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RESEARCH ARTICLE

Awareness of Ecosystem Services and Management of Mangroves in Maliwaliw Island, Salcedo, Eastern Samar, Philippines

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Abstract

Objectives: To determine the awareness of mangrove ecosystem services, uses of mangroves, awareness of mangrove management strategies, and challenges of households in Maliwaliw Island, Salcedo, Eastern Samar, Philippines. **Methods:** A survey was conducted using an interview schedule to determine the households' awareness of the mangrove ecosystem services and mangrove management strategies in Maliwaliw Island, Salcedo, Eastern Samar. Moreover, a mangrove management problem confrontation index (MMPCI) was also created to describe the mangrove management challenges in Maliwaliw Island. About 99 households completed and participated in the survey. Results were analyzed using appropriate descriptive statistical tools, and Spearman's rank correlation coefficient was used to determine the relationship between the selected socio-demographic characteristics of households and their awareness of the mangrove ecosystem services. **Findings:** Results showed that the households were very aware of the ecosystem services they directly experience on the island, e.g., coastal protection from typhoons (3.09), coastal protection from wave action and storm surge (3.07), and coastal protection from strong winds (3.03). Education, income, and years of stay have a weak correlation with several mangrove ecosystem services, implying that enhancing education and income over time may help improve the community's awareness of the importance of mangroves in sustaining their livelihood, well-being, and survival. The awareness of the mangrove ecosystem services is critical in enhancing the community's appreciation of their role in sustaining their livelihood and survival and engagement in conservation efforts. Moreover, the households identified typhoons and storm surges as the first two challenges in mangrove management, with a PC index of 249 and 255, respectively, for the island is prone to typhoons. Implementing mangrove management strategies is critical to ensure the sustainability of mangrove ecosystem services and the existence and survival of island communities. **Novelty:** The paper contributes to the limited studies on the island community's awareness of the mangrove

ecosystem services, especially in the Philippine context. Moreover, the study developed an MMPCI to highlight the top concerns in mangrove management that need to be addressed in an island community prone to typhoons and storm surges.

Keywords: Awareness; Ecosystem Services; Island; Mangrove; Mangrove Management

1 Introduction

Mangroves provide ecosystem services vital to food security, economy, survival, and resilience, especially to island communities prone to typhoons and storm surges. However, despite their well-recognized benefits, worldwide mangrove losses are significant [1]. The management of mangrove ecosystems also encounters pressures and challenges [1,2] to maintain them in sustainable conditions, requiring community involvement, which is influenced, among others, by management strategies and awareness of environmental information (e.g., mangrove ecosystem services) and programs [1]. Yet, there is an insufficiency of mangrove and conservation-related knowledge and awareness [3,4], that is, context-specific [5], and this aspect remains less explored, especially in the Philippines [3]. A context-specific understanding of the importance, benefits, and values of mangrove ecosystem services, their management, and challenges is crucial, especially for areas devastated by super typhoons, e.g., Typhoon Yolanda (aka Haiyan), to increase the community's appreciation of their importance in building disaster resilience and strengthen stakeholder's engagement in programs necessary for mangrove ecosystems sustainable management. Thus, the study determined the awareness of mangrove ecosystem services, management strategies, and challenges in Maliwaliw Island, Salcedo, Eastern Samar, Philippines.

2 Methodology

2.1 Study Site

The study was conducted in Maliwaliw Island, Salcedo, Eastern Samar, Philippines (Figure 1). Maliwaliw is an island barangay bordered by marine waters with no elevated area, which makes the entire village highly exposed to typhoons and their consequential effects, e.g., storm surges [6]. Brgy Maliwaliw is in the southwest part of the municipality of Salcedo. It is bounded north by Barangays Caga-ut and Cantamoja, east and south by Leyte Gulf, and west by Brgy. Sto. Niño of the municipality of Quinapondan, Eastern Samar. The barangay is about 17 km from the center of the municipality of Salcedo, Eastern Samar, and can be reached through a 30-minute motorized boat ride from the mainland in Brgy. Palanas, Salcedo, Eastern Samar [7]. Maliwaliw Island has natural and planted mangrove stands of approximately 0.23 km and 0.08 km from the shoreline, respectively [8]. The mangroves on the island include Sonneratia alba, Bruguiera gymnorrhiza [8], Rhizophora apiculata, and Rhizophora stylosa [9].

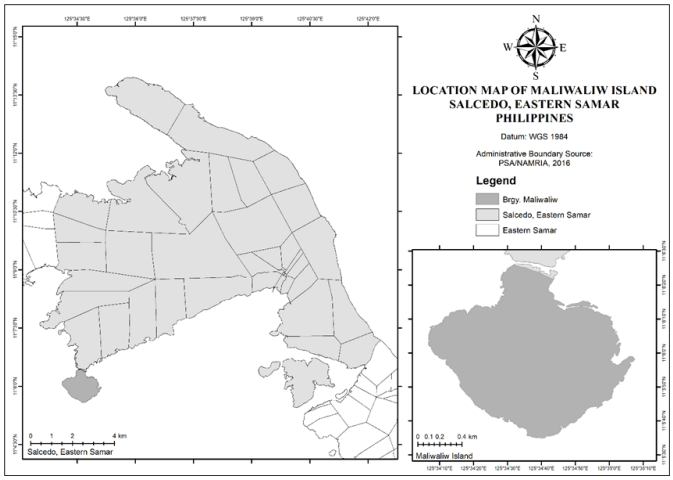

Fig 1. Location Map of Maliwaliw Island, Salcedo, Eastern Samar

2.2 Respondents of the Study

The respondents were the households in Maliwaliw Island, Salcedo, Eastern Samar. The household heads were surveyed in Maliwaliw Island, and any household member at least 18 years old was asked in their absence. There are about 106 households on Maliwaliw Island[10], and about 99 households completed and participated in the survey. The other households were either not available or failed to complete the survey.

2.3 Data collection and analysis

A survey was conducted using an interview schedule guide based on the literature. The interview schedule guide was piloted to test its clarity and relevance, and 30 households in one barangay near a mangrove area were asked to participate before using it in the actual survey. The respondents were asked about the households' socio-demographic characteristics, such as occupation, income, length of stay on the island, and educational attainment. The households' awareness of the mangrove ecosystem services and mangrove management strategies in Maliwaliw Island, Salcedo, Eastern Samar, were asked. The respondents rate their awareness based on a 0–4 Likert scale wherein 0 means "not at all aware," 1 means "slightly aware," 2 means "moderately aware," 3 means "very aware," and 4 means "extremely aware." The household uses of mangroves were also asked.

Moreover, a mangrove management problem confrontation index was also created to describe the mangrove management challenges in Maliwaliw Island. Problem confrontation refers to the assessment of the challenges, problems, constraints, or barriers[11] to mangrove management in Maliwaliw Island. The respondents were asked to rate their perceived management challenges on a 0–3 Likert scale. A score of 0 means "not a problem," while 3 means "highly problematic." The problem confrontation formula (Eq. 1) of Uddin, Bokelmann, and Entsminger[12] was adapted for the computation of the Mangrove Management Problem Confrontation Index (MMPCI).

$$MMPCI = (MMPCh\,x\,3) + (MMPCm\,x\,2) + (MMPCl\,x\,1) + (MMPCn\,x\,0) \quad (1)$$

MMPCh, MMPCm, MMPCl, and MMPCn refer to the number of respondents that confronted the problem as high, moderate, low, and not at all, respectively. The score ranges from 0 to 297, wherein 0 signifies very low mangrove management problem confrontation, and 297 indicates high mangrove management problem confrontation.

Results from the survey were analyzed using appropriate descriptive statistical tools, e.g., frequency analysis, percentages, and mean to describe the socio-demographic characteristics of the households, awareness of ecosystem services, and mangrove management strategies. Spearman's rank correlation coefficient was used to determine the relationship between the selected socio-demographic characteristics of households and their awareness of the mangrove ecosystem services.

3 Results and Discussion

3.1 Awareness of ecosystem services and household uses of mangroves

The households (Table 1) in Maliwaliw Island were surveyed to meet the objectives of the study. The majority (85%) of the households on the island earn an income of 5000 or less, while about 4% percent have an income of more than 10,000.00. Moreover, fishing (78%) is the primary source of income for most households on the island, while about 6% are employed in the government and other offices. Nearly half (48%) of the respondents have secondary education, while about 26% have a college education. About 82% of the households own their houses, and most households have access to communication, e.g., own a TV set (65%) and cell phone (89%). However, only 19% own a radio. In addition, the households on the island use firewood (83%), Liquefied petroleum (LP) gas (15%), and charcoal (1%) as fuel for cooking. The majority (83%) of the households have been on the island for over 10 years, and the majority have members of less than or equal to 5.

Table 1. Socio-demographic profile of the respondents surveyed inMaliwaliw Island (N=99)

Variables		Percentage
Income	0 – 5,000	84.85
	> 5,000 – 10,000	11.11
	> 10,000 – above	4.04
Primary source of income	Fishing	77.78
	Selling, e.g., sari-sari store owner/vendor	8.08
	Farming	3.03
	Employed	6.06
	Others, e.g., receive remittance, financial aid	5.05
House Ownership	Owner	82.83
	Rented	7.07
	Living with relatives/friends	10.10
Cellphone	With Cellphone	88.89
	No cell phone	11.11
Radio	With radio	19.19
	No radio	80.81
Television	With TV sets	64.65
	No TV sets	35.35
Fuel for cooking	LP gas	15.15*
	Firewood	82.83*
	Charcoal	1.01*
Household Size	≤ 5	85.86
	> 5	14.14
Education	Elementary	25.25
	High school	48.48
	College	26.26
Length of Stay	0 – 10 years	17.17
	> 10 years	82.83

*Multiple-choice question. Totals are not reported

Table 2 shows the awareness of the households in Maliwaliw Island about the mangrove ecosystem services. Table 3, on the other hand, shows the household uses of mangroves on the island. The households on the island were moderately aware of the climate regulation (2.15), flood (2.36), and erosion (2.40) control functions of the mangroves and very much aware of the coastal protection functions of the mangrove ecosystem, e.g., coastal protection from typhoons (3.09), coastal protection from wave action and storm surge (3.07), and coastal protection from strong winds (3.03). Mangrove forests are the first biological shield against typhoons and storm surges, for they can slow down storm surges [13]. However, the households were slightly aware of the other regulating services of mangroves, e.g., pollution control and detoxification (1.69), biological regulation (1.67), and carbon sequestration (1.39). The results show that households are more aware of ecosystem services they directly experience.

The study suggests conducting information and education campaigns about the different ecosystem services of mangroves to increase their understanding and appreciation of the various goods and benefits that can be derived from mangroves that are essential in their survival and existence.

Table 2. Households' Awareness of Ecosystem Services and their relationship with selected socio-demographic characteristics, N=99

Ecosystem Services	Mean ± Standard deviation	Education	Income	Years of Stay
Regulating Services				
Coastal protection from typhoons	3.09±1.18			
Coastal protection from storm surge	3.08±1.13			
Coastal protection from strong wave	3.05±1.97			
Coastal protection from strong winds	3.03±1.17			
Erosion control (retention of soil)	2.40±1.44			
Flood control	2.36±1.48			
Climate regulation (e.g., regulation of the increase of greenhouse gases that causes climate change, temperature, and precipitation)	2.11±1.37		.169*	
Pollution control and detoxification (e.g., removal of excess nutrients and pollutants	2.10±1.32		.325***	
Biological regulation (e.g., resistance to species invasions)	1.67±1.30		.176*	
Carbon sequestration	1.39±1.38	.190*	.253**	
Provisioning Services				
Mollusc	3.06±1.13			
Crabs	3.05±1.16			
Shrimps	2.98±1.18			
Fish	2.85±1.22	-.197*		
Firewood	2.21±1.45			.299***
Fence	1.87±1.37			.193*
Charcoal	1.83±1.40			.186*
Honey	1.66±1.51			
Furniture	1.55±1.42			
Food (e.g., fruit)	1.31±1.48		.226**	
Wood for house construction	1.27±1.44			
Wood for the fishing trap	0.87±1.26	.203*	.251**	
Feeds	0.85±1.22			
Wood for boat construction	0.61±1.11		.231**	
Medicine	0.60±1.07		.286***	
Pole for Fishing gear	0.57±0.97		.227**	
Supporting services				
Biodiversity (habitats for residents or transient species)	3.30±0.97	-.180*		.203**
Soil formation (sediment retention and accumulation of organic matter)	2.64±1.34			
Nutrient cycling (storage, recycling, processing, and acquisition of nutrients)	2.12±1.41			
Cultural Services				
Tourism (opportunities for tourism activities)	2.46±1.34	.222**	.240**	
Research	2.20±1.39	.169*		
Aesthetic (appreciation of natural features)	2.14±1.42		.200**	
Recreation (opportunities for recreational activities)	2.08±1.33		.252**	
Inspiration for culture, arts, and design	2.04±1.36		.200**	-0.221*
Education (opportunities for formal and informal education and training	1.91±1.32	.184*	.294***	
Spiritual experience	1.16±1.31			

***p=<.01 **p=<.0.05 *p=<.10

The mangrove ecosystems on the island provide various provisioning services that increase the economic and food security of the islanders. The households on the island catch fish (36%), shrimps (25%), crabs (29%), and mollusks (49%) in the mangrove areas of Maliwaliw Island, ranging from daily to occasionally. The households either use this food for personal consumption

or to earn a living. One of the respondents stated that when the weather is unfavorable, and they can't go to the sea to catch fish, they collect mollusks or shrimps and crabs in the mangrove areas of the island. The households were moderately aware of mangrove use as firewood (2.21) and charcoal (1.83). The households on the island use the dead mangroves as wood fuel., e.g., firewood (45%) and charcoal (1%). The households collect wood fuel very seldom to twice a week. However, the households were slightly aware of the other uses of wood, e.g., for house construction (1.27), fishing traps (0.87), boat construction (1.61), and poles for fishing gear (0.57). The result could be attributed to their awareness that mangrove harvesting is not allowed on the island. The results also explain why only a few households use mangrove wood for house construction (1%), boat construction (1%), poles for fishing gear (1%), wood for fishing traps (2%), fences (1%), and furniture (2%) (Table 3). Quevedo, Uchiyama, and Kohsaka [14] also found the same results, wherein most coastal villagers from Eastern Samar never utilized mangroves as raw materials for house repair and other constructions. The results imply that awareness of environmental policies, monitoring, and strengthened implementation could result in zero or minimal illegal activities in the mangrove areas.

Table 3. Household uses of mangroves in Maliwaliw Island, N=99

Uses		Frequency	Percentage
Food			
	Mollusk	49	49.49
	Fish	36	36.36
	Crabs	29	29.29
	Shrimp	25	25.25
	Honey	4	4.04
Fuelwood			
	Firewood	45	45.45
	Charcoal	1	1.01
Other uses			
	Feeds	3	3.03
	Wood for the fishing trap	2	2.02
	Ornamental	2	2.02
	Furniture	2	2.02
	Fence	1	1.01
	Pole for Fishing gear	1	1.01
	Wood for house construction	1	1.01
	Wood for boat construction	1	1.01

Mangroves also provide supporting services, e.g., nutrient and organic matter processing and sediment control. Mangrove forests act as the natural habitat and serve as laying, nursery, and feeding grounds for various wildlife species, e.g., fish, shrimps, and crabs, and support fishery production in coastal waters [15]. The households on the island were very much aware that the mangroves serve as a habitat for residents or transient species (3.31) and moderately aware that they support soil formation (2.64) and the nutrient cycling process (2.12). The households in Maliwaliw island were also slightly aware to moderately aware of the various cultural services of mangroves on the island, e.g., spiritual experience (1.16), education (1.91), aesthetic (2.12), inspiration for culture, arts, and design (2.04), recreation (2.08), research (2.20), and tourism (2.46) (Table 2).

The selected socio-demographic characteristics of households (education, income, and years of stay) have a weak correlation with several mangrove ecosystem services on the island (Table 3). For example, education and income have a weak correlation with the regulating services of mangroves (carbon sequestration) and cultural services (tourism, research, and education). Income has a weak correlation with the regulating services of mangroves (climate regulation, pollution control, detoxification, and carbon sequestration). Years of stay have a weak correlation with the provisioning services of mangroves (firewood, fence, and charcoal). Quevedo et al. [14] also found that the level of education and awareness of some ecosystem services, e.g., carbon sequestration and tourism, are correlated. The results imply that enhancing the education and income of the community over time may help improve the community's awareness of the importance of mangroves in sustaining their livelihood, well-being, and survival.

The awareness of the mangrove ecosystem services can enhance the community's appreciation of what the mangrove ecosystem can offer and its role in sustaining peoples' existence, livelihoods, and well-being [16]. Educating coastal communities about environmental policies can encourage compliance and support for conserving and protecting the mangrove ecosystem

to enhance its condition. Awareness of and utilization patterns of mangroves and their services is integral to conservation and management [3]. Moreover, the study suggests the conduct of mangrove species composition and distribution. Knowledge of the mangrove species on the island is critical in increasing the ecosystem services the community enjoys and enhancing mangrove management strategies. The mangrove ecosystem in Maliwaliw Island provides other goods and services not mentioned in the study that the island community can use and enjoy.

3.2 Mangrove Management Strategies and Challenges on Maliwaliw Island

Effective management strategies are critical to protect mangrove forests from degradation and ensure the sustainability of ecosystem services [17] to support the coastal communities that depend on them for food security, livelihood, existence, and survival. Table 4 shows the households' awareness of the different mangrove management strategies implemented on Maliwaliw Island. Table 5 , on the other hand, shows the problem confrontation (PC) index scores of the items related to mangrove management that ranged from 152 to 255, against a possible range of 0 to 297.

Table 4. Awareness of mangrove management strategies of households in Maliwaliw Island, Salcedo, Eastern Samar

Mangrove Management Strategies	Mean ± Standard deviation
Regulating the conversion of mangroves to the human settlement area	3.05±1.17
Rehabilitation of the mangrove area (e.g., planting of mangroves)	3.04±1.33
Regulating the conversion of mangroves to aquaculture	2.98±1.20
Mangrove cleaning activities	2.74±.1.21
Regulating the disposal of waste in the mangrove area	2.62±1.38
Regulating the harvest of mangroves	2.59±1.32
Development of the mangrove area into an ecotourism site	2.54±1.42
Establishment of community-based management of mangrove area	2.53±1.36
Conducting training and IEC about mangrove management	2.38±1.38
Resettlement of dwellers in mangrove areas to an inland area	2.10±1.36
Construction of temporary breakwaters to protect newly planted mangrove seedlings	1.63±1.44

The households in Maliwaliw Island were aware that converting mangroves for human settlement (3.05) and aquaculture (2.94), and harvesting of mangroves (2.59) were regulated. Nyangoko et al. [18] pointed out that management measures have to consider the socio-ecological characteristics of coastal communities rather than being based on strict management regulations, such as the complete ban on mangrove harvesting. The study suggests strengthened implementation of environmental laws and other local policies in the island barangay, including strengthened monitoring and evaluation in the mangrove areas to ensure their ecosystem services' sustainability because of the island's vulnerability to typhoons and storm surges.

Most households in Maliwaliw Island considered typhoons and storm surge the top two barriers to mangrove management, with a PC index of 249 and 255, respectively (Table 5). Mangroves play a significant role in coastal defence and disaster risk reduction, for they can reduce storm surge water levels by slowing water flow and reducing surface waves [19]. Yet, extreme events with very high-water levels and wind speeds, e.g., Super Typhoon Yolanda, may severely damage or destroy mangrove areas [9,19], rendering them less effective at reducing surge heights [19]. The natural recovery of damaged mangrove areas can take several years to decades. Mangrove restoration rehabilitation projects may hasten recovery [19]. Super Typhoon Yolanda on November 13, 2013, caused severe damage to the mangrove forests of Eastern Samar, including the mangroves in Maliwaliw Island [9]. About 98% of households were aware of the mangrove rehabilitation implemented on the island after Super Typhoon Yolanda, making rehabilitation one of the minor concerns at present.

The mangrove forest is critical for the survival and existence of islanders, for they rely on mangroves for food security and livelihood (e.g., fish, mangrove fruit, shells, and crabs) and wood (e.g., firewood). Thus, the households perceived overharvesting as a challenge in island mangrove management (Table 5). Sustainable community-based mangrove management is critical to ensure that the coastal community continues to enjoy the mangrove ecosystem services that contribute to their livelihoods and food security [20]. The households on the island were moderately aware (2.53) of the community-based management of the mangrove area on the island. The community-based mangrove management efforts on the island include mangrove tree planting and clean-up activities. However, the lack of participation of all community members in mangrove management concerns households, with a PC index score of 157. The study suggests strengthening the organizations on the island (e.g., Maliwaliw Multipurpose Organization), encouraging all community members to take an active part, and engaging them sustainably in other conservation efforts to ensure the conservation of the mangrove ecosystem.

Disposal of garbage in the mangrove areas and water pollution are barriers to effective mangrove management in Maliwaliw island, with a PC index of 173 (Table 5). Clean-up activities (3.74) and regulation on the disposal of waste in the mangrove area (2.62) are employed as mangrove management strategies on the island (Table 4). One of the islanders appealed that communities on the mainland and neighboring barangays should avoid throwing garbage in the sea, for they are being drifted to the mangrove areas. Solid waste remains a perennial problem in the Philippines, especially in island communities, due to a lack of information and education campaigns on proper waste disposal[21]. An improved island solid waste management system is urgent to ensure that the mangrove areas on the island will be protected from pollution and degradation.

Furthermore, the households are concerned about poor information and education campaigns about mangroves and their ecosystem services (PC score – 157) on the island (Table 5). Despite the respondents being moderately aware (2.38) of training and information and education campaigns (IEC) related to mangrove management on the island, only 26% of the respondents participated in these IECs. Environmental education is critical to effective mangrove management and in addressing the mangrove management challenges. The conduct of extension services of government agencies, e.g., higher education institutions, can help increase the awareness of the islanders on mangroves, ecosystem services, and sustainable management. The community is encouraged to attend barangay assemblies where information, e.g., barangay ordinances and programs, are publicly announced.

However, the absence of sufficient funds may hamper mangrove management activities[22]. The households considered insufficient funds a barrier to mangrove management in Maliwaliw Island, with an index score of 181 (Table 5). The mangrove forest in Salcedo, Eastern Samar, is one of the untapped resources for ecotourism[6]. The households in Maliwaliw island were moderately aware (2.54) of ecotourism development in the mangrove areas (Table 4). Mud crab ranching and bee culture on the island were considered eco-development tourism potential[7]. Ecotourism can contribute to conservation, environmental awareness and education, resource protection, and the engagement and empowerment of local people when thoroughly planned, and the economic, environmental, and cultural aspects of ecotourism are carefully considered[23]. The study suggests thorough planning of the stakeholders in developing the mangrove areas to ensure their sustainability and the existence and survival of coastal communities.

Overall, the Management Problem Confrontation (MMPC) Index developed by the study proved helpful in highlighting the topmost challenges in mangrove management that are specific to Maliwaliw Island and based on the islanders' perspective. Establishing MMPC Index can help conservation actors adequately plan programs and prioritize specific problems in mangrove management to achieve sustainability. According to Buncag[20], mangrove management systems that are contextual and suitable to the location are likely to be sustainable.

Table 5. Challenges forMangrove Management in Maliwaliw Island, Salcedo, Eastern Samar

Challenges to mangrove management	N	L	M	H	PC Score	Rank
Storm Surgesq	6	4	16	73	255	1
Typhoons	8	3	18	70	249	2
Lack of sufficient funds for mangrove management	18	20	22	39	181	3
Disposal of waste in mangrove areas	23	16	23	37	173	4
Water pollution in mangrove areas	26	15	27	31	162	5
Overharvesting of mangroves (e.g., firewood, fence, charcoal, construction materials, etc.)	29	19	14	37	158	6
Poor information and education campaigns about mangroves and their ecosystem services	15	28	39	17	157	7
Lack of community participation in mangrove management	18	27	32	22	157	7
Poor monitoring of the mangrove area	17	29	33	20	155	8
Lack of training in mangrove management	16	34	28	21	153	9
Poor implementation of ordinances and other environmental laws	21	23	36	19	152	10

4 Conclusion

Island communities rely on their natural resources for food, livelihood, existence, and survival, especially during calamities. Yet, understanding mangrove ecosystem services has received little consideration, especially in the Philippine context, which is critical in enhancing the islanders' appreciation of their importance and engaging in mangrove conservation and protection. The awareness of the mangrove ecosystem services is essential in improving the community's appreciation of their role in sustaining their livelihood and survival and participating in mangrove conservation efforts. A site-specific understanding of the importance, benefits, and values of mangrove ecosystem services, their management, and challenges is crucial in building disaster resilience and strengthening stakeholder engagement in programs necessary for mangrove ecosystems' sustainable management. For example, the households in Maliwaliw Island were very aware of the ecosystem services they directly experienced, e.g., coastal protection from typhoons (3.09), coastal protection from wave action and storm surge (3.07), and coastal protection from strong winds (3.03). Conservation efforts can be rooted in their awareness of the different ecosystem services that can encourage their engagement in mangrove conservation and preservation.

Moreover, the study determined the mangrove management strategies and developed the Mangrove Management Problem Confrontation (MMPC) Index to determine what aspect of mangrove management requires focus to enhance mangrove management conservation efforts. For example, while coastal clean-up is being conducted as a management strategy, garbage disposal in the mangrove areas remains a problem. Implementing effective mangrove management strategies is critical to ensure the sustainability of mangrove ecosystem services and coastal communities. Moreover, the Management Problem Confrontation (MMPC) Index highlights the topmost challenges in mangrove management. This method can help conservation actors adequately plan programs to address the identified problems in mangrove management. Typhoons and storm surges were identified as the first two challenges in mangrove management in Maliwaliw Island, with a PC index of 249 and 255, respectively. Coastal communities, e.g., Maliwaliw Island, prone to typhoons and other calamities, require sustainable mangrove forest resources to sustain their existence and survival. Thus, the results emphasized not only the issues in mangrove management but also the importance of mangroves in the disaster risk reduction of an island community and in building island resilience.

Moreover, the study suggests the conduct of mangrove species composition and distribution to explore further the ecosystem services the island communities can benefit from and determine the appropriate mangrove conservation strategies. The study also highly recommends the conduct of environmental extension to increase the awareness of the coastal community of the mangrove ecosystem services and mangrove management. The policymakers and other stakeholders can use the study's results in their programs and development plans to manage the mangrove ecosystem sustainably.

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