Assessing the Problems that Impede the Sustainability of Fish Culture in Laguna de Bay, Philippines

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The severity of the various problems confronting the sustainability of fish culture in Laguna de Bay, Philippines was reviewed and analyzed, the results and findings of which are summarized in this article. The study which was jointly conducted by the Southeast Asian Fisheries Development Center/Aquaculture Department (SEAFDEC/AQD) and the Philippine Institute for Development Studies (PIDS) in 2007 aimed to assess the aquaculture development in Laguna de Bay.

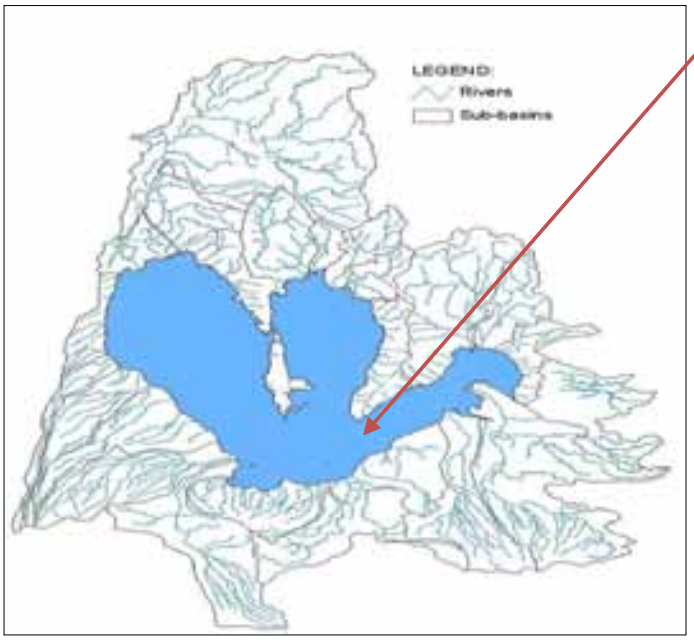

Fig. 1. Laguna de Bay and its watershed
(Source: Laguna Lake Development Authority)

Laguna Lake also known as Laguna de Bay is the largest lake in the Philippines. It is located in the middle part of Luzon bordering the capital region of Metro Manila and the provinces of Rizal and Laguna, and comprising three corporate bays: the west bay, central bay and east bay. The Lake flows and discharges water into Manila Bay through the Pasig River. The watershed of Laguna de Bay also known as the Laguna de Bay Region (**Fig. 1**, **Fig. 2**), has a total area of 292,000 ha and spans across 14 cities and 47 municipalities in the provinces of Rizal, Laguna, Cavite, Batangas, Quezon, and Metro Manila, providing livelihood to an estimated of 13.2 million people as of 2005.

Fish Culture in Laguna de Bay

Aquaculture is an important livelihood in Laguna Lake, where fish farmers use fishpens or fishcages to culture fishes. By definition, fishpen is an artificial and stationary water enclosure for culturing fish and other aquatic animal species. It is made of bamboo poles, wood, screen, and other construction materials intentionally arranged to prevent the escape of fish (**Fig. 3a**). On the other hand, a fishcage is an artificial and stationary or floating water enclosure smaller than a fishpen but made up of similar construction materials (**Fig. 3b**). In Laguna Lake a fishpen is further defined as having a water surface area of more than 1.0 ha while a fishcage has a water surface area of 1.0 ha or less. While a fishcage in the lake generally has a net bottom a fishpen has none. Fishpen and fishcage culture in Laguna de Bay is generally practiced within the aquaculture belt specified by the Laguna de Bay Fishery Zoning and Management

Fig. 2. Laguna de Bay almost blanketed with fish culture structures (*Source: Danilo C. Israel)*

Fig. 3. Fishpens (3a) and fishcages (3b) in Laguna de Bay *(Source: Danilo C. Israel)*

Plan (ZOMAP), where a maximum of 10,000 ha has been allocated for fishpen culture and 5,000 ha for fishcage culture.

The number of fishpen operators and the extent of fishpen culture in Laguna de Bay have increased in recent years. From 2000 to 2006 for example, the number of registered fishpen operators and total area of fishpens in the Lake in particular, have risen at an average annual growth rate of almost 10% and more than 8%, respectively. Furthermore, although the total area of registered fishcages had decreased at an annual average of more than 12%, the number of registered fishcage operators had increased at an average annual growth rate of more than 11%. In 2006, there were 455 registered fishpen operators in Laguna de Bay covering an area of 12,117 ha and 1,599 registered fishcage operators covering an area of 998 ha for a total 2,054 registered fishpen and fishcage operators utilizing a total area of 13,115 ha. Thus in 2006, the maximum limit of 10,000 ha for fishpens was exceeded by 2,117 ha while the area covered by the fishcages was still below the maximum limit of 5,000 ha. The main economic contribution of the aquaculture activities in Laguna de Bay is the fish that is produced, which in 2006 was 48,187 mt generating an income of about Philippine Pesos (PHP) 1.8 billion. The aquaculture industry in Laguna de Bay also employed 5,152 people in 2006 and generated for the government total registration fees of about PHP 84.4 million.

Aside from its economic contributions, aquaculture in Laguna de Bay has significant social implications. Firstly, the fish produced, mostly milkfish, tilapia, and carps are not cash crops but are relatively low-value species and thus, are mainly consumed by the lower economic brackets of the society which comprise the great majority of the country's population. Secondly, the dominant percentage of the cultured fish in the Lake is sold in Metro Manila where a highly significant segment of the urban and relatively politically-sensitive population of the country resides.

Problems Confronting Fish Culture in Laguna de Bay

From a review of relevant literatures, aquaculture activities in Laguna de Bay had always been confronted with various problems that hinder development (Palma *et al.*, 2005; Lasco *et al.*, 2005; Mane 1987; Delmendo, 1982; De La Cruz, 1981; Librero and Nicolas, 1981; Nicolas and Librero, 1977). Such previous research studies on Laguna de Bay identified numerous problems which could be classified into six main groups, namely: technical, production, economic, social, environmental and institutional problems (**Box 1**). Although grouped as such, the problems are not mutually exclusive but are generally and actually interrelated.

Of the various problems confronting the fish farmers in Laguna de Bay, social problems such as poaching, reduction in fishing areas, obstruction of navigational lanes, overcrowding of fishpens and fishcages, and existence of illegal fishpens and fishcages are specific problems which are either fully or partially caused by the aquaculture activity in the Lake. Furthermore, these problems negatively affect not only the aquaculture but also the other sectors in the Lake as well.

In addition, environmental problems such as the occurrence of algal blooms and the deterioration of water quality have been partly attributed as well to the aquaculture activity in the Lake. This could be due to irresponsible practices such as the excessive use of feeds, which leads to eutropication which increases the quantity of phosphate and nitrogen in the water, inducing algal bloom and finally leading to the deterioration of the water quality. Although improper feed management may be occurring to a certain degree, there is also reason to believe that it is not as widely practiced as feared. The results of the survey indicated that about 80% of

Box 1. Problems that impede aquaculture sustainability in Laguna de Bay, Philippines

Technical problems

- **Poorly-sited fishpens and fishcages.** Some fishpens and fishcages in Laguna de Bay, although located in the designated aquaculture belts, are actually poorly sited and not conducive for fish culture.
- **Inappropriate culture practices.** Some fishpen and fishcage culture practices adopted are inappropriate. For instance, the available natural food in the water is not fully utilized by the fish in a monoculture system.

Production problems

- **Occasional low supply of seeds.** Fry and fingerling for stocking are not always available resulting in occasional late stocking, low stocking or non-stocking of some fishpens and fishcages.
- **Poor quality of production inputs.** Production inputs used in fishpen and fishcage culture are of low quality resulting in poor harvest performance and high production costs.
- **High prices of production inputs.** Over the years, the prices of production inputs have been increasing because of the generally inflationary trend in the economy and the rising cost of fuel, among others.

Economic problems

- **Poor quality and low price of fish.** The fish cultured in Laguna de Bay is perceived to be of low quality. As a result, the market price of the fish is relatively low compared with the same species of fish produced by the other areas of the country.
- **Low level of fish processing.** Most of the fish cultured in Laguna de Bay are sold fresh or in frozen form. Fishpen and fishcage operators do not benefit from value addition due to traditional and inadequate technology for fish processing.
- **Lack of foreign markets for produce.** Fish from Laguna de Bay are generally sold only in the domestic market. Fishpen and fishcage operators do not benefit from international trade.
- **Lack of access to cheap capital.** Limited financial capital is a perennial constraint in fishpen and fishcage culture as traditional institutional sources like banks lend only at high interest rates and with stiff collateral requirements.
- **Too many middlemen.** The presence of several consignations, wholesalers, retailers and other fish traders have diluted the income derived by the fishpen and fishcage operators from their operations.

Social problems

- **Poaching.** The stealing of fish from fishpens and fishcages by poachers reduces the profits of operators and increases the chance of social conflict as well as forces operators to spend additional cost on security measures.
- **Reduction in fishing areas.** The construction of fishpens and fishcages, limits the area for fishing by municipal fishermen causing enmity between the fishers and operators of the fishpens and fishcages.
- **Obstruction of navigational lanes.** Some fishpens and fishcages obstruct the navigational lanes used by other sectors leading to conflicts between fishpen and fishcage operators and the other lake water users.
- **Overcrowding of fishpens and fishcages.** Fishpens and fishcages are highly overcrowded in some areas within designated belts causing conflicts among fishpen and fishcage operators.
- **Existence of illegal fishpens and fishcages.** Unregistered and inappropriately constructed fishpens and fishcages exist in Laguna de Bay including those located within and outside the aquaculture belts.
- **Presence of squatters.** The presence of illegal settlers in the coastal areas also caused problems particularly to fishcage operators near these areas as some of these squatters steal the property of operators.
- **Shoreline conversion.** Some coastal areas are already converted for residential, commercial and industrial uses hindering the movement of people and materials involved in fishpen and fishcage operations.

Environmental problems

- **Occurrence of algal bloom.** Algal bloom causes fish mortality or fish kill as stocks die of asphyxiation due to oxygen depletion, while the fish that could survive from such phenomenon could have tainted flesh and mud-like taste.
- **Proliferation of water hyacinth.** Water hyacinths crowding around fishpen and fishcages could also cause fish mortality, destruction of pen and cage structures and obstruction of the navigational lanes.
- **Invasion of alien species.** The proliferation of alien fish species, particularly the janitor fish of late, destroys the nets and competes for natural food and living space with the cultured species.
- **Occurrence of fish diseases.** Cultured fish in Laguna de Bay have also been affected by various diseases that cause fish mortality or fish kill which in turn reduce the viability of aquaculture operations.
- **Deterioration of water quality.** The worsening water quality in Laguna de Bay, which is caused mainly by water pollution results to occurrence of fish diseases, fish mortality and reduced fish quality (**Fig. 4**).
- **Siltation and Sedimentation.** Siltation and sedimentation has made Laguna de Bay shallow and reduced the living space for the fish and other aquatic animals as well as navigational space for man (**Fig. 5**).

Institutional problems

- **Obstructed saltwater inflow.** Fishpen and fishcage operators argue that the backflow of saltwater from Manila Bay into Laguna de Bay through the Pasig River is obstructed. Among others, this reduces the growth and natural food and contributes to the proliferation of water hyacinth.
- **Poor access to training and extension.** Fishpen and fishcage operators have limited access to training and extension, operating mainly based on practical experience. This has contributed to the general practice of traditional and less innovative aquaculture practices in the Lake.
- **Difficult registration process.** The registration process for fishpen and fishcage operations is considered by operators to be difficult, increasing the time spent and financial costs of registration.
- **Overall lack of government support.** Overall technical, financial, economic, market support and law enforcement by the government are considered inadequate by fishpen and fishcage operators. Government agencies are perceived as not doing enough to develop the aquaculture in Laguna de Bay.

Other problems

- **Occurrence of typhoons and floods.** Weather-related events like typhoons and floods destroy fishpens and fishcages causing the escape of cultured fish, destruction of property and economic losses to fishpen and fishcage operators.

Fig. 4. Slums and wastes in Laguna de Bay
(Source: Danilo C. Israel)

Fig. 5. Boys swimming in the Lake's silted shores
(Source: Danilo C. Israel)

fishpen operators and 50% of the fishcage operators adopt the extensive method of culture which depends largely on the natural food in the lake.

Siltation and sedimentation is another environmental problem in Laguna de Bay that may also be partly attributable to aquaculture. The overcrowding of fishpens and fishcages in some areas promotes poor water circulation leading to the accumulation of silt and sediments in such areas. Siltation and sedimentation is furthermore aggravated by the accumulation of decaying bamboos, Anahaw poles and other construction materials that are left rotting in the lake water by abandoned fishpen and fishcage operations. As caveat, however, while fishpens and fishcages may have contributed to algal bloom, reduced water quality and siltation and sedimentation, it may not be a major cause of the environmental problems in Laguna de Bay. For instance, Bacallan (1997) explained that of the water pollution in the lake, 40% came from agricultural sources, 30% was caused by industrial sources, and 30% came from domestic sources. Centeno (1987) further identified industrial effluents, sanitary wastes, and effluents from agri-business, run-off from agriculture and inflows from the Pasig River as among the various sources of water pollution in the Lake.

Severity of the Problems

Through a questionnaire survey, the perceptions of fishfarm operators in Laguna de Bay on the relative severity of the various problems confronting their aquaculture operations were collected and analyzed. Thereafter, the problems were ranked in terms of their relative severity and tested for significant differences. The results showed that the problems which were ranked as most severe were the environmental problems such as the deterioration of water quality, siltation and sedimentation, invasion of alien species, proliferation of water hyacinth, occurrence of algal bloom, and occurrence of fish diseases. Of these environmental problems, in particular, the deterioration of water quality, siltation and sedimentation and invasion of alien species were found significantly different from the other problems in terms of relative severity.

Outside of the environmental problems, there were individual problems which were also ranked highly in terms of their relative severity. Specifically, these problems include the social problem of poaching, institutional problem of limited overall government support, and the economic problem brought about by lack of access to cheap capital.

Results of the analysis further indicated that most of the problems were considered by most aquaculture operators in Laguna de Bay as at least lightly serious. Moreover, many of the problems, particularly those classified as technical, economic, social, institutional, and other problems were considered by most respondents as moderately serious. Furthermore, few respondents considered that the problems have not really impeded their operations while a substantial number of respondents had no opinion.

In summary, the analysis therefore showed that environment-related problems in Laguna de Bay are the most severe among the problems perceived by the fishpen and fishcage operators as seriously confronting their aquaculture operations. In addition to the environmental problems, other individual issues were also considered most severe particularly poaching, lack of overall government support and lack of access to cheap capital. It is important to remember that some of the problems considered as very serious are also those that are partly or fully caused by the aquaculture operations in the Lake.

Conclusion and Recommendations

The results showed that while aquaculture in Laguna de Bay is economically and socially important, it is facing numerous problems foremost of which are the environmental problems. These problems, therefore, have to be prioritized and addressed if aquaculture is to continue in the Lake in the future. Along this line, the important courses of action outlined in **Box 2**, most of which have already been put forward by some sectors involved in fishpen and fishcage culture in Laguna de Bay, are strongly recommended for a more rational management of aquaculture in the Lake.

Box 2. Recommendations for more rational aquaculture management in Laguna de Bay, Philippines

- Illegal structures in Laguna de Bay should be immediately dismantled. The total area allotted for fishpens of 10,000 ha, in particular, has been exceeded already even counting registered fishpens alone. Among others, dismantling will help improve the environmental conditions in the lake.
- The optimal area for fishpen and fishcage culture in Laguna de Bay should be determined once and for all, as some sectors argue that the present allotment of 15,000 ha is too large. There are also concerns that the allotment is beyond the specified 10% of the suitable water surface area of all lakes and rivers mentioned in the Philippine Fisheries Code of 1998.
- Research agencies should fund and conduct more research on environmental problems in Laguna de Bay. As environmental problems have been considered relatively more severe than any other problems, emphasis should be put on such concerns in order to serve the interests of the numerous stakeholders who depend on an environmentally sustainable lake for their livelihoods and needs.
- A clean-up of the waters of Laguna de Bay of decaying bamboos, Anahaw poles and other materials should be done. This activity may be conducted by the aquaculture operators within and around their fishpen and fishcages while the government can undertake clean-up campaign in the open areas.

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