



PROGRESS REPORT

(November 2007-August 2008)

Sustainable Fisheries Management Program for Lake Mainit: Phase II. Comprehensive Resource Assessment

Prepared by

**MSU Naawan Foundation for Science
and Technology Development, Inc.**

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PROJECT INFORMATION

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1. PROJECT AREA, SCOPE AND DURATION

Lake Mainit is a shared resource of the provinces of Agusan del Norte and Surigao del Norte, bordered by eight municipalities that comprise the Lake Mainit Watershed (Fig. 1). The fisheries resource assessment project, however, covers only six municipalities immediately surrounding the lake and Kalinawan River, namely, Mainit, Alegria (in Surigao del Norte), Kitcharao, Jabonga, Santiago, and Tubay (in Agusan del Norte), with a total of 31 coastal or lakeshore barangays. The comprehensive resource assessment (Phase II) covers the period November 2007-October 2008 to complete a 12-month project duration. The results of this assessment will provide the scientific basis for formulating a comprehensive fisheries management plan for Lake Mainit that shall, in turn, be integrated into the Lake Mainit Development Agenda.

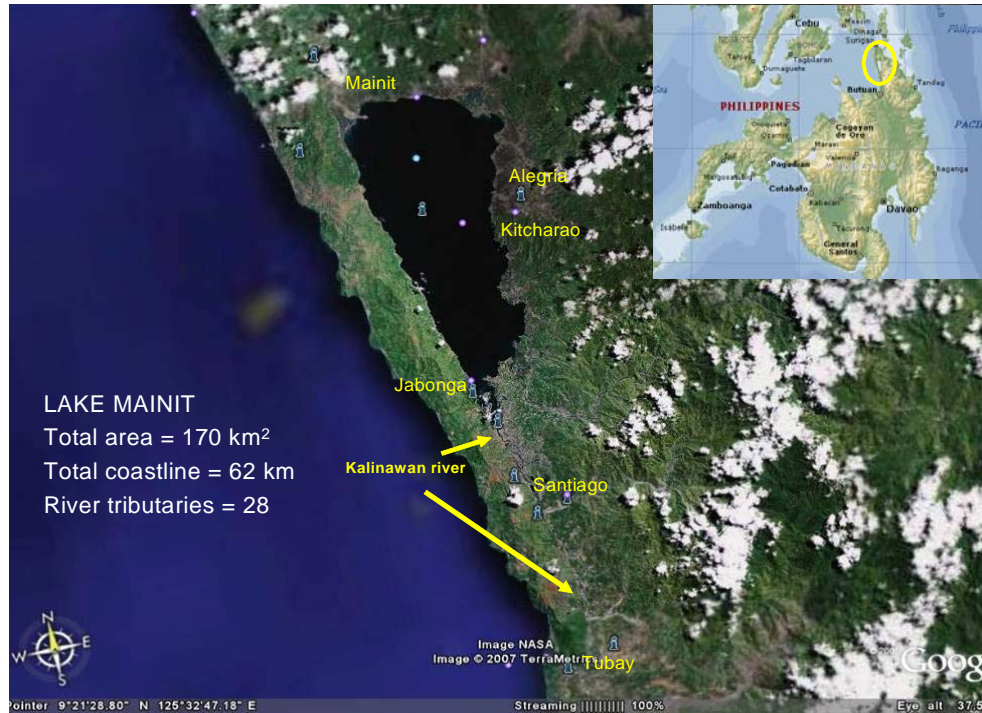


Figure 1. Map showing the location of Lake Mainit in northeastern Mindanao.

2. METHODOLOGY FOR PHASE II – COMPREHENSIVE FISHERIES AND STOCK ASSESSMENT

Phase I-Rapid Resource Assessment of the project covered the period August-October 2007 and the results have been reported in the Inception Report, the data presented therein already form part of the comprehensive fish stock assessment component of Year 1 which covers the following sub-components:

- 1) Assessment of Aquatic Diversity and Assessment of Lake and Riverine Fisheries;
- 2) Population Biology and Stock Dynamics; and
- 3) Socio-Economic Profiling and Institutional Arrangements

Gathering of relevant data on biodiversity, fisheries production, stock dynamics and survey of interventions and institutional arrangements continued from November 2007 until September 2008. This leaves only October 2008 to complete data gathering under the three project components.

2.1 Aquatic Diversity and Assessment of Lake and Riverine Fisheries

During the comprehensive fish stock assessment phase of the project, monitoring of fish catch and effort from different sampling sites around the lake was made monthly from November 2007 to September 2008 with the assistance of local research partners (LRPs) assigned to each of six stations. Relevant fisheries information from each fisher was recorded

on standard data sheets for a minimum of 15-20 days each month, specifically on the following:

- Gear and boat type used and number of units
- Kinds of fish caught
- Volume or weight of fish (kg)
- Number of hours fishing (including travel time)
- Location of fishing ground/area

The species composition of landed catch was determined by gear type to show the diversity of fisheries resources in the lake and river, and of catches of various gear types. Maps showing the distribution of fishing gears and major fish and invertebrate resources were also generated, but these need to be validated once again with fishers around the lake. Voucher specimens of different plant species, fish, and invertebrates were collected during the survey. Species reportedly present in the area, but without voucher specimens, were also listed and noted. Photographs were taken for every gear, including its measurements.

2.2 Fish Population Biology and Stock Dynamics

Data on body length, weight, sexual maturity, and other biological parameters of major fishery resources were gathered each month. Detailed analysis is focused on two species of gobies, *Glossogobius giuris*, known as *Pijanga* and *Hypseleotris agilis*, known as *Bugwan*, whose population dynamics and fishery were studied in the middle 1990s by Galicia and Lopez (2000). Whenever possible, at least 100 individuals of each species were sampled from catches of *pukot* and *baling* in the lakeshore municipalities of Jabonga, Kitcharao and Mainit each month within a three-day period. Biological parameters such as size ranges, sex ratios, and maturity stages) were determined from monthly data. Gonadal maturity was determined based on a modified 5-point classification scale (immature, maturing, mature, gravid (spawning) and spent (resting). Monthly biological data are important in the analysis of length-weight relationships and population dynamics of commercially important stocks that can help in formulating fisheries management measures.

2.3 Socio-Economic Profiling, Institutional Arrangements and Intervention Programs

The socio-economic profile presented in the Inception Report was primarily based on output of a series of focus group discussion conducted under a Participatory Resource Appraisal (PRA) in the six municipalities surrounding Lake Mainit. Information from the FGDs was supplemented in Phase II with information from the provincial and municipal profiles, key informant interviews (KII) and validated through walk-through or ocular surveys, and interviews of fishing households in 24 barangays around the lake and Kalinawan River. Data on municipal ordinances related to fisheries and environmental management were also obtained from municipal profiles and reports provided by LGU offices. A survey of non-government and people's organizations in each municipality and the intervention programs implemented thus far was also made.

3. RESULT HIGHLIGHTS

3.1 Aquatic Diversity and Fisheries of Lake Mainit and Kalinawan River

3.1.1 Aquatic Biodiversity

Finfish Resources

A total of 40 species of finfish belonging to 21 families were identified in Lake Mainit and Kalinawan River based on collected samples during the survey (Table 1). This number exceeded the 37 species reported by Pauly et al. (1990), however 14 species listed in Pauly et al (1990) are not reported in the present study. This difference in species diversity across time could be attributed to a number of factors. Some species may have been locally extinct due to overfishing or the increased prominence of introduced or exotic species (such as tilapia, carp, and catfish).

Of the 40 species found in the Lake, 14 species are freshwater fishes and 27 species are noted to be marine fishes that enter freshwater bodies seasonally, usually to spawn. Many of the marine species in the list are caught in Kalinawan River where the monitoring stations of Santiago and Tubay, Agusan del Norte are located. Many of these fishes have wide habitat ranges where they inhabit coastal lakes, rivers, estuaries, lagoons and creeks. The marine species *Mugil cephalus* or mullet (family Mugilidae) also breeds in freshwater areas. Figure 2 pictures of major fishes caught in the Lake.

Majority of these fishes are caught at mature stages except for *Therapon jarbua* (family Theraponidae) where many juveniles or young stages are caught by various gears. Young stages of *T. jarbua* and young adults of *Valamugil cunnesius* are known to enter freshwater ecosystems (Conlu 1982). Ambassids, represented by *Ambassis sp.* locally known as “ibis”, are either estuarine or freshwater. Fish families such as Clariidae, Lutjanidae, and Carangidae are represented in the catches from Kalinawan River. Two freshwater species, namely, *Oreochromis nilotica* (tilapia) and *Cyprinus carpio* (carpa) are known to be introduced fishes in the Lake. The list of fishes compiled by Pauly et al. (1990) from various sources indicated that at least 24 species were either marine or migratory, entering freshwater at certain times of the year or their life cycle.

The gobies *Glossogobius giuris* (locally called *pijanga*) and *Hypseleotris agilis* (*bugwan*) are the most popular species, reported to be the most abundantly caught fish in the 1980-81 assessment of Pauly et al. (1990) and the 1995-96 study of Galicia and Lopez (2000). These gobies are considered by fishers in Lake Mainit as native or indigineous, although Pauly et al. (1990) reported that they may be marine species entering freshwater ecosystem of the lake. The eel *Anguilla sp.* (*kasili*) used to be caught in abundance, but recent reports suggest its abundance has diminished. A species of anchovy, locally called *bolinao*, was formerly identified as *Atherina sp.*, but recent taxonomic references identify it as *Neostethus thessa* (FishBase 2007). Figure 3 shows the distribution of major kinds of fish around the lake, with the higher diversity found on the northeastern side (Mainit to Kitcharao).

Table 1: Diversity of finfish caught for Lake Mainit and Kalinawan River (August 2007 to September 2008).

Family	Species Name	Local Name	Common Name
1 Anabantidae	<i>Anabas testudineus</i>	Puyo; Bakang	Gourami
2 Anguillidae	<i>Anguilla marmorata</i>	Kasili	Eel
3 Carangidae	<i>Caranx sp 1</i>	Langub	Trevally
4 Carangidae	<i>Caranx sp 2</i>	Bogok	Caranx
5 Carangidae	<i>Ulua mentalis</i>	Samin-samin	Caranx
6 Centropomidae	<i>Lates calcarifer</i>	Laya	Giant sea perch
7 Chandidae	<i>Ambassis sp 1</i>	Ibis	Glassfish
8 Chandidae	<i>Ambassis sp 2</i>	Ibis	Glassfish
9 Chandidae	<i>Ambassis commersonii</i>	Ibis pangan	Glassfish
10 Channidae	<i>Channa striata</i>	Haluan	Chevron snakehead
11 Chanidae	<i>Chanos chanos</i>	Bangus	Milkfish
12 Cichlidae	<i>Oreochromis nilotica</i>	Tilapia	Nile Tilapia
13 Cichlidae	<i>Oreochromis mossambica</i>	Lipunan	Mosambique Tilapia
14 Clariidae	<i>Clarias batrachus</i>	Bangkok	Thai catfish
15 Clariidae	<i>Clarias sp</i>	Agok-ok; Pantat; Hito	Native catfish
16 Cyprinidae	<i>Cyprinus carpio</i>	Carpa	Common carp
17 Cyprinidae	<i>Puntius binotatus</i>	Gabot	Spottedbarb
18 Engraulidae	<i>Engraulis sp</i>	Mole	Anchovy
19 Eleotridae	<i>Hypseleotris agilis</i>	Bugwan	Goby
20 Gerridae	<i>Gerres filamentosus</i>	Latab	Spotted mojarras
21 Gobiidae	<i>Glossogobius giuris</i>	Pijanga	White goby
22 Gobiidae	<i>Glossogobius sp</i>	Bul-a	Goby
23 Gobiidae	<i>Ophiocara aporos</i>	Durod	Snakehead gudgeon
24 Hemiramphidae	<i>Hemiramphus sp</i>	Suloy-suloy	Halfbeak
25 Leiognathidae	<i>Leiognathus equulus</i>	Mawalay; Sap-sap	Common slipmouth
26 Leiognathidae	<i>Leiognathus sp</i>	Pot-pot	Slipmouth
27 Lutjanidae	<i>Lutjanus argentimaculatus</i>	Gingaw	Red snapper
28 Lutjanidae	<i>Lutjanus sebae</i>	Bilbigan	Emperor red snapper
29 Lutjanidae	<i>Lutjanus sp</i>	Aha-an	Snapper
30 Mugilidae	<i>Mugil cephalus</i>	Banak; Balanak	Flathead mullet
31 Mugilidae	<i>Valamugil cunnessius</i>	Gisaw	Long-arm mullet
32 Mugilidae	<i>Mugil sp</i>	Lampohon	Mullet
33 Mullidae	<i>Upeneus sp</i>	Bod-bod/salmoyete	Goatfish
34 Phallostethidae	<i>Neosthetus thessa</i>	Bolinao	Priapium fish
35 Scatophagidae	<i>Scatophagus argus</i>	Kikilo	Spotted scat
36 Siganidae	<i>Siganus punctatus</i>	Buras	Rabbit fish
37 Siganidae	<i>Siganus sp</i>	Danggit	Rabbit fish
38 Sillaginidae	<i>Sillago sihama</i>	Aso-os	Common whittings
39 Theraponidae	<i>Therapon jarbua</i>	Bugaong	Convex-lined therapon
40 Theraponidae	<i>Mesopristis cancellatus</i>	Pigok	Cross-barred grunt
Unconfirmed identification		<i>Luyab</i>	Juvenile pijanga
		<i>Saguyon</i>	Mixed fry of bugwan and pijanga
		<i>Bakoko</i>	Unidentified
		<i>Bungusan</i>	Unidentified
		<i>Subok</i>	Unidentified
		<i>Anga; Bunog</i>	Unidentified



Figure 2. Common finfish species of commercial value in Lake Mainit. A) *Glossogobius giurus* B) *Hypseleotris agilis* C) *Oreochromis nilotica* D) *Cyprinus carpio* E) *Channa striata* F) *Mugil vaigiensis* G) *Anguilla* sp. H) *Neostethus thessa*.

Aquatic plants

A total of fourteen (14) species of aquatic plants classified into six submerged and eight floating plants were identified in Lake Mainit (Table 2; Fig. 4). Voucher specimens were collected and preliminary identification was made based on Winterton & Shcer (2007) and a poster published by PCAMRD. All submerged plants form extensive underwater meadows with the exception of *Ottelia alismoides*. A common aquatic plant is *Vallisneria* sp., locally called *lusay* and is akin to the marine eelgrass, is found growing along clear shoreline waters together with *Hydrilla verticillata*, *Najas graminea* and *Ceratophyllum* sp. *Hydrilla*, known locally as *dugman*, tends to grow quite extensively as monospecific mats with an average percent cover of 86%, particularly in the municipality of Jabonga along the mouth of Kalinawan river and along Alegria toward Mainit. *Hydrilla* has been reported to be a noxious plant in Washington Bay (Winterton & Shcer, 2007), its ability to form extensive mats making the bottom anoxic. Since *dugman* is a very fast growing plant it can compete for space with other plant species in the lake, and may reduce oxygen in relatively stagnant lake waters.

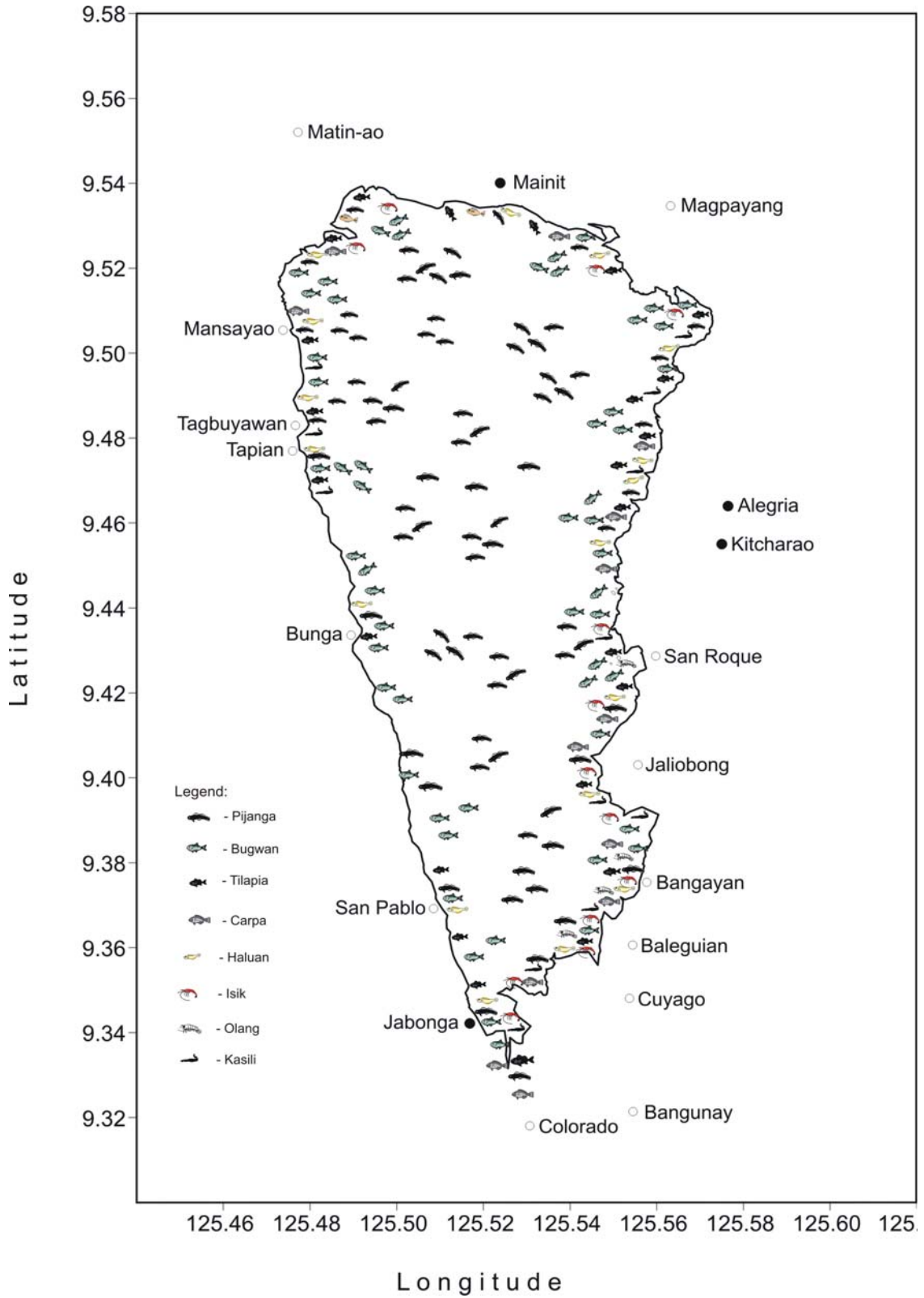


Figure 3. Resource map of Lake Mainit showing distribution of major fish and crustacean resources.

Table 2. List of aquatic plants occurring in Lake Mainit and its outlet Kalinawan River.

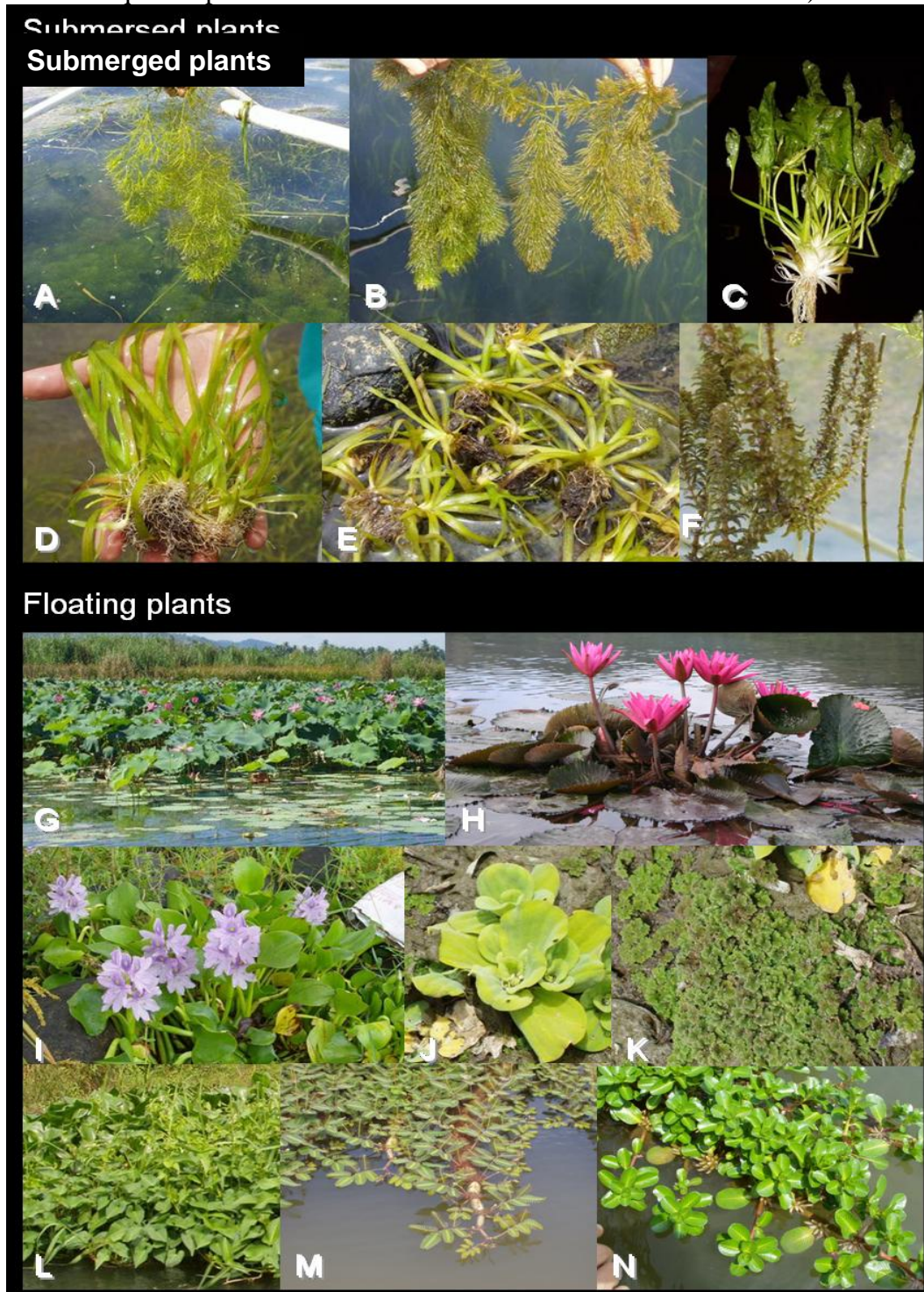
	Local Name	Common Name
Submerged Plants		
<i>Vallisneria sp.1</i>	Lusay	Eel grass, tape grass
<i>Vallisneria sp.2(rosette type)</i>	Lusay	Eel grass
<i>Hydrilla verticillata</i>	Dugman	Hydrilla
<i>Najas graminea</i>	None	Water nymph
<i>Ceratophyllum sp.</i>	None	Coontail, hornwoot
<i>Ottelia alismoides</i>	None	Duck lettuce
Floating & Emergent plants		
<i>Echornia crassipes</i>	Water lilies	Water hyacinth
<i>Pistia stratiotes</i>	None	Water lettuce
<i>Nelumbo nucifera</i>	Paguse	Sacred lotus, lotus lilly
<i>Azolla sp.</i>	None	Pond fern
<i>Neptunia sp. (oleracea?)</i>	<i>Kupo-kupo, hibi-hibi</i>	Small leaf sensitive plant, Neptunia
<i>Ipomea sp. (aquatica?)</i>	Tangkong	Kangkong, water spinach,
Unidentified 1	Red lotus	Red lotus
Unidentified 2 (see Fig. 11)	No local name	-

Among the emergent plants, *Nelumbo nucifera* locally known as *pagusè* occurs in wide patches with an estimated total area of 11.26 hectares within the lake (Fig. 5). The largest *pagusè* bed was recorded in Barangay Mayag (5.2 ha) of the municipality of Mainit, followed by Tagbayawan (2.7 ha) in Alegria. Several small patches (less than a hectare) of *pagusè* are observed in Jabonga and San Roque. Fruits of *pagusè* are harvested mostly by children and are eaten or sold in bundles for P0.50 each.

The water lily or hyacinth (*Echornia crassipes*) is a floating plant common along the shoreline and all throughout Lake Mainit, and cover almost the whole stretch of the Kalinawan river bank. In some areas, bamboo poles are provided to collect the water hyacinths, which become fish shelter and fishing areas for the local communities. During the flood season or “*guob*”, the river may be impassable due to the build up of dense growth of the plant. The piling up of this plant in the shallow parts of the river can cause back flow, thus, raising the water level of the lake significantly.

Usually found on the periphery of the dense water lily spread is the red stem kangkong, *Ipomea sp.* A number of floating plants such as the *Neptunia sp.* locally known as “*kupo-kupo*” or “*hibi-hibi*” occur in small patches along the upper part of Kalinawan river.

Figure 4. Aquatic plants of Lake Mainit and Kalinawan river: A) water nymph



B) coontail or hornwort C) duck lettuce D) eel grass or tape grass E) eel grass rosette type F) Hydrilla G) lotus lily H) red lotus I) water hyacinth J) water lettuce K) pond fern L) kangkong or water spinach M) Neptunia or small leaf sensitive plant N) unidentified.

Downstream of Kalinawan River the bottom is primarily sandy-muddy. Submerged plants are conspicuously absent, except for filamentous green algae which are used as baits

for pole fishing of tilapia. Approximately 3 km from the river mouth, a small patch of duck lettuce, *Ottelia alismoides*, was noted growing on muddy substrates with cover ranging from 15% to 80%.

Aquatic plants along the river bank of Kalinawan river comprise at least six species which were identified based on their local names, namely: *Tigbao*, *Ayaganay*, *Dawpang*, *Moti-moti*, *Tamok*, and *Makahiya*.

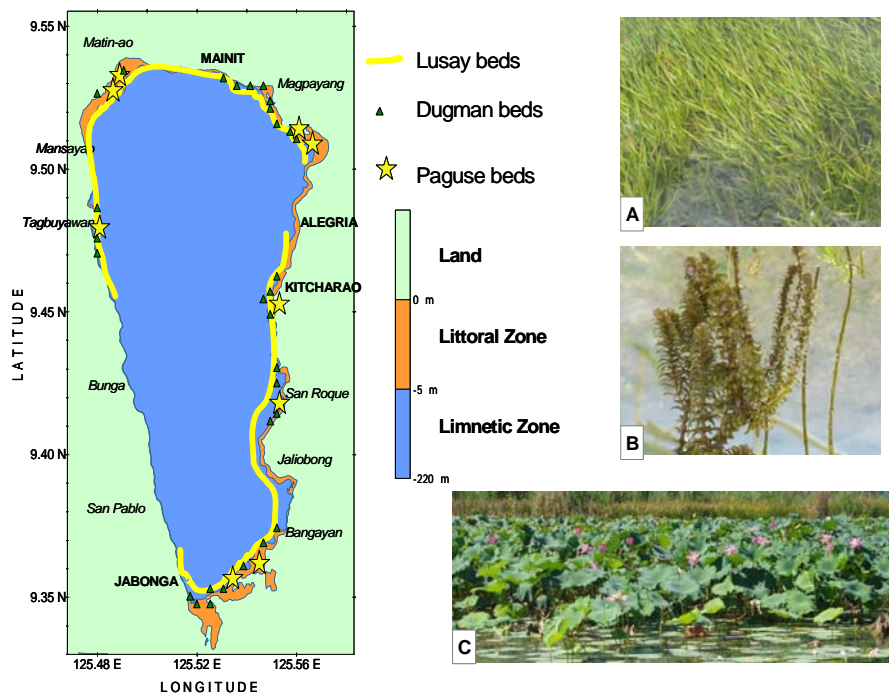


Fig. 5. Distribution of major aquatic plants A) *Vallisneria* sp or *lusay*. B) *Hydrilla verticillata* or *dugman* C) *Nelumbu nucifera* or *paguse* in Lake Mainit

Aquatic Invertebrates

At least ten major groups of aquatic invertebrates are found around Lake Mainit which are composed of bivalves, gastropods, crabs, and shrimps. The most common bivalve is of the genus *Corbicula* (Family Corbiculidae) locally called *kabibi* which probably composed of two or more species. Abrea (2003) identified *Corbicula manilensis* and four other unknown species along the littoral zone of Mainit and Kitcharao. These bivalves are commonly found along the littoral zones of Tagbuyawan, San Pablo, San Roque, Mainit, Jabongga, and as far as Habungon and La Paz along Tubay River (Fig. 6). Also found was the Taiwan shell, *Anodontia* (Cristaria) *woodiana* (Family Unionidae), an introduced species occurring along San Pablo, San Roque, Mainit, Jabongga, and La Paz.

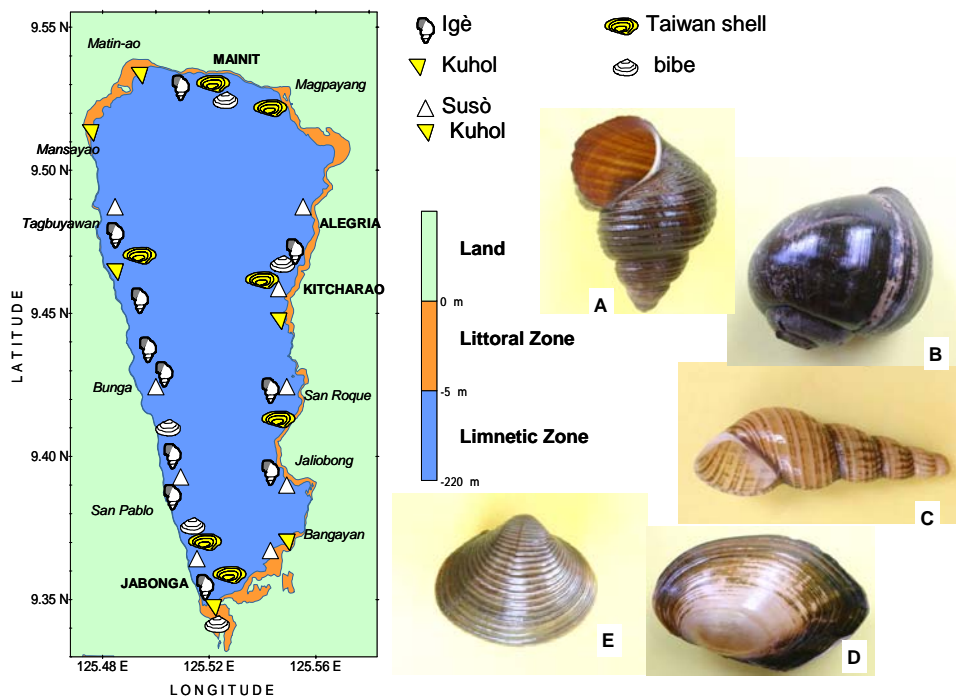


Figure 6. Distribution of mollusks in Lake Mainit. A. *Viviparia angularis* (ige) B. *Pomacea canaliculata* (kuhol) C. *Melania* sp (susò). D. *Anodontia woodiana* (Taiwan shell) and E. *Corbicula* sp. (bibe).

3.1.2 Profile of Lake and Riverine Fisheries

Fishing Gears

A total of seven major fishing gear groups were documented as follows: seines, impounding nets, mobile impounding nets, gillnets, traps and pots, hook and line, and simple hand implements (Table 3). These gears, with the exception of fish corrals, crab traps, fish traps, gillnets and hook and line, are active, *i.e.* those that capture fish and invertebrates by active pursuit or gear movement. Many gear types have several variants or modifications, leading to a higher number of gear types operating in the lake and Kalinawan River. Figure 7 shows the distribution of the major fishing gears used in Lake Mainit and Kalinawan River. Although banned in most municipalities, beach seine or “*baling*” is operated in the northern part of the lake, while “*boso*” or diving with compressor has been reported to still operate in the midsection of Lake Mainit.

Landed Fish Catch

The total fish catch of the Lake and Kalinawan river is estimated at 219.5 tons recorded from August 2007 to July 2008, based on landed fish catch data in 27 of the 32 major and minor landing areas of the six municipalities around Lake Mainit. The lake fishery

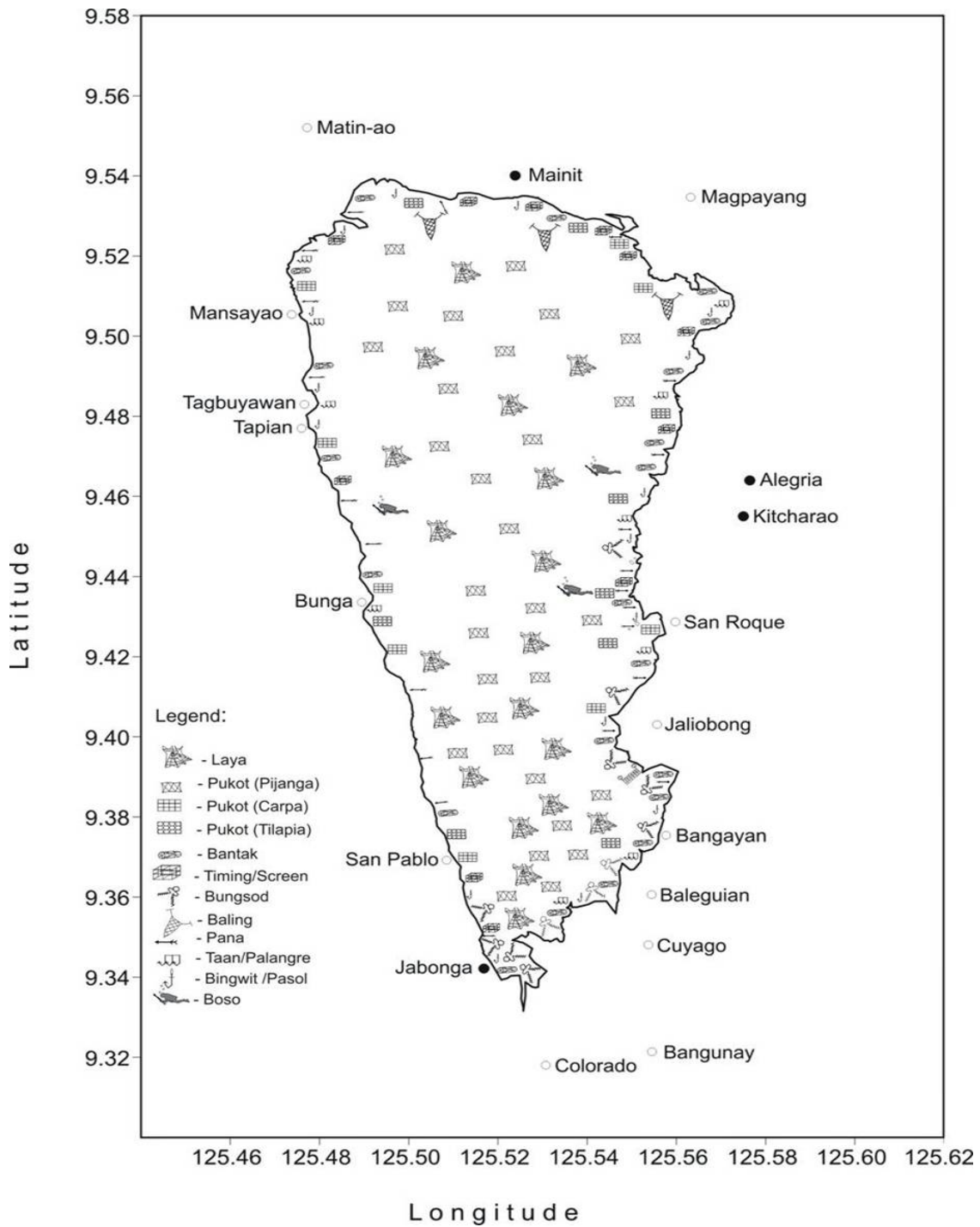


Figure 7. Map of fishing gear distribution in Lake Mainit.

represented by stations Mainit, Alegria, Kitcharao & Jabonga accounted for 94% (206.5 tons) of the total catch, while the Kalinawan river represented by Santiago and Tubay contributed only 6% (13.04 tons) of total landed catch (Fig. 8-9). Extrapolating our

estimates based on the 27 monitored landing areas yields an estimated 252 tons of fish caught for a one year period. Our present value is less than 2% of the total annual catch of 15,108 tons reported in 1980-81 by Pauly et al. (1990).

Table 3. Distribution of fishing gears in Lake Mainit and Kalinawan river.

Gear types		Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay
English Name	Local Name						
Seines							
Beach seine	<i>Baling, sinsin</i>	x					x
Impounding Nets							
Barrier net	<i>Panira/lambat</i>					x	
Fish corral	<i>Bungsod</i>			x	x	x	
Mobile Impounding Nets							
Cast net	<i>Laya, paapong</i>	x		x	x		x
Gill Nets							
Set gill net	<i>Pante-taan</i>						
2 cm mesh (goby)	<i>Pukot pang-pijanga</i>	x	x	x	x		
3.2 cm mesh (gourami)	<i>Pukot pang-gurami</i>					x	
6 cm mesh (tilapia)	<i>Pukot pang-tilapia</i>	x	x	x	x	x	
15 cm mesh (carp)	<i>Pukot pang-carpa</i>	x	x	x	x		
Drift gill net	<i>Paanod, pante-anod</i>						x
Traps/Pots							
Crab trap	<i>Bantak</i>	x		x	x		
Fish trap	<i>Timing, screen</i>	x	x	x	x	x	
Modified fish trap	<i>palaksuhan</i>					x	
Hook and Line							
Simple hook & line	<i>Bingwit/Pasol</i>			x	x		x
Multiple handline	<i>Buldos, bundak</i>			x			
Bottom set longline	<i>Taan, palangre</i>	x	x	x	x		
Hand Instruments							
Spear	<i>Pana</i>	x	x	x	x	x	x
Harpoon	<i>Sapang</i>			x			
Scoop net	<i>Sarap</i>	x		x			

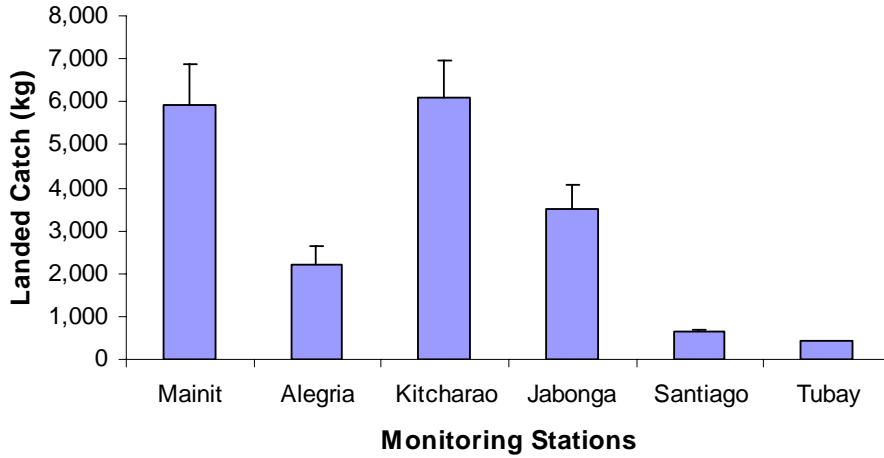


Figure 8. Landed catch in the six municipalities around Lake Mainit and Kalinawan River from August 2007 to July 2008. Error bars are standard errors of n=12 months.

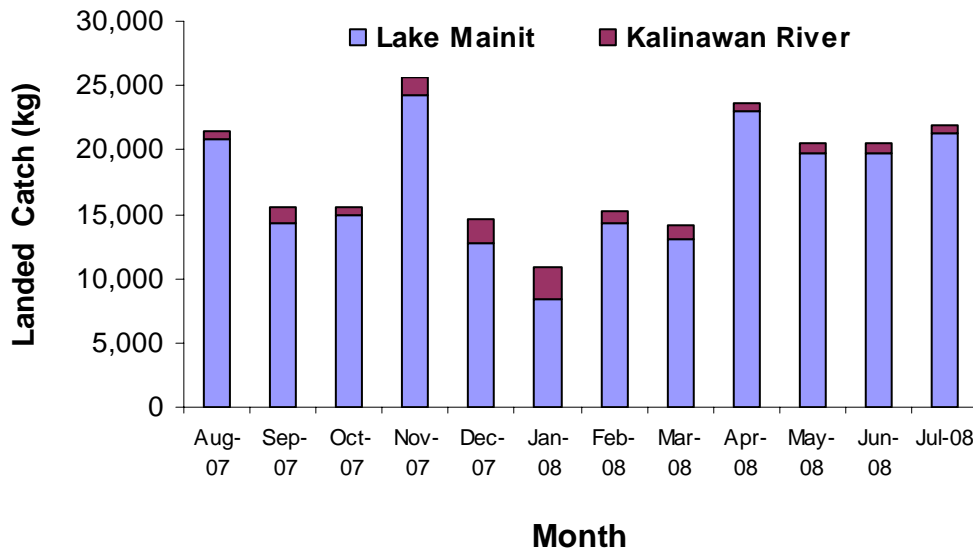


Figure 9. Comparison of the monthly landed fish catch (kg) in the six municipalities around Lake Mainit and Kalinawan river.

Among the monitored stations, Kitcharao contributed the highest fish catch accounting for 33.26% of total landed catch from the lake, followed by the municipalities of Mainit (29.6%), Jabonga (19.09%) and Alegria (12.11%). Kalinawan river represented by Santiago and Tubay had low fish catch contributing less than 3% of total fish catch landed (Table 4). However, Tubay had the most number of species recorded with 27 species caught by various gears. Most of the species reported are marine species caught near the mouth of

Table 4. Total landed fish catch in kilogram from August 2007 to July 2008.

Local Name	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay	Total
<i>Agok-ok</i>			23		61		83
<i>Ahaan</i>						16	16
<i>Asohos</i>						38	38
<i>Bakang</i>					13		13
<i>Bakoko</i>				12		3	15
<i>Banak</i>	12	5	6	79	25	36	148
<i>Bangkok</i>	231	13	189	36	138		607
<i>Bangus</i>						5	5
<i>Bilbigan</i>						27	27
<i>Bolinao</i>	8		1,573				1,581
<i>Bugaong</i>						194	194
<i>Bugok</i>						19	19
<i>Bugwan</i>	4,716	182	1,920	1,786			8,604
<i>Bul-a</i>						3	3
<i>Bungusan</i>	73						73
<i>Buras</i>						192	192
<i>Carpa</i>	602	3,307	4,207	4,852	2,115	227	15,310
<i>Durod</i>					1		1
<i>Gabot</i>				10	44		54
<i>Gingaw</i>			3		7	88	97
<i>Gisaw</i>					3	48	51
<i>Gurami</i>				24	62		86
<i>Haluan</i>	2,201	1,336	986	1,539	2,095		8,142
<i>Hito</i>				113			113
<i>Ibis</i>	0				1	6	7
<i>Ibis amihan</i>						791	791
<i>Kasili</i>	49	19	724	246	28	5	1,072
<i>Kikilo</i>				5	2	142	148
<i>Lampohon</i>						6,972	6,972
<i>Langub</i>				12	1	2	1
<i>Latab</i>						35	35
<i>Laya</i>			12				12
<i>Lipunan</i>		91					91
<i>Luyab</i>	18,070		4,692	29			22,791
<i>Mole</i>						23	23
<i>Pantat</i>	19	618	38		225		891
<i>Pegok</i>				64		59	122
<i>Pijanga</i>	34,080	424	37,751	27,953			100,208
<i>Potpot</i>						2	2
<i>Saguyon</i>	34		1,144				1,178
<i>Salmoyete/Bodbod</i>						0	0
<i>Samin-samin</i>						0	0
<i>Sapsap</i>						3	3
<i>Tilapia</i>	4,211	20,523	9,199	4,411	3,094	50	41,487
Subtotal: finfish	64,305	26,518	62,466	41,171	7,912	8,986	211,308

Local Name	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay	Total
<i>Alimango</i>			8				8
<i>Ige</i>	14		575				588
<i>Isik</i>	528		3,484				4,012
<i>Kagang</i>			268				268
<i>Olang</i>	551	439	6,333	94			7,417
Shells			47				47
Shrimps	19				156		156
<i>Suso</i>			96				96
Subtotal: invertebrates	1,112	439	10,811	94	156	0	12,592
Grand Total	65,417	26,957	73,277	41,265	8,068	8,986	223,900

Kalinawan River draining into Butuan Bay. Landed catch in Kitcharao comprise 22 species, while the lowest number of 12 species comprise the landed catch in Alegria.

Based on recorded catches, the most abundantly caught fish in the six municipalities around Lake Mainit is the goby, locally called *pijanga*, accounting for 48.4% of the total landed catch between August 2007 and September 2008 (Fig. 10). This result seems to contradict common observations and local perception that *pijanga* is already a diminishing resource in the lake. Local research partners and fishers around Lake Mainit, however, have validated this result by noting that much of the *pijanga* catch is being exported to Butuan City and other neighboring towns. This would explain why *pijanga* is not commonly encountered in the local markets around the lake, but would reinforce the importance of this goby to the local economy of Lake Mainit.

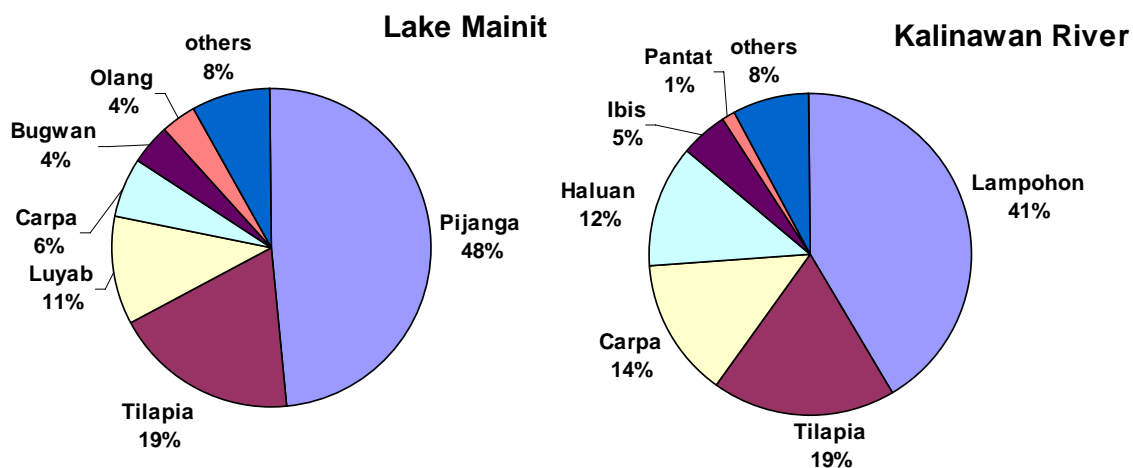


Figure 10. Relative abundance of the major finfish species in Lake Mainit and Kalinawan river from August 2007 to July 2008

Data from landed fish catch also showed that Lake Mainit and Kalinawan River have distinct fishery resource profiles (Fig. 10). *Pijanga* contributes more than half (48.4%) of the total fish catch from the lake followed by the *tilapia* (18.5%), *luyab* (11.0%) and *Carp* (6.3%). In Kalinawan river, the mullet locally known as *lampohon* contributed 40.9% of total landed catch in the river, followed by tilapia (18.4%), *carpa* (13.7%) and *haluan* (12.3%).

The fishing gear with the largest contribution to fish production in all municipalities is the set gillnet (*pukot*) which accounted for 28% of landed catch from the lake and 38% from Kalinawan River. *Baling* (13%) and *laya* (11%) also landed larger catches compared to other fishing gears in the Lake (Fig. 11). Catches of *pana*, *bantak* and *timing* contribute only a small percentage to the total capture fisheries production from the lake. Another major gear with large recorded catches (31%) in Kalinawan River is drift gillnet, locally called *pante-anod*. This result needs to be validated, however, as this gear is operated only by fishers in Tubay and probably includes marine fish catches from Butuan Bay.

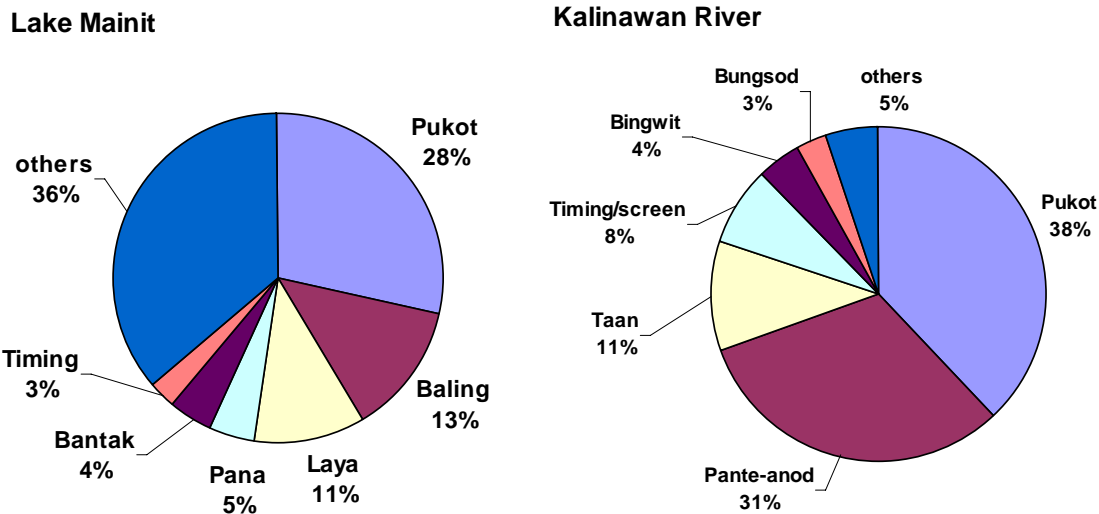


Figure 11. Relative contribution of major gear types in Lake Mainit and Kalinawan river fisheries.

The total number of fishers per m 5-6). Mainit has the most number of fishers (54 fishers/day), followed by Kitcharao (38 fishers/day) while Santiago has the fewest fishers (11) on an average day. Estimated catch per unit effort (CPUE) is, however, highest in Jabonga (9.73 kg/fishers/day), followed by Mainit (7.09 kg/fisher/day). The lowest CPUE so far recorded is 1.14kg/fisher/day in Tubay.

Table 5. Summary profile on fishing effort in Lake Mainit and Kalinawan river.

	Mean Landed Catch (kg) per month	Mean No. Fishers per month	Mean No. fishing days monitored per month	Mean No. Fishers per day	Mean Catch per Fisher per day (kg)
Mainit	6362	897	17	54	7.09
Alegria	2215	538	25	21	4.12
Kitcharao	6085	887	23	38	6.86
Jabonga	3494	359	17	22	9.73
Santiago	663	218	20	11	3.04
Tubay	424	373	15	25	1.14
Total	19243	3272	117	171	32.98
Average	3207	545	20	29	5.33

3.2 Population Biology and Stock Dynamics

Detailed biological analysis was conducted on only two major fishes in Lake Mainit, namely, *pijanga* (*Glossogobius giuris*) and *bugwan* (*Hypseleotris agilis*), which were also studied by Galicia and Lopez (2000). These two species of goby are the most popular and abundant native fishes in the lake and their catches support the local economy. Changes in the population dynamics of these important species are of interest to fisheries management, and detailed information in their biology is critical to development of measures to sustain their fisheries.

3.2.1 Classification of Fishes of Lake Mainit

The fishes in Lake Mainit can be classified into four different groups. These fishes can be grouped into lake fishes, amphidromous fishes, riverine fishes and catadromous fishes. The lake fishes are confined in the lake and these include commercially important fishes such as catfish, mudfish, tilapia, common carp, endemic eleotrid and the white goby. Small lake fishes that are of low commercial importance include the climbing perch, spotted barb, priapium fish, freshwater halfbeak and unidentified small fish known as “subok”.

The amphidromous fishes are euryhaline fishes (wide tolerance to salinity range) that migrate to Lake Mainit during periods of flooding and inundation (November – January) and this include snappers, mullets, milkfish, scats, tarpons, ten pounders and trevallies. These amphidromous fishes are caught mostly along the Kalinawan River using traps as the river is a migration pathway between Lake Mainit and the marine waters of Butuan Bay.

Table 6. Catch per unit effort (CPUE) per fisher per gear of the common fishing gears used in Lake Mainit and Kalinawan river.

Fishing Gear	Lake Mainit				Kalinawan River		Average
	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay	
<i>Baling</i>	5.2			3.8			4.5
<i>Bantak</i>	7.1	3.3	3.6	3.7	3.7		4.3
<i>Bingwit</i>	4.0	2.8	2.4	3.0		1.5	2.7
<i>Buldos</i>	3.5			9.0			6.3
<i>Bungsod</i>	1.6	3.2	16.3	14.3	6.0		8.3
<i>Buso</i>			9.3				9.3
<i>Darak</i>				2.0			2.0
<i>Dompil</i>	13.0			10.8			11.9
<i>Kuryente</i>	3.0						3.0
<i>Lambat</i>					4.3		4.3
<i>Laya</i>	6.3		16.7	12.7			11.9
<i>Mosket</i>						1.1	1.1
<i>Palaksuhan</i>					3.2		3.2
<i>Palangre</i>	14.7			6.6		4.3	8.5
<i>Palutaw</i>				35.0			35.0
<i>Pana</i>	3.8	3.2	4.7	3.2	4.2	2.9	3.7
<i>Pante-anod</i>						1.1	1.1
<i>Pante-taan</i>						1.2	1.2
<i>Pontak</i>			2.0				2.0
<i>Pukot</i>	11.3	4.1	9.0	7.5	3.1		7.0
<i>Sapang</i>			14.7				14.7
<i>Sapyaw</i>			12.1				12.1
<i>Sarap</i>	8.7		18.7				13.7
<i>Sin-sin</i>						2.5	2.5
<i>Skylab</i>	18.0						18.0
<i>Surit</i>						2.9	2.9
<i>Taan</i>	9.8	3.0	3.3	9.3	3.3		5.7
<i>Timing/screen</i>	10.2	5.6	4.2	7.0	1.8		5.8
Average	8.0	3.6	9.0	9.1	3.7	2.2	7.4

The riverine fishes are fishes that stay in the 28 watershed rivers and Kalinawan River and the seasonal Pagusi Lake along the Kalinawan River. Riverine fishes include *Puntius binotatus*, freshwater halfbeaks, carps, tilapia, silversides, tapiroid grunters, and fishes locally known as *anga*, *bunog*, *durod* and *ibis*. The catadromous fishes are represented by the giant mottled eel locally known as *kasili* and the tapiroid grunter locally known as *pigok*. These fishes grow in freshwater environments but migrate to marine waters during spawning.

3.2.2 Biological Characteristics of Major Fish Stocks

Length-frequency data on the two species of gobies are available from August 2007 to August 2008, covering more than 12 months of biological data which are viable for detailed analysis of growth, mortality, recruitment and other parameters needed to describe the population dynamics of these important fish species. Detailed analysis of length-frequency and biological data is yet to be done using the computer software package FiSAT (or FAO-ICLARM Stock Assessment Tools) to obtain these parameter estimates.

The common goby *Hypseleotris agilis* Herre. The common eleotrid locally known as *bugwan* (*Hypseleotris agilis* Herre) is a native fish species of Lake Mainit (Fig. 12) that belongs to Family Gobiidae. It is an omnivorous fish that thrives in the littoral zone of the lake. Lake Mainit being the clearest lake in the Philippines has an extensive littoral zone due to its very high transparency of approximately 6.65 m and corresponding 1% Photosynthetically Active Radiation (PAR) depth of 33.25 m. This eleotrid can still be caught at these depths.



Fig. 12. The eleotrid *Hypseleotris agilis* Herre locally known as *Bugwan*.

H. agilis caught in Lake Mainit by beach seine (*baling*) and gillnet (*pukot*) ranged in size between 51 – 180 mm although size ranges vary from month to month. The size range of *bugwan* observed in the present assessment is slightly smaller than the size range of 40-185mm studied by Galicia and Lopez (2000). Monthly sex ratios of mature individuals of *H. agilis* generally show more female than male *bugwan*. Monthly gonadal stage frequency distribution for *H. agilis* (Fig. 13).

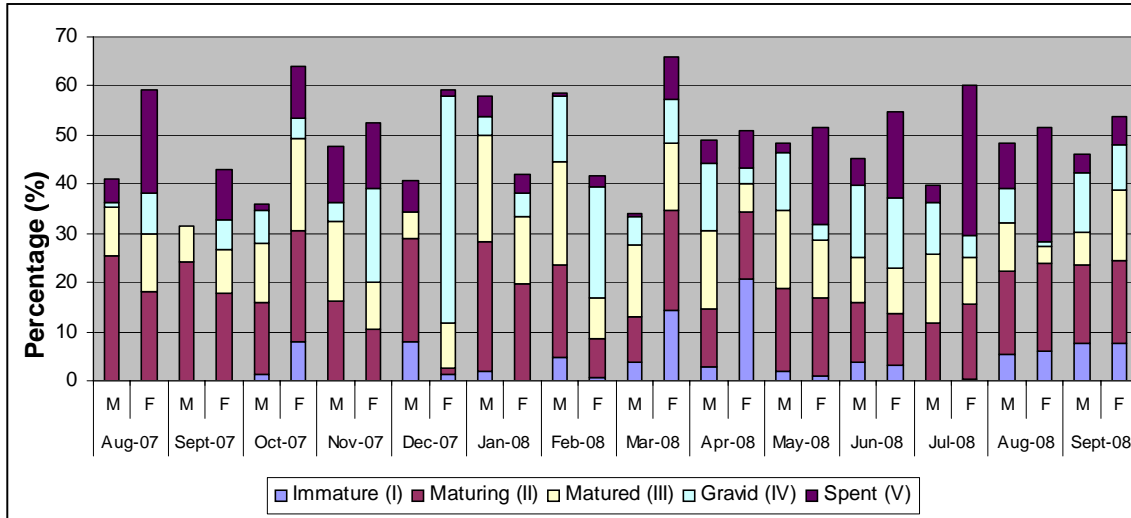


Figure 13. Monthly gonadal maturity stages in male and female *H. agilis* caught by beach seine and gillnet in Lake Mainit.

The White Goby (*Glossogobius giuris*). The white goby (*Glossogobius giuris*) locally known as *pijanga* (Fig. 14) is characterized by having fused ventral fins which are used functionally to anchor on substrates. The *pijanga* from Lake Mainit are found in littoral and limnetic zones and support a major fishery in the lake ecosystem.



Figure 14. The white goby, *Glossogobius giuris*, locally called *pijanga*.

The *G. giuris* catches from Lake Mainit during August 2007 to September 2008 range in size from 50 – 241 mm, which are smaller than the size range of 25 to 305 mm reported by Galicia and Lopez (2000). Monthly gonadal stage frequency distributions show variation of peaks from month to month (Fig. 15). Monthly sex ratios are variable, with the tendency toward more female than male mature individuals.

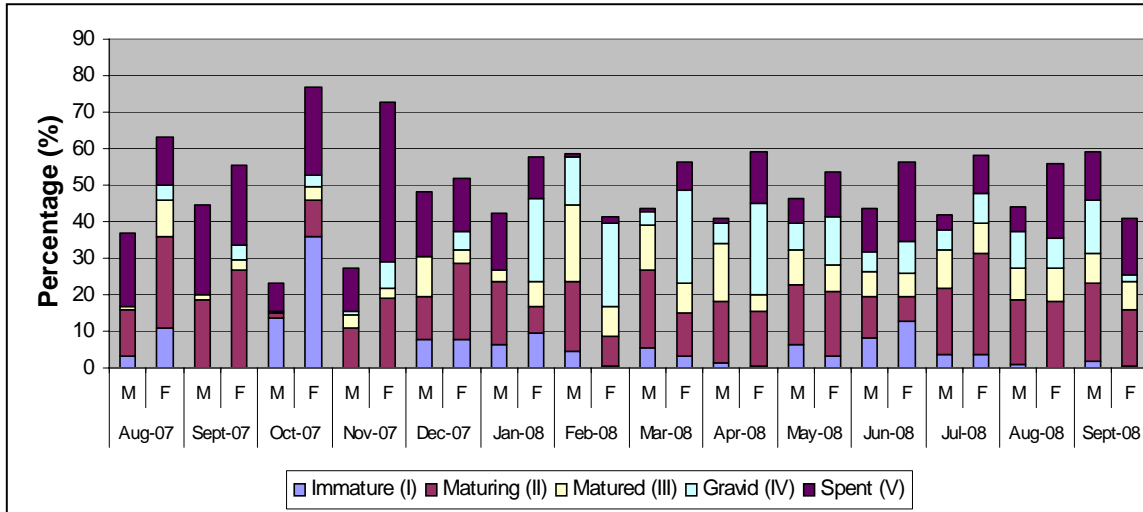


Figure 15. Monthly gonadal maturity stages in male and female *G. giuridis* caught by beach seine and gillnet in Lake Mainit.

The length –weight relationships of *bugwan* and *pijanga* are presented in Table 7 as separated by sex and as overall values for the species. The derived value of regression slope (**b**) is 3.12 for combined sexes of *bugwan*, while a **b** or 3.25 was derived for combined sexes of *pijanga*. These **b** values indicate that both species of goby have allometric growth, that is, the fishes grow in weight faster than their growth in length. For an ideal fish which maintains dimensional equality, the isometric value of **b** would be 3, as occasionally observed in many species of fish (Allen 1938). The slope (**b**) value less than 3 indicates that a fish becomes more slender as it increases in length. A slope value greater than 3 denotes stoutness or allometric growth (Pauly 1984). However, deviation from isometric growth is often observed, as most fish change their body shape as they grow.

Table 7. Length –weight relationships and related statistics for the two gobies collected in Lake Mainit, Philippines.

Species	Sex	No.	Length		Weight		Regression Parameters		
			min	max	min	max	α	b	R ²
<i>Hypseleotris agilis</i> (Bugwan)	Male	994	5.5	18	2	58	0.0101	3.1103	0.9425
	Female	1177	5.2	14.8	2	46	0.0095	3.1252	0.9556
	Overall	2311	5.1	18	1	58	0.0097	3.1204	0.9556
<i>Glossogobius giuridis</i> (Pijanga)	Male	2278	5.9	22	2	100	0.0090	3.0238	0.9358
	Female	2845	5.7	24.1	2	128	0.0079	3.0746	0.9206
	Overall	5629	5	24.1	1	128	0.0050	3.2523	0.9414

Detailed analysis of length-frequency and biological data is yet to be done using the computer software package FiSAT (or FAO-ICLARM Stock Assessment Tools) to obtain parameter estimates on growth, mortality, recruitment and other relevant aspects of the population dynamics of these important fish species.

3.3 Socio-Economic Profile, Institutional Arrangements and Intervention Programs

3.3.1 Demographics

Fisher Population. The series of focus group discussions (FGD) conducted in the Rapid Assessment Phase of the project (August-October 2007) covered a total of 46 barangays, although only 31 of these have been reported as coastal barangays around Lake Mainit (LMDA, 2005). Estimates of population in coastal barangays surrounding Lake Mainit were obtained from the most recent municipal profiles, although the year reported varies across municipalities (Table 8). Unfortunately, as of this report no data have been forwarded from Alegria and Santiago. It can be seen on the table that estimates of fisher population by FGD participants are much higher than the number validated by the Local Research Partners from each municipality, with the exception of Alegria where the FGD estimate is much too low (Table 8). Based on data provided by barangay officials, BFARMCs and fisherfolk associations to the LRPs, a total of 1,746 fishers are users of the fisheries resources of Lake Mainit and Kalinawan River.

Table 8. Lakeshore and fishing populations in Lake Mainit municipalities.

Province Municipality	Surigao del Norte			Agusan del Norte			Total
	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay	
Shore population*	2007	2005	2004	2004	2006	2004	
	18,817	No data	5,498	4,582	No data	8,778	
No. of Fishers:							
Municipal Profile*	No data	No data	185	261	66	109	-
FGD, 2007**	435	78	880	1,230	1,028	477	4,128
LRP, 2008***	280	233	436	212	170	415	1,746
Full time	99	No data	54	No data	45	290	-
Part time	170	No data	382	No data	125	125	-

* Municipal Profiles, most recent data available, year indicated

**FGD, Focus Group Discussion in 2007

***Data from Local Research Partners (Municipal Agriculture Offices), 2008

On the average, about 36% of these fishers are full-time while the rest only fish on a part-time capacity, presumably because they have other livelihood opportunities. More fishers (69.9%) are engaged full time in fishing in Tubay than in Mainit (35.4%), Santiago (26.5%), and in Kitcharao (12.4%). In many municipalities around Lake Mainit fishing comes secondary, as the wide agricultural land attract lakeshore residents to go on farming. Results of household interviews conducted among 302 respondents from 24 barangays (Fig. 16) present updated information on demographic characteristics of lakeshore communities.

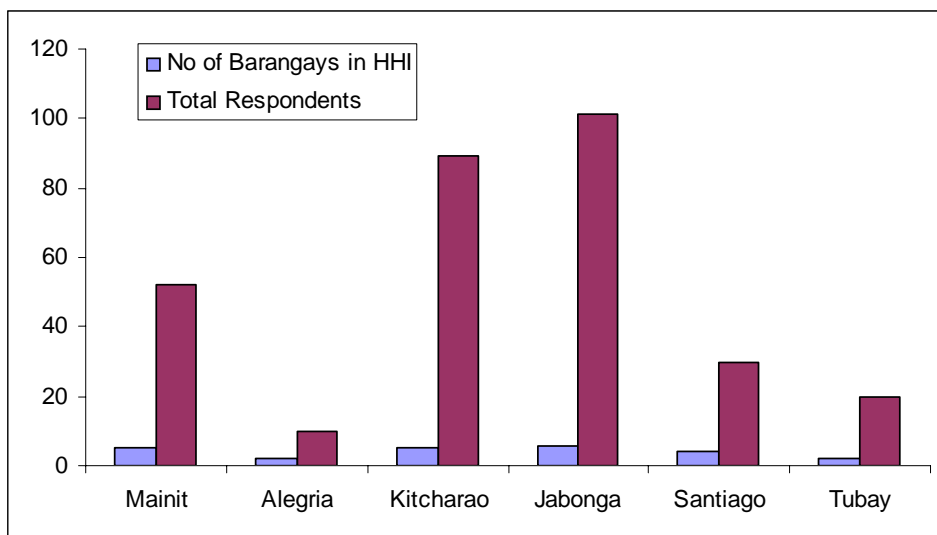


Figure 16. Number of respondents and coastal barangays around Lake Mainit covered by the household interview conducted between April and August, 2008.

Employment and Age Profile of Respondents. Most of the 302 respondents were males (97%) and married (95%). Most of the fishers are engaged full time as fishers except in Jabonga and Santiago where more respondents are part time fishers (Fig. 17). Most of them are within the age range 31-40 years old (45.7 %) while a few (6%) respondents are quite old (60-70 years old) but possess a very good memory and who can describe the fisheries in past years very well (Fig 18).

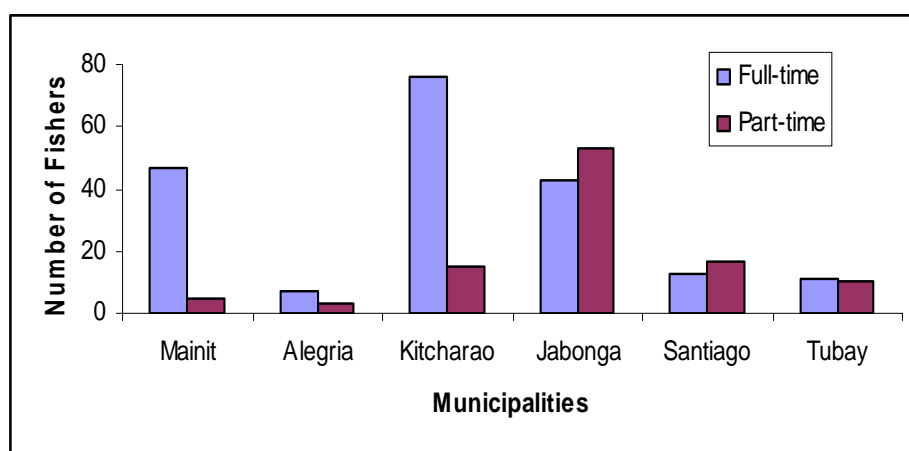


Figure 17. Classification of respondents by type of fishing engagement.

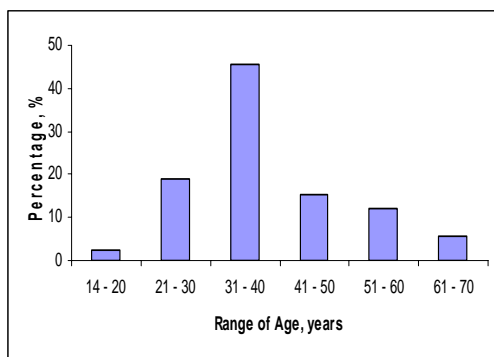


Figure 18. Percent distribution of the respondents by age range.

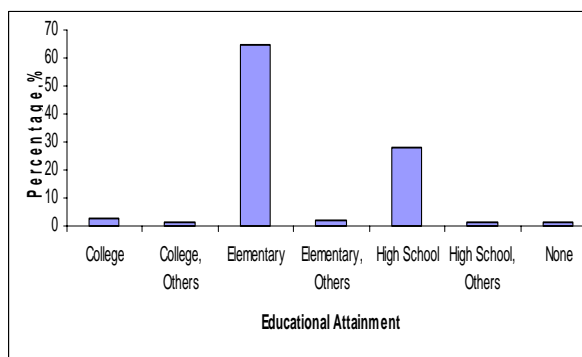


Figure 19. Distribution of respondents based on educational attainment.

Education. The literacy rate, defined as having the ability to read and write, of the population in Lake Mainit range from 80% in Alegria to 93.7% in Mainit (Table 9). Most of the fishers have gone to elementary schools and know the basic reading and writing skills (Fig 19). In addition, many of them have developed skills in *pukot* and *bantak* making, carpentry and masonry, automotive driving, carpentry and electrical skills.

Table 9. Summary of demographic and economic characteristics among fishing households around Lake Mainit and Kalinawan River. (Source: Municipal Fisheries Profile).

Municipality	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay
Year*	2007	2005	2004	2004	2006	2004
No. of Households	4,621	1,300	2,821	3,416	No data	1,668
Ave No. of Children	No data	4	5	4	6	4
Literacy Rate, %	93.69	80.00	92.5	No data	No data	No data
Ave. Annual Income, Phpesos	No data	22,800	36,000	24,000	No data	No data
Annual/capita consumption, kg/yr	No data	No data	18	124	No data	No data
Top 5 types of employment	Carpentry	Farming	Farming	Gov't employment	Fishing	Farming
	Farming	Govt Worker	Fishing	Contract worker in agriculture	Mining	Fishing
	Fishing	Private Self-employed	Forestry		Farming	Trading
	Govt employ.		Labor		Buy & sell	fish vending
	Small Business		Microbusiness		Sari-sari store	Sari-sari store

Most fishers are knowledgeable about fishing history and trends. Most of them were born and grew within their municipality and are familiar with the dynamics of the lake and its fisheries (Fig 20). Others (13%) have just joined the fishing community by way of marriage about 10 or 20 years ago. The oldest of the respondents belong to the 60 -70 age group who had been fishing in the lake since they were young.

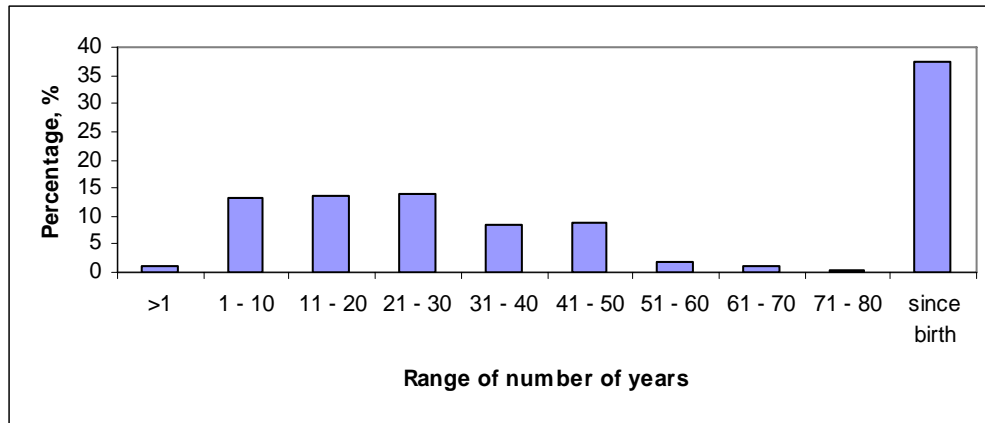


Fig. 20. Number of years of residence of respondents around Lake Mainit.

Tenure and Housing. Through the years of residing in Lake Mainit only 33.83% have acquired lot for house construction either by inheritance or purchase by installment (Fig 21). Most of them do not have security (66.17%) for they are largely dependent on rental (36%), such as in Jabonga and Mainit, or the generosity of private individuals. In Jabonga, the rental ranges from P250 to P360 per year. Rental rates in Mainit are quite higher, ranging from P120 to P720 per year. Many fishers occupy the barangay lots (21.31%) especially in Santiago. Others (3.28%) are occupying the Mamanwa Resettlement site in Jabonga.

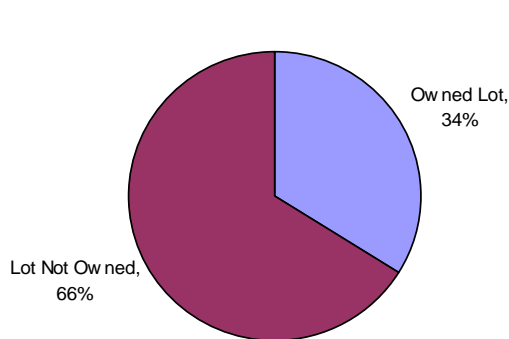


Figure 21. Percent distribution of lot ownership.

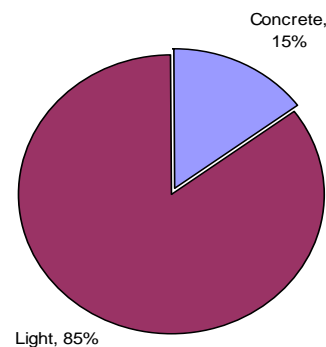


Figure 22. Distribution of respondents by type of dwelling .

Most respondents built their own houses (92.61%) made from light materials (84.42%) while the few others who can afford built concrete houses (14.86%) (Fig. 22). They also enjoy a few amenities like refrigerator, television and stereo sets especially in Mainit,

but for many others radio sets and electricity are considered enough. Water is supplied by the barangay in common outlets or connections supplied to the family or household at a monthly rate.

Household Size. The number of children in a family ranges from one (8.9%) to 13 (0.36%), with four children having the highest frequency of families (19.22%). It is obvious from the data that many fisher families have practiced population control with more than 60% or respondents having less than 5 children (Fig 23).

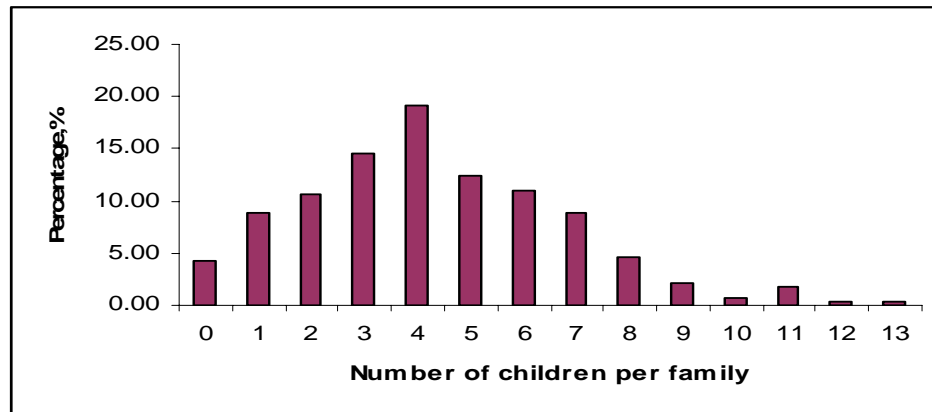


Fig. 23. Percentage distribution on the number of children per family.

The household size corresponds to the number of children, thus, many families have six members in a household (Fig 24). Some larger families have accommodated married children or relatives.

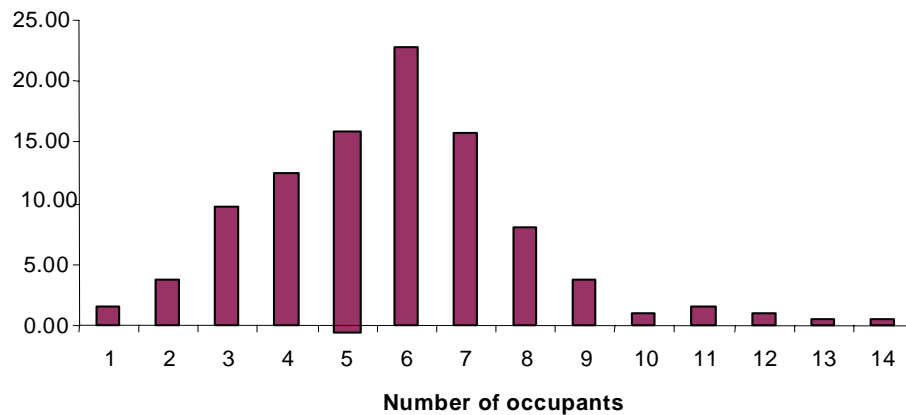


Fig. 24. Percentage distribution of the household size in Lake Mainit communities.

Sources of Income and Living Standards. For full time fishers, fishing in Lake Mainit and Kalinawan River is the main source of income (85%), followed by farming (12%). Other minor income-generating activities are operating a sari-sari store (1%),

engaging in mini-scale mining (1%) and many others (Fig 25). For the part time fishers, farming is the main source of income supplemented by fishing and other livelihood options (Fig 26) especially in Jabonga and Santiago.

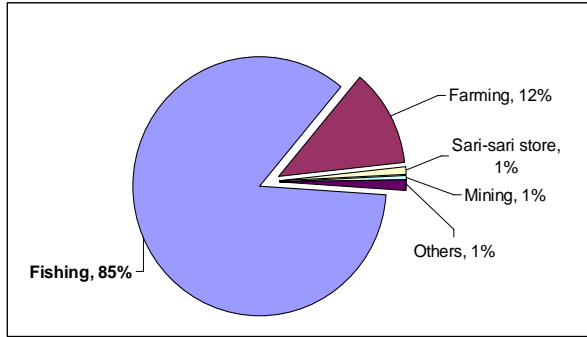


Fig. 25. Primary and secondary sources of income of full time fishers.

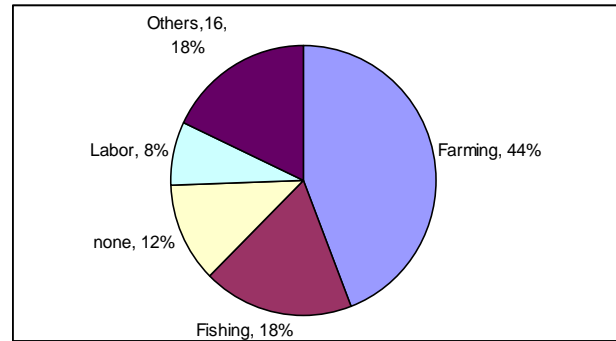


Fig. 26. Primary and secondary sources of income of part-time fishers.

3.3.2 Profile on Fishing Effort, Fish Production and Economics

As in the number of fishers, data on the number of fishing boats from different sources also show wide variations among the municipalities. Estimates from FGD data are very high especially in Kitcharao, Jabonga, and Santiago, and slightly higher only in Mainit. An opposite trend is observed in Alegria where data from the municipal agriculture office showed higher estimate of boats than the FGD (Table 10, Fig. 27).

Table 10. Estimates of the number of fishing boats in Lake Mainit and Kalinawan River.

Province Municipality	Surigao del Norte			Agusan del Norte			Total
	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay	
Municipal data*	2007	2005	2004	2004	2006	2004	
Motorized	62	4	56	86	1		209
Non-motorized	190	140	118	118	33	No data	599
Total	252	144	174	204	34		808
Fishing Boats, FGD**							
Motorized	152	3	293	180	88	50	766
Non-Motorized	166	53	551	853	25	362	2,010
Total	318	56	844	1,033	113	412	2,776
Fishing Boats, LRP**							
Motorized	62	4	56	131	22	No data	275
Non-Motorized	190	140	118	82	106	No data	636
Total No Boats	252	144	174	213	128	No data	911

*Recent data available, year indicated; **FGD, Focus Group Discussion in 2007; *** Data from LRP

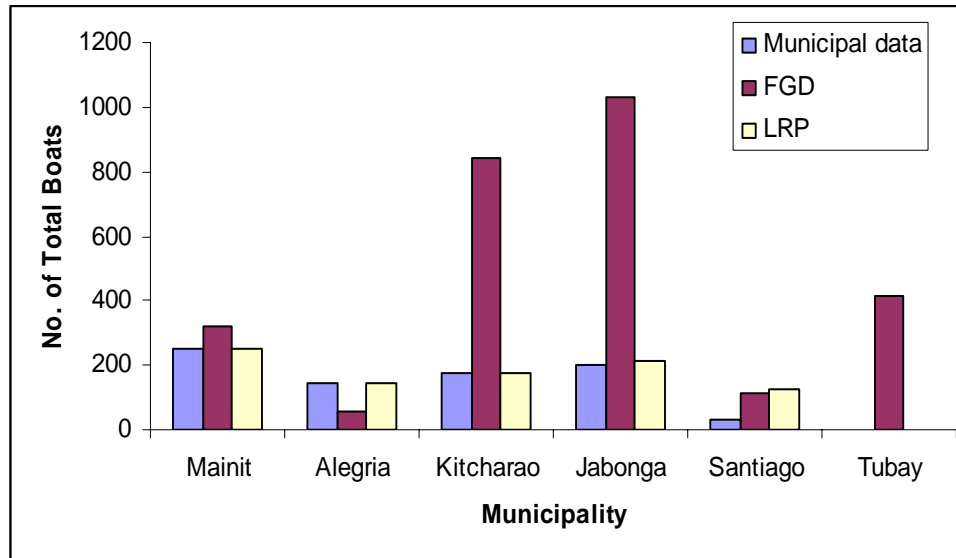


Figure 27. Comparison on the number of fishing boats, by source.

Data from LRPs are considered more reliable than from FGDs since these were personally gathered from the latest barangay-based statistics and fisherfolk organizations. On the average, motorized boats comprise 43.2% of the fishing boats around the lake and river areas while the rest are non-motorized bancas or dug-out canoes with or without outriggers.

The report of the Aquatic Diversity and Assessment of Lake and River Fisheries (this volume) indicates 19 different kinds of fishing gear operate in Lake Mainit and Kalinawan River. Fishing gears used in lake and river fisheries are quite diverse: including simple to multiple handlines, longlines, gill nets, push nets, modified cast nets, drag seines, barriers, fish corrals and traps, spears, and even fish shelters and snail dredges and many others ingenious implements of simple construction. The most commonly used gears are various modifications of hook-and-line or *pasol/bingwit*, gillnet (*pukot*), fish traps (*timing*), spear (*pana*) and the modified cast net or *laya*. Mainit based on information provided by fishers during FGDs. Most of these gears are operated using either motorized or non-motorized boats with crew size of 1-2 fishers, except for beach seine (*baling*) which requires at least seven fishers to operate.

Results of fisheries monitoring of 27 coastal barangays around the lake show that as much as 252 tons of fish is produced from Lake Mainit and Kalinawan River in a year. At an average price per kilogram of fish at Php60, the total annual revenues from the fisheries can reach Php1.51 million. Average catch-per-unit-effort (CPUE) of all stations is 5.33 kg/fisher/day, which would translate to an estimated gross revenue of Php320 per fisher on a daily basis. On the other hand, costs of fishing are high (Fig. 28) and thus, net incomes tend to be low. Moreover, daily household expenditures are quite high (P228-353) so that many fishers end up having either low or zero net incomes (Fig. 29). In some cases, fishers experience negative net incomes, an obvious indicator that for some fishers, fishing has become unprofitable.

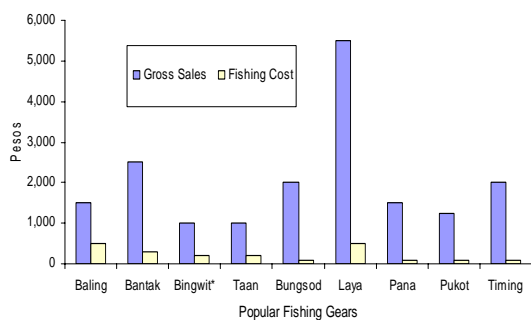


Figure 28. Gross sales and fishing cost of popular gears.

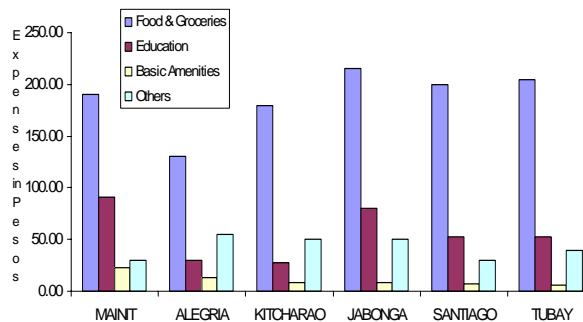


Figure 29. Comparative distribution of average daily expenditures per municipality.

3.3.3 Institutional Arrangements and Intervention Programs

National Government /Regional Line Agencies

A number of national government and regional line agencies have defined mandates toward natural resource and environmental management and have been active participants in Lake Mainit and environs, as follow:

- DENR- Department of Environment and Natural Resources
- DENR- Mines and Geosciences Bureau (MGB)
- Department of Agriculture (DA) - Bureau of Fishery and Aquatic Resources (BFAR)
- Department of Agrarian Reform (DAR)
- Department of Education (DepEd)
- Cooperative Development Authority (CDA)
- National Economic Development Authority (NEDA)
- Department of Tourism (DOT)
- Department of Public Works and Highways (DPWH)
- Department of Social Welfare and Development DSWD
- Department of Trade and Industries (DTI)

These agencies implement various programs around the lake, however, their actions are independent from one another and sometimes efforts either overlap or conflict. There is a need to harmonize or synchronize the activities and programs pursued by each agency and integrate them into a common task of protecting, conserving and managing the resources and restoring the integrity of the Lake Mainit environment.

Non-Government Organization (NGOs) and People's Organization (POs)

Aside from government agencies, a large number of non-government organizations and people's organizations are part of resource management of the lake, initiating

empowerment of the stakeholders as a tool for environmental governance at the municipal and barangay levels. The people are organized to collectively express their concerns and implement their agreed policies and regulations (Table 11).

Table 11. Summarized List of municipal-based NGOs and POs around Lake Mainit.

Municipality	ACRONYM	Name	Source
Mainit		Magsaysay Livelihood Association	Municipal Profile
		Mainit Livelihood for Progress	Municipal Profile
		Mainit Centerpoint Association	Municipal Profile
	ALAS	Barbers group - SPELL OUT	This study, 2008
	BESWAMC	Barangay Ecological Solid Waste Management Committee	Municipal Profile
	LVA	Lakeside Vendors Association	Municipal Profile This study, 2008
	MACCAP	Mainit Concerned Citizen Action for Progress	Municipal Profile
	MAFARA	Mansayao Farmers Association	This study, 2008; Municipal Profile
	MAFIAS	Matin-ao Federated Association	Municipal Profile This study, 2008
	MAFVEMCO	Mainit Fishermen and Vendors Multi-Purpose Cooperative	This study, 2008; Municipal Profile
	MAPAMCO	Matin-ao Agri Multi-Purpose Cooperative	Municipal Profile
	MASFO	Mansayao Small Fisherfolk Organization	This study, 2008; Municipal Profile
	MCCD	Mainit Concerned Citizen for Development	Municipal Profile
	MFA	Magsaysay Farmers Association	Municipal Profile
	MIFA	Mainit Integrated Fisherfolk Association	This study, 2008; Municipal Profile
	MMPC	Mainit Multi-Purpose Cooperative	Municipal Profile This study, 2008
	ROFAMCO	Roxas Farmers Multi-Purpose Cooperative	Municipal Profile
	ROFAO	Roxas Farmers Association	Municipal Profile
SANIFA	San Isidro Farmers Association	Municipal Profile	
TAMUCO	Tolingon Agro Multi-Purpose Cooperative	Municipal Profile	
Alegria	REACH Foundation	Rural Enterprise Assistance Center Foundation, Inc.	Municipal Profile
	ALRUWA	Alegria Lakeshore & Rural Workers Association	Municipal Profile
	PROPESEANS ERC		Municipal Profile This study, 2008
	FFA	Federation of Farmers Association	This study, 2008
Kitcharao	BLA	Bangayan Lakeview Association	Municipal Profile This study
	CAFFA	Canaway Farmers and Fisherfolk Association in Canaway	Municipal Profile This study
	CroFA	Crossing Fisherfolk Association	This study
	CYMO	Crossing Youth Movement Organization	This study
	JAFFA	Jaliobong Farmers and Fisherfolk Association in Jaliobong	Municipal Profile This study

	PFFA	Poblacion Farmers and Fisherfolk Association	Municipal Profile This study
	SAROMCO	San Roque Multi-purpose Cooperative	Municipal Profile This study
	SARUFA	Sangay-San Roque Farmers Assoc	This study
Jabonga		A. Beltran Fisherfolk Assoc, Baranggay	This study This study
		Religious Group	This study
		Jabonga Fisherfolk Association	This study
		Farmers Organization	This study
	BFO	Bunga Fisherfolks Org	This study
	BUNGAT	Bag-ong Ugma Nga Gui-hiusahan Alang sa Tanan	This study
	CARBMPC		This study
	CFA	Colorado Fisherfolk Assoc	This study
	FPC	Fisher Folks Production Collective	This study
SAPFA	San Pablo Fisherfolk Association	This study	
	STIMULUS		This study
Santiago	EMIFMC	E. Morgado Integrated Forest Development Multipurpose Cooperative (EMIFDMPC)	Municipal Profile This study
	JUFA	Jagupit United Farmer Association	Municipal Profile This study
	LUFA	Lapaz Upland Farmers Association	Municipal Profile This study
	SIUFMULCO	San Isidro United Farmer Multi-Purpose Coop	Municipal Profile This study
	TCFA	Tribal Casagayan Farmer Association	Municipal Profile
	TUFAD	Tagbuyacan Upland Farmers Association	Municipal Profile This study
Tubay		Organisasyon sa Gagmayng Mananagat sa Poblacion Dos	Municipal Profile
		Nagkahiusang Gagmayng Mananagat sa Cabayawa	Municipal Profile
		Punta Gracia Fishers Association	Municipal Profile

Research Institutions

The following government and private education and research institutions in Mindanao are involved in Lake Mainit through their environmental concerns in the conduct of biological and social researches:

- Mindanao State University System (MSUS) through its specific campuses namely, MSU Marawi, MSU at Naawan, and MSU-Iligan Institute of Technology
- Surigao del Norte College of Agriculture and Technology (SNCAT)
- Xavier University (XU)

Health care initiatives especially on the dreaded schistosomiasis and other social research studies were conducted by XU. Aquaculture production of tilapia was technically supported by SNCAT while biological and limnological studies were done by the MSU. The Philippine Council for Aquatic and Marine Research and Development (PCAMRD) participated in the management through funding support for scientific investigations.

Intervention Programs

Lake Mainit and its surrounding municipalities have attracted the attention of various programs and projects introduced to the communities. The intervention programs are categorized arbitrarily into the following: livelihood options, credit facilities for financial assistance, health care, infrastructure, and environmental programs, based on accounts of FGD participants, barangay/organization's officials, and household respondents. Most of the livelihood projects are on livestock dispersal (introduced since 1980s), farming, provision of farming implements, and fish culture. Financial assistance is largely on small-scale lending to POs and organization members, but several programs have supported infrastructure and health facilities (Table 12). Several national and foreign funding agencies have supported these various programs (Table 13).

Environmental rehabilitation projects are quite limited, with a focus on tree planting and establishment of fish sanctuaries in Lake Mainit at Alegria and Kitcharao. Among the six municipalities around Lake Mainit covered by the present project, Alegria, Jabonga and Santiago appear to be the most benefited by these intervention programs (Table 12), while Tubay has the least number of support programs. It is possible, however, that the enumeration from the FGDs is incomplete.

Impacts of Intervention Programs

The analysis of the impacts of all these intervention programs is still underway. Determination of the positive or negative impacts of the numerous interventions implemented in the lake and environs is important in evaluating the efficacy of programs, and in finding ways to improve future implementation. From the donor or sponsor's perspective, impact evaluation would determine if the amount of funding expended on the program is commensurate with the results or outcome.

Table 12. Intervention programs and projects introduced in Lake Mainit communities.

Programs/Projects	Mainit	Alegria	Kitcharao	Jabonga	Santiago	Tubay
Livelihood:						X
Hog dispersal	X		X	X	X	
Goat dispersal	X	X		X	X	
Carabao dispersal		X	X	X	X	
Chicken dispersal		X				
Cow/cattle dispersal		X	X		X	
Power turtle farm machine					X	
Hunger Mitigation Program (Vegetable Gardening)			X			
Upland-Lowland farming				X	X	
Fish Cage culture					X	
2. Financial assistance:						
Lending	X	X	X	X	X	X
Vending: meat, food				X		X
<i>Sari-sari</i> Store						X
3. Health Care:						
Health Center	X	X			X	
Botica sa Barangay		X				
Birthing Clinic		X				
Disease Control/Treatment		X		X		
Daycare Center					X	
Senior Citizen Center					X	
4. Infrastructure:						
School Building	X					
Water System	X	X		X	X	
Solar Power				X		
River spillway				X		
Farm to market road	X	X	X	X		
5. Environmental Rehabilitation						
Tree Planting	X		X			
Fish Sanctuary		X	X			
* Plan for 2007: Mini Nursery of fruit trees				X		
Total No. Programs/Projects	9	12	8	12	12	4

Table 13. List of international agencies and its initiatives in Lake Mainit communities.

International Agencies	Partner Agencies/NGOs	Intervention Activities
Ahencya Espanyol Cooperacion Internacional (AECI)	Convergence	Eco-Tourism center Farm level grain center
Australian Agency for International Development – Philippine Australia Community Assistance Program (AusAID-PACAP)	LMDA DOH/MOH	Community assistance programs: Health Interventions Biodiversity conservation Resource Management Construction: gabions & bamboo plantation Solid waste management project
Australian Agency for International Development (AusAID)	RHU	Community development assistance Infrastructure and Health services
Asian Development Bank (ADB)	INFRES, DENR	Farm-to-market road Lake Mainit Watershed sub-project Reforestation
British Department for International Development-Development Assistance to Mindanao	LGU	Community Development Assistance
Canadian International Development Agency (CIDA)	LMDA NEDA XU-RIMCU	Building construction Implementation of ESWM Strengthening capability building Info-book on gender-based profile
Christian Aid, Oxfam-Great Britain, Save the Children – UK, and Voluntary Services Overseas (VSO)	LGU	Community Development Assistance
CULION Foundation Inc.	UNICEF P/RHU	Iron and Vitamin A Supplement Pre-natal care program Construction of Municipal Health Office
Hassall and Associates International		Community Development Assistance (PACAP-FOCAS)
International Fund for Agricultural Development (IFAD)	DAR DA NMCIREMP	Road rehabilitation Water system construction Drainage canal system construction Food processing, hog fattening, rattan craft Livelihood assistance projects Farm to market road construction
NAESVAD-Ahencya Espanyol	RHU, LGU	Health Centers Vaccination and immunization
Philippine-Australia Technical Support for Agrarian Reform and Rural Development (PATSARRD)	LGUs	Swine production Native chicken raising Goat dispersal Vegetable production Dried Fish production Organic fertilizer training
Spain-Technical Assistance Facility	NEDA	Food sufficiency improvement
Spanish Government, IPADE	LGU	Rattan production
UNDP Small-Grants Program (United Nations Development Programme)	AFBHF AID Foundation	Biodiversity Conservation Resource Management Strengthening Capability Building
United Nations International Children’s	RHU	Schistosomiasis Treatment

Emergency Fund (UNICEF)	CFI	Iron and Vitamin A Supplement Pre-natal care program
United States Agency for International Development (USAID)	DOH XU-RIMCU	LGU Performance survey Health Services
World Vision	Surigao del Norte People's Initiatives Dev't Assoc, Inc (SNPIDA)	Evaluation of ADP-Surigao del Norte
World Bank	LGUs	Water system improvement Potable Water system Alley and diversified cropping with livestock Floating fish cages Abaca production, swine production and micro-watershed agro-forestry, tree plantation, Lake-grass Protected Area Lakeshore Fish Sanctuary

Source: Roxas, PG. 2005

UPCOMING ACTIVITIES

A number of activities are yet to be accomplished toward the last quarter of the project. These are detailed in the following workplan in Table 14. Although the original plan was to complete the project by December 2008, a month is allowed for the publication of project outputs (posters, field guides, etc.), the submission of the final technical report, and the conduct of a final workshop to validate the draft SFM plan.

Table 14. Workplan for the remaining project activities (Period: September 2008-January 2009).

Component/Activities	Accomplishment Schedule																
	Sept'08			Oct			Nov			Dec			Jan'09				
1. Aquatic Diversity & Fisheries Assessment																	
a. Monitoring of fish catch and effort in 6 stations	■	■	■	■	■	■											
b. Validate descriptions of fishing gears and variants				■	■												
c. Validate resource map with local community				■	■												
d. Collect add'l fish and invertebrate specimens for liquid preservation						■	■										

e. Continue photodocumentation of resources of the Lake & Kalinawan R.																				
f. Mapping of sanctuaries around lake Mainit using GPS coordinates																				
2. Fish Stock Dynamics																				
a. Collection of fish specimens and biological analysis																				
b. Mapping of distribution of major fish stocks																				
c. Complete photodoc'n of major fish stocks																				
d. Data encoding																				
3. Socio-Economics & Survey of Interventions and Institutional Arrangements																				
a. Collection of remaining secondary data																				
b. Data encoding and summary																				
Overall Project Activities																				
Preliminary report presentation & FM planning workshop																				
Data analysis & Report Writing																				
Packaging and Submission of Final Report																				
Preparation and printing of posters and field guides																				
Final Workshop (validation and finalization of SFM plan)																				

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