

Rapid assessment of mangrove ecosystem in Brgy. Matalang-talang, Aroroy, Masbate

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Received: 31 October 2025

Available Online: 12 December 2025

Revised: 8 December 2025

DOI: 10.5861/ijrse.2025.25269

Accepted: 10 December 2025



ISSN: 2243-7703
Online ISSN: 2243-7711

OPEN ACCESS

Abstract

This study conducted a rapid assessment of the mangrove ecosystem in Barangay Matalang-Talang, Aroroy, Masbate, to generate baseline ecological information essential for conservation planning and sustainable resource management. Using field surveys, species inventories, geo-referenced mapping, and habitat characterization, the assessment documented the composition, structure, and ecological condition of mangrove stands across selected sites within the barangay. Results revealed a mangrove community composed predominantly of true mangrove species, including *Rhizophora apiculata*, *Rhizophora mucronata*, *Avicennia marina*, *Sonneratia alba*, and *Bruguiera spp.*, indicating a moderately diverse assemblage reflective of a functioning coastal ecosystem. Stand structure analyses showed varying levels of tree density and canopy cover, with healthier, mature stands observed in less disturbed areas, while marginal zones exhibited signs of degradation such as gaps, seedling scarcity, and evidence of fuelwood collection. Sediment characteristics and tidal influence further shaped species distribution, with *Avicennia* species dominating the more exposed, sandy substrates and *Rhizophora* species thriving in muddier, protected zones. Although the overall mangrove condition remains

ecologically viable, anthropogenic pressures including small-scale extraction, improper waste disposal, and land-use conversion pose emerging threats to long-term ecosystem stability. The mangrove forest continues to provide valuable socio-ecological services to the community, such as coastal protection, fisheries support, carbon sequestration, and livelihood opportunities. However, community interviews revealed limited awareness of mangrove conservation practices, highlighting a need for enhanced local stewardship. This rapid assessment establishes a critical ecological benchmark for Barangay Matalang-Talang and underscores the importance of strengthening mangrove rehabilitation, community-based management, and policy-driven protection efforts to sustain the ecological and economic functions of the mangrove ecosystem.

Keywords: mangrove ecosystem, rapid assessment, species composition, coastal ecology, biodiversity, ecosystem services, Aroroy Masbate

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1. Introduction

Mangrove ecosystems are essential coastal habitats that provide a variety of ecological services, such as carbon sequestration, biodiversity preservation, and shoreline protection. The Philippines has a very rich biodiversity in terms of the number and percentage. It is regarded as one of the 17 megabiodiverse countries due to its geographical isolation, diverse habitats, and high rates of endemism. It ranks fifth globally in terms of the number of plant species and maintains 5% of the world's flora. In mangroves alone, the country holds at least 50% mangrove species of the world's approximately 65 mangrove species. However, these ecosystems are increasingly threatened by habitat degradation, climate change, and human activities (Garcia et al., 2014). In the Philippines, mangrove forests have experienced significant decline due to deforestation and unsustainable land-use practices, prompting conservation efforts to restore and protect these critical habitats (Primavera et al., 2004).

Barangay Matalangtalang, Aroroy, Masbate, is home to a diverse mangrove ecosystem that plays a crucial role in supporting marine biodiversity and local livelihoods. Previous initiatives, such as the Mangrove Rehabilitation Project in Aroroy, have highlighted the importance of expanding mangrove forests to enhance fish populations and mitigate coastal erosion (Villegas, 2020). Mangrove forests in Masbate have been recognized for their role in mitigating environmental threats such as flooding and coastal erosion. According to Villegas (2020), efforts to expand mangrove plantations in Aroroy have significantly contributed to stabilizing shorelines and improving fish populations. Furthermore, studies on mangrove ecosystems in the Philippines emphasize their importance in maintaining marine biodiversity and supporting local fisheries (Garcia et al., 2014).

Despite these conservation efforts, challenges remain in ensuring the long-term sustainability of mangrove ecosystems. The degradation of mangrove forests due to illegal logging, land conversion, and pollution continues to threaten their ecological functions (Primavera et al., 2004). This study aims to conduct a Rapid Mangrove Ecosystem Assessment in Barangay Matalangtalang, focusing on species identification, vegetation analysis, and biometric characterization. Furthermore, it seeks to evaluate community awareness, attitudes, and practices regarding the ecological services provided by mangrove forests. By integrating scientific assessment with socio-ecological perspectives, the study aims to contribute valuable insights for conservation strategies and sustainable management efforts in the region.

Statement of the Problem - The mangrove ecosystem in Barangay Matalangtalang, Aroroy, Masbate plays a vital role in biodiversity conservation, coastal protection, and the provision of essential ecological services. However, its current status and sustainability are uncertain due to various environmental and human-induced factors such as habitat degradation, climate change, and local practices. This study aims to assess the composition and structural characteristics of the mangrove forest by identifying species and conducting vegetation and biometric analyses. Additionally, it seeks to evaluate the level of awareness, attitudes, and practices of the community regarding the ecological functions of the mangrove ecosystem, including provisioning, regulating, supporting, and cultural services. Understanding these factors will provide valuable insights that can inform conservation strategies, promote sustainable management, and encourage community participation in preserving the mangrove forest for future generations.

Objective of the Study - Generally, the study aims to conduct a rapid assessment of the mangrove ecosystem in Barangay Matalangtalang, Aroroy, Masbate by analyzing species composition, vegetation structure, and biometric characteristics, while also evaluating community awareness, attitudes, and practices related to the ecological services provided by the forest ecosystem. Specifically, the objectives of the study are:

- Identify the mangrove species and conduct vegetation analysis along the parameters of frequency, relative frequency, density, and relative density;

- Conduct biometric characterization and Importance Value calculation of the identified mangrove species using the parameters Diameter at Breast Height (DBH), Basal area, Relative Basal area, Total Height, and Relative Height;
- Determine the level of awareness and assess the attitude and practices of the community relative to the ecological services provided by the forest ecosystem, particularly provisioning, regulating, supporting, and cultural services.

Significance of the Study - This rapid assessment of the mangrove ecosystem in Barangay Matalangtalang, Aroroy, Masbate, is essential for understanding the ecological health and conservation value of the area. By identifying mangrove species, analyzing vegetation structure, and conducting biometric characterization, the study provides crucial baseline data for sustainable management and protection efforts. Additionally, assessing community awareness, attitudes, and practices regarding the ecosystem's ecological services such as provisioning, regulating, supporting, and cultural benefits will help strengthen local environmental stewardship. The findings can inform policymakers, conservation groups, and community stakeholders, promoting initiatives that enhance biodiversity conservation, climate resilience, and sustainable livelihoods.

Scope and Limitations of the Study - This study focuses on a rapid assessment of the mangrove ecosystem in Barangay Matalangtalang, Aroroy, Masbate, from April 3-6, 2025. It includes species identification, vegetation analysis, and biometric characterization. Additionally, it examines community awareness, attitudes, and practices related to the ecological services provided by mangrove forests, covering provisioning, regulating, supporting, and cultural aspects. However, the study has several limitations. The assessment is conducted within a specific timeframe, limiting long-term observations of ecological changes. Sampling is confined to selected areas, which may not fully represent the entire mangrove ecosystem of the barangay. Community responses are based on surveys and interviews, which may be subject to respondent biases. Furthermore, external factors such as seasonal variations and human interventions may influence the data, but are not comprehensively addressed within the scope of this study.

Theoretical Framework - This study is anchored on three interrelated theoretical constructs: Vegetation Ecology Theory, Forest Biometrics and Importance Value Theory, and the Ecosystem Services and Community-Based Natural Resource Management (CBNRM) Framework. Together, these theories provide a comprehensive foundation for assessing the ecological composition of mangrove forests and the socio-environmental engagement of the local community.

- Vegetation Ecology Theory supports the examination of plant species distribution and abundance based on environmental factors and ecological interactions.
- Forest Biometrics and Importance Value Theory guide the biometric assessment of tree species using indicators such as Diameter at Breast Height (DBH), basal area, relative basal area, total height, and relative height. These parameters are essential for calculating the Importance Value Index (IVI), which reflects the ecological dominance and role of each species.
- Ecosystem Services Framework (as defined by the Millennium Ecosystem Assessment) and the CBNRM approach underpin the investigation of human-mangrove interactions. These frameworks classify the benefits provided by ecosystems into provisioning, regulating, supporting, and cultural services, and emphasize the importance of local participation, awareness, and sustainable practices in natural resource management.

Conceptual Framework - This study is anchored on the ecological and sociocultural dimensions of mangrove ecosystems, integrating biophysical vegetation analysis and community awareness toward ecosystem services. The conceptual framework interrelates three core components: mangrove vegetation structure, biometric characterization, and community perception and behavior, forming the basis for evaluating both the ecological

status and socio-environmental engagement within the study area. The framework outlines the following relationships:

- **Mangrove Vegetation Analysis.** This component involves the identification of mangrove species and vegetation analysis using parameters such as frequency, relative frequency, density, relative density, and relative abundance. These indicators serve as baseline measures of species composition and ecological dominance in the area.
- **Biometric Characterization and Importance Value Calculation.** Structural data are gathered through measurements such as Diameter at Breast Height (DBH), basal area, relative basal area, total height, and relative height. These parameters are used to compute the Importance Value Index (IVI), offering a quantitative basis for determining the ecological role and dominance of specific mangrove species.
- **Community Awareness, Attitude, and Practices.** This component assesses the local community's level of awareness, attitudes, and practices toward the mangrove forest ecosystem. It specifically relates to how communities perceive and interact with the four major categories of ecosystem services: Provisioning Services, Regulating Services, Supporting Services, and Cultural Services.

The conceptual relationship is defined as follows: the ecological characteristics of mangrove vegetation and their biometric significance inform the level of ecosystem health, while the community's awareness and practices serve as both indicators and drivers of ecosystem service sustainability. This framework supports the investigation of potential alignment or disconnect between ecological data and sociocultural dynamics.

2. Methodology

Research Design - This study utilized a mixed-method research design to gather data on the assessment of the ecological status of the mangrove stand and the different ecological services provided by the mangrove stand at Brgy. Matalang-talang, Aroroy, Masbate.

Site Description - Aroroy is a coastal municipality in the province of Masbate. It has a land area of 440.30 square kilometers, which is 10.64% of Masbate's total land Area. Its population is estimated to be about 88,351 in the 2020 census conducted by the Philippine Statistics Office, which is 9.72% of the total population of the province. Aroroy is one of the most visited municipalities in the province of Masbate due to its rich culture and different tourist destinations. Aroroy is also a place for environmental research due to the different ecosystems found in the municipality. It is in this context that the study site was determined, one of the coastal barangays of Aroroy, which is a suitable place for the conduct of the study for the ridge-to-reef ecosystem. The study site (Figure 1) is a mangrove stand with a natural mangrove ecosystem, and it is also one of the mangrove plantation sites of the mining company FILMINERA Resources Corp. The assessment was conducted to determine the ecological status and the possible effects of mining in the mangrove stand.



Figure 1. Study Site: Matalang-talang, Aroroy, Masbate

Survey Instrument - A structured survey questionnaire was developed to collect data from the residents. The questionnaire was designed to cover the following key areas: Socio-Demographic Profile, Provisioning Services, Regulating Services, and Cultural Services.

Vegetation Analysis - Vegetation analysis of the mangrove stand was conducted to determine the ecological status and diversity of species in the mangrove stand. A random sampling method was used to establish sampling quadrats in the study area. A total of (five) 5 sampling nested 10 x 10-meter sampling quadrats with 5 x 5 and 1 x 1 subplots (Figure 2) were established, marked by ropes and poles during the assessment. Mangrove species (mature, sapling, and seedlings) found inside the sampling quadrat were identified and recorded in terms of their family name, scientific name, and local name. The “Field Guide to Philippine Mangroves” by Jurgen H. Primavera (2009) was used for identification. Biometrics of mangrove as total height and diameter at breast height (dbh), were gathered during the mangrove identification to differentiate the mature plants from saplings and seedlings. Protocols for measuring mangrove dimensions of the DENR-FMB were used.

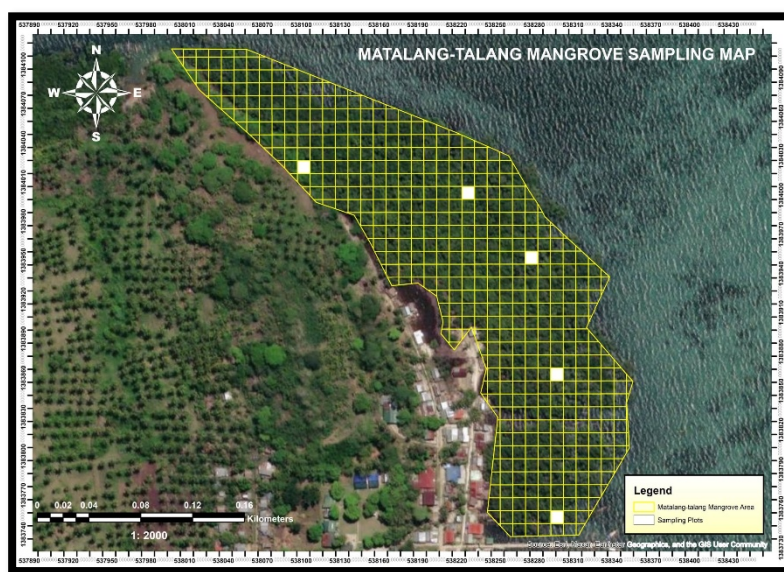


Figure 2. Map with Sampling Plot Layout

The vegetational analysis and biometric characterization were determined using the following parameters:

- A. Density. It measures the thickness of the vegetation in the area by determining the number of individuals in a unit area.
- B. Relative density. It determines the percentage of a particular species that occurs. It shows the dispersion of species within the sampling area.
- C. Frequency. It determines the percentage of a particular species that occurs. It shows the dispersion of species within the sampling area.
- D. Relative frequency. It is defined as the probability of finding the species in any one plot and can only be compared between plots of equal size. It is measured by the formula:
- E. Basal Area. The basal area of a tree refers to the cross-sectional area of the tree trunk at breast height (typically 4.5 feet or 1.3 meters above ground). It's a common forestry measurement used to estimate stand density, tree size, and potential timber volume.
- F. Relative Basal Area. It is computed by the formula shown below: the basal area of a species is divided by the total basal area of all species multiplied by 100.
- G. Species Importance Value (SIV). Is the measure of the spatial value index of one particular species,

simply termed the Importance Value Index.

3. Results and discussions

This chapter presents the data collected and discusses the trends and relationships of variables, answering the objectives of the study centering on vegetation analysis, biometric characterization, and the community's level of knowledge and awareness, attitude, and practices relative to the ecological services provided by the mangrove ecosystem, particularly provisioning, regulating, supporting, and cultural services.

3.1 Vegetation Analysis

To describe the current status of the mangrove stand, species identification and parameters such as frequency, relative frequency, density, and relative density were used and analysed. Table 1 presents the data collected.

Identified Mangrove Species - As shown in Table 1, there were four (4) identified mangrove species in the study area, namely, *Rhizophora apiculata* and *Rhizophora mucronata* (Rhizophoraceae), *Avicennia marina* (Avicenniaceae), and *Sonneratia alba* (Lythraceae), with a total of 47 individual trees found in all five (5) quadrats. These mangroves were riverine to landward species except *Sonneratia alba*. The families of Rhizophoraceae and Avicenniaceae prefer sandy-muddy substrate and lower salinity waters commonly found landward and near river mouths, which is observed in the locations where these species were present.

Table 1
Identified mangrove species and their vegetation and biometric characteristics

SPECIES			VEGETATION PARAMETERS					BIOMETRIC PARAMETERS				
Family name	Scientific name	Common name	TOTAL (N)	FREQUENCY (%)	REL. FREQUENCY (%)	DENSITY	REL. DENSITY (%)	AVE. DBH (cm)	AVE. HEIGHT (m)	BASAL AREA (cm)	REL. BASAL AREA (%)	IMPORTANCE VALUE (%)
Rhizophoraceae	<i>Rhizophora apiculata</i>	Bakauan lalaki	7	40	18	0.014	15	11	10	121	9	42
	<i>Rhizophora mucronata</i>	Bakauan babae	4	40	18	0.008	9	7	5	39	3	30
Avicenniaceae	<i>Avicennia marina</i>	Miapi	29	100	45	0.058	62	19	8	277	21	128
Lythraceae	<i>Sonneratia alba</i>	Pagatpat	7	40	18	0.014	15	33	9	877	67	100
GRAND TOTAL			47	220								

This further explains why these species were found together in the same locations.

As described in the studies of Pat Malabrigo and Primavera et al., *Rhizophora apiculata*, *Rhizophora mucronata*, and *Avicennia marina* were species that co-exist in the same area. In addition, they prefer low to middle tidal levels, such as in landward zones, and they thrive best in sandy-muddy substrates. In the case of *Sonneratia alba*, they were found in quadrats 1 and 3. These can be explained by the fact that these quadrats were located near the open sea, which favors this species. *Sonneratia alba* is a species that thrives best in seaward zones with coralline-sandy substrate, just like in the locations where they were present. These findings are further supported by the studies of Primavera et al. and Agaloos 1994 as baseline studies for mangroves in the Philippines, showing that *Sonneratia alba* co-occupy areas of *A. marina* and *Rhizophora spp.*, but they can also dominate zones with sandy to coralline substrate, which are characteristics of seaward areas.

In addition, the data further shows that of all the identified species, *A. marina* is the most dominant in terms of number, with a total of 29. This is attributed to the mangrove planting activity conducted in the study area (Figure 3), which revealed that *A. marina* was used as seedlings for planting. As observed, quadrat 4 (Appendix 1) hosts the highest number of individuals, with no other species except *A. marina*, was found, suggesting that it is a planting site with noticeable proper spacing, characteristics of an area for tree planting.



Figure 3. Signage showing that *Avicennia marina* is one of the selected species planted in the area

Frequency and Relative Frequency - As shown in Table 1, *A. marina* has the highest frequency and relative frequency value of 100 and 45 percent, respectively, while the other species have frequency and relative frequency values of 40 and 18 percent. This data implies that *A. marina* was found in all quadrats, while the rest of the identified species were present in two (2) quadrats only. As discussed, *A. marina* was used as the species for mangrove planting in the area. Furthermore, as shown in Figure 1, the other identified species, particularly *R. apiculata*, *R. mocrunata*, and *S. alba*, were not part of the selected species for planting. By this, it favors the current dominance in terms of the number of *A. marina* in the study area. In addition, based on the study of Primavera et al., *A. marina* is the most widely distributed mangrove species; it colonizes a variety of substrates from muddy, sandy, and even coralline fringing mangroves. With the current human activities in the area, such as mangrove planting combined with its colonizing characteristics, this explains the species' presence in the site.

Density and Relative Density - In terms of density and relative density, the data show that *A. marina* has the highest value of 0.058 and 62 percent, respectively, followed by *R. apiculata* and *S. alba* with both 0.014 and 15 percent, and the least is *R. mocrunata* with values of 0.008 and 9 percent. This data is directly related to the number of individuals per species. Since there is a direct relationship between density, relative density, and individual count, a higher individual representation means higher density and relative density, as supported by the data. *A. marina* has 29 individuals, being the highest, while *R. mocrunata* has 4, being the lowest. These numbers are then correlated to the biological requirements of the species, particularly preferred substrate and zonation. Correct species zonation encourages more growth and reproduction.

3.2 Biometric Characterization

To physically characterize the mangrove stand in the area of the study, parameters such as average Diameter at Breast Height (Ave. DBH), average Height, Basal Area (BA), and Relative Basal Area (Rel. BA) were measured. These parameters were used to determine if the mangrove stand is within the ideal growth range in comparison with the baseline studies of Primavera et al. (2004).

Average Diameter at Breast Height - As shown in Table 1, the order of Ave. DBH from highest to lowest is *S. alba* (33cm), *A. marina* (19cm), *R. apiculata* (11cm), and *R. mocrunata* (7cm). These values are correlated with the species' biological characteristics and number of individuals. Of all the identified mangrove species, *S. alba* has the largest average diameter at breast height. This result is directly related to its average tree growth ranging from 20-120cm as indicated in the study of Primavera et al., compared with the rest of the identified species, which ranged from 10-40cm (*R. apiculata*), 8-20cm (*R. mocrunata*), and 10-70cm (*A. marina*). In the case of the study, *S. alba*'s DBH range is 1.97-57.07cm, while the other species have 6.13-18.60cm (*R. apiculata*), 2.51-9.58cm (*R. mocrunata*), and 6.76-47.14cm (*A. marina*). This only shows that in the area of the study, *S. alba* are generally bigger in girth, and in terms of being a species, they are usually bigger compared to the other identified species, as indicated in the study of Primavera et al. In the case of *R. mocrunata* having the lowest average DBH, this is

due to a small number of individuals counted. A smaller sample size means a lower average value relative to the other species.

Average Height - Based on the data, the order of average height from highest to lowest is *R. apiculata* (10m), *S. alba* (9m), *A. marina* (8m), and *R. mocrunata* (5m). The same with DBH, these values are affected by the species' biological characteristics and the number of individuals. In the area of the study, the average heights of the identified species are as follows: 4.77-18.45 (*R. apiculata*), 5.9-17.2 (*S. alba*), 4.38-15.2 (*A. marina*), and 4.15-6.2 (*R. mocrunata*). This data shows that *R. apiculata* is generally taller compared to the others. This result is attributed to the proper zonations where *R. apiculata* were found, which is further supported by the average range of this species in terms of height (4-20m), which is obviously taller values compared to the other species identified. In the case of *R. mocrunata* having the lowest average Height, this is again due to a small number of individuals counted. A smaller sample size means a lower average value relative to the other species.

Basal Area and Relative Basal Area - As shown in Table 1, the order of Basal Area and Relative Basal Area from highest to lowest is 877cm and 67% (*S. alba*), 277cm and 21% (*A. marina*), 121cm and 9% (*R. apiculata*), and 39cm and 3% (*R. mocrunata*). This data is directly related to the DBH values of the species. *S. alba* has the highest DBH value, and since DBH has a direct relationship with Basal Area, since Basal Area is computed through Circumference, which is derived from DBH value, higher DBH means higher Basal Area and vice versa, such as in the case of *R. mocrunata* being the lowest. Both Basal Area and DBH values are affected by the environmental conditions, such as proper zonations and tidal conditions in the area of the study.

Importance Value - To determine the importance value of the identified tree species, data on Relative Density (RD), Relative Basal Area (RBA), and Relative Frequency (RF) are needed. The summation of these parameters determines the importance value of each species. As shown in Table 1, the order of importance value from highest to lowest is *A. marina* (128%), *S. alba* (100%), *R. apiculata* (42%), and *R. mocrunata* (30%). Revealed by the data, in terms of the parameters (RD, RBA, RF), *A. marina* and *S. alba* are the top-most species, while *Rhizophora* species were the lowest. It was shown that *A. marina* and *S. alba* have the highest values for Relative Densities, Basal Areas, and Frequencies, making them have higher importance values in comparison with *R. apiculata* and *mocrunata*. This only implies the ecological importance of the species in the community. As the data shows, *A. marina* and *S. alba* are the most ecologically important species in the mangrove stand, meaning they serve greater ecological services than the other species, given that they were the most dominant in the area. On the contrary, while *Rhizophora* species have the lowest importance value, it does not mean that they were not important. The values only show the significance of their contribution to the overall ecological services that the mangrove stand provides. Given that their importance value is low, this means that in order to improve the mangrove stand in terms of ecological services, these species can be a priority in efforts on replanting or conservation.

3.3 Socio-Demographic Profile of The Respondents

Mangrove ecosystems are among the most productive and ecologically important coastal environments, providing a wide range of ecosystem services that support both biodiversity and human well-being. This section presents and analyzes the findings from a community-based survey aimed at understanding local perceptions and experiences related to the provisioning, regulatory, and cultural services provided by mangroves in Barangay Matalang-talang, Aroroy, Masbate.

Gender - With 66.7% of respondents being female and 33.3% male, the sample reflects a female-majority perspective. This suggests that women are often more directly involved in utilizing mangrove provisioning services such as collecting firewood, food, and medicinal plants, and may have greater awareness of cultural and supporting services. Additionally, the data likely reflects women's stronger environmental engagement and community roles, especially in coastal and rural settings. However, men's roles often related to fishing, timber, or land-use decisions may be underrepresented, which could influence the balance of perspectives in the study. Based on the SDSSU Multidisciplinary Research Journal, in Calatagan Mangrove Forest Conservation Park in Batangas, Philippines,

women exhibited significantly higher knowledge, awareness, economic valuation, and conservation practices of mangrove resources than men, while men in formal positions like local government showed strong conservation awareness through active engagement (Creencia and Querijero, 2018).

Age - The age distribution of respondents shows that a majority (66.6%) are aged 41 and above, with 33.3% above 60 and 33.3% between 41–60 years old. This suggests that the study captures insights from older individuals who may have long-standing interactions with mangrove ecosystems, potentially resulting in higher awareness and more experience-based practices, especially regarding provisioning and cultural services. Meanwhile, only 13.3% of respondents are under 25, and 20% are between 25–40, indicating limited input from younger age groups, who may have different perspectives or lower engagement with mangrove-related activities. This age profile may influence the overall perception and reported practices toward mangrove ecosystem services. In mangrove-dependent communities in Southeast Asia, middle-aged and older adults were more involved in resource extraction and management. They tend to show higher awareness of provisioning and regulating services, while the youth were more disconnected due to urban migration and changing livelihood patterns (Walters et al. 2008).

Civil Status - The data shows that 48.3% of respondents are married, 27.6% are widowed, and 24.1% are single. This indicates that the majority are or have been part of family units, which may influence their greater dependence on mangrove ecosystem services, especially provisioning services like food, fuel, and livelihood resources. Married and widowed individuals likely older and more rooted in the community may also have deeper experience and stronger attitudes toward conservation. In contrast, single respondents, often younger, may have less direct engagement with mangrove resources, potentially affecting their level of awareness and practice. Often, married or widowed individuals had higher awareness of mangrove ecosystem services due to direct responsibility for family needs such as food and income (Badola et al. 2012).

Area of Residence - The data shows that most respondents (62.1%) reside in the coastal zone, followed by 17.2% in the marine zone, 13.8% near the river, and only 6.9% from the upland area. This indicates that most participants live in areas with direct and frequent interaction with mangrove ecosystems. Those in the coastal and marine zones likely have greater awareness and practical engagement with mangrove provisioning and regulating services such as fishing, storm protection, and erosion control. Their location positions them to observe and rely on mangrove benefits more closely, which can influence stronger attitudes and conservation practices. In contrast, upland residents may have less exposure and lower dependence, potentially affecting their awareness levels.

Years of Residency - All respondents (100%) have been residing in Brgy. Matalang-Talang, for more than ten (10) years, indicating a long-term connection to the local environment. This suggests a high potential for deep-rooted awareness and experience-based practices related to mangrove ecosystem services, especially provisioning, cultural, and supporting services. Their long residency likely means they have firsthand knowledge of changes in mangrove conditions over time and may exhibit stronger attitudes toward conservation due to personal and livelihood reliance on mangrove resources. Environmental Conservation Practices of Coastal Communities examines conservation behaviors in Dumangas, Iloilo. It found that long-term residents especially those aged 61+ prioritized preservation projects, local regulations, and proper waste management in mangrove areas.

Frequency of Interaction with The Environment - With 96.7% of respondents interacting with the environment daily, this indicates a high level of direct engagement with the mangrove ecosystem. This frequent interaction likely enhances their awareness of ecological services, especially provisioning like food, fuel, and materials, and regulating services such as coastal protection and water regulation. In coastal Quezon Province, daily interaction with mangrove ecosystems was positively correlated with higher awareness and stronger conservation attitudes, particularly regarding food collection and shoreline protection. Daily exposure also suggests that their attitudes and practices are shaped by firsthand experience, making them more likely to observe changes in the environment and participate in conservation or resource-use activities. The small percentage with monthly interaction may have limited awareness or indirect dependence on the mangrove ecosystem.

Types of Respondents - Most of the respondents are fisherfolk (65.5%), followed by farmers (20.7%) and

local officials (27.6%), with a few household solos, sari-sari store owners, and those working outside the barangay (each 3.4%). This profile indicates that most respondents depend directly on mangrove ecosystem services, especially provisioning services like fish, shellfish, and other natural resources. Fisherfolk and farmers are likely to have high awareness and daily interaction with mangroves, shaping strong attitudes and practical knowledge related to resource use and conservation. Local officials may contribute more to policy awareness and management practices, while the small number of other occupations suggests a more limited or indirect interaction with the ecosystem.

Average Monthly Income - The data shows that 76.7% of respondents earn below ₱10,000 monthly, 20% earn between ₱10,001–₱20,000, and only a small percentage earn ₱20,001–₱50,000. This indicates that the majority belong to low-income households, which may lead to greater dependence on mangrove provisioning services (e.g., fishing, fuelwood, crabs) for subsistence and livelihood. Lower-income groups are often more directly reliant on natural resources, potentially resulting in higher awareness and practical engagement, but may also face limited capacity to adopt sustainable practices without support. This economic context is important when assessing attitudes and practices toward mangrove conservation.

Engagement in Fishing - The data shows that 76% of respondents are engaged in fishing, while 23.3% are not. This suggests that a large majority of the community directly depends on mangrove-related provisioning services, such as fish, crabs, and shellfish, for their livelihood and food supply. Their active involvement in fishing likely contributes to higher awareness and stronger attitudes toward the importance of mangrove ecosystems in supporting marine life, coastal protection, and resource sustainability. Meanwhile, the minority not engaged in fishing may interact with mangroves in other ways, like farming and small trade, possibly influencing a different perspective on ecosystem services. Communities reliant on fishing show stronger conservation behaviors when they recognize the link between mangroves and fishery productivity (Aburto et al. 2015).

Type of Fishing - The data reveal that 95.7% of respondents are engaged in open sea fishing, 17.4% in river fishing, and 0% in mariculture. This indicates that the community primarily relies on open sea fishing, which is closely linked to the provisioning services of mangrove ecosystems such as nursery support for fish stocks and protection of coastal waters. The presence of river fishing suggests some level of interaction with inland mangrove or brackish areas, contributing to broader ecological awareness, particularly of supporting and regulating services. The absence of mariculture may reflect limited access to aquaculture technology or capital, which can affect how communities diversify their use of mangrove-related resources.

3.4 Provisioning Services

A total of 26 out of 30 household respondents participated in the focus group discussion. The remaining 4 respondents are not directly affected nor benefited from the mangroves. The data collected indicates how local communities depend on various provisioning services from the mangrove ecosystem. The number of people utilizing each service is shown in Table 2. The data reveal that fish and crustaceans are the most utilized provisioning services, with 24 people each reporting reliance on them. This reflects the fundamental role of mangrove ecosystems in supporting fisheries-based livelihoods and food security. The high number of users highlights the importance of mangrove-associated aquatic habitats as a primary source of protein and income for coastal populations. Edible plants, reported by 10 people, and materials for roof thatching, used by 8 people, also represent significant services. These uses emphasize how mangroves provide not only food resources beyond fishery products but also raw materials for traditional housing, which are vital in rural and resource-dependent communities. The category labeled "Others" (9 people) suggests additional minor provisioning uses, such as the collection of mollusks, honey, or traditional crafting materials. These uses, though less frequently mentioned, point to the diverse and multifunctional nature of mangrove ecosystems. In contrast, mangrove wood (2 people), medicinal plants (1 person), and palm wine (1 person) were much less frequently reported. The limited use of mangrove wood might reflect conservation awareness, legal restrictions, or a shift toward more sustainable or alternative construction materials.

Table 2*Number of people utilizing each service.*

PROVISIONING SERVICE	FREQUENCY
Fish	24
Crustaceans	24
Mangrove Wood	2
Medicinal	1
Edible Plants	10
Others	9

Similarly, the minimal use of medicinal plants and palm wine may indicate a decline in traditional knowledge, limited access to specific species, or a cultural transition away from traditional practices. Overall, the data illustrates that while some provisioning services are widely used, others are niche or declining in use. These trends underline the importance of sustainable resource management and cultural preservation to ensure the continued benefit of mangrove ecosystems for current and future generations. Mangrove ecosystems are vital for local livelihoods, particularly in coastal communities. Studies have shown that mangroves provide essential resources such as fish, crustaceans, and wood, which are integral to the daily lives of many. For instance, in the Philippines, a study on mangrove restoration projects found that local participation not only improved social capital but also enhanced access to information and services, thereby supporting livelihoods (Valenzuela, et al. 2020).

To understand how often people, rely on mangrove ecosystems for provisioning services, respondents were asked about the frequency with which they gather resources. The results are summarized in Table 3. The data reveals that most people gather resources from mangroves on a monthly (11 people) or occasional (9 people) basis. This suggests that while mangrove provisioning services are used regularly by the community, they are not always part of daily or even weekly routines for most respondents. This moderate frequency likely reflects a balanced use of mangrove resources, either due to seasonal availability, sustainability concerns, or complementary sources of livelihood and food.

Table 3*Frequency of resource gathering from mangroves*

FREQUENCY	NUMBER OF PEOPLE
Daily	1
Weekly	5
Monthly	11
Occasionally	9
Never	0

A smaller number of individuals (5 people) gather resources every week, indicating a more consistent reliance on mangrove products for household or livelihood needs. Only one person reported daily resource gathering, which may reflect specialized dependence, such as small-scale fishing or harvesting. Importantly, no respondents reported “never” gathering resources from mangroves, underscoring that the ecosystem plays at least some role in the lives of all individuals surveyed. This highlights the universal value of mangroves within the community, even if usage varies in intensity.

Respondents were also asked about the extent to which mangrove ecosystems contribute to their household income. The responses are summarized in Table 4. The data indicate that most respondents perceive mangroves as an important source of income for their households. Specifically, 13 people reported that mangroves contribute “very much” to their income, and another 9 people indicated “somewhat”, suggesting that a significant portion 22 out of 26 respondents derive at least some income from mangrove-related activities. This high reliance highlights the vital economic role mangrove ecosystems play in supporting livelihoods, particularly in coastal communities. Such income could come from activities like fishing, harvesting crustaceans, collecting mangrove wood, or other small-scale enterprises dependent on mangrove resources. Only a small number of respondents reported not at all (1 person) or no reliance (3 people) on mangroves for income, indicating that while some community members have diversified livelihoods or alternative income sources, mangroves remain broadly significant for most.

Table 4*Contribution of mangroves to household income*

LEVEL OF CONTRIBUTION	NUMBER OF PEOPLE
Very much	13
Somewhat	9
Not at all	4

3.5 Regulating Services

Respondents were asked about their perception of the mangrove ecosystem's role in protecting their community from natural disasters such as typhoons, floods, and storm surges. The overwhelming majority of respondents (25 out of 26) strongly perceive mangroves as providing significant protection against natural disasters such as typhoons, floods, and storm surges. Only one person regarded the protection as moderate, while none doubted or were unsure about the protective role of mangroves. Respondents were asked to rate the importance of mangrove ecosystems in regulating water quality. The data indicate that all respondents (26 out of 26) unanimously regard mangroves as very important in regulating water quality. No respondents expressed uncertainty or perceived lesser importance. This consensus underscores the community's strong awareness of the critical role mangroves play in maintaining healthy coastal and estuarine environments. Mangroves act as natural filters by trapping sediments, absorbing pollutants, and cycling nutrients, thereby enhancing water clarity and quality. Mangroves play a significant role in regulating water quality and mitigating climate change. They act as natural filters, trapping sediments and pollutants, and sequester carbon, thereby enhancing water clarity and reducing greenhouse gas concentrations. In southeastern Cuba, communities acknowledged the regulating services of mangroves, such as climate regulation and coastal protection, which are vital for adapting to environmental changes (Yanet Cruz Portorreal et al, 2024).

Respondents were asked whether they believe mangrove ecosystems play a role in carbon storage and help reduce climate change. The data shows that most of the respondents (24 out of 26 people) recognize mangroves as playing a significant role in carbon storage and climate change mitigation. An additional two respondents acknowledged a role but perceived it as less significant. Importantly, no respondents denied mangroves' role or expressed uncertainty. This strong awareness among the community reflects increasing global and local recognition of mangroves as vital "blue carbon" ecosystems. Mangroves are known to sequester and store large amounts of carbon in their biomass and sediments, often at rates higher than terrestrial forests, thereby helping reduce greenhouse gas concentrations in the atmosphere. The unanimous positive response regarding the role of mangroves in climate mitigation suggests that awareness campaigns and educational programs about ecosystem services have been effective or that experiential knowledge from living near mangrove areas is influential.

3.6 Cultural Services

Respondents were asked whether they or their community used mangrove ecosystems for cultural or spiritual purposes. The responses are summarized in Table 5. The data reveal a varied and somewhat uncertain relationship between the community and the cultural or spiritual use of mangroves. Notably, no respondents reported frequent use of mangroves for cultural or spiritual activities, while 4 people acknowledged occasional use. Meanwhile, 8 people indicated that they never use mangroves for such purposes, and a significant number (14 people) were unsure about whether such uses occur. Mangroves often hold cultural and spiritual importance for coastal communities. In Benin, West Africa, sacred traditions have played a crucial role in mangrove conservation. Communities have integrated voodoo deities into their conservation efforts, leading to the protection and restoration of mangrove areas. Similarly, in the Rufiji Delta of Tanzania, communities recognized cultural services provided by mangroves, including spiritual beliefs and natural beauty, which were essential for community cohesion and identity (Nyangoko et al., 2020). In summary, the data points to a limited but present cultural and spiritual role of mangroves within the community, alongside a notable gap in awareness or connection. Addressing this gap could enrich conservation strategies by incorporating the full spectrum of ecosystem values.

Table 5*Use of Mangroves for Cultural or Spiritual Activities*

RESPONSE	NUMBER OF PEOPLE
Yes, frequently	0
Yes, occasionally	4
No, never	8
I'm not sure	14

Respondents were also asked whether they believe mangroves enhance the aesthetic or recreational value of their community. The responses are summarized in Table 6. The data shows that the majority of respondents (20 out of 26) perceive mangroves as adding significant aesthetic and recreational value to their community. Only one respondent thought mangroves add a little value, and none believed mangroves do not add any value. A smaller group (5 people) was unsure about their contribution in this regard.

Table 6*Perceived Aesthetic and Recreational Value of Mangroves*

RESPONSE	NUMBER OF PEOPLE
Yes, they add significant value	20
Yes, but only a little value	1
No, they do not add value	0
I'm not sure	5

This strong positive perception reflects the recognized importance of mangrove ecosystems not only for their direct economic and ecological benefits, but also for their role in enhancing the visual appeal and recreational opportunities within coastal communities. Mangroves often provide scenic natural landscapes, support bird watching, fishing, boating, and other outdoor activities that contribute to the well-being and quality of life for residents. The absence of negative responses indicates broad community appreciation for the mangrove environment. However, the presence of some uncertainty suggests that further awareness-raising efforts could help deepen understanding of the diverse benefits mangroves provide beyond provisioning services. Mangroves also offer aesthetic and recreational benefits. In the Sundarbans, Bangladesh, tourism related to mangrove ecosystems contributes significantly to the local economy, with visitors engaging in wildlife watching and forest walks (Nobi et al., 2021).

Respondents were asked whether they consider mangrove ecosystems important for fostering community bonding and social activities. The data shows that a significant majority of respondents (22 out of 26) consider mangrove ecosystems to be very important for community bonding and social activities, with an additional 4 people acknowledging them as somewhat important. No respondents viewed mangroves as unimportant or were unsure. This strong consensus suggests that mangroves are valued not only for their ecological and economic roles but also as important social spaces where community members gather, interact, and strengthen social ties. Mangrove areas often serve as venues for communal activities such as fishing, festivals, cultural ceremonies, or simply as shared natural spaces that foster a sense of belonging and identity. Such social ecosystem services are critical for community resilience and well-being, enhancing social cohesion and facilitating collective action, including conservation efforts. The high value placed on mangroves for social functions may also reflect traditional practices and cultural heritage linked to these ecosystems.

Respondents were asked whether they believe there are efforts in their community to protect and conserve mangrove ecosystems. The data reveal that the majority of respondents (23 out of 26) perceive that their community is actively engaged in efforts to protect and conserve mangrove ecosystems. An additional 3 respondents acknowledge that some efforts exist, but feel these are insufficient. No respondents reported the absence of conservation efforts or expressed uncertainty. This widespread recognition of community conservation initiatives suggests strong local awareness and commitment toward sustaining mangrove ecosystems. Active conservation efforts might include mangrove reforestation, regulation of resource harvesting, community education programs, or participation in environmental governance. In conclusion, the data underscores a positive outlook on community-led mangrove protection efforts, while also pointing to the need for continued support and

enhancement of these initiatives to ensure sustainable management. (6) Community involvement is crucial for effective mangrove conservation. In northern Sri Lanka, community participation in mangrove restoration significantly impacted mangrove cover, highlighting the importance of local engagement in conservation efforts. Similarly, in the Philippines, local participation in mangrove restoration projects has been shown to increase social capital and improve access to information and services, thereby enhancing community resilience and livelihoods (Valenzuela, 2020).

Out of 26 respondents, 7 provided open-ended suggestions on what should be done to enhance the management and conservation of mangroves in their area. The responses indicate a community interest in practical and participatory approaches to improving mangrove conservation. The most frequently mentioned actions include clean-up drives, mangrove planting, and mangrove monitoring, each suggested by two respondents. These activities reflect proactive strategies that combine direct ecosystem restoration with ongoing stewardship. Clean-up drives, especially when coordinated with the Local Government Unit (LGU), highlight the community's recognition of the importance of removing pollution and maintaining healthy mangrove habitats. This aligns with the understanding that mangrove degradation is often linked to human impacts such as waste accumulation. Mangrove planting is identified as a vital restoration effort to replenish degraded areas and enhance ecosystem functions. Reforestation is a commonly recommended practice in mangrove conservation worldwide and reflects local willingness to participate in hands-on restoration. Monitoring of mangrove health and resources is also emphasized, suggesting awareness of the need for ongoing assessment to inform management decisions and ensure sustainability.

Lastly, raising public awareness and education was mentioned, underscoring the importance of informed community members who understand the ecological and socio-economic benefits of mangroves. Education can empower local stakeholders to take ownership of conservation initiatives and promote sustainable resource use. Overall, these responses reflect a community ready to engage in diverse conservation activities, with an emphasis on collaboration, restoration, and knowledge-sharing. These insights provide valuable guidance for designing locally relevant mangrove management programs that harness community participation and support.

4. Summary, conclusions, implications, and recommendations

Summary - Generally, the study aimed to conduct a rapid assessment of the mangrove ecosystem in Barangay Matalangtalang, Aroroy, Masbate, from April 3-6, 2025. It includes species identification, vegetation analysis, and biometric characterization. Additionally, it examines community awareness, attitudes, and practices related to the ecological services provided by mangrove forests, covering provisioning, regulating, supporting, and cultural aspects. To accomplish the objectives, the study utilized a mixed-method research design incorporating field data collection for vegetation and biometric characterization, and a survey with the use of a structured instrument, facilitated in the coastal community near the mangrove stands as the primary respondents. Revealed by the data, the findings led to the following results.

- The vegetation analysis shows that there were four mangrove species found in the area of the study, namely, *Rhizophora apiculata* and *Rhizophora mucronata* (Rhizophoraceae), *Avicennia marina* (Avicenniaceae), and *Sonneratia alba* (Lythraceae), with a total of 47 individual trees found in all five (5) quadrats. Of all the species, *A. marina* has the highest values for frequency, relative frequency, density, and Relative density, followed by *S. alba*, *R. apiculata*, and *R. mucronata* being the lowest.
- As shown by the data, the order of Ave. DBH from highest to lowest is *S. alba* (33cm), *A. marina* (19cm), *R. apiculata* (11cm), and *R. mucronata* (7cm). For average height, is *R. apiculata* (10m), *S. alba* (9m), *A. marina* (8m), and *R. mucronata* (5m). While for Basal Area and Relative Basal Area are 877cm and 67% (*S. alba*), 277cm and 21% (*A. marina*), 121cm and 9% (*R. apiculata*), and 39cm and 3% (*R. mucronata*). Furthermore, the data revealed that the importance values of the identified species are *A. marina* (128%), *S. alba* (100%), *R. apiculata* (42%), and *R. mucronata* (30%).

- Based on the knowledge, attitude, and practices of the respondents relative to the ecological services of the mangrove stand (provisioning, regulating, and cultural), the data revealed that fish and crustaceans are the most utilized provisioning services. The overwhelming majority of respondents (25 out of 26) strongly perceive mangroves as providing significant protection against natural disasters such as typhoons, floods, and storm surges. Furthermore, notably, no respondents reported frequent use of mangroves for cultural or spiritual activities.

Implications for teachers - The findings of this study underscore the crucial role that teachers can play in strengthening environmental literacy and fostering community stewardship in coastal and rural schools. Since the mangrove ecosystem in Barangay Matalang-talang remains ecologically viable yet vulnerable to anthropogenic pressures, teachers are in a unique position to integrate mangrove conservation concepts into classroom instruction. Through contextualized lessons in science, social studies, and values education, teachers can help students understand the ecological functions of mangroves such as coastal protection, biodiversity support, and climate regulation and relate these directly to the local experiences of their families and community. Teachers can also emphasize critical thinking about human–environment interactions, helping learners recognize how daily practices, waste disposal habits, and livelihood activities affect the health of the mangrove ecosystem. Moreover, teachers can serve as facilitators of community-engaged learning by designing experiential activities that connect classroom knowledge with actual field observations. School-based initiatives such as mangrove monitoring, coastal clean-ups, simple biodiversity recording, and participation in tree-growing programs can cultivate environmental responsibility among learners. By collaborating with local government units, environmental agencies, and community leaders, teachers can broaden students’ exposure to sustainable resource management and deepen their understanding of socio-ecological issues. This alignment of curriculum and real-world application fosters not only academic learning but also the development of advocacy, leadership, and stewardship values among the youth.

Implications for students (learners) - For students, the study highlights the importance of developing a strong appreciation for the ecological and socio-economic value of mangroves within their own community. The results show that the health of local mangroves directly influences food sources, coastal safety, and long-term livelihood opportunities. Understanding these connections empowers students to become active participants in conservation efforts not merely observers. By engaging in hands-on activities such as species identification, waste management practices, and awareness campaigns, students can cultivate environmental responsibility and become catalysts for positive change within their households and wider barangay. The study emphasizes that informed and proactive youth are essential to sustaining the ecological services and long-term resilience of the mangrove ecosystem.

Conclusion - The mangrove stand in the study site is predominantly *A. marina*, making it the most important species relevant to its ecological significance in the mangrove forest. In addition, the biometric characteristics of the individual trees were within the range of the normal growth of the identified species based on the studies of Primavera and Malabrigo. Though the community hosts few species, the stand is considered to be thriving and in good condition. As to its ecological services as perceived by the community, the people of Brgy. Matalang-talang demonstrates strong awareness and appreciation for the provisioning, regulating, and cultural services of mangroves. This study confirms that mangrove ecosystems provide vital services to the community, including food, income, disaster protection, water quality regulation, and climate change mitigation. While fewer respondents emphasized cultural uses, most acknowledged the aesthetic and social value of mangroves. Community awareness and participation in conservation are strong, with many suggesting practical actions like planting, clean-ups, and education. These findings highlight the importance of supporting local efforts and integrating community needs into mangrove management for long-term sustainability. Bridging this gap through education, empowerment, and inclusive management is essential for sustaining the vital ecosystem services mangroves provide.

Recommendations - Based on the findings and conclusions of the study, the following recommendations are proposed:

- For future studies, considering the physico-chemical characterization of the area, both water and soil can be supplementary as additional objectives to have a holistic view of the current condition of the mangrove stand.
- The use of modern instruments for tree biometrics, such as digital tree calipers and laser height measuring devices, can be considered to have more accurate measurements.
- For better triangulations of data relative to the survey, adding more respondents and the inclusion of administrators and agencies involved in the mangrove protection and conservation are ideal.
- A more comprehensive mangrove stand assessment is recommended to deepen the database for the mangrove stand of the area of the study.
- Lastly, for mangrove management, conservation, and community engagement, a comprehensive education campaign, tree growing, community-based programs, and diversification of mangrove species are highly recommended.

5. References

- Badola, R., Barthwal, S., & Hussain, S. A. (2012). Attitudes of local communities towards conservation of mangrove forests: A case study from the east coast of India. *Estuarine, Coastal and Shelf Science*, *96*, 188-196.
- Creencia, G. B. A., & Querijero, B. V. (2018). Community-based management of the calatagan mangrove forest conservation park in batangas, Philippines: a case study on environmental sustainability. *Asia Pacific Journal of Academic Research in Social Sciences*, *3*(1), 21-27.
- Cruz Portorreal, Y., Beenaerts, N., Koedam, N., Reyes Dominguez, O. J., Milanés, C. B., Dahdouh-Guebas, F., & Pérez Montero, O. (2024). Perception of mangrove social–ecological system governance in southeastern Cuba. *Water*, *16*(17), 2495.
- Garcia, K. B., Malabrigo, P. L., & Gevaña, D. T. (2014). Philippines' mangrove ecosystem: status, threats and conservation. *Mangrove ecosystems of Asia: Status, challenges and management strategies*, 81-94.
- Nobi, M. N., Sarker, A. H. M., Nath, B., Røskoft, E., Suza, M., & Kvinta, P. (2021). Economic valuation of tourism of the Sundarban Mangroves, Bangladesh. *arXiv preprint arXiv:2110.00182*.
- Nyangoko, B. P., Berg, H., Mangora, M. M., Gullström, M., & Shalli, M. S. (2020). Community perceptions of mangrove ecosystem services and their determinants in the Rufiji Delta, Tanzania. *Sustainability*, *13*(1), 63.
- Primavera, J. H. (2004). *Philippine mangroves: Status, threats, and sustainable development*. In M. Vannucci (Ed.), *Mangrove management and conservation: Present and future* (pp. 192–207). United Nations University Press.
- Valenzuela, R., Yeo-Chang, Y., Park, M. S., & Chun, J. N. (2020). Local people's participation in mangrove restoration projects and impacts on social capital and livelihood: A case study in the Philippines. *Forests*, *11*(5), 580.
- Villegas, A. (2020). *Mangrove rehabilitation project in Aroroy, Masbate: Impacts on coastal protection and biodiversity*.
- Walters, B. B., Rönnbäck, P., Kovacs, J. M., Crona, B., Hussain, S. A., Badola, R., ... & Dahdouh-Guebas, F. (2008). Ethnobiology, socio-economics and management of mangrove forests: A review. *Aquatic Botany*, *89*(2), 220-236.

