impacts*, **Wetlands Ecology and Management** **23**, 2015, pp. 115–137 DOI: <https://doi.org/10.1007/s11273-014-9397-8>.
- [17] J.C. Ellison, **Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems**. WWF, Washington D.C. (2012). Retrieved from: <https://www.cakex.org/sites/default/files/documents/WWFBinaryitem27746.pdf>.
- [18] B. B. Walters, P. Rönnbäck, J.M. Kovacs, B. Crona, S.A. Hussain, R. Badola, F. Dahdouh-Guebas, *Ethnobiology, socio-economics and management of mangrove forests: A review*, **Aquatic Botany**, **89**(2), 2008, pp. 220-236. DOI: <https://doi.org/10.1016/j.aquabot.2008.02.009>.
- [19] J.H. Primavera, J.M.A. Esteban, *A review of mangrove rehabilitation in the Philippines: Successes, failures and future prospects*, **Wetlands Ecology and Management**, **16**(5), 2008, pp. 345-358. DOI: <https://doi.org/10.1007/s11273-008-9101-y>.
- [20] S.G. Salmo III, D.D. Torio, J.M.A. Esteban, *Evaluation of rehabilitation strategies and management schemes for the improvement of mangrove management programs in Lingayen Gulf*, **Science Diliman**, **19**(1), 2007, pp. 24-34. Retrieved from: https://www.academia.edu/5312589/Evaluation_of_Rehabilitation_Strategies_and_Management_Schemes_for_the_Improvement_of_Mangrove_Management_Programs_in_Lingayen_Gulf.
- [21] M. Beger, A.R. Harborne, T.P. Dacles, J.L. Solandt, G.L. Ledesma, *A framework of lessons learned from community-based marine reserves and its effectiveness in guiding a new coastal management initiative in the Philippines*, **Environmental Management** **34**, 2004, pp. 786-801. DOI: 10.1007/s00267-004-0149-z.
- [22] D.M Cabahug Jr., F.M. Amb., S.O. Nisperos, N.C. Truzan Jr., *Impact of Community-based Mangrove Forestation to mangrove dependent families and to nearby cooastal areas in Central Visayas: a case example*. (Editor: National Mangrove Committee) *Mangroves of Asia and the Pacific: Status and Management. Technical Report on the UNDP/UNESCO Research and Training Pilot Programme on Mangrove Ecosystems in Asia and the Pacific. RAS/79/002. UNESCO, UNDP Programme*, 1986, pp. 441-466.
- [23] L.D. Camacho, D. Leni, D.T Gevaña, L.L. Sabino, C.D. Ruzol, J.E. Garcia, A.Charmaine D. Camacho, T.N. Oo, A.C. Maung, K.G. Saxena, L.Liang, E.Yiu, K.Takeuchi *Sustainable mangrove rehabilitation: Lessons and insights from community-based*

- management in the Philippines and Myanmar*, **APN Science Bulletin**, 2020, DOI: <https://doi.org/10.30852/sb.2020.983>.
- [24] U.A. Tejada, A.M.C.C. Cauilan, *Knowledge, attitude and practice of coastal communities on mangrove benefits, conservation and rehabilitation*, **International Network for Natural Sciences**, 2019. DOI: <http://dx.doi.org/10.12692/ijb/14.3.446-462>.
- [25] P. Da Silva, *Exploring a community's knowledge and use of a coastal mangrove resource: the case of Wellington Park, Guyana*, **International Journal of Science, Environment and Technology**, **4**(3), 2015, pp. 759-769.
- [26] K. Kandasamy, B. Bingham, *Biology of Mangroves and Mangrove Ecosystems*, **Advances in Marine Biology**, **40**, 2001, pp. 81-251. [https://doi.org/10.1016/S0065-2881\(01\)40003-4](https://doi.org/10.1016/S0065-2881(01)40003-4).
- [27] M. D. Fortes, *Causes of failure (and success?) of mangrove restoration in the Philippines*. (Editor: Khenmark, C.) **Ecology and management of mangrove restoration and regeneration in East and Southeast Asia: Proceedings of the ECOTONE IV 18-22 January 1995**. Wang Tai Hotel Surat Thani, Thailand. Kasetsart University Royal Forest Department, National Research Council of Thailand, The Thai National Commission for UNESCO, National MAB Committee of Japan, UNESCO ROSTSEA, 1995, pp. 129-141.
- [28] N.Z. Feka, G.N. Ajonina, *Drivers causing decline of mangrove in West-Central Africa: a review*, **International Journal of Biodiversity Science, Ecosystem and Management**, **7**(3), 2011, pp. 217-230. <https://doi.org/10.1080/21513732.2011.634436>.
- [29] K. Carpenter, V. Springer, *The center of the marine shore fish biodiversity: The Philippine Islands*, **Environmental Biology of Fishes**, **72**(4), 2005, pp. 457-480. <https://doi.org/10.1007/s10641-004-3154-4>.
- [30] M. Cudiamat, R. Rodriguez, *Abundance, structure and diversity of mangroves in a community-managed forest in Calatagan, Batangas: Verde Island Passage Philippines*, **Asia Pacific Journal of Multidisciplinary Research**, **5**(3), 2017, pp. 27-33.
- [31] J. Creswell, **Educational research: Planning, conducting, and evaluating quantitative and qualitative research** (4th edition), 2012, Pearson Education, New Jersey.
- [32] J.H. Primavera, *Philippine mangroves: Status, threats, and sustainable development*, (Editor: M. Vannucci), *Mangrove Management and Conservation, Present and Future*, 2004, United Nations University Press, Tokyo and New York, pp. 192-207. Retrieved from: <https://repository.seafdec.org.ph/handle/10862/480>.
- [33] Online QDA Website (2012). *What is Qualitative Data Analysis (QDA)?* Retrieved from: http://onlineqda.hud.ac.uk/Intro_QDA/what_is_qda.php.
- [34] Libweb.surrey.ac.uk Website (2017). *Analysing Survey Data: Handling Open-Ended Questions (OEQ's) Using CAQDAS*. University of Surrey.
- [35] S. Das, A.S. Crépin, *Mangroves can provide protection against wind damage during storms*, **Estuarine, Coastal and Shelf Science**, **134**, 2013, pp. 98-107, <https://doi.org/10.1016/j.ecss.2013.09.021>.
- [36] C. Paillon, L. Wantiez, M. Kulbicki, M. Labonne, L. Vigliola *Extent of Mangrove Nursery Habitats Determines the Geographic Distribution of a Coral Reef Fish in a South-Pacific Archipelago*, **PLoS ONE** **9**(8), (2014), Article Number: e105158. <https://doi.org/10.1371/journal.pone.0105158>.
- [37] S. Das, *Does mangrove plantation reduce coastal erosion? Assessment from the west coast of India*, **Regional Environmental Change** **20**, 2020, Article number: 58. <https://doi.org/10.1007/s10113-020-01637-2>.
- [38] R. R. Twilley, J. W. Day Jr., **The productivity and nutrient cycling of mangrove ecosystems**, (Editors: A. Yáñez-Arancibia and A. L. LaraDomínguez), *Ecosistemas de Manglar en América Tropical*. Instituto de Ecología A.C. México, UICN/ORMA, Costa Rica, NOAA/NMFS Silver Spring MD USA, 1999, p.p 127-152. Retrieved from: <https://www.researchgate.net/profile/Robert->

- [Twilley/publication/238731714](https://www.researchgate.net/publication/238731714) *The Productivity and Nutrient Cycling of Mangrove Ecosystems/links/00b7d52cf5c0d3aec5000000/The-Productivity-and-Nutrient-Cycling-of-Mangrove-Ecosystems.pdf*.
- [39] M. Erickson-Davis, *New study finds mangroves may store way more carbon than we thought*. *Mongabay series: Global Forest Reporting Network*. 2 May 2018. Retrieved from: <https://news.mongabay.com/2018/05/new-study-finds-mangroves-may-store-way-more-carbon-than-we-thought/>.
- [40] D.H.O. Mirera, *The Effects of Mangrove Habitat Degradation on Fish Abundance and Diversity in Ungwana Bay, Kenya*, 2007, Egerton University. Retrieved from: <https://www.oceandocs.org/handle/1834/7211>.
- [41] J. Garcia, L.D. Camacho, A. Charmaine, L. Camacho, D.T. Gevaña, T.N. Oo, Aye, K.G. Saxena, L. Liang, K. Takeuchi, L. Loma, E. Yiu, *Sustainable Mangrove Rehabilitation for Global and Local Benefits*, 2019, 10.13140/RG.2.2.11918.51523. DOI: 10.13140/RG.2.2.11918.51523.
- [42] P.D. Abeysinghe, *Antibacterial Activity of some Medicinal Mangroves against Antibiotic Resistant Pathogenic Bacteria*, **Indian Journal of Pharmaceutical Sciences**, 2021. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2929774/>. DOI: 10.4103/0250-474X.65019.
- [43] D. N. Rasquinha, R.D. Mishra, *Impact of wood harvesting on mangrove forest structure, composition and biomass dynamics in India*, **Estuarine, Coastal and Shelf Science**, **248**, 2021, Article number: 106974. <https://doi.org/10.1016/j.ecss.2020.106974>.
- [44] L. Lopez-Hoffman, I.E. Monroe, E. Narvaez, M. Martinez-Ramos, D.D. Ackerly, *Sustainability of mangrove harvesting: how do harvesters' perceptions differ from ecological analysis?* **Ecology and Society** **11**(2), 2006, Article number: 14. DOI: 10.5751/ES-01820-110214.
- [45] F. Dahdouh-Guebas, C. Mathenge, J.G. Kairo, N Koedam, *Utilization of mangrove wood products around Mida Creek (Kenya) amongst subsistence and commercial users*, **Economic Botany** **54**, 2000, pp. 513–527. <https://doi.org/10.1007/BF02866549>.

Received: September 22, 2021

Accepted: August 23, 2022