

THE AQUACULTURE INDUSTRY IN REGION 10: STATUS, PROBLEMS AND PROSPECTS

Elvira Y. Adan, Felisa Valdez, Marissa Y. Salarda
and William R. Adan

This research was undertaken to study the situation of the aquaculture industry in Region 10, specifically, its status, its problems, and its prospect. The primary data were collected by means of conducting informal personal interviews with people in the industry such as hatchery and fishpond owners and operators and officers of aquaculture associations.

Region 10 comprises of seven provinces and a total of 23 municipalities. Its fishery resources consist of 1,160 km of fishing coastline, 31,197 sq. km of marine waters, 38,837 ha of communal waters, 5,171.80 ha of coastal and mangrove areas utilized as brackishwater fishponds and 404 ha utilized as freshwater fishponds. The Region has some coastal fry and fingerling grounds where culturable seedlings of prawns and finfishes are collected for fishpond or cage culture operations.

In 1989, the aquaculture industry of the region contributed 11.49% of its total fishery production. Misamis Occidental has the greatest potential for the culture of prawns, shrimps, milkfish, crabs, bivalves, and mollusk because of its proximity to Panguil Bay and Murciolagos Bay.

The key investment projects in aquaculture for Region 10 are milkfish and prawn culture in ponds, prawn hatchery operations, mussel, oyster, and seaweed production, fishmeal processing, fish processing.

The region has an estimated total fishpond area of 5171.804 hectares. There is an apparent shift in the size and ownership status of fishponds in the region from private ownership to corporate fish farms and corporate ownership as a way of circumventing the consequences of the agrarian reform law.

Twenty prawn hatcheries are established in Region 10.

MSPCO
LIBRARY

The culture of fish using fishcages is still on its experimental stage in the Region and the entry of predators, competitors, and other less productive species allegedly limited the production of siganids, milkfish, squid, and prawns in these cages. Cage maintenance and inadequate food supply are also recognized problems in the operation of fish cages.

The fattening of juvenile and thin, mature crabs in cages is an evolving aquaculture activity around Panguil Bay and the problems encountered are the declining supply of gravid female crabs, juveniles crabs and thin mature crabs and the lack of the technological know-how that crab farmers can adopt.

Seaweed (*Eucheuma*) farming started as early as four years ago. *Sargassum* farms are also found in the Region. The main problems of seaweed farming are: the plants are prone to fungal attacks during the rainy season and the lack of drying space for the harvested seaweeds.

For mussel culture, two test farms have been set up by the Department of Agriculture.

Culture-based fish production in Bukidnon come from the 173 fishfarmers culturing tilapia and carp in 32.80 has backyard fishponds in 1989. In Surigao del Norte, the freshwater fish production of 684 MT in 1987 come from Lake Mainit, where 53 operators operate 32.65 has of Tilapia farms.

Of the species cultured, only prawns and shrimps undergo some processing for marketing in headless and frozen form. There are 17 prawn exporters in the Panguil Bay area with buying stations throughout the Bay area and freezing plants in Ozamiz City, Cagayan de Oro City, Surigao City and Butuan City.

For fishery conservation and management purposes, the Department of Agriculture implemented the Artificial Reef Project and installed 2191 units of artificial reef in different marine waters of the Region. One major purpose of the project is to provide additional breeding and growing areas for the fish population. Instead, a common cursory evaluation of the project seems to point out that in some ways the devices encourage overfishing.

Rationale

Until now there are no formal studies on the aquaculture activities of the Region. Too little attention has been given to the industry and benchmark data necessary to describe the status and the viability of the industry in the Region is wanting.

This study, therefore, aims to describe the situation the industry finds itself in, as well as identify the problems experienced by and the prospect facing fish aquaculturists.

The data generated from the study can be useful in determining the direction of the regional thrust necessary to sustain the growth of the aquaculture industry in the Region. Issues concerning opportunities for crop diversification, questions related to the expansion of aquaculture activities in terms of spatial coverage and the adoption of high-input technologies, and concern for manpower development and upgrading, will be dealt with accordingly.

The study will also give information about the needs of the various aquaculturists in the Region. Said information will guide government institutions in formulating programs and services necessary to fill these needs.

The result of the study will also serve as an asset for NEDA and other policy-making bodies in the formulation of appropriate programs and policies necessary to improve returns from aquaculture ventures with considerations of the various conservation and management constraints.

Objectives

The objectives of the study are:

1. To identify the various forms and systems of aquaculture activities in the Region;
2. To determine the level of development of the various aquaculture operations in the Region;

3. To determine, classify and evaluate the problems affecting the industry;
4. To assess the potentials for growth of the industry;
5. To recommend policies along production, conservation and management purposes.

Methodology

Area of Concern

The study concentrates on the aquaculture operations in Region X, which is composed of the provinces of Misamis Occidental, Misamis Oriental, Bukidnon, Camiguin, Agusan del Norte, Agusan del Sur, and Surigao del Norte. The region is where the first pilot commercial prawn fry hatchery was established (MSU-IFRD, 1973) and it is also home to several hatcheries and fishponds. The provinces of Bukidnon and Surigao del Norte provide freshwater areas whose potential for fish culture can be exploited.

Except for Surigao, the region generally lies outside the typhoon belt, and its climate is characterized by an evenly distributed rainfall throughout the year. Its coastal waters have temperatures and salinity levels within the optimum range required in prawn and milkfish culture (MSU, 1975).

Respondents of the Study

The respondents are hatchery, fishponds, and fish cages or pen operators, owners, managers, and caretakers, presidents or members of corporations, associations and cooperatives, consultants, aquaculture input suppliers, bankers, fish traders (including exporters and importers), BFAR, NEDA, and DENR field personnel assigned to monitor aquaculture projects, and ecologists.

Data Collection Procedures

Data collection are divided into two phases:

Phase I - Inventory of existing aquaculture ventures and the gathering

of the complete list of fish aquaculturists in the region.

Phase 2 - Data gathering for the various parameters under consideration.

In provinces where respondents in a particular category number less than or equal to twenty, complete enumeration is resorted to in gathering of the primary data; otherwise, a maximum of twenty respondents per province per category are interviewed. Data are gathered by means of informal personal interviews which the researchers, armed with guide questions, blank data sheets and cassette, conduct in fishponds or hatchery sites. Prior to interviewing individual operators, interviewees first interview association presidents, if any. Technical information are gathered during field visits and spot observations of the operations.

Analysis

The exploratory nature of the study calls for a qualitative approach to analysis wherein descriptive statistics such as frequency distributions, averages, percentages, scores and minimum and maximum values, are used.

The "project feasibility" approach is used to determine the financial viability of each venture. The discounted cash flow methods, involving computing for the net present values (NPV), and the internal rates of return (IRR) are conducted to determine the feasibility of the various projects under various costs and productivity assumption and conservation considerations.

To measure the marketability of the product of a particular aquaculture venture, with respect to the variables in the marketing mix, regression analysis is used. Marketability is operationalized in terms of the volume of production sold immediately upon reaching the harvestable size.

Results and Discussions

Region 10 is comprised of seven provinces, namely, Misamis Occidental, Misamis Oriental, Agusan del Norte, Agusan del Sur, Surigao del Norte, Bukidnon and Camiguin. It has a total of 23 municipalities and seven cities.

The region's fishery resources consist of 1,160 km of fishing coastline, 31,197 sq. km of marine waters and 38,837 ha of communal waters. Some 5,171.80 of coastal and mangrove areas are utilized as brackishwater fishponds and 404 ha are utilized as freshwater fishponds in the landlocked provinces of Bukidnon and Agusan del Sur.

In 1989, the aquaculture industry in the region brought in 11.49% of its total fishery production. This figure implies the predominance of capture-based fishing activities in the region.

The provinces of Misamis Occidental, Agusan del Norte, and Surigao del Norte have been identified as the major contributors to aquaculture production. These provinces, together with Misamis Oriental, have also been identified as sources of fry and fingerling inputs to fishpond operations. Misamis Occidental has been identified as having the greatest potential for the culture of prawns, shrimps, milkfish, crabs, bivalves, and mollusk because of its proximity to Panguil Bay and Murcielagos Bay.

The following have been identified as the key investment projects in fisheries for Region 10: milkfish and prawn culture in ponds, prawn hatchery operations, mussel, oyster, and seaweed production, fishmeal processing, fish processing, and shark liver oil extraction. The markets for the end products of these projects include both the local and foreign markets.

Fishpond Operations

The region has an estimated total fishpond area of 5171.804 hectares, with Misamis Occidental recording the largest area (Table 1).

Table 1. Fishpond Area by province.

Misamis Occidental	1787.56 has.
Surigao del Norte	1042.39
Agusan del Norte	1785.39
Misamis Oriental	555.46
Total	5171.80 has.

Brackishwater fishpond operation: Misamis Occidental

The province of Misamis Occidental is strategically located at the western side of Panguil Bay and at the southern side of Murcielagos Bay. Its being surrounded by bays and coves and shoals, and the presence of rivers and mangroves along its coasts, make the coastal waters of Misamis Occidental naturally favorable to the culture of prawns, shrimps, crabs, and milkfish. The province has some 1787.564 ha of fishponds of which 799.47 ha. are located along the coasts of Panguil Bay. Tables 2, 3, and 4 summarizes the brackishwater fishpond operation profile for the province.

Table 2. Brackishwater fishpond operation in Misamis Occidental.

Total fishpond area	1787.564 ha
Operational	1013.69 ha
Non operational	773.874 ha
Total number of operators	196
Total number of farms	196
Undeveloped	22
Converted to ricelands, sold abandoned, or nor operated	43
Developed, operational	131
Sugpo farms	79
Intensive	3
Extensive	76
Bangus farms	17
Sugpo/Bangus farms	34
Tilapia	1

Table 3. Production profile of fishponds in Misamis Occidental.

	Production in kg/ha/crop			Areas of concentration
	Lowest	Highest	Average	
Sugpo (intensive)	3400	7300	5133	Ozamiz
Sugpo (extensive)	30	400	177	Bonifacio, Ozamiz
Bangus	400	1000		Plaridel, Baliangao
Sugpo/Bangus	20:20	2000:800		Plaridel, Baliangao
Tilapia	68	-	-	Panaon

Table 4. Intensive Prawn Pond operation profile: Misamis Occidental.

Ownership status	Corporation
Number of employees	5-18
Initial capital	P125,000 to P2.5 M
Annual Gross Sales	P200,000 minimum
Profit margin	40% to 50%
Production capacity	3 tons-8 tons per year
Percent utilization of pond	50%

The production from these ponds lead to the establishment of buying stations in Panguil Bay and its vicinities. Likewise in recognition of this major product from the area, the regional integrated area development program had identified Tangub as a growth center for fish production and light industries.

Brackishwater fishpond operation: Misamis Oriental

The fishponds of Misamis Oriental are relatively new compared to the fishponds in the other areas of Mindanao. A greater portion of the total fishpond area have been developed only in the late 1970s and in the early 1980s. These are concentrated in the towns of Alubijid, Opol, Jasaan, Balingasag, Gingoog and Talisayan. The other municipalities also have

fishponds but in limited number and areas.

The following table presents a summary profile of a typical prawn pond operation in the province.

Table 5. Profile of pond operations in Misamis Oriental.

Period established	1980
Ownership	Mostly single proprietorship
Number of operations per year	2-3
Duration of culture	4-5 months
Stocking density	11 to 12 fry/sq.m.
Survival rate	50-60%
Initial capitalization	P550,000 to P2.0 M
Utilization rate	73%
Market	Local and foreign

Fishpond Operations: Agusan del Norte and Surigao del Norte

Agusan del Norte has a total of 1785.39 ha managed by some 234 fishpond operators, majority of whom are engaged in the polyculture of prawns and milkfish. The fishponds are located in Buenavista (52 operators/ 22%), and in Nasipit and Cabadbaran towns. Intensive farms are found in Butuan City and in the town of Magallanes.

Surigao del Norte has a total of 1042.39 ha of which 345.91 ha are under FLAs. Of the leased fishponds 200.28 are developed and are managed by 16 operators. The fishponds are located in Placer and in Surigao City and Mangagoy, Bislig. Production from fishponds amounted to 684 MT (aquaculture) out of the 56284 MT total fishery production for the province.

Commercial fishery production, on the other hand, is much more, at 55089 MT out of the total production of 56284 MT. The commercial fishery value comes from the province's 23.340 ha of marine waters.

Fishpond Size and Ownership Status

There is an apparent shift in the size and ownership status of fishponds in the Region. In the 1970s, pond ownership was basically of two types: private ownership, evidenced by land titles, and leaseholds, by virtue of the fishpond lease agreement with the Bureau of Fisheries and Aquatic Resources. The advent of land reform sees the formation of corporate fish farms and corporate ownership of the same as a way of circumventing the consequences of the agrarian reform law.

Prospects of Fishpond Operation

As shown in Tables 4 and 5, the percentage utilization of fishponds in the two Misamis provinces is between 50% and 73%, respectively. It was observed that fishponds in the other provinces are similarly underutilized. Furthermore, there are claimed and titled mangrove areas and swamps that have been cleared for fishpond purposes as well as areas that are covered by FLAs that are not all developed and operational. The data for Region 10 show that of the total area designated for fishpond purposes, only around 70% are actually fully operational, leaving some 20% in the state of underdevelopment and 10% still to be developed. Once all these idle and semi-idle areas have been developed and become operational, and once the developed fishponds have been utilized to its maximum capacity total production from ponds will considerably increase.

At the same time, the Department of Trade has initiated moves to open up the market for prawns in Europe. The market potential for prawns in the said community is big and is attainable once the product becomes acceptable to the European palate

Prawn Hatchery Operations

So far, twenty prawn hatcheries have been established in Region 10. The distribution of hatcheries by province are as follows: Misamis Occidental-4, Misamis Oriental- 12, and Agusan del Norte- 4.

As can be seen above, Misamis Oriental has the greatest number of hatcheries. The profile of a typical hatchery operation in the provinces is given in Table 6. The twelve hatcheries of Misamis Oriental and their production profiles are listed in Table 7.

Table 6. Prawn hatchery profile, Misamis Oriental.

Date established	1980
Ownership	Single Proprietorship/corporation
Number of employees	5-8
Initial capitalization	P1.65 M
Gross Sales	P550,000 per annum
Profit Margin	18%
Production capacity	2 M fries per annum
Utilization rate	54%

The twelve hatcheries of Misamis Oriental have an estimated total production of 35.5 million fries per month. Three are government-owned, the others are owned either by single proprietorship or by corporations and are mostly self-financed. The hatcheries have an average of 9 operations each per year and some 10% to 15% of these are discarded due to low survival rates at the early larval stages. Operations which are not discarded have an average survival rate of 16 %. The highest recorded survival rate in 1988 was 65%.

Table 7. Production profile of hatcheries operating in Misamis Oriental, 1988.

Misamis Oriental, 1988	Number of fry per 35 day operation Range
A. Barangay	
1. Grandeur	Not operating
B. Small scale	
2. V-5	90,000 - 246,000
3. MSU CPHT	45,000 - 310,000
C. Medium scale	
4. GAIC	700,000 - 1,400,000
5. G.A. Lim and Sons	95,000 - 950,000
6. Mauswagon	200,000 - 800,000
7. Yaman Dagat	• Not available
8. San Jose	Not available
9. MSU IPP	140,000 - 1,000,000
D. Large scale	
10. SPDA	100,000 - 1,700,000
11. Twin Gold	300,000 - 1,500,000

Prawn hatcheries are likewise found in Misamis Occidental and in Agusan del Norte. Also serving the fry requirements of the region and of the nearby provinces is a hatchery in Lala, Lanao del Norte and two others in Kabasalan and Naga, Zamboanga del Sur (Table 8).

Table 8. List of hatcheries in the vicinity of Misamis Oriental.

BELCAH	Lala, Lanao del Norte
DRS	Kabasalan, Zamboanga del Sur
Gamolo Hatchery	Manticao, Misamis Oriental
Panguil Bay Aquafarms	Ozamiz City
SMJ Hatchery	Butuan City
P. Ynot Hatchery	Butuan City
Living Waters Hatchery	Butuan City
Calo Hatchery	Cabadbaran, Agusan del Norte
Veloso Hatchery	
Alfonso Lim Hatchery	
Panaon Prawn Development Corporation	

Prawn Hatchery: Target Markets

When the hatchery operators in Misamis Oriental were yet planning to put up their hatcheries, they already considered the extensive fishponds found in Regions 9 and 12, as well as the pond areas of Agusan del Norte in Region 10 as their market. Operators specifically target Zamboanga del Sur and Lanao del Norte because of the relatively large fishponds found in these two provinces and because of the apparent shift of operators in the same places towards intensive stocking.

The 1989 and 1990 production of Misamis Oriental hatcheries, however, revealed that the market for fry is still the province itself, followed of course by Lanao del Norte. The fishfarmers of Lanao del Norte get their fry from Misamis Oriental for reasons of proximity. Table 9 shows the percentage distribution of fry disposed of by Province.

Table 9. Distribution of Misamis Oriental hatchery produced fry, by province.

Destination	% of total production
Misamis Oriental	48.01%
Lanao del Norte	26.59
Cotabato	11.21
Misamis Occidental	6.59
Zamboanga del Sur	2.69
Bohol	2.68
Butuan	2.23
	100.00%

N=8,211,065 fry

Furthermore, the fish farmers of Lanao del Norte get their fry from Misamis Oriental for reasons of proximity.

Problems: Prawn Hatchery Operations

The hatchery industry is beset with profit-limiting factors such as the increase in the prices of the major inputs to the operation. Power rates have been hiked and the prices of feeds and chemicals have likewise increased. Improved technology and increased production have sometimes created stiff competition between hatcheries to the point where operators sell below the agreed floor price set by their association.

The concern of the government for the conservation of fish habitats and for the protection of fish resources of Panguil Bay have created a shortage of spawners to the detriment of the operators and of the fishfarmers. Trawls have been declared illegal and are banned. It is to be noted that trawls are the common gear used in catching spawners from the bay.

There are also fry smugglers who operate through the Philippine backdoor. In 1989 fry were reportedly smuggled in from Taiwan and Malaysia and threatened the local operators.

Prospects: Prawn Hatchery Operation

The shift to the intensive method of prawn farming have significantly increased the demand for fry. Possible development of the underdeveloped and undeveloped areas plus advances towards the control of prawn diseases are expected to create additional demand for the product.

Based on the minimum and maximum production of the hatcheries, the potential fry supply from the Misamis Oriental hatcheries is only between 15M and 90M per year. Also taking into consideration the fry production of hatcheries in the adjacent provinces, the supply still runs short of the potential demand which is estimated to be between 1B and 2B when the total fishpond areas reported would have been fully developed and utilized. The demand is further expected to increase when fishpond operators choose to shift to the intensive culture of prawns.

Fishcages

The culture of fish using fishcages is still on its experimental stage as far as Region 10 is concerned. The establishment of demonstration cages has been initiated by the Department of Agriculture and are found in the municipalities of Lopez Jaena, Baliangao, and Plaridel in Misamis Occidental, and in Opol in Misamis Oriental. The said cages have stocks of siganids, milkfish, squid, and prawns. The entry of wild fry and fingerlings in the cages have further diversified the catch to include other pelagic fishes which are indigenous in the area. The entry of predators, competitors, and other less productive species have been identified as a limiting factor in the production of fish in cages. Cage maintenance and inadequate food supply are also two other identified problems in the operation of fish cages. Feeds usually consist of ground camote and freshwater snails crudely processed using the ordinary handmill.

So far the length of culture for each species has not been determined. The fish are harvested when they reach marketable size which usually takes place beyond the profitable duration.

The operation of fish cages in Plaridel is being financed through the LEAD project of the Department of Agriculture, while the fish cages in Lopez Jaena are being operated by the members of a local cooperative (LOJAMFISCO) using loan proceeds from the SPDA. There are four operators in Plaridel and 30 operators in Lopez Jaena. Each operator is allowed to operate two fish cages and the cages vary in dimensions from 2x2x10 cu.m. to 3x4x2 cu. m. to 9x9x2 cu.m.

Fattening Crabs in Cages

The fattening of crabs in cages is an evolving industry in the swamp areas around Panguil Bay. Juvenile and thin, mature crabs from the mangroves and from the coastal waters of the Bay are caught and stocked in cages. Stocking rate is 10 kg of crabs per cage, where a cage usually measures 3m x 8ft x 4ft. The cultured organism are harvested after 18 days of the fattening period at which time the crabs have attained some 300% growth increment.

Feeds for fattening crabs consist of kuhol and clam meat. The industry proved viable for most who engaged in the said activity and operators expect to get some P24 million per year from the operation of a one-hectare farm. This early, however, problems related to crab fattening have cropped up and include the following: declining supply of gravid female crabs and of juveniles and thin mature crabs, and the lack of technological know-how which can be adapted by the crab farmers in the area.

Seaweed Farming

Seaweed farming in the coastal areas of Region 10 is a more recent activity. Most farms were started some three or four years ago except for those found in Camiguin which were started in the early 1980s.

Seaweed farms of commercial scale are found in the island of Mantigue in the province of Camiguin. The said farms are managed by a cooperative and total some 20 hectares. The species cultured is *Eucheuma* sp. Another four hectare is being operated by 32 members of the Mantigue Seaweed Farmers Association and is financed by LEAD funds. The said farms have since expanded to 50 hectares and produce from 100 to 120 tons worth more than half a million pesos every 45 days.

There are also *Eucheuma* farms in Laguindingan, Misamis Oriental. In Misamis Occidental, six licensed *Eucheuma* farmers are reported to be operating in Danao, Plaridel. Other *Eucheuma* farmers are operating in Ozamiz City. *Sargassum* farms, on the other hand, are found in El Salvador, Misamis Oriental.

The farms in Misamis Oriental are financed through a loan from the Land Bank of the Philippines in the amount of P100,000. It is managed by a seaweed farmers association which has 21 members.

In Agusan del Norte, seaweed farms are found in Vinapor, Carmen.

The seaweed farms in Misamis Oriental are limited to one hectare per farmer and there are 5 farms registered with the Department of Agriculture. In Misamis Occidental, majority of the farms are from 0.25 ha to only 0.5 ha and the largest farm recorded is only 2 ha. Family-size farms of more or less 1/4 ha were found to be more manageable and feasible

and are therefore recommended. Given the size constraint and in order to augment their income, seaweed farmers also catch fish and are primarily sustenance fishermen themselves.

Most seaweed farmers in the Region adapt the monoline submerged and the monoline floating method of culturing seaweeds. The lines are placed in areas where water is at least 2 meters deep, is highly saline, and where bottom soil is composed of hard sand and rocks and is corraline. These are also places where algae and eel grasses grow. The sites are marked by buoys for ease in locating the plants. Seedlings usually come from Plaridel and Ozamiz and also from Camiguin and Bohol. Another identified source of seedlings is a seaweed farm in Nangka, Zamboanga del Norte.

Production was reported to peak in June. Two weeks after planting, each plant weighed from 7 kg to 8 kg. There is available market for the product. Seaweeds are sold in the local markets but are sometimes bought in bulk by processors and by feed millers.

The main problem identified for the industry is that the plants are prone to fungal attacks during the rainy season. Affected plants are rendered unsaleable and are disposed of to prevent further spread of the fungus infection. Another identified problem of the industry is the lack of drying space for the harvested seaweeds. Also, seaweed farming is labor-intensive, especially if the farm is located near river mouths where the plants are subjected to run-offs. In such instances, there is a need to clean the plants, thus the need for extra manpower to do the job.

Mussel and Oyster Culture

Some 80 hectares have been pinpointed by the BFAR as potential sites for oyster culture in the region. Panguil Bay has been specifically identified as a potential site in Misamis Occidental (Table 8). So far, however, no oyster farm of commercial size has been reported.

Table 10. Estimated potential area for oyster culture by province, Region 10.

Misamis Occidental	10 ha
Misamis Oriental	10 ha
Surigao del Norte	10 ha
Camiguin	50 ha

Source: BFAR

As for mussel culture, two farms have been set up by the Department of Agriculture for the purpose of determining whether green mussels coming from Cavite will thrive in Panguil Bay as well as in Benoni Lagoon in Camiguin. The first which was set up in Silanga, Tangub has been on-going and has yet to produce encouraging results. On the other hand, the production of brown mussels in Panguil Bay is highly promising.

Freshwater Resources

The province that is potentially rich in freshwater fishery resources is Bukidnon. The province has three major lakes: Pinamaloy Lake in Don Carlos, Lake Apo in Valencia, and Pigtauranan Lake in Maramag. There is also a 1,200 ha man-made lake in Maramag which resulted from the operations of the National Power Corporation (NAPOCOR) in the area.

The freshwater fishery resources of the province have been largely for family consumption purposes only. The production is basically capture-based, with mudfish, catfish, tilapia and other freshwater fishes being caught with hooks, nets and traps. Culture-based production comes from the 173 fishfarmers culturing tilapia and carp in backyard fishponds (Table 10). The ponds usually measure from 0.10 to one hectare with the majority measuring 0.25 ha only. Total area devoted to the culture of tilapia and carp is 32.6785 in 1989. The NAPOCOR lake is also stocked with the same species and provides an additional source of fish for the province. Overall inland fishery production totaled 228 MT.

Table 11. Profile of freshwater fishpond operation in Bukidnon

	<u>No. of operators</u>	<u>Pond size Range (has)</u>	<u>Total Area (has)</u>
Kadingilan	4	0.25 to 0.35	1.58
Manolo Fortich	30	0.10 to 1.00	7.00
Cabanglasan	6	0.25 to 0.50	1.75
Valencia	20	-	1.72
Kalilangan	13	0.02 to 0.50	2.58
Baungon	10	0.10 to 0.30	2.00
Sumilao	16	30 sq.m. to 1000 sq.m.	1.085
Maramag	12	0.25 to 1.50	5.085
NAPOCOR	-	-	1,200
Impasug-ong	3	-	0.3785
Damulog	25	0.06	0.20
Pangantucan	20	0.01 to 0.25	1.50
Malaybalay	14	-	6.00

The other province with freshwater fishery resource is Surigao del Norte, although it is better known for its rich marine grounds. Its inland fisheries primarily come from Lake Mainit where 53 operators operate 32.65 ha of Tilapia farms. Surigao del Norte produced 684 MT of freshwater fishes in 1987.

Fish Processing

Fish processing has been considered in this study to determine the part of production due to aquaculture that involves processing into other forms. It was found out that of the species cultured, only prawns and shrimps undergo some processing. Prawns harvested from fishponds along with prawns and shrimps caught from Panguil Bay are classified according to size, washed, and frozen after their heads have been removed. They are thus shipped to their destinations in headless and frozen forms.

The other cultured species undergo size classification but instead of freezing they are iced and brought to their destinations in relatively fresh conditions.

There are 17 prawn exporters operating in the Panguil Bay area with Ozamiz City as their base. The same companies have buying stations throughout the bay area and have freezing plants in Ozamiz City, Cagayan de Oro City, Surigao City and Butuan City. The following exporters and processors have been identified to be operating in the region: AA Export-Import Co., Sugeco, San Miguel, Resin Philippines, Kuruma and Triumph.

Conservation and Management

It is a recognized fact that for fish culture to be continuously viable, conservation and management measures have to be planned, implemented and religiously observed. The importance of such measures come into the picture especially as a continuous supply of fry and fingerlings is the primary input to fish culture operations. There is a need to protect the natural habitat, feeding grounds, and nursery grounds of cultivable species to be assured of a steady supply of fry and fingerlings.

So far, the Department of Agriculture is tasked with this responsibility. To date, the only conservation measure implemented by the department is the artificial reef project. The said project was first implemented in 1987. Since then, a total of 2191 reefs have been established in the region (Table 11) and are expected to benefit a total of 3960 beneficiaries. The artificial reefs are of four types or modules: timber, bamboo, tire, and concrete.

Table 12. Summary of the number of artificial reefs established in Region 10

Province	No. of sites	Number of modules				Total	*
		Bamboo	Tire	Cement			
Agusan del Norte	29	329	130	242	-	701	814
Camiguin	14	133	8	5	-	146	231
Mis. Occ.	13	596	39	-	-	635	402
Mis. Orr.	38	452	122	17	-	591	1393
Surigao Norte	15	14	60	40	4	118	542
Total	109	1314	278	83	4	2191	3960

*Total beneficiaries

It was found out, however, that the tires and bamboo modules served as fish aggregating device which encouraged overfishing in the area where the modules are located. Furthermore, the said modules have low life spans and end up littering the sea bottom instead.