Multidisciplinary Approach to the Assessment of Buenlag-Sabangan River at Binmaley, Pangasinan Philippines

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Abstract - *Biological and physico-chemical components of Buenlag-Sabangan River as well as stakeholders' interventions were studied to assist the municipal government of Binmaley, Pangasinan in the preparation of a proposal for the development of the area. Results revealed 23 species of macroflora in the riparian system of the river with Rhizophora apiculata as the most important species (IVI=36.81%). The macrofloral diversity of the riparian system; however, was low (H'=1.31). Aquatic macrofaunal community, on the other hand, is composed of 20 species of fish, 11 species of crustaceans and six (6) species of mollusks. The community structure of aquatic fauna is characterized by high importance value index (IVI=43.94%) of non-edible species of small mussel (unidentified) and very low IVI (<5%) of economically important of fish species, an indication that the river is overfished. Aquatic macrofaunal diversity was also low (H=1.71). Recorded water physic-chemical parameters were within the standard set by the DENR for Class C water, which suggests that the water is fit for fish cultivation. The river and its resources were moderately utilized mostly as sources of water for fishpond, as sources of food and livelihood. Strategies employed by local stakeholders relevant to resource protection, conservation, and management were moderately implemented; however, a more serious problem on low catch was still encountered by the respondents. Reduction in the number of fishing apparatus, provision of an alternative source of income and implementation of property right system, was proposed to increase catch per unit effort.*

Keywords: *Multidisciplinary approach; assessment; macroflora; macrofauna; importance value; diversity*

INTRODUCTION

The river provides more suitable water (brackish water) for many fish species and other aquatic organisms due to its unique characteristic: the "mixing bowl" of freshwater and marine water. River and riparian systems are highly valued as they provide not only easy access to water but also to transportation, food production, recreation and natural beauty with high levels of biological diversity. The province Pangasinan in the northern Philippines has extensive river system. It is where Agno River, the 5th largest river in the country and the third largest river in Luzon, branched out to spread and discharge most of its waters. Several tributaries of the Lower Agno River, which feeds a considerable number of fishponds, crisscrossed the municipality of Binmaley in the central part of Pangasinan. Buenlag-Sabangan River is just a fingertip of one of these tributaries. The Municipal Agriculture Office of Binmaley, Pangasinan has proposed a development plan of the area, owing to its social, economic, and environmental relevance. Data and other information on the status of the biological, physic-chemical and even social components of the river ecosystem are necessary for any development plan to be sustainable; hence, the conduct of this study.

MATERIALS AND METHODS

Location of the Study

The study was conducted in barangay Buenlag-Sabangan River adjoining Buenlag and Sabangan in Binmaley, Pangasinan. The river is a small tributary connected to a branch of the Lower Agno River, Salapingao River, and to another branch, Dupo River, by a confluence. It is connected to Lingayen Gulf via Pantal River of Dagupan City, despite its proximity to the coastal waters of Binmaley, Pangasinan (Fig.1).

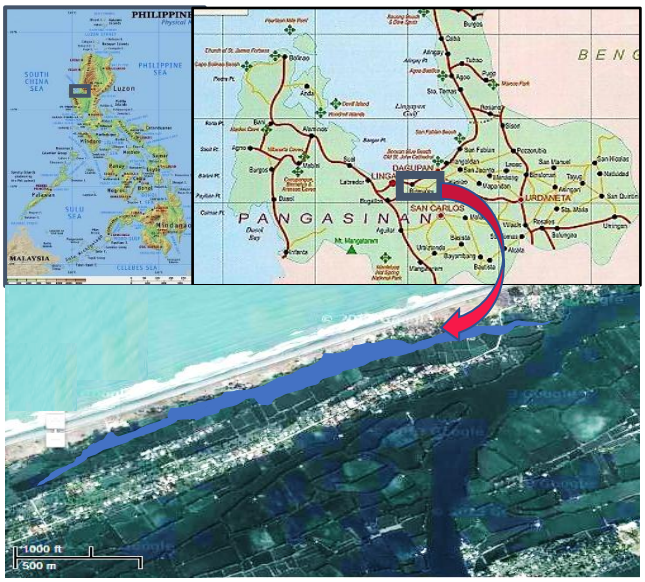

Figure 1. The Buenlag-Sabangan River

Data Collection Procedure

The biological components of the river ecosystem were assessed as to the community structure (species composition, frequency, dominance, density, importance value, and diversity) of the riparian macroflora and aquatic macrofauna. Thirty (30) quadrats measuring 2mx50m were laid in the riparian system for the collection of macroflora. All the species in each quadrat were identified *in-situ* and simultaneously, total enumeration of individuals per species was undertaken. For fishes and crustaceans, four (4) sampling stations were established and along the river channel. Samples were collected from each station using fyke nets. Species collected were photo-documented, identified and classified to the species level using fish species guide [1]. For mollusks, three (3) small 1x1m quadrats were laid in each larger quadrat used for mangrove opposite each fishing station. Mollusks, on the other hand, were collected using bare hands.

Water physico-chemical parameters such as depth, visibility, temperature, pH, dissolved oxygen, and salinity were monitored *in situ* in the upstream portion of the river and compared with the data obtained by BFAR-NIFTDC at Bunuan Binloc, Dagupan City in the same area and the standard set by various authorities.

A total of 290 respondents composed of different stakeholders of the Buenlag-Sabangan River were interviewed using the survey questionnaire to determine the means and extent of utilization of the river and its resources, extent of implementation of management and conservation strategies as well as to identify the problems encountered in the utilization and management of the river and their corresponding solutions.

Determination of the Community Structure

Species composition of riparian macroflora and aquatic macrofauna was determined by identifying the species in all the quadrats laid. Identification was supported by photographs of all species taken during the survey. Frequency (f) was computed by counting the number of quadrats/stations where a species occurred over the total number of quadrats/stations. Density (d) of a species was obtained by getting the ratio of the number of individuals of a species (n_i) and the area sampled (A). Abundance (a), on the other hand, was derived from the ratio of the total number of a total number of individuals of a species in all quadrats and total quadrats in which the species occurred. The Importance Value Index (IVI) was computed using the formula: (RF)+(RD)+(RA)/3 where: RF (relative frequency) = Frequency of a species/sum frequencies of all species) × 100; RD (relative density) = (Number of individuals of a species/ total number of individuals) × 100; RA (relative abundance) = (abundance of a species/sum abundances of all species) × 100. Shannon-Weiner Diversity Index was computed using the formula: $H' = -\sum pi \log pi$, where: H' = index of species diversity, S = total number of species; $pi = n_i/N$, where n_i= number of individual in a species and N= total number of individuals in all species.

Determination of the extent of utilization and implementation of the management and conservation measures

Table 1. Scale and Categories

Scale	Categories			Point
	EU	EICMS	SP	
1.00-1.80	Very Poorly Utilized	Very Poorly Implemented	Not serious	1
1.81-2.60	Poorly Utilized	Poorly Implemented	Less serious	2
2.61-3.40	Moderately Utilized	Fairly Implemented	Moderately serious	3
3.41-4.20	Much Utilized	Well Implemented	More serious	4
4.21-5.00	Very much utilized	Very Well Implemented	Extremely serious	5

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Likert Scale (Table 1) was used to describe the extent of utilization of the river and implementation of management and conservation strategies and seriousness of the problems encountered by the stakeholders of Buenlag-Sabangan River.

RESULTS AND DISCUSSION

Biological Components

Community Structure of Riparian Macroflora. Results of the study (Table 2) revealed that 23 species of macroflora belonging to 18 families and 21 genera abound the riparian system of Buenlag-Sabangan River. Eleven (47.83%) are true mangroves and 12 (52.17%) are associated species. Of the mangrove species, 72.27% fall under the category of major species and only 27.27% fall under minor species (Fig. 2). The total number of true mangrove species constitute only 17% of the total number of species globally and 28-37% in the Philippines, considering the 65 species of true mangrove [2] and 30-40 species [3].

Analysis of the community structure of the riparian system evealed that *Rhizophora apiculata* was the most important species considering the Importance Value Index of IVI=36.81%. Other species have less than 10% relative values except for *Rhizophora mucronata* and *Avicennia marina* wherein only the relative frequencies exceeded 10% (11.27% and 10.29%, respectively). The diversity value of the riparian macroflora (H'=1.31) is generally low (Fig. 3). The H' value of 1.57 recorded for the riparian flora in the headwaters of Layawan River in Sebucal, Oroquieta City, Misamis Occidental, is relatively high and reflects evenness in the distribution of trees totaling 74 species [4]. The mossy-forest of Mt. Data National Park in Sinto, Bauko, Mountain Province has an H' value of 2.633 for flora [5]. Gomez's (2012) description of such H' value as relatively diverse agrees with the inference of Barbour et al. (1999) that an ecosystem with H' value greater than 2 is regarded as the medium to high diversity [6].

Table 2. Community structure of riparian macroflora in Buenlag-Sabangan River

SPECIES OF	ni	# of	f	rf	d	rd	a	ra	IVI
Rhizophora apiculata	5765	30	1.00	14.71	1.92	68.68	192.17	41.75	41.71
Rhizophora mucronata	826	23	0.77	11.27	0.28	9.84	35.91	7.80	9.64
Avicennia marina	538	21	0.70	10.29	0.18	6.41	25.62	5.57	7.42
Bruguiera cylindrica	263	19	0.63	9.31	0.09	3.13	13.84	3.01	5.15
Avicennia officinalis	230	18	0.60	8.82	0.08	2.74	12.78	2.78	4.78
Excoecaria agallocha	99	17	0.57	8.33	0.03	1.18	5.82	1.27	3.59
Pandanus tectorius	77	2	0.07	0.98	0.03	0.92	38.50	8.36	3.42
Lumnitzera racemosa	101	15	0.50	7.35	0.03	1.20	6.73	1.46	3.34
Derris trifoliata	142	10	0.33	4.90	0.05	1.69	14.20	3.09	3.23
Artocarpus ovatus	84	13	0.43	6.37	0.03	1.00	6.46	1.40	2.93
Nypa fruticans	68	3	0.10	1.47	0.02	0.81	22.67	4.92	2.40
Acanthus ilicifolius	25	1	0.03	0.49	0.01	0.30	25.00	5.43	2.07
Acrosticum aureum	40	6	0.20	2.94	0.01	0.48	6.67	1.45	1.62
Sonneratia alba	20	8	0.27	3.92	0.01	0.24	2.50	0.54	1.57
Cocos nucifera	28	2	0.07	0.98	0.01	0.33	14.00	3.04	1.45
Calophyllum inophyllum	33	4	0.13	1.96	0.01	0.39	8.25	1.79	1.38
Acacia farnisiana	25	3	0.10	1.47	0.01	0.30	8.33	1.81	1.19
Leucaena leucocephala	8	1	0.03	0.49	0.00	0.10	8.00	1.74	0.77
Aegiceras corniculatum	10	3	0.10	1.47	0.00	0.12	3.33	0.72	0.77
Ipomoea pes-caprae	5	2	0.07	0.98	0.00	0.06	2.50	0.54	0.53
Sesuvium portuculastrum	3	1	0.03	0.49	0.00	0.04	3.00	0.65	0.39
Hibiscus tiliaceus	3	1	0.03	0.49	0.00	0.04	3.00	0.65	0.39
Terminalia cattapa	1	1	0.03	0.49	0.00	0.01	1.00	0.22	0.24
TOTAL	8,394	30	6.80	100.00	2.80	100.00	460.29	100.00	100.00
H' = 1.31									

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Considering only the true mangroves species with mean H' value of 1.062, this value is higher than that of the mangrove forest in Canaoalan River, Binmaley, Pangasinan with H' value of 0.446 and Patogkawen and Bayaoas river in Tambac, Dagupan City, Pangasinan with H' values of 0.617 and 0.593, respectively [7]. Slightly higher diversity value (H=1.78) was reported for a mangrove forest in Malhiao, Badjan, Cebu [8].

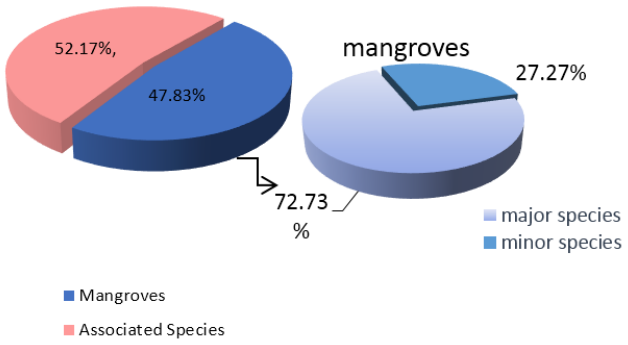

Figure 2. Percentage composition of the different categories of riparian macroflora

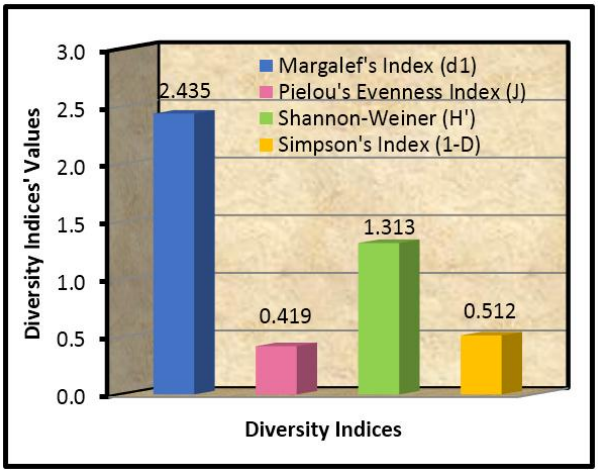

Figure 3. Diversity indices values of riparian macroflora

Community Structure of Aquatic Macrofauna. The aquatic community includes twenty (52.63%) species of fish; 11 (28.95%) species of crustaceans (54.55% shrimps and 45.45% crabs); and 6 (18.42%) species of mollusks. The fishes collected belong to 20 families and also 20 genera, whereas crustaceans are from 3 families and 4 genera of shrimps; and 2 families and 4 genera of crabs. Mollusks, on the other hand, belong to 6 families and 7 genera (Table 2). Related studies conducted in various parts of the country revealed the following aquatic faunal composition: 30 species of fish, 23 species of gastropods (14 univalves and 9 bivalves) 2 species of arthropods (crustaceans) and 1 species of echinoderm (*Holothuria scabra*) were reported by in Pasuquin, Ilocos Norte [9]; in Tabuk and Cabgan Islets in Palompon, Leyte there were 63 species consisting of 22 species of mollusks, 20 species of echinoderms, 8 species of crustaceans, 4 species each of fish, tunicates, and sponges, and 1 cnidarian species [10]; in Malhiao, Badian, Cebu, 9 species of echinoderms, 6 species of mollusk, 4 species each of sponges, arthropod and fish, and 1 cnidarian species were recorded [8]. Faunal composition in a mangrove-fringed shallow tidal creek located within the northern part of the Ranong Biosphere Reserve in Klong Ngao, Ranong, Thailand includes 30 species of crustaceans and 34 species of mollusks (Macintosh et al., 2002). In Nigeria, a minimum of 15 species (12 genera and 11 families) in Rhizophora swamp; 14 species (11 genera and 10 families) in mixed macrophytes; and 23 species (18 genera and 16 families) in Nipa swamp were recorded [12] and in Aceh Besar and Banda Aceh districts, Indonesia 14 species of Gastropods and 5 species of Bivalves in the mangrove ecosystem rehabilitation areas were identified [13]. Species composition in different mangrove areas differ based on the physical characteristics of the area, method of collection and period of sampling.

Table 3. Community structure of aquatic macrofauna in Buenlag-Sabangan River

No. Fishes	*Scientific Name*	# of Stations	ni	f	rf	a	ra	IVI
1	*Anguilla sp.*	1	1	0.25	1.14	1.00	0.11	0.62
2	*Apogon sp*	4	48	1.00	4.55	12.00	1.32	2.93
3	*Chanos chanos*	4	34	1.00	4.55	8.50	0.94	2.74
4	*Oreochromis mossambicus*	2	2	0.50	2.27	1.00	0.11	1.19
5	*Anadontos sp*	2	1	0.50	2.27	0.50	0.06	1.16
6	*Stolephorus sp*	2	6	0.50	2.27	3.00	0.33	1.30

Table 3 (cont). Community structure of aquatic macrofauna in Buenlag-Sabangan River

No.	*Scientific Name*	# of Stations	ni	f	rf	a	ra	IVI
Fishes								
7	*Bunaka sp*	2	21	0.50	2.27	10.50	1.16	1.72
8	*Gerres sp*	4	125	1.00	4.55	31.25	3.45	4.00
9	*Acentrogobius sp*	3	18	0.75	3.41	6.00	0.66	2.04
10	*Rhynchorhamphus sp.*	2	2	0.50	2.27	1.00	0.11	1.19
11	*Leognathus sp.*	2	6	0.50	2.27	3.00	0.33	1.30
12	*Mugil cephalus*	4	26	1.00	4.55	6.50	0.72	2.63
13	*Suggrundus sp.*	4	42	1.00	4.55	10.50	1.16	2.85
14	*Scatophagus argus*	2	4	0.50	2.27	2.00	0.22	1.25
15	*Rastrelliger brachysoma*	1	1	0.25	1.14	1.00	0.11	0.62
16	*Siganus guttatus*	1	1	0.25	1.14	1.00	0.11	0.62
17	*Sphyraena sp*	1	1	0.25	1.14	1.00	0.11	0.62
18	*Leiopotherapon sp.*	3	4	0.75	3.41	1.33	0.15	1.78
19	*Tetraodon sp.*	3	92	0.75	3.41	30.67	3.38	3.40
20	*Pseudotriancanthus sp.*	1	55	0.25	1.14	55.00	6.07	3.60
Crustacean								
A. Shrimps								
1	*Alphaeus sp*	1	16	0.25	1.14	16.00	1.76	1.45
2	*Macrobrachium sp.*	2	34	0.50	2.27	17.00	1.87	2.07
3	*Penaeus sp.*	4	112	1.00	4.55	28.00	3.09	3.82
4	*Penaeus indicus*	1	4	0.25	1.14	4.00	0.44	0.79
5	*Metapenaeus ensis*	2	61	0.50	2.27	30.50	3.36	2.82
6	*Penaeus monodon*	1	7	0.25	1.14	7.00	0.77	0.95
B. Crabs								
7	*Varuna sp*	2	3	0.50	2.27	1.50	0.17	1.22
8	*Metapograpsus messor*	3	3	0.75	3.41	1.00	0.11	1.76
9	*Metapograpsus frontalis*	1	9	0.25	1.14	9.00	0.99	1.06
10	*Portunus pelagicus*	3	9	0.75	3.41	3.00	0.33	1.87
11	*Scylla serrata*							
Mollusks								
A. Gastropods								
1	*Nerita sp.*	2	6	0.50	2.27	3.00	0.33	1.30
2	*Terebralia sp.*	1	9	0.25	1.14	9.00	0.99	1.06
3	*Telescopium telescopium*	4	125	1.00	4.55	31.25	3.45	4.00
B. Bivalves								
4	*Isognomon ephippium*	2	6	0.50	2.27	3.00	0.33	1.30
5	*Polymesoda expansa*	2	9	0.50	2.27	4.50	0.50	1.38
6	*Crassostrea sp.*	4	302	1.00	4.55	75.50	8.33	6.44
7	Small brown mussel	4	1899	1.00	4.55	474.8	52.36	28.45
23	Total		3106	22.00	100.00	906.8	100.00	100.00
H'=1.71								

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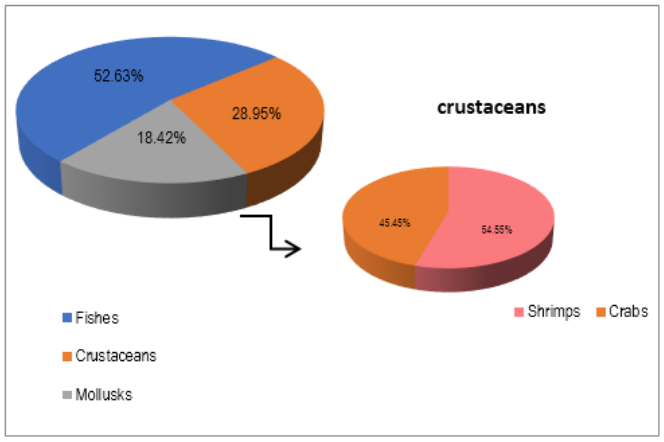

The aquatic community structure of the area under study was characterized by high density and abundance of non-edible species of small *brown mussel* (d=158. 25/m^2, a=474.8). The low frequency, abundance, and density of edible and marketable species indicate low catch and the income for the fisherfolks in the area. Considering the data gathered and the computed H' value of 1.71, study area has generally low aquatic macrofaunal diversity. The diversity index was affected by the evenness of the distribution of individuals per species. Some species, especially *small brown mussel* have much higher frequency compared to other species.

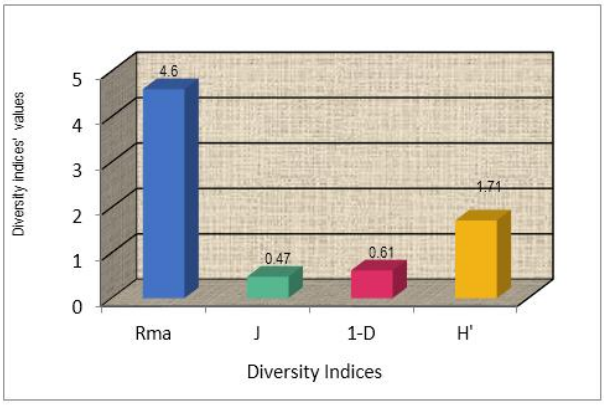

Figure 4. Diversity Indices of different aquatic macrofaunal

Water Physico-chemical Characteristics

The Physico-chemical parameters recorded in the study area in the Buenlag-Sabangan River during the study period was generally within the standard set by DENR [14] and other authorities. Mean water depth (2.39m), visibility (1.61m), temperature (31.57ºC), and pH (7.61) were within the optimum range for the growth of fish, only dissolved oxygen (3.72mg/l) and salinity (30.44ppt) readings fall below the standard of 5mg/l and 10-25ppt, respectively (Table 4).

Stakeholders' Intervention

Extent of utilization of the River and its Resources.

The water resources of the river was much utilized as source of pond water by 85 (29.31%) of the respondents and moderately utilized for fishing by 142 (48.97%) of the respondents but 16 (5.52%) and 19 (6.55%) of them poorly utilized the water for recreational and educational purposes. The aquatic macrofauna (fishes, crustaceans and mollusks) were much utilized as food by 261 (90%) of the respondents and moderately utilized for business by 183 (63.10%) of the respondents but poorly utilized for educational purposes. The riparian macroflora, on the other hand, were moderately utilized for protection against storm surge, strong wind and heat of the sun by 73 (25.17 %) of the respondents, the mangroves were also moderately utilized as gleaning area by 82 (28.28%) of the respondents but poorly utilized as source of fuel, construction and decoration materials, food, educational purposes and source of planting materials for nursery/reforestation.

The land within the riparian and adjacent area were much utilized as fishpond by 85 (29.31%) of the respondents and moderately utilized for residential and agricultural purposes by 53 (3.34% and 2.96%, respectively) of the respondents. Generally, Buenlag-Sabangan River was moderately utilized by the respondents of this study (Table 5).

Table 4. Water parameters recorded in the present study and by BFAR-NIFTDC along with the standard set by various authorities

Water Parameters	Present Study				Bfar				Standard
	March	April	May	Mean	Feb	Apr	Jul	Mean	
Water Depth (m)	2.85	1.85	2.26	2.32	2.50	4.86	2.40	3.25	2-3m[(1)]
Water Visibility (m)	2.35	1.28	1.77	1.80	1.60	2.50	2.00	2.03	<1.00[(2)]
Temperature (ºC)	31.76	32.60	33.10	32.49	27.99	35.35	33.46	32.27	27-31[(3)]
Salinity (ppt)	31.40	32.00	30.00	31.13	30.95	32.77	30.06	31.26	15-30[(3)]
Dissolved Oxygen (mg/L)	5.25	4.24	3.52	4.34	4.00	5.57	3.87	4.48	5[(4)] (minimum)
Water pH	7.22	7.10	7.19	7.17	6.90	7.51	7.33	7.25	6.5-8.5[(4)]

[1]Rosario, 1998 [2]IFAS, 2010 [3]FAO, 2006 [15] [4]DAO, 1990-34

Table 5. Extent of utilization of Buenlag-Sabangan River and its resources by local stakeholders (n=290)

Means of Utilization	Frequency (f)	Percentage (%)	Extent of Utilization	Description
A. Water				
Source of pond water	85	29.31	3.85	MU
Fishing	142	48.97	3.27	MoU
Recreation (swimming)	16	5.52	2.06	PU
Educational purposes	19	6.55	2.58	PU
Mean			2.94	MoU
B. Aquatic Macrofauna				
Food	261	90.00	3.95	MU
Business	183	63.10	3.31	MoU
Educational purposes	19	6.55	2.58	PU
Mean			3.28	MoU
C. Riparian Macroflora				
Source of fuel , construction and decoration materials	147	50.69	2.57	PU
Source of planting materials for nursery/reforestation	29	10.00	2.28	PU
Buffer and shade for protection	73	25.17	3.21	MoU
Educational purposes	22	7.59	2.59	PU
Gleaning area (roots of mangroves)	82	28.28	3.28	MoU
Food (some species of mangroves)	46	15.86	2.28	PU
Mean			2.70	MoU
D. Land (Riparian)				
Residential	53	18.28	3.34	MoU
Agriculture/forestry	53	18.28	2.96	MoU
Fishpond	85	29.31	3.75	MU
Mean			3.35	MoU
Grand Mean			2.99	MoU

Multiple Responses

Table 6. Extent of implementation Strategies employed by various stakeholders in the management and conservation of Buenlag-Sabangan River (n=290)

Strategies	**Frequency (f)**	**Percentage (%)**	**Extent of Implementation**	**Description**	**Stakeholders Involved**
Implementation of Municipal Ordinance	83	28.62	3.14	FI	MAO
Water quality monitoring	19	6.55	2.37	PI	BFAR/MAO/PSU
Registry and licensing of fishers, vessels & apparatus	58	20.00	2.47	PI	MAO
Monitoring control & surveillance	44	15.17	3.00	FI	Fisherfolks/MAO
Stock enhancement	61	21.03	2.67	FI	BFAR
Seminars/trainings on fish culture/feeds and feeding	64	22.07	2.75	FI	BFAR/PSU/ SantehFeeds
Seminars/trainings on other alternative livelihood	69	23.79	3.19	FI	PSU/DOST /BFAR
Information dissemination on solid waste mgt. (Training & Brgy Assembly)	52	17.93	3.13	FI	PSU/Brgy. Officials
Garbage collection	16	5.52	2.13	PI	Municipal SWM
Clean and green (barangay level)	182	62.76	3.64	WI	PSU/BrgyOfficials/ BHW and Brgy Tanods
Mean			2.88	FI	

Only the clean and green project of the two barangays were rated as well implemented by 145 (50%) of the respondents. The planting of mangroves and other trees was rated as fairly implemented by 125 (43.10%) respondents. The same rating was afforded on seminars/trainings on alternative livelihood by 69 (23.79%) respondents; trainings on fish culture (feeds and feeding) by 64 (22.07%) of the respondents; stock enhancement by 61 (21.03%) of the respondents; information dissemination on solid waste management by 52 (17.93%) of the respondents. The implementation of Municipal Ordinance was also rated as fairly implemented by 83 (28.62%) of the respondents, but of the three components identified by the respondents, only the monitoring control and surveillance was rated as fairly implemented by 44 (15.17%). The other two: registry and licensing of fishers, vessels and apparatus and water quality monitoring was rated as poorly implemented (PU) by 44 (15.17%) and 19 (6.55%) of the respondents, respectively. Generally, the extent of implementation of the management and conservation strategies employed by various stakeholders was rated as fairly implemented by the respondents of this study (Table 6).

Issues/Problems Encountered by the Stakeholders in the Utilization and Management of the River and their Proposed Solutions

Eight (8) issues/ problems were encountered by the stakeholders in the utilization and management of Buenlag-Sabangan River. Their level of seriousness were evaluated and results revealed that low catch was considered by 139 (47.93%) of the respondents as more serious (MrS) problem. Moderately serious (MoS) issues/problems are flooding, pollution, poaching, soil erosion, and lack of alternative source of income as perceived by 92(31.72%), 105 (36.21%), 71 (24.48%), 64 (22.07), and 53 (18.28%), respectively. The only less serious issues/problems, was cutting of mangroves as perceived by 20 (6.90%) of the respondents. Generally, issues and problems encountered by the respondents were rated as moderately serious by the respondents of this study.

The following solutions to the identified problems were proposed by the respondents. For problems on low catch, majority (109 or 37.59%) recommended the reduction on the number of fishing apparatus (FAs). Some (53 or 18.28%) said that alternative source of income should be provided. Not so few (36 or 12.41%) proposed the implementation of property right system and only 12(4.14%) proposed stock enhancement and a moratorium on fishing using FAs. On the problem on pollution, 41 (14.14%) of the respondents recommended regular garbage collection; 32 (11.03%) proposed training and massive IEC on waste management; 24 (8.28%) compulsory training of fishpond caretakers and operators on feeding fish. On flooding, 65 (22.1%) suggested to plant more trees in the river, beach areas and in their houses, some (49 or 16.90%), particularly fishpond operators said they have to fence fishponds with nets to prevent escape of their stocks; and some (23 or 7.93%) proposed landfilling in low lying areas. On poaching, 71 (24.48%) fyke net operators said that they should regularly monitor their fishing apparatus. Some (59 of 20.34%) of them said that the law should strictly be enforced when the poachers are caught. For lack of alternative sources of income, 83 (28.62%) respondents said there is a need of intensive training/seminars particularly on livestock raising, and food processing and 64 (22.07%) said that there is a need to form a group or organization so as to secure fund for livelihood projects easily. For soil erosion and siltation, 31 (10.69%) of the respondents said that the river needs dredging while 15 (5.17%) of them suggested that there is a need to plant more trees especially in the beach area and river bank. Conversion of river into fishpond according to 9 (3.1%) respondents has to be reported to DENR as the agency who have the power to solve such issue. The problem on the cutting of trees, especially mangroves, 20 (6.9%) of the respondents proposed that violators caught will just be reprimanded and asked to plant trees besides the fully cut ones and for 12 (4.14%) respondents a massive IEC on the banning of cutting trees especially mangroves should be done by concerned municipal as well as barangay officials.

Implication on sustainable development and conservation

Developing the area is a challenging activity for the stakeholders of the river. The baseline data gathered in the assessment would be very significant baseline information to effect and measure changes or success of a development project. The result on low biological diversity, some improper utilization and poor implementation of some management strategies and serious problems on low level of catch would give the stakeholders idea on the components of the sustainable development plan to be implemented.

Likewise, management consultant would be challenged to strengthen organizational structure or governance of the area.

The high density and IVI of the non-edible mollusks could be an opportunity and not a threat when its utilization is explored. It could be another subject of research that would benefit not just the researcher/s but the river and the stakeholders themselves.

CONCLUSION AND RECOMMENDATION

Buenlag-Sabangan River is dominated by few species of riparian macroflora and aquatic macrofauna which implies a need for further resource protection and management. Despite the good water of the river, low level of catch was experienced and was considered as more serious problem hence, the stakeholders proposed reduction on the number of fishing apparatus and provision of alternative sources of income to reduce dependence of the community on the river as source of food and means of livelihood. The resources of Buenlag-Sabangan River are moderately utilized by the respondents through various means and strategies employed in the management and conservation were fairly implemented which denote a need for stronger governance and institutional linkage.

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