

Community-Based Mangrove Forest Management Sustainability Analysis in Tagpait, Aborlan and Bacungan, Puerto Princesa City, Palawan, Philippines

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Received June 1, 2021; Revised April 7, 2022; Accepted April 21, 2022

Cite This Paper in the following Citation Styles

(a): [1] Mark Joseph J. Buncag , "Community-Based Mangrove Forest Management Sustainability Analysis in Tagpait, Aborlan and Bacungan, Puerto Princesa City, Palawan, Philippines," *Environment and Ecology Research*, Vol. 10, No. 3, pp. 325 - 333, 2022. DOI: 10.13189/eer.2022.100301.

(b): Mark Joseph J. Buncag (2022). *Community-Based Mangrove Forest Management Sustainability Analysis in Tagpait, Aborlan and Bacungan, Puerto Princesa City, Palawan, Philippines*. *Environment and Ecology Research*, 10(3), 325 - 333. DOI: 10.13189/eer.2022.100301.

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Abstract Community-based mangrove forest management is the national strategy of the Philippines for mangrove protection. However, aquaculture, resource extraction, and tourism activities of the community may cause degradation and no assurance of sustainability. A number of generalizations may be drawn as to the purposes of this study. This study is useful in developing the contextualized evaluation tool and evaluating the mangrove management system of the communities. This study evaluated the sustainability of mangrove forest management systems by the local community in Tagpait, Aborlan, and Bacungan, Puerto Princesa City, using applicable criteria and indicators (C & I) of sustainable mangrove forest management that were identified through FGDs. This study also identified seven applicable criteria and 35 indicators. The formulation of the verifiers through the rating scale for each applicable indicator was conducted through FGDs and KIIs. The formulated verifiers were used to evaluate the sustainability of mangrove management systems in both communities using HHI, FGDs, KIIs, and secondary data analysis. The results show that Tagpait has a grand mean of 2.31, while Bacungan has a grand mean of 2.47, in which Bacungan has a higher rating of sustainability of mangrove forest management system. Both communities fall under the fair status of sustainability. Also, the Overall Sustainability Index value of Bacungan is 0.35 (moderately sustainable) while Tagpait has 0.33 (moderately sustainable). Hence,

Bacungan has better management, but by looking at the Sustainability Index for Individual Criteria, each community has its strengths and weaknesses in sustainable management. Lastly, this study may be utilized by concerned agencies to evaluate the sustainability of the mangrove management system of each community.

Keywords Applicable Criteria and Indicators, Mangrove Forest Management System, Sustainability Index

1. Introduction

Mangrove ecosystem comprises valuable tropical forests that provide ecosystem services such as stabilization of coastlines, protection of communities against disasters, provision of habitat for various animals, and storage of carbon [1]. Also, it provides ecosystem services that are useful in the daily subsistence and livelihood of humans, which include the provision of firewood and lumber, food, tourism, and medicine. Additionally, it administers indirect benefits such as the regulation of strong wind and waves, protection against hazards [2], filtration of water from sediments to maintain water quality [3], and provision of habitat to various migratory birds and marine organisms to increase production of marine products beneficial to the

livelihood of the communities [2].

Community-based mangrove forest management is the national strategy of the Philippines. It requires the active involvement and commitment of communities in the management and protection of mangroves beneficial for the present and future generations. Forest Management by the local communities is an essential instrument to attain sustainability in the management of natural resources like mangrove forests [4-5]. Unfortunately, there is no guarantee that every management system of mangroves is sustainable for some specific reasons: over-utilization of resources, mass tourism and conversion to aquaculture [6-7]. Thus, evaluating the sustainability of community-based mangrove forest management is a practical approach for proper management [5].

Two important Mangrove Forest Management Systems in Palawan are in focus for this study. The Tagpait Coastal Management Association (TACMA) is primarily managed by each household that belongs to the *Tagbanua* tribe, one of the Indigenous Cultural Communities (ICC) in Palawan province. The Department of Environment and Natural Resources Forest Management Bureau (DENR-FMB) granted the stewardship in 1991 to 78 households who initiated afforestation of 78 hectares of mangrove through the financial and technical support of Industrial, Spiritual and Cultural Advancement International (OISCA), a Japan-based organization [8]. Regoniel and Pacañot [8] stated that mangrove cutting is granted by their organization, TACMA, for housing use and aquaculture livelihood of the household members. However, mangrove cutting by residents from other places is a major concern of the TACMA. Aside from that, this mangrove forest is also engaged in tourism activities like mangrove sight-seeing which provides additional livelihood, besides fishing and gleaning [9].

Another mangrove forest managed by a community is located in Bacungan, Puerto Princesa City, Palawan. This mangrove management was initially implemented and initiated by the ABS-CBN Foundation and the City Government of Puerto Princesa City. The area was engaged in tourism livelihood until now in which paddle boating and floating restaurants are some of them. The Bacungan Mangrove Eco-tourism Service Cooperative manages the area with support from the Community Based Sustainable Tourism Organization (CBST) and the City Tourism Office of Puerto Princesa, which saw an increase in the annual tourist arrival from the year 2015 to 2016.

Tagpait community members are all indigenous people (IPs) that use indigenous practices in mangrove management and livelihood activities like fishing and

farming. On the other hand, Bacungan community members are composed of a mixture of IPs, non-IPs and migrants using a modern mangrove management system. Mangroves provide support for fishing livelihood, tourism livelihood, aquasilviculture, and buffer against disasters. Tourism livelihood, no matter how beneficial it is to the community, can cause degradation of the natural environment without sustainable strategies and measures [10]. A notable example is the influx of tourists exceeding the carrying capacity of mangrove forests, which in turn causes disturbance and degradation. Also, aquaculture as one of the livelihoods can cause depletion of mangroves [11]. The community expands aquasilviculture to increase income that has led to damage of mangroves.

In these community-based mangrove management cases, it is highly recommended to conduct a sustainability analysis of their management systems for the proper management of resources. Sustainability analysis as operationally defined in this study is the evaluation of the sustainability status of community-based mangrove forest management. Hence, this study evaluated the sustainability status of community-based mangrove forest management of Tagpait and Bacungan using the applicable C & I that will be developed. Also, this study assessed the applicable C & I and formulated verifiers in each applicable indicator. The formulated verifier for each applicable indicator was used to evaluate the sustainability status.

2. Materials and Methods

This research was conducted in two areas with existing community-based mangrove management as stated in Figure 1. One of the areas is the Barangay Tagpait, Aborlan, Palawan, with coordinates of 9°24' 50.665" North and 118° 33' 20.984" East. The area is approximately 60 km from the province's capital, the city of Puerto Princesa, with 0.78 km² of mangrove forest. The other area is in Bacungan, Puerto Princesa, Palawan with coordinates of 9° 53' 48" North and 118° 43' 27" East with 3.78 km² of mangrove.

The research design of this study is a method with a combination of both quantitative and qualitative approaches. The qualitative approach was utilized to determine the applicable sustainable mangrove management criteria and indicators for both mangrove forest management systems. The quantitative approach was used to assess the level of awareness and perception of the community and evaluate the sustainability of mangrove management systems in Tagpait, Aborlan, and Puerto Princesa City, Palawan.

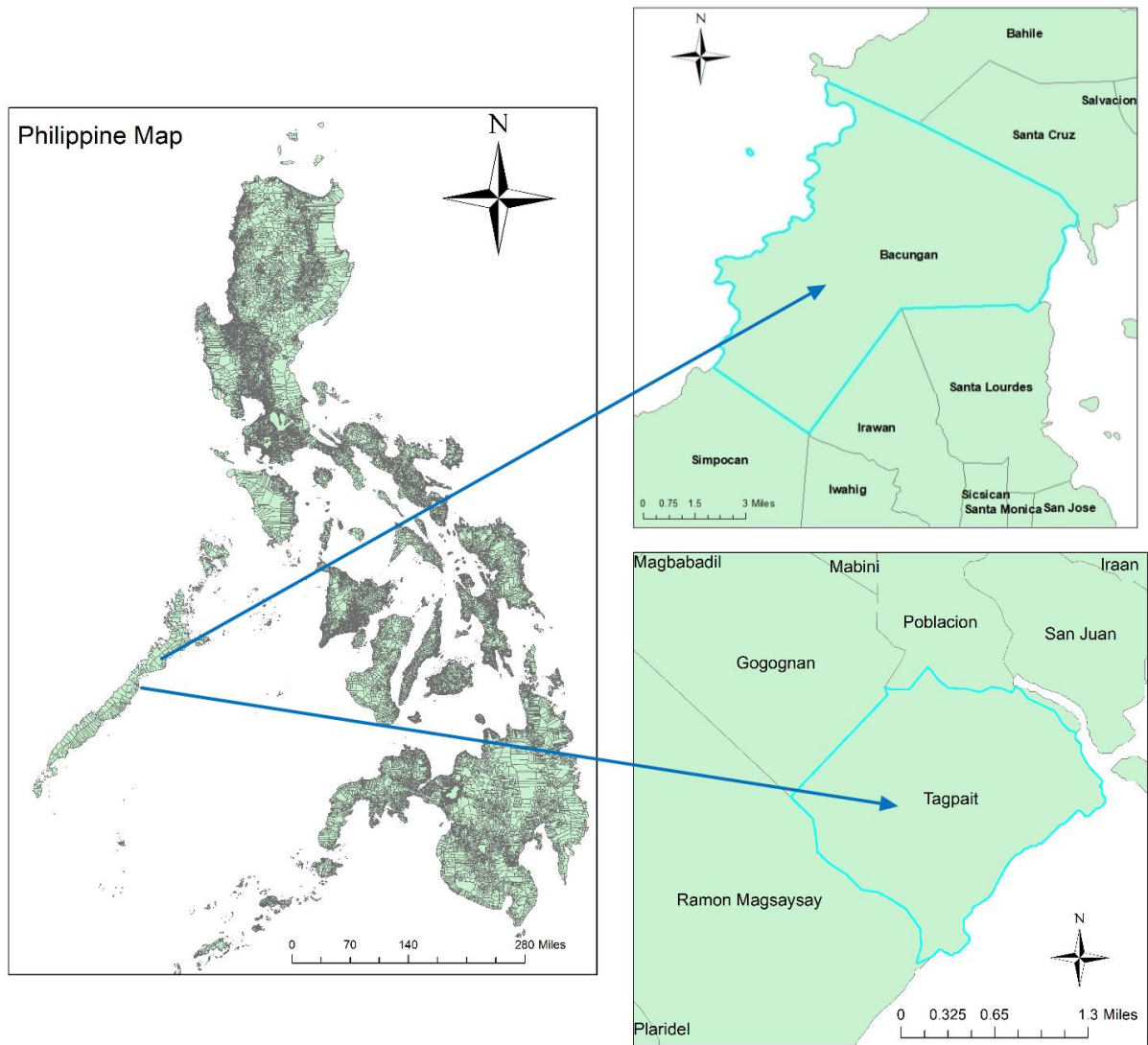


Figure 1. Research Area: Bacungan, Puerto Princesa City and Tagpait, Aborlan, Palawan

The steps in sustainability analysis in this study involve the following: identification of applicable criteria and indicators, development of verifiers in the form of a rating scale for each applicable indicator that will serve as evaluation tool and evaluation of sustainability using the developed evaluation tool. Specifically, the C & I was utilized in the sustainability analysis of the mangrove management system in both communities. The DENR-FMB set a total of 57 indicators under seven criteria suitable to the Philippines’ mangroves based on the International Tropical Timber Organization [12]. The DENR-FMB criteria include (1) Enabling Status of Sustainable Mangrove Management, (2) Forest’s Extent and Condition, (3) Health of Forest Ecosystem, (4) Forest Production, (5) Biodiversity, (6) Protection of Soil and Water Quality and quantity, and (7) Socio-economic and Socio-cultural Components [13]. In line with this long list of C & I set by the DENR-FMB, this study used a series of Focus Group Discussion (FGD) with well-represented participants to assess the suitable Sustainable Mangrove

Management C & I in both communities. Three FGDs were implemented for each community in which guide questions, visual aids, recorder, etc. were utilized. The researcher implemented three FGDs for each community with 12-15 well-represented participants [5,15].

After the determination of a suitable C & I is the development of verifiers through a rating scale for each identified applicable C & I, followed by an analysis on sustainability using the verifiers. Then, to undertake sustainability analysis for Mangrove Management Systems, the identified suitable C & I were utilized. The verifier’s rating scale ranges from 1 to 3 in which 1 is equivalent to “low” or “poor”, 2 is “fair”, and 3 as “high” or “good” for each suitable indicator of sustainable mangrove management’s seven criteria through KII and FGD [14]. In the implementation of FGD, each community conducted three FGDs with 15 well-represented participants from different sectors to develop rating scales as verifiers for each suitable indicator under each criterion, and succeeded by validation. Then, to standardize the rating scale as

verifiers and its suitability to both communities, consultation and validation were conducted. The well-represented participants for FGD are from all sectors in each community: community leaders, leaders and members of the IP, elderly, fishers, farmers, tour guides, women, and members of the local community [15].

Lastly, through household interviews using a survey questionnaire, FGD, KII, and secondary data analysis, each indicator will be rated using the developed rating scale as verifiers. The community members' level of awareness on suitable sustainable mangrove management C & I were assessed through a rating scale, with 1 as the lowest and 5 as the highest. Level of awareness defined as the perceived level of awareness of the respondent on the applicable sustainable mangrove management C & I: 1 is very low awareness ($\leq 20\%$ level of awareness), 2 is low (21%-40% level of awareness), 3 moderately aware (41%-60% level of awareness), 4 high (61%-80% level awareness), and 5 as very high (81%-100% level of awareness). In the range of mean level of awareness, 1-1.5=1 (very low awareness); 1.51-2.5=2 (low awareness); 2.51-3.5=3 (moderate awareness); 3.51-4.5=4 (high awareness); and 4.51-5=5 (very high awareness).

The local community's awareness and perception of importance is included in designing a household interview (HHI) survey questionnaire [5]. It was assessed through a rating scale, with 1 as the lowest and 5 as the highest. Perception on importance is defined as the level of perceived importance of the respondents on the applicable sustainable mangrove management C & I, wherein level 1 stands for "very insignificant" ($\leq 25\%$ perceived level of importance), level 2 as "insignificant" (26%-50% perceived level of importance), level 3 (no opinion), level 4 as "significant" (51%-75% perceived level of importance), and level 5 as "very significant" (76%-100% perceived level of importance). In the range of the mean perception on importance, 1-1.5=1 (highly insignificant); 1.51-2.5=2 (insignificant); 2.51-3.5=3 (no opinion); 3.51-4.5=4 (significant); and 4.51-5=5 (highly significant).

The total samples for HHI were computed based on the formula of Robert Slovin with a 0.05 margin of error and confidence level of 95%. There is a household number of

78 within the community of TACMA in Tagpait, while there are 33 in the Mangrove Eco-tourism Service Cooperative of Bacungan. In this case, the number of samples for Tagpait is 65, while there is 30 in Bacungan, Puerto Princesa amounting to a total of 95 samples. Thereafter, the researcher utilized the household list in selecting the samples for HHI as the sampling frame. Microsoft Excel random generator was used in the random sampling to choose samples. To sum everything up, the entire data analysis includes descriptive statistics like mean and percentage, Mann Whitney-U Test to compare the level of awareness and perception of importance of two communities.

3. Results

The verified common applicable C & I in the mangrove management systems in Tagpait, Aborlan, and Bacungan, Puerto Princesa consists of seven criteria with 35 indicators. Table 1 shows the actual number of indicators and the number of applicable indicators. The relevant criteria include (1) Enabling Conditions of Sustainable Forest Management, (2) Extent and Condition of Forest, (3) Forest Ecosystem Health, (4) Forest Production, (5) Biological Diversity, (6) Soil and Water Protection and (7) Economic, Social and Cultural Aspects. The criteria and indicators of sustainable mangrove forest management were based on the selection of the International Tropical Timber Organization [12].

After the identification of applicable C & I for sustainable mangrove management, the formulation of verifiers was done using the rating scale as a means to quantify each applicable criteria and indicator. The verifiers in the form of a rating scale that was formulated together with the local community members through a series of Focus Group Discussions (FGD) were used in the evaluation. The developed rating scale was classified into 3 (Good), 2 (Fair), and 1 (Poor). This was used in the evaluation of the sustainability of mangrove forest mangrove system.

Table 1. No. of Indicators and Applicable Indicators

Criteria	No. of Indicators (Long List)	No. of Applicable Indicators (Short List)
1. Enabling Condition of SFM	11	7
2. Extent and Condition of Forest	6	5
3. Forest Ecosystem Health	2	2
4. Forest production	12	3
5. Biological Diversity	7	4
6. Soil and water Protection	5	3
7. Economic, Social, and Cultural Aspects	14	11
Total	57	35

Comparing the Level of Awareness and Perception of Importance in Both Communities

The two communities (Tagpait and Bacungan) were compared and analyzed to determine if there is a significant difference in the level of awareness on applicable C & I. This was carried out by subjecting their independent samples to analysis using a Mann-Whitney U test. The p-value is 0.001 which is less than 0.01 with an alpha level of 0.05 (p-value<0.01<0.05). Therefore, it is apparent that there is a significant difference in the level of awareness on applicable C & I between Tagpait and Bacungan. Tagpait, Aborlan has a higher level of awareness compared to Bacungan, Puerto Princesa City. In the level of awareness, the following rating is followed: 1-1.5=1 (very low awareness); 1.51-2.5=2 (low awareness); 2.51-3.5=3 (moderate awareness); 3.51-4.5=4 (high awareness); and 4.51-5=5 (very high awareness). Tagpait has a mean of 3.81 (high awareness), while Bacungan has a mean of 3.43 (moderate awareness). In both communities, most members are engaged in fishing livelihood, which is dependent on mangroves. Compared to other forms of livelihood, the people involved with such fishers are found to be more aware of mangrove management.

The two communities (Tagpait and Bacungan) were also compared and analyzed to determine if there is a significant difference in perception of the importance of applicable C & I. Once again, with the aid of a Mann-Whitney U test, the independent samples were analyzed. The p-value is 0.016 which is less than 0.05 alpha level (p-value<0.05). Therefore, there is a significant difference in the perception of the importance of the applicable C & I between Tagpait and Bacungan. In the perception of the importance of two communities, Tagpait, Aborlan proved to be higher compared to that of Bacungan, Puerto Princesa City. In the perception of importance, the following rating is followed: 1-1.5=1 (highly insignificant); 1.51-2.5=2 (insignificant); 2.51-3.5=3 (no opinion); 3.51-4.5=4 (significant); and 4.51-5=5 (highly significant). The result shows that Tagpait has a mean of 4.78 (highly significant) while Bacungan has a mean of 4.70 (highly significant).

Evaluation and Comparison between Two Communities

Tagpait has a grand mean of 2.31, while Bacungan has a grand mean of 2.47, in which Bacungan has a higher rating of sustainability of mangrove forest management system (see Table 2). The evaluation rating of both communities falls under fair rating. In criterion 1 (Enabling Condition of Sustainable Forest Management), Tagpait has an average rating of 1.71 (fair) while Bacungan has an average rating of 1.86 (fair); both communities have a poor rating in terms of funding in forest management for planting, clearing, livelihood, and monitoring as well as the capacity of the community members for planning sustainable forest management, monitoring, evaluation and feedback on

progress. In other words, the two communities have a poor capacity to evaluate and monitor their management system. Some policies are implemented in the community for the protection and conservation of mangroves but not monitored. Also, both communities have management plans but not fully implemented; participation of members is only about 50%-89% during activities and meetings.

Table 2. Mean of Scores of Each Criterion

Criteria	Tagpait	Bacungan
C1 Enabling Condition of SFM	1.71	1.86
C2 Extent and Condition of Forest	3.00	3.00
C3 Forest Ecosystem Health	3.00	3.00
C4 Forest production	2.33	2.33
C5 Biological Diversity	1.75	2.25
C6 Soil and Water Protection	2.00	2.67
C7 Economic, Social, and Cultural Aspects	2.36	2.18
Grand Mean	2.31	2.47

Both communities got an average rating of 3 (good rating) for criterion 2 (Extent and Condition of Forest) and criterion 3 (Forest Ecosystem Health). 100% of the area in both communities is committed for protection and production. There are good changes in each mangrove area in which vacant spaces have been planted and cut trees have been replaced. Based on the accomplishment report of Tagpait, the community members planted approximately 1000 propagules with an 85% survival rate. In Bacungan, they planted 1500 propagules as part of their primary activities. Also, the majority of the mangrove areas are in good forest conditions. Affected areas for disturbances and degradation caused by humans are only about 1% of the total area of their mangrove forests. Affected areas for disturbances and degradation due to natural causes like storms, strong winds, and floods are only about 2% of the total areas of their mangrove forests. Certain mangrove species, namely *Sonneratia sp.* and *Avicennia sp.* are observed by the communities to have lesser damage and faster recovery in case of flood occurrence. This characteristic is also confirmed by Primavera et al. [16] stating that the species under the genus of *Sonneratia* and *Avicennia* are more resilient against disturbances. In the case of the mangrove forests in Calauit Island in Palawan and Eastern Samar that were devastated by typhoon Haiyan last November 2013, *Rhizophora apiculata* has the highest percentage of defoliated trees with 53.13%; most of the trees have a diameter class of 3cm. In those areas, *Avicennia sp.* and *Sonneratia sp.*, however, have higher vegetation resistance and recovery potential [17].

In Criterion 4 (Forest Production), both communities have a rating of 2.33 (Fair). The actual harvest of products is very satisfactory in Tagpait, while it is only satisfactory in Bacungan. The common harvests in both communities

are mud crabs, shrimps, shells, and fish, which they use for commercial and household consumption. While the harvest in Bacungan is purely non-wood products, Tagpait has both non-wood and wood products. Utilization of wood products is allowed but for house construction only and requires the approval of the community leaders. Currently, the average harvest per household in a day (3-4 hours of fishing time) in Tagpait for assorted fish is 5-8 kg, crabs and shrimps are 4-6kg, and shells are 10-15kg [18]. In Bacungan, the average harvest per household in a day (2-5 hours of fishing time) for assorted fish is 5-10 kg, crabs and shrimps are up to 10kg and shells are 8-15 kg.

For criterion 5 (Biological Diversity), Tagpait has a rating of 1.75 (fair), while Bacungan has 2.25 (fair). Both communities have existing procedures to protect endangered, rare, and threatened species of forest flora and fauna but not fully implemented. Also, both communities have procedures for the protection and monitoring of biodiversity in production forests but not fully implemented. The implementation of their procedures for biodiversity protection is constrained by insufficient knowledge for protection and insufficient resources. Nevertheless, looking at the actual biological condition, both have good biological diversity. In Tagpait, there are eight species of mangroves present, which include *Rhizophora apiculata* as the most abundant followed by *Rhizophora mucronata*, *Sonneratia alba*, *Ceriops tagal*, *Rhizophora stylosa*, and *Avicennia alba*. The new additional species planted are *Aegiceras corniculatum* and *Aegiceras floridum*. In Bacungan, the most abundant species among 13 species in the area is *Rhizophora mucronata*, followed by *Rhizophora stylosa*, *Xylocarpus granatum*, *Rhizophora apiculata*, *Avicennia alba*, *Avicennia marina*, *Sonneratia alba*, *Lumnitzera littorea*, *Bruguiera sexangula*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Avicennia officinalis*, and *Sonneratia caseolaris*. In criterion 6 (Soil and water protection), Tagpait has a rating of 2 (fair), while Bacungan has a rating of 2.67 (good). Tagpait has procedures to ensure protection of downstream catchment and soil but not fully implemented. Soil and water are crucial for the health of vegetation like mangroves [19, 20]. Bacungan, on the other hand, has some procedures to ensure the protection of downstream catchment and soil and implemented like regular clean-up drive in the river and mangrove area. In terms of actual physical condition, the current pH level of soil in Tagpait is 7.16, which indicates almost neutral while Bacungan has 5.46, which is quite acidic. The concentration of Nitrogen (N), Phosphorus (P), and Potassium (K) is 1.5% OM, 190 ppm, and 256 ppm, respectively. In Bacungan, the concentration of Nitrogen (N), Phosphorus (P), and Potassium (K) is 4.5% OM, 148 ppm, and 1,152 ppm, respectively. For every 100g, the percentage of soil organic carbon stock in Tagpait is 0.6% (0.6 grams), and the percentage of organic matter is 1.032% (1.032g). Bacungan, on the other hand, has 1.8% (1.8 grams) organic carbon stock in soil and an organic matter percentage of

3.096% (3.1g). Regarding water quality, the DENR-DAO 34-90 [21] stated that both Bacungan River and Aborlan River (connected to Tagpait, Aborlan) are Fair for class A (Public Water Supply), Fair for class B (Recreation), Good for class C (Fishery water) and excellent for class D (Irrigation and Livestock Farming, etc.) [22]. Aborlan River has a concentration of the following: total suspended solids is 7 mg/L, dissolved oxygen is 8.5mg/L, BOD is 1.7g/L, oil and grease is 2.1 mg/L, nitrates is 1.7mg/L and phosphates 0.2 mg/L. In contrast, Bacungan river has a concentration of the following: total suspended solids is five mg/L, dissolved oxygen is 8.2 mg/L, BOD is 1.8g/L, oil and grease is 4 mg/L, nitrates is 1 mg/L, and phosphates 0.3 mg/L [22].

In criterion 7 (Economic, Social and Cultural Aspects), Tagpait has a rating of 2.36 (Fair), while Bacungan has a rating of 2.18 (Fair). Tagpait has a higher level of participation of indigenous people and incorporation of traditional knowledge in the planning and management. Both communities have issues with marketing their products; especially because there are some competitors outside. They practice the *Barter System* (exchanging of products) in which they can have rice, vegetables, and other goods in exchange for their marine products. Additionally, Tagpait community members make dried fish so that they can sell these for a longer time. Overall, Tagpait has a grand mean of 2.31, while Bacungan has a grand mean of 2.47 in which Bacungan has a higher rating of sustainability of mangrove forest management system. Both communities fall under the fair status of sustainability.

Sustainability Index for Mangrove Management System

The mathematical model for the sustainable index for individual criteria (SIIC) and the Overall Sustainability Index (OSI) presented below was also used as an additional way to evaluate the sustainability of mangrove forest management using the rating score for each indicator in the criteria. Weights of every criterion and number of C & I were used in the equation. The weight for each criterion is 14.28%, which is equally divided into seven criteria. If the value of SIIC and OSI is ≥ 0.40 , it is highly sustainable while moderately sustainable if ≥ 0.25 but < 0.40 . Poor or low sustainability is presumed if the value is < 0.25 .

The computed value of the Sustainability Index for Individual Criteria (SIIC) and Over-all Sustainability Index (OSI) is presented in Table 3. For criterion 1 (Enabling condition of SFM), Tagpait has a value of 0.24 (low sustainable) while Bacungan has 0.27 (moderately sustainable) in which Bacungan has a higher value. Both communities have no sufficient funding from both government and non-government organizations for actions such as planting, clearing of disturbances to planted mangroves, livelihood activities, and monitoring. Also, both communities have low capacity for planning

sustainable management and periodic monitoring and evaluation. The participation of the members of both communities is only about 50%-89%. Although the two communities have existing mangrove forest management plans, they are not fully implemented due to the lack of funding and technical support. Bacungan has an existing valid community-based mangrove forest management agreement. Tagpait, on the other hand, has a special agreement with the DENR but has long since expired in 2018. Currently, the community is in the process of applying for the renewal of their agreement.

Table 3. Value of Sustainability Index for Individual Criteria (SIIC) and Over-all Sustainability Index (OSI)

Criteria	Tagpait	Bacungan
C1 Enabling Condition of SFM	0.24	0.27
C2 Extent and Condition of Forest	0.43	0.43
C3 Forest Ecosystem Health	0.43	0.43
C4 Forest production	0.33	0.33
C5 Biological Diversity	0.25	0.32
C6 Soil and Water Protection	0.29	0.38
C7 Economic, Social, and Cultural Aspects	0.34	0.31
Over-all Sustainability Index (OSI)	0.33	0.35

Note: Highly sustainable if the value is ≥ 0.40 ; moderately sustainable if ≥ 0.25 but < 0.40 ; poor or low sustainable if < 0.25 .

In criterion 2 (Extent and Condition of Forest), both communities have an SIIC value of 0.43 (highly sustainable).

In criterion 3 (Forest Ecosystem Health), both communities have an SIIC value of 0.43 (highly sustainable).

Criterion 4 (Forest production) in both communities has an SIIC value of 0.33 (moderately sustainable).

Criterion 5 (Biological Diversity) in Tagpait has an SIIC value of 0.25 (moderately sustainable) while Bacungan has 0.32 (moderately sustainable).

In criterion 6 (Soil and water protection), Tagpait has an SIIC value of 0.29 (moderately sustainable) while Bacungan has 0.38 (moderately sustainable).

Lastly, criterion 7 (Economic, Social and Cultural Aspects) has an SIIC value of 0.34 (moderately sustainable) in Tagpait and 0.31 (moderately sustainable) in Bacungan.

The value of the overall sustainability index (OSI), as shown in Table 3, reveals that Tagpait has 0.33 (moderately sustainable), while Bacungan has 0.35 (moderately sustainable). Thus, this owes to the fact that the two communities have their own strengths and weaknesses upon looking at each sustainable criteria and indicator of mangrove forest management.

4. Conclusions

There are 7 and 35 assessed applicable sustainable

mangrove forest management C & I in Tagpait and Bacungan out of the 7 and 57 indicators. The applicable criteria are (1) Enabling Conditions of Sustainable Forest Management, (2) Extent and Condition of Forest, (3) Forest Ecosystem Health, (4) Forest Production, (5) Biological Diversity, (6) Soil and Water Protection, and (7) Economic, Social and Cultural Aspects.

In the evaluation of the sustainability of mangrove forest management using the mean of scores and sustainability index for individual criterion, Bacungan has a higher rating than Tagpait in criterion 1 (Enabling condition of SFM), criterion 5 (Biological diversity), and criterion 6 (Soil and water protection). Tagpait, on the other hand, has better management in Criterion 7 (Economic, social and cultural aspects). In criterion 2 (Extent and condition of the forest), criterion 3 (Forest ecosystem health), and criterion 4 (Forest production), both communities have the same level of sustainable management. The weaknesses of both communities are funding, capacity for planning and management, forest product industry, and implementation of strategies for sustainable mangrove management. The OSI value of Bacungan is 0.35 (moderately sustainable), while Tagpait has 0.33 (moderately sustainable). Hence, according to the results concluded from the data, Bacungan apparently has a higher sustainability rating than Tagpait. It can be summed up through the following reasons: (1) Bacungan has existing tenurial instrument from the government; (2) Bacungan has implemented actions for the protection of species of flora and fauna; (3) Bacungan has tourism activities which have sustainable income for livelihood and mangrove protection; and (4) Bacungan has implemented soil and water protection strategies.

5. Recommendation

- Regular monitoring and evaluation of the community-based mangrove management using the developed applicable criteria and indicators. The M & E should be conducted by the local community with the guidance and support of the local government, DENR, academe, and others. This is highly useful in addressing identified weaknesses in the capacity for planning and periodic monitoring and evaluation.
- The initiation and encouragement of the M & E of the community-based mangrove management system using the applicable criteria and indicator in other areas in the country is highly needed to raise awareness of the status of the sustainability of mangrove management system.
- Academic institutions, national and local governments, as well as NGOs may provide support to the local community in the monitoring and evaluation of the mangrove management system by giving relevant training and workshops, and technical and financial support.
- The identified weaknesses of Tagpait and Bacungan should be improved. Their common weaknesses are

stability of funding, capacity for planning and management of the local community, absence of forest product industry for the development of the local economy, and implementation of suitable strategies for sustainable mangrove management. Both government and NGOs may give aid by providing financial assistance, planning and M & E workshops, training on the establishment and management of efficient forest product industry and market, and others.

Acknowledgements

I want to express my deepest thanks to Dr. Leonardo M. Florece, Dr. Mark Dondi M. Arboleda, Dr. Hildie Maria E. Nacorda, and Dr. Dixon T. Gevaña for their invaluable and constant support and guidance throughout the conduct of my study. I want to thank CHED, DOST-SEI and Palawan State University for financial support.

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