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Mangrove Composition, Ecosystem Services and Management Practices in Barangay Buenlag, Binmaley, Pangasinan

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Abstract - This study assessed the mangrove species composition, density, ecosystem services and management practices in Barangay Buenlag, Binmaley, Pangasinan. To determine the species composition and density, five (5) quadrats measuring 5m x 20m were placed alternately at 200-m interval along the riverbanks. On the other hand, a focus group discussion (FGD) was conducted among concerned participants from Barangay Council, fishermen and local residents to determine the mangrove ecosystem services and management practices. Results of the study showed that there were 7 species of mangroves belonging to 5 families identified along the riverbanks; *Rhizophora apiculata, Rhizophora mucronata, Bruguiera cylindrica, Avicennia officinalis, Sonneratia alba, Lumnitzera racemosa* and *Excoecaria agallocha*. *R. apiculata* registered the highest mean density with 0.184 stands per 100 m^2 while *Lumnitzera racemosa* gained the lowest with 0.002 stands per 100 m^2. The mangroves provide the basic ecosystem services from provisioning, regulating, supporting and cultural. Key management measures employed ranged from planting seedlings, prohibiting cutting of mangroves and avoiding dumping of wastes.

Key words: Species Composition, Density, Ecosystem Services, Management Practices

INTRODUCTION

Mangroves are assemblages of woody halophytes that are the foundational species of intertidal forest and shrubland ecosystems thriving along the tropical and subtropical coastlines, estuaries, lagoons, and river deltas [1]. These halophytes can tolerate high salinity concentrations and oxygen-poor soil [2]. Mangroves may grow either as trees or shrubs according to existing environmental conditions such as climate, salinity of the water, topography and edaphic features of the area [3].

Mangroves constitutes about 0.7% of the world's tropical forests [4]. Around 15.2 million hectares of mangroves are estimated to exist worldwide in 2005, down from the previous 18.8 million hectares in 1980 [3]. The Philippines has 240,824 hectares of mangroves in 2010 while the province of Pangasinan has 207 hectares in the same year [5]. Mangroves play a remarkable role, providing not only a source of food and resources but also protecting coastlines, preventing erosion and regulating our climate [6-8]. This vulnerable ecosystem offers a range of ecosystem goods and services including fuel wood, food and timber, climate regulation and cultural services [9].

Ecosystem services refer to the benefits human populations derive, directly or indirectly, from ecosystem functions [6] or simply the benefits people obtain from ecosystems [10]. The ecosystem services provided are categorized as

provisioning, regulating, supporting and cultural [10-11]. Provisioning services are the direct, consumable products derived from the mangrove. Regulating refers to the services regulate ecosystem flows while supporting represents the services that support the ecosystem. The cultural includes the spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences [12].

Mangroves are thriving in the riverbanks in most barangays of the coastal town of Binmaley, Pangasinan including Barangay Buenlag. The ecosystem services provided by mangroves to the people both directly and indirectly are not documented including the ecological benefits derived in the mangrove ecosystem. This study has been undertaken to provide baseline information on the various ecosystem services and management practices of mangroves in Barangay Buenlag, Binmaley, Pangasinan.

MATERIALS AND METHODS

Research Design

This study employed a descriptive-survey method of research. The species of mangroves found in each station were determined and counted. A focus-group discussion (FGD) was adopted to determine the mangrove ecosystem services and management practices among concerned respondents in the barangay.

Location of the Study

The study was conducted in Barangay Buenlag, Binmaley, Pangasinan (Figure 1). The mangrove composition and density were assessed in the riverbanks of the said barangay. Five (5) quadrats (stations) were established at the riverbanks with an interval of 200m. Each quadrat measures 5 m x 20 m (100 m^2).

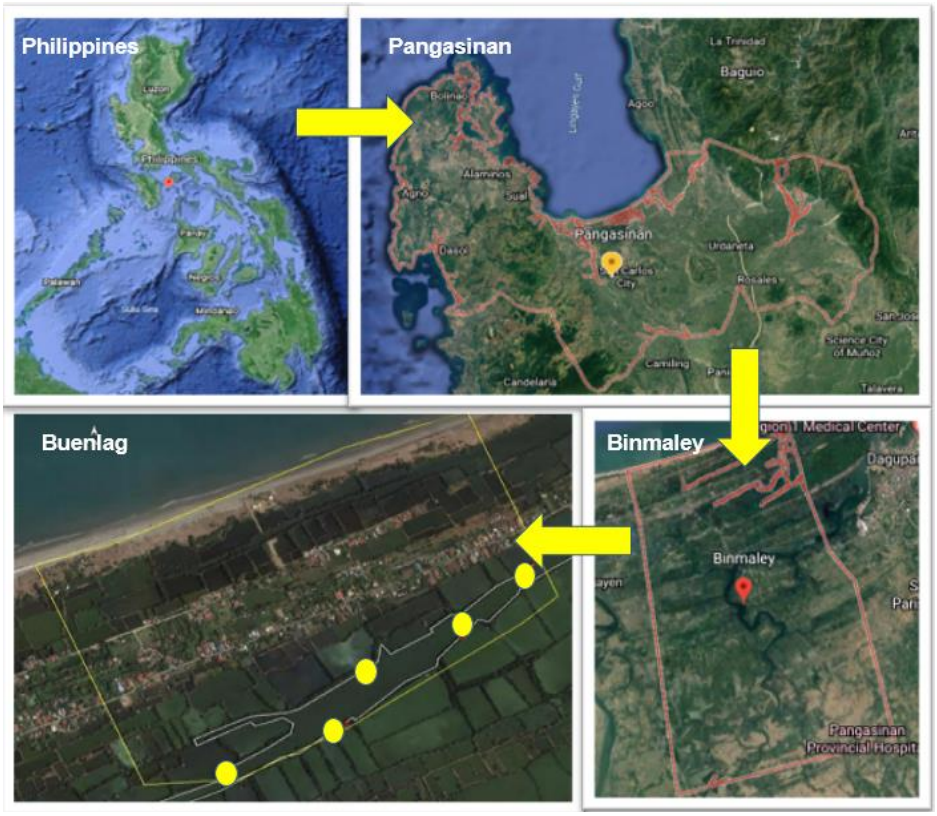

Figure 1. Location map of the sampling stations.

The coordinates of each sampling station were taken using a portable Global Positioning System (GPS) (Table 1).

Data Gathering Procedure

Identification and Enumeration of Mangroves

A rented-motorized banca was used to approach the established quadrats for sampling. Species of mangroves were identified based on the field guide books of [2,13,14]. Each species identified was photographed. Individual stand of each species was carefully counted and recorded. Only matured mangroves were considered in the counting.

Determination of Density

Density. The density of mangroves was computed using the formula of English et al. (1994):

Density = Total Number of Mangroves/Total Sampling Area

where:

Number of Mangroves: Total number of counted mangroves per quadrat

Total Sampling Area ($100m^2$): 20m length x 5m width

Ecosystem Services and Management Practices

A focus group discussion (FGD) or group interview was undertaken to solicit local residents' knowledge and information on the ecosystem services and management practices of mangroves. Guide questions were prepared and transcribed the information gathered among community members, barangay officials and representatives of community organizations. A group interview was conducted in a place where all participants feel convenient and an area where "bystanders" were not allowed. Strict health protocol was observed during the focus group discussion where participants are required to wear face masks and face shields and maintain physical distancing. A total of 10 respondents participated in the group interview. The interview was properly documented.

Table 1. Coordinates of the sampling stations in the riverbanks of Barangay Buenlag, Binmaley, Pangasinan.

Station	Corner	North	East
1	1	16° 2'54.75"N	120°17'32.20"E
	2	16° 2'54.41"N	120°17'31.68"E
2	1	16° 2'47.75"N	120°17'25.76"E
	2	16° 2'46.87"N	120°17'24.97"E
3	1	16° 2'44.46"N	120°17'17.42"E
	2	16° 2'43.93"N	120°17'16.61"E
4	1	16° 2'38.78"N	120°17'14.73"E
	2	16° 2'37.97"N	120°17'14.73"E
5	1	16° 2'34.41"N	120°17'05.05"E
	2	16° 2'33.82"N	120°17'04.03"E

RESULTS AND DISCUSSION

Species Composition

There were 7 species of mangroves belonging to 5 families found in the riverbanks of Buenlag, Binmaley, Pangasinan (Table 2). The species identified were; *Rhizophora apiculata, Rhizophora mucronata, Bruguiera cylindrica, Avicennia officinalis, Sonneratia alba, Lumnitzera racemosa* and *Excoecaria agallocha.*

The common genera of mangroves in the Philippines are *Rhizophora, Avicennia, Bruguiera* and *Sonneratia* [13]. Three genera (*Rhizophora, Avicennia* and *Sonneratia*) of the common mangroves were found in the riverbanks of Buenlag, Binmaley, Pangasinan. The findings of this study differed to the early study in Barangay Buenlag-Sabangan riverine system, where 12 species of mangroves were identified namely; *Rhizophora apiculata, Rhizophora mucronata, Bruguiera cylindrica, Avicennia officinalis, Avicennia marina, Excoecaria agallocha, Lumnitzera racemosa, Aegiceras corniculatum, Sonneratia alba, Nipa fruticans, Acrostichum aureum* and *Acanthus elicifolius* [15]. The difference may be attributed to the coverage of the sampling stations where they included the Sabangan river. Nevertheless, all the species identified in the present study were all present in their list.

Density

The mean density of mangroves obtained in the riverbanks of Buenlag, Binmaley, Pangasinan was 0.043 stands per 100 m^2 (Table 3). *Rhizophora apiculata* registered the highest mean density with 0.184 stands per 100 m^2 while *Lumnitzera racemosa* gained the lowest with 0.002 stands per 100 m^2.

The dominance of *R. apiculata* in terms of the mean density is comparable in the mangrove areas of Dinagat Islands, Negros Occidental where the same species obtained the highest population density and frequency [16]. Conversely, *R. apiculata* registered lower density with 715 stands per hectare as compared to *Avicennia marina* mean density of 7855 stands per hectare in Panabo Mangrove Park, Panabo City, Davao del Norte [17]. Both *R. mucronata* and *R. apiculata* dominated the population of mangroves out of the 4 species of mangroves found in Pamintayan, Dumanquillas Bay, Philippines [18]. The dominance of *R. apiculata* in the riverbanks of Buenlag, Binmaley, Pangasinan can be attributed to its habitat where it is usually found in the intermediate estuarine zone. Buenlag river is located in the intermediate zone. The said species can withstand high currents and tides where it can tolerate a salinity up to 65 ppt though its optimal growth at 8-10 ppt [19]. This tree can grow along with its close relative, *R. mucronata* and may grow as a pure stand [20].

Table 2. Species composition of mangroves in the riverbanks of Barangay Buenlag, Binmaley, Pangasinan.

Family	Species	Common Name	Local Name
Rhizophoraceae	*Rhizophora apiculata*	Bakawan-lalaki	Pakar
	Rhizophora mucronata	Bakawan-babae	Pakar
	Bruguiera cylindrica	Pototan-lalaki	Pakar
Avicenniaceae	*Avicennia officinalis*	Api-api	Payar
Sonneratiaceae	*Sonneratia alba*	Pedada	Palpaltak
Combretaceae	*Lumnitzera racemosa*	Kulasi	Kulasi
Euphorbiaceae	*Excoecaria agallocha*	Buta-buta	Makabulag

Table 3. Density of mangroves in the riverbanks of Barangay Buenlag, Binmaley, Pangasinan.

Family	1	2	3	4	5	Total	Mean
Rhizophora apiculata	0.260	0.030	-	0.390	0.240	0.920	0.184
Rhizophora mucronata	-	0.230	0.170	-	0.010	0.410	0.082
Bruguiera cylindrica	0.060	-	-	-	0.040	0.100	0.020
Avicennia officinalis	-	-	0.010	0.010	-	0.020	0.004
Sonneratia alba	-	-	0.020	-	-	0.020	0.004
Lumnitzera racemosa	-	-	-	0.010	-	0.010	0.002
Excocaria agallocha	0.010	-	-	-	0.010	0.020	0.004
Total	0.330	0.260	0.200	0.410	0.300	1.500	0.043

Ecosystem Services

The different ecosystem services provided by the mangroves in terms of provisioning, regulating, supporting and cultural are presented in Table 4.

The people of Barangay Buenlag have utilized the mangroves for several purposes. The direct utilization of mangroves is comparable to other people living near or along the mangrove areas both in the local and global scenarios.

The ecological benefits derived from mangroves are undoubtedly high and of great importance for human, aquatic and terrestrial organisms. The mangroves in the Philippines harbor a total of 295 fish species belonging to 78 families where 197 of these species have commercial value [20]. Surprisingly, more than half of the country's 1,500 towns and 42,000 villages depend on these habitats for food and other goods and services [22].

Mangroves have several uses namely; fuel wood, charcoal, poles, wood for construction, wood products, bark for dyeing, tanning, wine additives, fodder and forage, handicrafts and ornaments and fishing using plants [23]. The major ecological role and services of tropical mangrove ecosystems include carbon export and storage, nursery function, coastal protection and land building [11]. In Niger Delta, Nigeria, 10 ecosystem services derived from mangroves were enumerated; cooking, charcoal manufacture, building, food, medicinal herbs, fishery, forest products, recreation and tourist attraction, spiritual purpose and production of dyes [24]. The following ecosystem services of mangroves were also noted in Vanuatu; subsistence fishery, coastal fishery, recreational coastal fishery, wood extraction, medicinal use, mangrove tourism, coastal protection, bio-remediation, sediment trap, carbon sequestration and biodiversity credits [25]. The economic value of mangroves as these habitats reduce flooding to 613,500 people/year and could avert damages to 1 billion US$/year in residential and industrial property [26]. Without mangroves, flooding and damages to people, property and infrastructure in the country is estimated to increase yearly by about 25% [26].

Management Practices

The management and protection of mangroves employed by the respondents in Barangay Buenlag, Binmaley, Pangasinan are presented in Table 5.

The management measures employed by the stakeholders of Barangay Buenlag is similar to the findings of [27] in the management of Nipa palm in Barangay Balococ and Bantayan, Lingayen, Pangasinan. Key measures upheld were planting Nipa along their riverbanks, regular monitoring and cleaning, avoid dumping of wastes in Nipa palm and control of cutting Nipa fronds.

Table 4. Mangrove Ecosystem Services in Barangay Buenlag, Binmaley, Pangasinan.

Ecosystem Service	Specific Services
Provisioning	The mangroves are used as fishing ground to gather fish, mollusk, crustaceans and other species
	Twigs are used for fuel or firewood
	Trunks are cut and burn for charcoal
	Provides nursery ground for fry or juvenile fishes
	The timber use for house construction
	The seedlings and saplings are sold for other source of income
Regulating	The presence of mangroves along the riverbanks serves as protection for strong winds and typhoons
	Mangroves prevent the erosion of the riverbanks or dikes and control flooding
	The various root systems help in filtering water
	The leafy rhizophorans provide shade
	Mangroves provide fresh air
Supporting	The prop roots of the rhizophorans trap the incoming litters for sediment formation
	The accumulated leaf litters of mangroves help in nutrient cycling
	Mangroves help in sequestering carbon dioxide
Cultural	The mangroves serve as avenue for educational research
	Use for educational purposes like field observation and survey
	Use for recreation like bird watching and picture taking
	Provides aesthetic value for the residents and visitors

Table 5. Management and protection of mangroves in Barangay Buenlag, Binmaley,Pangasinan.

	Management Measures
1.	Planting seedlings/saplings in the riverbank
2.	Prohibiting the cutting of matured mangrove trees
3.	Attending seminars or trainings on the management of mangroves ecosystem.
4.	Encouraging everyone to plant more mangroves and explain the importance of planting mangroves
5.	Prohibiting the dumping of wastes along the riverbanks
6.	Participation in the clean-up operation of the barangay in the mangrove area
7.	Regular monitoring of mangroves
8.	Establishment of zonations in the river

Several tools for effective management and protection of mangroves include the following: local involvement, sustainable silviculture, sustainable aquaculture, protected areas, wider management regimes, restoration and afforestation, managed realignment, improving knowledge based, improving outreach, strengthening capacity and others [28]. Mangrove rehabilitation is one of the management measures and can be achieved through the following steps: 1. Local site coordination, 2. Comprehensive site assessment,

3. Participatory mangrove rehabilitation planning, 4. Participatory project implementation and 5. Participatory monitoring and evaluation [29]. The local participation of the stakeholders in the management of mangroves is deemed necessary to attain its sustainability [30].

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