

# Community knowledge and utilization of mangroves in Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines

JEMER A. ALIMBON<sup>1,✉</sup>, MARK RONALD S. MANSEGUIAO<sup>2,✉✉</sup>

<sup>1</sup>Department of Teacher Education, UM Tagum College. Mabini St., Tagum City 8100, Davao del Norte, Philippines.

Tel.: +63 907-943-6788, ✉email: alimbon.jemer@gmail.com

<sup>2</sup>Institute of Teacher Education, Davao del Norte State College. New Visayas, Panabo City 8105, Davao del Norte, Philippines.

✉✉email: markronald.manseguaio@dncs.edu.ph

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**Abstract.** Alimbon JA, Manseguaio MRS. 2021. Community knowledge and utilization of mangroves in Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines. *Intl J Bonorowo Wetlands* 11: 51-57. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management. However, this aspect remains less explored, especially in the Philippines. Hence, this study assessed the community knowledge and utilization of mangroves in Panabo Mangrove Park, Panabo City, Davao del Norte Philippines, using a survey research design. Through a simple random sampling procedure, 154 residents living near the area were surveyed using a questionnaire. Data were analyzed using frequency and percentages. Results revealed that the majority were knowledgeable of the existence and the services of mangroves except for their medicinal uses. It was also found out that many respondents have more minor to no knowledge of the different species of mangroves. Further, most respondents reported that they used the mangrove ecosystem as a food source on varying frequencies but never utilized it for other purposes such as fuelwood, medicine, dyeing agent, construction materials, fishing poles, household furniture, and other items.

**Keywords:** Community knowledge, utilization, ecosystem services, mangroves, Philippines

## INTRODUCTION

Mangroves are a community of plants comprised of many species (see Tomlinson 1986; Primavera 2009; Spalding et al. 2010; Duke 2011; Leбата-Ramos 2013), which are known to be ecologically tolerant as they can survive in extreme conditions such as hypersalinity and high solar radiation (Adame et al. 2021). Worldwide, this ecosystem, which links the marine and terrestrial ecosystems, is considered one of the most productive (Sreelekshmi et al., 2021). The mangrove ecosystems are recognized for their roles in maintaining marine biodiversity in tropical and subtropical regions and their functions in the global biogeochemical processes and climate change mitigation (Wang and Gu 2021).

Moreover, mangroves are known to affect human well-being (Hsieh et al. 2015; Akanni et al. 2018) through their immense provisioning, regulating, supporting, and cultural ecosystem services (Primavera et al. 2018; Kadaverugu et al. 2021). These benefits include providing food and livelihood to residents (Sawairnathan and Halimoon 2017; Barua and Rahman 2019; Gevaña et al. 2019; Quevedo et al. 2019). For example, the locals sell the fish, fuelwood, and logs in the market in exchange for cash to sustain their needs (Nfotabong-Athuell et al., 2009; Shah and Datta, 2010). The mangrove ecosystem also serves as a source of raw materials for charcoal making and construction (Nfotabong-Athuell et al. 2009; Sinfuego and Buot 2014; Gonzales et al. 2017). Other benefits include medicinal uses such as *Rhizophora* spp. as a treatment for external

hemorrhage and tooth decay (Nfotabong-Athuell et al. 2011) and *Avicennia marina* for sunburn (Arbiastutie et al. 2021).

However, knowledge deficits of the mangrove ecosystem and its services exist (Dencer-Brown et al., 2018). As noted, local populations have limited knowledge of mangrove species and their ecological and economic benefits (Satyanarayana et al., 2012). Darkwa and Smardon (2010) even found out that fishers lack the scientific knowledge necessary to derive the benefits offered by mangroves ultimately. Another concern is that destruction is inevitable because of community dependence on its known consumptive uses like charcoal making (Kusmana and Sukwika 2018; Ritabulan et al. 2019). Anthropogenic threats to mangrove include firewood overharvesting, house construction, timber production, agriculture, and aquaculture activities (Nfotabong-Athuell et al. 2011; Warren-Rhodes et al. 2011; Jones et al. 2015; Gonzales et al. 2017; Marican et al. 2018) and, more recently, ecotourism (Ramli et al. 2018; Mahmood et al. 2021) and urban expansion (Moschetto et al. 2021).

These knowledge inadequacies and unsustainable human interventions primarily pose enormous challenges to mangrove conservation and restoration (Biswas et al., 2009). Though efforts were made, apparent gaps on how stakeholders (e.g., community members) can transform initiatives into actions for sustainable development are still evident (Garcia et al. 2014). Effective management and conservation of mangroves require knowledge of their ecosystem services (Friess et al. 2016). In the Philippines,

very few studies (i.e., Quevedo et al. 2019; Tejada and Caulan 2019; Ballad and Mangabat 2021) explored the local knowledge and perspectives on mangroves and their utilization. In Davao Gulf, which is found in the southeastern part of the Philippines, studies were primarily focused on the assessment of mangrove species diversity (Jumawan et al. 2015; Pototan et al. 2017, 2021; Cardillo and Novero 2018) and recently included aboveground biomass and carbon stock (Alimbon and Manseguiiao 2021). Hence, this study aimed to assess mangroves' community knowledge and utilization in Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines. The results of this study are expected to provide baseline information on the sociodemographic profile, level of knowledge, and extent of utilization of the residents. Having this relevant data would help the authorities make informed decisions on the mangrove management and conservation efforts, especially those that involve the local populations.

## MATERIALS AND METHODS

### Study area

This study was conducted in Barangay J.P. Laurel, Panabo City, Davao del Norte, Philippines (Figure 1) last April 2019. It is located in the southeastern portion of the

city facing Davao Gulf. This coastal village hosts the Panabo Mangrove Park (7°16'20.579" N, 125°40'50.984" E). This mangrove community houses several mangrove species, including *Aegeciras corniculatum*, *Avicennia marina*, *Rhizophora apiculata*, *Rhizophora mucronata*, and *Sonneratia alba* (Alimbon and Manseguiiao 2021). Based on the 2015 Census of Population, Barangay J.P. Laurel had a population of 6,561 individuals (Philippine Statistics Authority, 2015).

### Research design

This is a quantitative type of research employing a survey research design (Creswell 2012) to assess the community knowledge and utilization of mangroves in the area.

### Research respondents

The respondents of this study were the residents inhabiting near or adjacent to the mangrove community. This study only included those living within the 500-m radius from the boundary of the mangrove park. A total of 154 respondents were selected using random sampling. This sample size was determined using Slovin's formula:  $n = N/(1+Ne^2)$ , where  $n$  is the sample size,  $N$  is the population size, and  $e$  is the margin of error set at 0.05.



**Figure 1.** Location of Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines (Google Earth, 2021)

### Research instrument

This study utilized a structured questionnaire designed to determine (1) the demographic profile of respondents, (2) the level of community knowledge, and (3) the extent of community utilization of mangroves. The questionnaire was translated into a local dialect of Panabo City, Philippines, to be easily understood. Indicators for community knowledge and utilization of mangroves were assessed using a 4-point Likert scale. To ensure validity, the instrument underwent content validation by experts. To ensure reliability, it was pilot tested to community members who are not included in the study yet, inhabit near a mangrove area. Inconsistencies noted during reliability checks were corrected before the actual data gathering.

### Data analysis

Data on the demographic profile of residents, levels of community knowledge, and the extent of utilization were tabulated and analyzed using frequency and percentages.

## RESULTS AND DISCUSSION

### Profile of the respondents

Table 1 presents the demographic profile of the respondents. The majority of the respondents are aged 21-30 years old at 24.0%, males at 51.30%, and married at 66.2%. Most of them (55.8%) reached or finished secondary education, while few (2.60%) did not have formal education. In terms of occupation, only 5.8% of the respondents are into fishing which means that most are not into fishery-related or coastal-resource-utilization-related work. These include housewives (27.3%), skilled workers (26.6%), students (22.1%), businessmen (11.7%), private employees (3.3%), government employees (2.6%), and farmer (0.7%). Most of the respondents, at 31.2%, claimed to have resided in the area for five years or less, which means that they recently moved into the area. This influx of residents in the area should be monitored, for Chong (2006) mentioned that increasing coastal population could potentially cause mangrove degradation. In terms of income, 83.8% of the respondents earned PhP 10,000.00 or less ( $\leq$  USD 200), which is lower than PhP 10,756.00 ( $\approx$  USD 215), the average monthly poverty threshold for a family of five (PSA, 2020). This means that the monthly income of many families in the area is not sufficient to meet their minimum basic food and non-food needs.

### Level of community knowledge

This study assessed the community's knowledge of mangroves' existence and ecosystem services in the area (Table 2). The result showed that most of the respondents (81.1%) were very knowledgeable of the existence of mangroves in the area. Surprisingly, a few reported having less to nonknowledge of its presence, at 6.5% and 3.9%, respectively. This could be because they recently moved into the area since most respondents claimed to have lived there for only five years or less.

**Table 1.** Demographic profile of the respondents

Demographic variables		n	%
Sex	Male	79	51.3
	Female	75	48.7
Marital Status	Single	44	28.6
	Married	102	66.2
	Widowed	5	3.3
	Others (e.g., live-in)	2	1.3
	Did not provide information	1	0.7
Age	20 and below	36	23.4
	21 to 30	37	24.0
	31 to 40	30	19.5
	41 to 50	23	14.9
	51 to 60	16	10.4
	61 and above	9	5.8
	Did not provide information	3	2.0
Education	No formal education	4	2.6
	Elementary	38	24.7
	Secondary	86	55.8
	College	18	11.7
	Graduate/Post-graduate	2	1.3
	Did not provide information	6	4.0
Number of years in the area	5 and below	48	31.2
	6 to 10	29	18.8
	11 to 15	27	17.5
	16 to 20	12	7.8
	21 or more	35	22.7
	Did not provide information	3	2.0
Occupation	Fisherman	9	5.8
	Farmer	1	0.7
	Housewife	42	27.3
	Student	34	22.1
	Businessman	18	11.7
	Government employee	4	2.6
	Private employee	5	3.3
	Others (i.e., skilled workers)	41	26.6
Monthly income	PhP 10,000.00 and below	129	83.8
	PhP 10,001.00 - PhP 20,000.00	23	14.9
	PhP 20,001.00 - PhP 30,000.00	2	1.3

Note: US\$ 1.00  $\approx$  PhP 50.00

Despite the very high knowledge about mangrove existence demonstrated by most surveyed residents, results showed that many have more minor to non-knowledge of the different species of mangroves, both at 31.2%. Notably, during the survey, respondents could only provide generic local names of *Avicennia*, *Sonneratia*, and *Rhizophora* species. Only very few respondents could provide local terms specific for *R. apiculata* and *R. mucronata*. This observation is quite similar to the findings of Nfotabong-

Athuell et al. (2011), which revealed that residents near mangrove forests are only familiar with one to four species. Longépée et al. (2021) also found that their respondents have lower local ecological knowledge regarding the number of mangrove species and their names.

Community knowledge on provisioning services of mangroves was also asked. Many respondents reported that they were very knowledgeable on the following services: food source (59.7%), fuel resource (51.9%), and construction and fishing materials (44.8%). Awareness that mangroves provide one or all of these benefits was documented in several studies (e.g., Dencer-Brown et al. 2019; Quevedo et al. 2019; Setiyaningrum 2019; Wahyuni et al. 2021). Most locals recognize these benefits due to their perceived importance and direct value to human livelihood (Nyangoko et al., 2021). Interestingly, many surveyed residents were not knowledgeable of mangroves being a source of firewood and charcoal at 24.7% and construction and fishing materials at 27.9%. Further, the community seems to have limited knowledge of the medicinal use of mangroves since 76.0% of the respondents claimed not to know this benefit. Similar accounts were reported wherein respondents demonstrate a doubtful understanding of the medicinal benefits of mangroves (Sulaiman et al. 2019; Wahyuni et al. 2021). Nyangoko et al. (2021) even found that local inhabitants perceive this benefit as unimportant compared to other provisioning services.

Further, knowledge on supporting and regulating services of mangroves was assessed. Most surveyed respondents were knowledgeable about mangroves being a habitat and a nursery or spawning ground for other organisms, at 70.8% and 71.4%, respectively. In addition, 74.0% of the locals were very knowledgeable about the mangrove community as protection from coastal erosion and intense winds and waves during storms. In comparison, 38.3% were very knowledgeable on the role of mangroves in oxygen release and carbon sequestration. Residents' significant knowledge of the above benefits could be

attributed to their educational attainment. Education is regarded as an essential factor that elevates ability and determines the understanding of residents about the mangrove ecosystem (Abd Rahman and Asmawi 2016; Sawairnathan and Halimoon 2017). As reflected in Table 1, 68.83% of the respondents reached secondary (high school) education. Secondary education allows residents to have minimum knowledge of the mangroves (Abd Rahman and Asmawi 2016). This record of local populations' sufficient knowledge affirmed the findings of several studies (Nfotabong-Athuell et al. 2011; Warren-Rhodes et al. 2011; Ferichani and Prasetya 2012; Da Silva 2015; Sawairnathan and Halimoon 2017; Tejada and Cauilan 2019), which mentioned that residents are aware of the goods and ecological services they benefit from the mangrove ecosystem.

### The extent of community utilization

The extent of community utilization of mangroves was also assessed (Table 4). Many respondents (71.4%) reported that mangroves serve as their food source on varying frequencies from rare occasions to all the time. The food items usually collected from the area were fish and shellfish. However, 28.6% of the surveyed locals never accessed the site to obtain food.

Though several studies (e.g., Dahdouh-Guebas et al. 2000; Nfotabong-Athuell et al. 2011; Da Silva 2015; Gonzales et al. 2017; Numbere 2019) already documented that local inhabitants used mangroves as firewood, charcoal, fodder, construction materials, fishing apparatus such as poles, medicine, dyeing agent, household furniture, and other items, very few respondents claimed to have benefited these uses of mangroves in the study site. Even as a source of income, only 16.2% reported to benefit from it. These income-generating mangrove-related activities included selling caught fish and shellfish and participating in activities initiated by the local government unit.

**Table 2.** Level of community knowledge of mangroves in Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines

Community knowledge	Very knowledgeable		Moderately knowledgeable		Less knowledgeable		No knowledge at all	
	n	%	n	%	n	%	n	%
Mangroves exist near my area	125	81.1	13	8.4	10	6.5	6	3.9
Mangroves have different species	32	20.8	26	16.9	48	31.2	48	31.2
Mangroves serve as habitat for other organisms	109	70.8	12	7.8	15	9.7	18	11.7
Mangroves serve as a nursery ground for fish, mollusks, crabs, and shrimp	110	71.4	17	11.0	14	9.1	13	8.4
Mangroves offer protection from coastal erosion and intense wind and waves during storms	114	74.0	12	7.8	13	8.4	15	9.7
Mangroves serve as a food source	92	59.7	18	11.7	23	14.9	21	13.6
Mangroves provide fuel resources (e.g., firewood, charcoal)	80	51.9	18	11.7	18	11.7	38	24.7
Mangroves provide construction and fishing materials (e.g., timber, fishing stakes, and fishing boats)	69	44.8	25	16.2	17	11.0	43	27.9
Mangroves have medicinal use	16	10.4	8	5.2	13	8.4	117	76.0
Mangroves release oxygen and absorb carbon dioxide	59	38.3	26	16.9	26	16.9	43	27.9

**Table 3.** The extent of community utilization of mangroves in Panabo Mangrove Park, Panabo City, Davao del Norte, Philippines

Community utilization	Always		Sometimes		Rarely		Never	
	n	%	n	%	n	%	n	%
I use mangroves as a food source	26	16.9	29	18.8	55	35.7	44	28.6
I use mangroves as construction materials for houses	4	2.6	6	3.9	7	4.5	137	89.0
I use mangroves as fishing materials (e.g., poles for fish traps, rafts, boats)	6	3.9	5	3.2	10	6.5	133	86.4
I use mangroves as medicine	3	1.9	4	2.6	12	7.8	135	87.7
I use mangroves as firewood	7	4.5	6	3.9	7	4.5	134	87.0
I use mangroves as charcoal	5	3.2	2	1.3	5	3.2	142	92.2
I use mangroves as house furniture (e.g., chairs, tables) and household items (e.g., baskets, mortar, tool handles)	7	4.5	6	3.9	9	5.8	132	85.7
I use mangroves in agriculture (e.g., fence, fencing posts, fodder [feeds])	8	5.2	4	2.6	10	6.5	132	85.7
I use mangroves as a dyeing agent	4	2.6	1	0.6	5	3.2	144	93.5
I use mangroves as a source of income	4	2.6	5	3.2	16	10.4	129	83.8

This non-extensive utilization of mangroves can be attributed to the fact that most residents' occupations are not fisheries and other mangrove-related activities. Only nine (5.84%) respondents claimed to be fishermen. Further, this could be due to the considerable knowledge of residents about laws and policies regarding conservation, protection, utilization, and development of mangroves (Sulistiyowati and Astuti 2018). In the Philippines, cutting off all mangrove species is banned (Revised Forestry Code of the Philippines). Also, conversion of mangroves to fishpond or any purpose is declared unlawful under Republic Act No. 10654. As observed in the study site, a poster was hung reminding the public not to cut trees or build a structure within the mangrove forest.

Moreover, the result of this study was on the contrary of the findings of studies in a few countries in Africa where a large percentage of households living near mangrove forests still depend on these resources for subsistence and other economic needs (Nfotabong-Athuell et al. 2009; Da Silva 2015; Warui et al. 2020). In addition, Gonzales et al. (2017) found out that in Rio Tuba, Palawan, Philippines, the community still harvests mangrove trees for house construction and charcoal production. However, it was noted by Satyanarayana et al. (2012) that the trend of utilizing mangrove resources has now decreased.

In conclusion, the community is knowledgeable of the existence of mangroves in the area, but a significant number of the surveyed respondents did not know that mangroves have different species. Also, the majority are knowledgeable of the mangrove ecosystem services except for medicinal uses. In terms of utilization, it can be considered as not extensive except being a food source since many respondents reported that they obtain food (e.g., fish, shellfish) from the area at varying frequencies. This non-utilization of mangroves, incredibly destructive uses (e.g., fuelwood, charcoal) by most residents, could be due to their line of occupation and their awareness of existing laws that prohibit such acts.

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