

Laguna de Bay

EXPERIENCE AND LESSONS LEARNED BRIEF

Adelina Santos-Borja*, Chief, Research and Development Division, Laguna Lake Development Authority, Pasig, Philippines, lennieborja@yahoo.com

Dolora N. Nepomuceno, Assistant General Manager, Laguna Lake Development Authority, Pasig, Philippines

* Corresponding author

1. Introduction

Laguna de Bay is the largest, most important lake in the Philippines. Its watershed contains 66 Local Government Units (LGUs), grouped into 5 provinces, 49 municipalities and 12 cities with an estimated population of 6 million people. The creation of the Laguna Lake Development Authority (LLDA) in 1966 started with a vision of the political leaders from the provinces of Rizal and Laguna to cultivate the potential of the lake and its environs for further development and, at the same time, control its environmental degradation. It also reflects the wisdom of the lawmakers in creating a separate agency to manage the lake amidst the multiple political jurisdictions in the watershed. A unique feature of the jurisdictional area of the LLDA is that it goes beyond the lake's watershed (Figure 1).

The existence of an Authority in the drainage basin puts Laguna de Bay in the best position in terms of conservation and management, compared to the other lakes in the Philippines and, perhaps, to some of the lakes within the Asian region. The current state of Laguna de Bay is the result of actions taken by its different stakeholders; thus, although everyone is accountable, most of the responsibility goes to the LLDA.

Although the lake is a multiple use resource, its dominant use is for fisheries. The

introduction of fishpen technology in the lake has produced economic benefits, but also has become a source of serious conflict on resource utilization and access that reached the attention of the President of the Philippines. It took 15 years to develop a feasible and acceptable management plan to address the concerns regarding the lake. Rapid urbanization

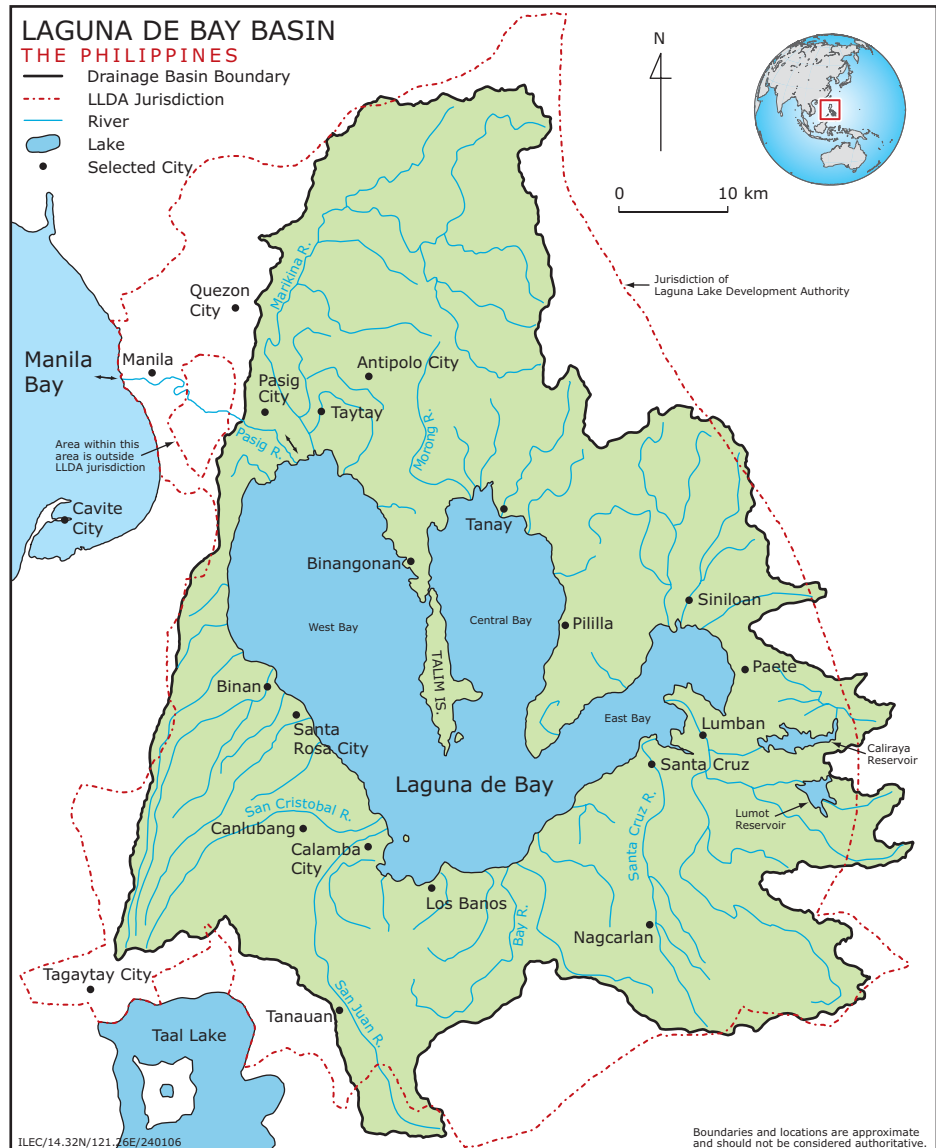


Figure 1. The Laguna de Bay Basin.

and industrialization have greatly increased the demand for environmental goods and services, mirroring the challenges the LLDA faces in sustainably managing the lake basin.

The LLDA has both a developmental and regulatory mandate, but with more emphasis on the latter because of its present structure and financial capability. Although it is yet to assume a developmental role, it has laid the groundwork for this role. It is an agency with a very broad mandate, but with limited resources, with the result that some of its mandates are not yet exercised. Given this predicament, the LLDA was able to pioneer the Environmental User Fee System (EUFS) in the Laguna de Bay Region. The EUFS will be implemented by the Department of Environment and Natural Resources throughout the country.

The trust and cooperation of a substantial proportion of the stakeholders, donor agencies and international organizations enjoyed by the LLDA did not come easily; it was and still is a work in progress.

2. Background

2.1 Biophysical Features

Laguna de Bay used to be an “arm of the sea” (Wolfe and Self 1983; Adams 1910; and Gervacio 1964). The evolution of the lake was defined by at least three major paleosalinity shifts that occurred over the past 6,000 years (Jaraula 2001). Sea-level changes and tectonic changes controlled the evolution of the lake from a brackish to a marine and ultimately to a fresh body of water that now lies at 14°10’-14°35’ N, 121°-121°30’ E, specifically in the island of Luzon, the biggest of the 7,100 islands of the Philippine archipelago.

Among the 216 lakes in the Philippines (Santos-Borja 2001), Laguna de Bay is the largest, with a surface area of 900 km². It also is one of the largest lakes in southeast Asia and one of the shallowest, with an average depth of 2.5 m. It has a water volume of 2.25 km³. The high surface area to volume ratio accounts for the lake’s characteristic turbidity. The water retention time is approximately 8 months. Its shoreline of 285 km delineates three distinct bays; namely, the West Bay, Central Bay and East Bay that converge towards the south. A South Bay also is referred to along the southwestern towns of Laguna Province. The West and Central Bays are separated by Talim Island, the largest, most populated of the nine islands within the lake.

Table 1. Watershed Land Use.

Land Use Type	Area (ha)	Percent
Forested Areas	19,100	5%
Open Areas	59,480	14%
Built-up/Industrial Areas	110,780	29%
Agricultural Areas	198,640	52%

The watershed area excluding the lake itself is 2,920 km², approximately 1.3% of the country’s land area of 300,000 km². It is occupied by the provinces of Rizal and Laguna, and partly by the National Capital Region, and the provinces of Cavite, Batangas and Quezon, consisting of 8 cities and 49 municipalities, including 2 lakeshore cities and 27 lakeshore towns. More than 100 streams flow into its drainage area, which is divided into 24 sub-basins. There is only one outlet, the 27 km Pasig River, which drains to Manila Bay. When the lake level is lower than Manila Bay, and when there is sufficient tidal fluctuation that can push saltwater into the lake, Pasig River becomes a tributary. During backflow of the Pasig River, therefore, Laguna de Bay becomes a brackish water lake. The extent of saline water intrusion depends on the duration of the backflow and the prevailing climatic conditions. The normal chloride concentration ranges between 250-350 mg/L but can reach 4,000 mg/L at sustained Pasig River backflows (see Figure 2 below). The fishermen and aquaculture operators favor this phenomenon because higher salinity improves the lake’s transparency by the flocculating effect of saline water on the suspended colloidal particles in the water column. Subsequently, an abundance of phytoplankton follows (Santos-Borja 1994).

The lake provides a variety of environmental goods and services to the surrounding communities, which extend to other stakeholders inside and outside the basin. It provides food, water for irrigation, power supply, cooling of industrial equipment and, more recently, a source of raw water for domestic supply. It also is a convenient transport route for people and products, a receptacle for floodwaters coming from Metropolitan Manila, and a sink for treated and untreated liquid wastes. Its dominant use at present is for fishery, both open water fishing and aquaculture.

The lake also is part of the flyway of migratory birds for shelter and food. Its full potential as a place for recreation and nature appreciation has not been given much importance, due perhaps to the environmental degradation observed in some parts of the lake, especially closer to Metropolitan Manila.

Observance of religious rites in the lake (e.g., baptism; fluvial parade in honor of the patron saint) reflects the close link of lakeshore inhabitants to the lake. There also are some historical sites, such as the town of Calamba in Laguna Province, the home of the Philippines’ national hero, Dr. Jose P. Rizal, who also highlighted the significance of the lake and the Pasig River in the daily lives of people in one of his novels. The Laguna de Bay watershed abounds with natural and cultural scenic spots, including Mt. Makiling and Pagsanjan Falls and the century-old churches in Pakil, Pangil and Majayjay in Laguna Province. The Angono petroglyphs in the lakeshore town of Binangonan Rizal is a world cultural heritage site.

Watershed land use is presented in Table 1. The watershed has a forest cover of only 5% of total watershed area, mainly represented by Mt. Makiling which is considered a microcosm of the only remaining forested environment in the Laguna de

Bay basin (Sly 1993) as well as being one of the 18 centers of plant biodiversity in the Philippines (DENR/UNEP 1997), following its early designation in 1910 by the Philippine Government as a Forest Reserve.

Approximately 1,990 km² (52% of the total land area) is used for agricultural purposes, mainly livestock raising and coconut, fruit trees and rice farming. Industrial and urban areas account for 29% of the watershed area, while deforested areas (grass, bushland) comprise 14%. There has been a rapid land conversion for industrial and residential uses in the past 20 years.

2.2 Political and Socio-economic Features

2.2.1 *The Watershed and the Laguna de Bay Region*

In 1983, the term Laguna de Bay Region was introduced through Executive Order 927 *Further Defining Certain Functions and Powers of the Laguna Lake Development Authority*. LLDA can exercise its mandate (indicated by “LLDA jurisdiction” line in Figure 1) over almost the whole watershed, as well as political units such as Quezon, Manila, Kalookan and Pasay which are located outside the watershed area but within the National Capital Region (NCR).

Technically, the Laguna de Bay Region is not synonymous to the lake’s watershed. This reflects the previous lack of appreciation by lawmakers of using the watershed as the management unit for the environmental protection of Laguna de Bay. The inclusion of areas outside the watershed was essentially a political accommodation. The city of Makati, the Philippine’s prime financial district, together with Mandaluyong and San Juan, were carved out of the continuous land mass in the National Capital Region (the area along the Pasig River marked “outside LLDA jurisdiction” in Figure 1). Extension of the LLDA’s management unit outside the watershed has been an irritant to local officials and regulated industries at times, and a source of confusion in exercising its mandate. With the Laguna de Bay Region so defined, it is necessary to differentiate between the LLDA’s geographical jurisdiction (its 2,920 km² watershed) and its administrative jurisdiction (the Laguna de Bay Region, with a total area of about 3,880 km²). Unless otherwise specified, all the facts and figures in this document refer to the Laguna de Bay Region, which is composed of the National Capital Region, 5 provinces, 51 municipalities, and 10 cities, altogether comprising 66 local government units.

2.2.2 *Demography*

The population growth and distribution in the watershed is strongly influenced by the proximity of some lakeshore towns to Metropolitan Manila. About 18.3% of the total population resides in the National Capital Region. The growth rate is 2.25%, slightly higher than the average national growth rate (2.02%). The population density is 20 persons/ha.

The more densely populated municipalities are located within or close to Manila, with the high population growth rate attributed to migration in from other regions of the country,

resulting mainly from the perceived economic opportunities in Manila (Francisco 1985).

2.2.3 *Economy*

In terms of economic output, the Laguna de Bay Region produces a Gross Regional Domestic Product of PhP101.3 billion and a potential labor force of 6.1 million in 1990 (LLDA 1995). Agriculture still retains considerable economic importance, being the watershed’s dominant land use.

Industrial establishments previously were concentrated in the Metropolitan Manila area, but have expanded over the last 20 years to other cities and municipalities. As of July 2003, there are about 4,351 industrial establishments in the basin. Based on the industry sub-sector classification, the majority are food manufacturing, livestock raising, chemical and pharmaceuticals, metals, minerals and non-metals. Real estate and housing, shopping centers and recreational facilities constitute the highest number of business establishments.

The aquaculture industry also thrives in the Laguna de Bay Region, with ownership classified into corporation, cooperative and individual operators. The hired fish pen and fish cage caretakers, service contractors that construct fish pens and fish cages, and suppliers of materials and fish vendors also benefit from this industry. Ironically, there are not many socio-economic studies on such an important industry, resulting in a lack of accurate information on its economic benefits. Another factor is the reluctance of fish pen operators to disclose their harvest and earnings, their apprehension being that the disclosure will be used as a basis for determining their tax obligation and for increasing fish pen fees. Thus, the LLDA estimated the lake’s fish production on the basis of the stocking density, mortality rate and average size of harvestable fish, with the estimated 2002 harvest being 60,000 tons/ha.

2.3 Institutional and Managerial Features

2.3.1 *The Laguna Lake Development Authority and its Evolution*

The potential of the lake and its environs for further development, and perceived threats from the rapidly changing character of the lake region, prompted the political leaders of the Rizal and Laguna Provinces to enact legislation in the early 1960s geared toward management of the lake and its resources and control of environmental degradation. This move was intended to create an instrument to facilitate rational utilization of the lake’s resources, under the belief that creation of an “Authority” would facilitate cooperation, coordination and resource pooling among national government agencies, local governments and the private sector (Francisco 1985). On July 18, 1966 the Laguna Lake Development Authority was created through Republic Act 4850 *An Act Creating the Laguna Lake Development Authority, Prescribing Its Powers, Functions, and Duties, Providing Funds Thereof and for Other Purposes*. As stated in the law, its mandate is “to promote and accelerate the development and balanced growth

of the Laguna Lake area and the surrounding provinces, cities and towns...with due regard and adequate provisions for environmental management and control, preservation of the quality of human life and ecological systems, and the prevention of undue ecological disturbances, deterioration and pollution.” Three years after enactment of R.A. 4850, the LLDA was organized as a semi-government corporation. Presidential Decree (P.D.) 813 of 1975 further expanded the LLDA’s mandate to address environmental concerns and conflicts over the lake’s jurisdiction and control. This was followed by the 1983 Executive Order (E.O.) 927, which further strengthened the institutional, financial and administrative responsibilities of the Authority, including its regulatory functions in industrial pollution.

The General Manager is the Authority’s Chief Executive, with the corporate power vested in the Board of Directors. An operational subsidy of PhP1,000,000 was appropriated annually for five years from the National Government general fund. Thereafter, the LLDA became a self-sustaining organization, with its operation financed through income from regulatory fees and fines, laboratory services, resource user fees (aquaculture operation, water abstraction) and from its corporate investments and marketable securities.

In 1993, the LLDA was placed under the administrative supervision of the Department of Environment and Natural Resources (DENR), through Executive Order 149. As such, it maintains its separate policy-making functions through the Board of Directors. The LLDA decides and acts on policy matters, although not all are elevated to the DENR Secretary for final approval, since the Secretary is an LLDA Board member.

Laguna de Bay is the only lake in the Philippines managed by a special agency of the Philippine Government. Although the LLDA is mandated by law to perform its function as a basin wide authority, it does not have control over all projects affecting the lake and its region, due to overlapping areas of jurisdiction with other government agencies. The latter exercise their respective mandates in the region on policy and planning, regulation and infrastructure development. The Local Government Units also exercise their mandate on environmental protection and management, which was further strengthened by Republic Act 7160 or the Local Government Code. The existence of many players, the majority being government institutions, has become a liability in the management of the Laguna de Bay Region (see Section 3.4.2).

2.3.2 *The LLDA Mandate vis-à-vis Provision of Livelihood Funding Mechanisms*

The Charter of the LLDA authorizes it to lend or facilitate the extension of financial assistance and/or act as surety or guarantor of worthwhile agricultural, industrial and commercial enterprises. However, this provision was recently affected by the issuance of Executive Order No. 138 dated 10 August 1999 *Directing Government Entities Involved in the Implementation of Credit Programs to Adopt the Credit Policy*

Guidelines Formulated by the National Credit Council. Being a government-owned and controlled corporation (GOCC), the LLDA is no longer allowed “to be engaged in providing credit services directly or indirectly to various sectors.”

This national initiative is aimed at rationalizing directed credit programs to provide greater access by marginalized sectors to financial services and to improve their living conditions. It was envisioned to provide the enabling environment for the efficient functioning of markets and participation of the private sector.

In the late-1970s up to the early-1990s, the LLDA implemented some financing mechanisms to address the socio-economic condition of marginalized users of the lake’s water resources, prompted by the following conditions:

- Declining lake productivity—Factors contributing to the declining lake productivity include pollution from industries, siltation and sedimentation, fertilizer runoff from agricultural lands, encroachment of shoreland areas, and rapid conversion of prime agricultural lands into industrial and residential lands;
- Effect of the Napindan Hydraulic Control Structure (NHCS) on the lake fisheries—The small fishermen blamed the prevention of entry of saline waters from Manila Bay through the Pasig River for the productivity decline, claiming saline water was an important factor in clearing the lake water of turbidity, thereby promoting growth of natural fish food. The NHCS was eventually opened; and,
- Protracted use of the lake as a source of domestic water supply—The pronouncement in early-1990 by then President Corazon C. Aquino that the Government would use Laguna de Bay as a domestic water supply caused widespread apprehension and agitation among fishermen, although they were assured by the LLDA that they would not be affected by this move.

These factors had three potential major consequences: (a) lower income for marginal fishermen and other lake dependent sectors; (b) displacement/unemployment because of perceived restrictions in using the lake for fisheries; and (c) conflict of interest among different resource uses/users versus domestic water supply, causing further agitation of other non-fishery sectors as well.

In response, the LLDA identified some important financing programs/projects partly supported from its corporate revenues, external sources (e.g., LGUs, overseas development assistance), envisioned to provide alternative livelihoods through an integrated package of assistance to the fisherfolk and other stakeholders dependent on the lake’s resources. The programs/projects sought to transform these stakeholders and users totally dependent on the lake’s natural resources into versatile entrepreneurs capable of engaging in other

income-generating projects, in addition to lake-based activities like fishing.

Laguna de Bay Fishpen Development Project (LBFDP). In December 1978, the Asian Development Bank (ADB) and the OPEC Fund for International Development approved a loan to finance the Laguna de Bay Fishpen Development Project (LBFDP), with the Development Bank of the Philippines (DBP) and the Laguna Lake Development Authority (LLDA) as executing agencies. The project was conceived to help marginal fisherfolk improve their socio-economic condition by providing them with an opportunity to enter into fishpen and fishcage industries, to systematically develop the lake fishery through fishpen/cage technology, and augment the region's fish supply, including nearby provinces.

The LBFDP was designed to organize small fishermen into cooperatives, provide credit, a supply of fingerlings and other production inputs, and harvesting and marketing support services, in order for the cooperatives to own and operate their own fishpen/cage modules.

The project had two components, namely:

- Fishpen development. Provision and administration of sub-loans for developing five and ten hectare fish pen modules, covering an area of 1,680 ha, benefiting about a thousand fishermen-families residing in LDBR. This component is administered by the DBP with LLDA assistance; and,
- Hatchery/nursery complex and related facilities and services. Construction of a large-scale hatchery/nursery complex and provision of other facilities and services, including consulting services, under LLDA supervision.

In spite of the systematic organization of small fishermen cooperatives by the LLDA, and establishment and operation of fish pen modules by the cooperatives, the project was deemed unsuccessful by both the Philippine Government and the ADB, because its implementation was constrained by design deficiencies and inadequate environmental assessments, leading to drastic changes in project design and scope, implementation delays, and consequent shortfalls in targeted outputs. Most loans made under the Fishpen Development or credit component of the LBFDP were in arrears and never collected by the DBP, thereby having to be written off. The project was terminated in March 1988.

Based on the November 1996 ADB Post-Evaluation Office Report, the key lessons from this LBFDP experience were: (a) the need to incorporate adequate environmental concerns into the technical design of the project and to conduct environmental assessments on an on-going basis; (b) the importance of adequate risk analysis at the project design level, and of balancing risks with appropriate safeguards; (c) the need to provide institutional mechanisms for training, organizing and motivate small fishermen, and provide them

prompt assistance, especially in the aftermath of typhoons and calamities, as well as in their daily subsistence; and (d) the urgency of institutionalizing mid-term and periodic project implementation reviews. Overall, fishery projects, especially for marginalized fishermen, should be supported by reliable resource surveys.

Livelihood development program. Recognizing its resource limitations, the LLDA undertook a joint livelihood program, with counterpart funding from the Rizal and Laguna Provincial Governments in 1990. It was intended to provide start-up financing to small-scale livelihood projects of lake stakeholders, with the Provincial Livelihood Offices implementing the credit program on the ground, and the LLDA providing technical assistance (e.g., training on fishery and aquaculture-related training; advisory services). For their part, the Rizal and Laguna Provinces each contributed an equivalent amount to the livelihood fund, which was rolled over to finance succeeding batches of income-generating projects. Other program components included institution building (organizing cooperatives) and enterprise development, and provision of support services (e.g., management assistance, marketing and raw materials sourcing). Out of 13,000 target lakeshore families below the poverty threshold, the program supported 3,250 families, in terms of livelihood assistance during its first year of implementation, with granted loans totaling about PHP11.50 million.

While the signed Memorandum of Agreement (MOA) between the LLDA and Provincial Governments provided for monitoring and evaluation protocols, including periodic physical and financial reports from the implementers to the LLDA, there was no strict adherence to the requirements under the MOA. Although the Agreement provided for the scheduled remittance of interest to the LLDA after the principal had been rolled over several times, for example, there was initially only partial remittance, and eventually none whatsoever.

3. Biophysical Environment

3.1 Past and Current Conditions

3.1.1 Biodiversity and Fishery

Laguna de Bay is traditionally used as a communal fishing ground for daily sustenance and livelihood, explaining why the earliest recorded studies on the lake focused mostly on fisheries (Mane 1929, Villadolid and Sulit 1931, Villadolid 1934, Mane and Villaluz 1939). Concerns already were raised on the use of destructive fishing gear, over-fishing, declining native species populations, and pollution of the Pasig River.

Studies on the fish population of Laguna de Bay during 1960-1964 (Delmendo and Bustillo 1968) showed that there were 23 species of fish belonging to 16 families and 19 genera. The most dominant and important species were *Therapon plumbeus* and *Glossogobius giurus* (white goby). Most of the stock were migratory species, but were scarce in distribution due to pollution of the Pasig River, suggesting a high mortality

for migrating fry. Stocking the lake with milkfish since 1959 due to its higher market price, was reported and was identified as a reason for the accidental introduction of other species.

During the same period, there was an alarming decline in the sea catfish (*Arius manilensis*) population, which used to constitute the lake's fishery. This was attributed to a decrease in the snail (*Thiara sp.*) population because of rampant dredging to sustain the duck farming industry, notably in the eastern towns of Rizal Province. Related to this industry is the making of "balut" which is a native delicacy of boiled unhatched duck embryo, although after almost twenty years, there was a tremendous decrease in the number of duck farms.

The catfish population started to increase a few years after the introduction of aquaculture in the early-1970s and it is now the most commonly-caught fish in the lake. It thrives near the fish pen areas, where the catfish seek shelter.

Aquaculture became a very lucrative lake-related business, encouraging the culture of other species (e.g., tilapia; bighead carp, *Hypophthalmichthys nobilis*). A stock assessment of major fishery resources showed the open water catch is composed of 13 species, including the shrimp commonly found in the lake (Palma et al. 1997). Of the fish species, the most commonly caught were *Tilapia sp.*, *H. nobilis* and *A. manilensis*.

In 2002, an alarming population of janitor fish (*Hypostomus plecostomus*) was observed in the lake and tributary rivers. This is a common aquarium fish because of its ability to clean organic debris. Maintenance of aquariums became a very popular hobby in the late-1900s, now being a common fixture in homes, offices and businesses. Businessmen ventured in the culture of aquarium fish along the lakeshore and near the rivers, and the escape of janitor fish from such operations is believed to have caused this introduction.

The most common phytoplankton in the lake are blue-green algae and diatoms. The former is composed mostly of *Anabaena*, *Anabaenopsis*, *Microcystis* and *Oscillatoria*, while the diatom population is dominated by *Stephanodiscus*. Other genera (e.g., *Coscinodiscus*, *Melosira*) also are consistently found throughout the year. Representative genera of green algae include *Scenedesmus*, *Hormidium*, *Closterium* and *Pediastrum*. Dinoflagellates like *Glenodinium* and *Ceratium* are rarely present. An abundance of phytoplankton is generally observed from May to September. Algal blooms that sometimes reach alarming levels occur during these months, often dominated by *Microcystis sp.*

The zooplankton population consists of rotifers like *Brachionus angularis*, *B. calyciflorus*, *B. urceolaris*, *B. forficula*, *B. falcatus*, *Keratella sp.*, *Trichocerca sp.*, *Filinia sp.* *Asplanchna sp.* and *Hexarthra sp.* The cladocerans are composed of *Diaphanosoma*, *Bosmina*, *Ceriodaphnia*, and *Moina*. The identifiable copepods include the adult forms of *Mesocyclops sp.*, *Thermocyclops sp.* and *Arctodiaptomus sp.*

The benthic fauna is composed of mollusks (e.g., *Corbicula*, *Melanoides*, *Thiara*), oligochaetes (e.g., *Branchiura*, *Limnodrilus*, *Naididae*); the ostracod *Cypricercus sp.*, and the dipterans represented by chironomid larvae.

There presently are no recorded endemic species in Laguna de Bay, probably because it is a very young lake, formed some 6,000 years ago. Its link to Manila Bay, and the introduction of non-native species, also could have contributed to this phenomenon.

3.1.2 Water Quality

Critical pollution levels were detected in the lake in 1973 (SOGREAH 1974). It is estimated that about 5,000 tons of nitrogen entered the lake, 26% being of domestic origin, 36% from livestock and poultry, 5% from industrial sources, 11% from fertilizers, and 22% from Pasig River backflow. The average nitrate concentration was 150 µg/L, with the total nitrogen assumed to be between 900-1,000 µg/L. The inorganic phosphate concentration was less than 40 µg/L, and the total phosphate was below 100 µg/L. The initial findings were that nitrogen limits algal growth in Laguna de Bay. A follow-up study from 1975 to 1977 also indicated nitrogen was the most likely limiting factor controlling algal growth in the lake.

Reassessment of the status of Laguna de Bay in 1984 (BCEOM 1984) showed that nitrogen still can be considered the main eutrophication factor, although there also were times when light (at times of high turbidity) and temperature (during the cooler months when blue green algae numbers were low) seemed to limit the maximum algal biomass. It is believed Laguna de Bay has not yet reached an extreme level of eutrophication. Recent estimates in 2000, generated via the Laguna de Bay waste load model, indicated a total nitrogen input of 13,800 tons nitrogen per year, with 79% being from domestic sources, 16.5% from agricultural activities, 4.5% from industrial effluents, and 0.5% from other sources.

Laguna de Bay is classified as a Class C inland water (DENR 1990), meaning it is suitable for fisheries. Assessment of its water quality is based on the criteria for different parameters, including dissolved oxygen, biochemical oxygen demand (BOD), nitrate, phosphate, dissolved solids, suspended solids, etc. Values of chloride ion, transparency, total suspended solids, chemical oxygen demand (COD_C) and dissolve oxygen are presented in Figure 2 for Station I which is located near the center of the West Bay. These parameters reflect that the lake's water quality is within the Class C criteria, except for chloride. Although not presented in Figure 2, the phosphate concentration exceeded the maximum limit in 1997, an El Nino year.

Due to its eutrophic character, algal blooms are common occurrences in the lake. A lake-wide algal bloom of *Microcystis sp.*, with concentrations up to one million algae per milliliter, was recorded in 1973. Its most damaging effect on aquaculture was in 1975 (June-July), killing about 5 million of milkfish.

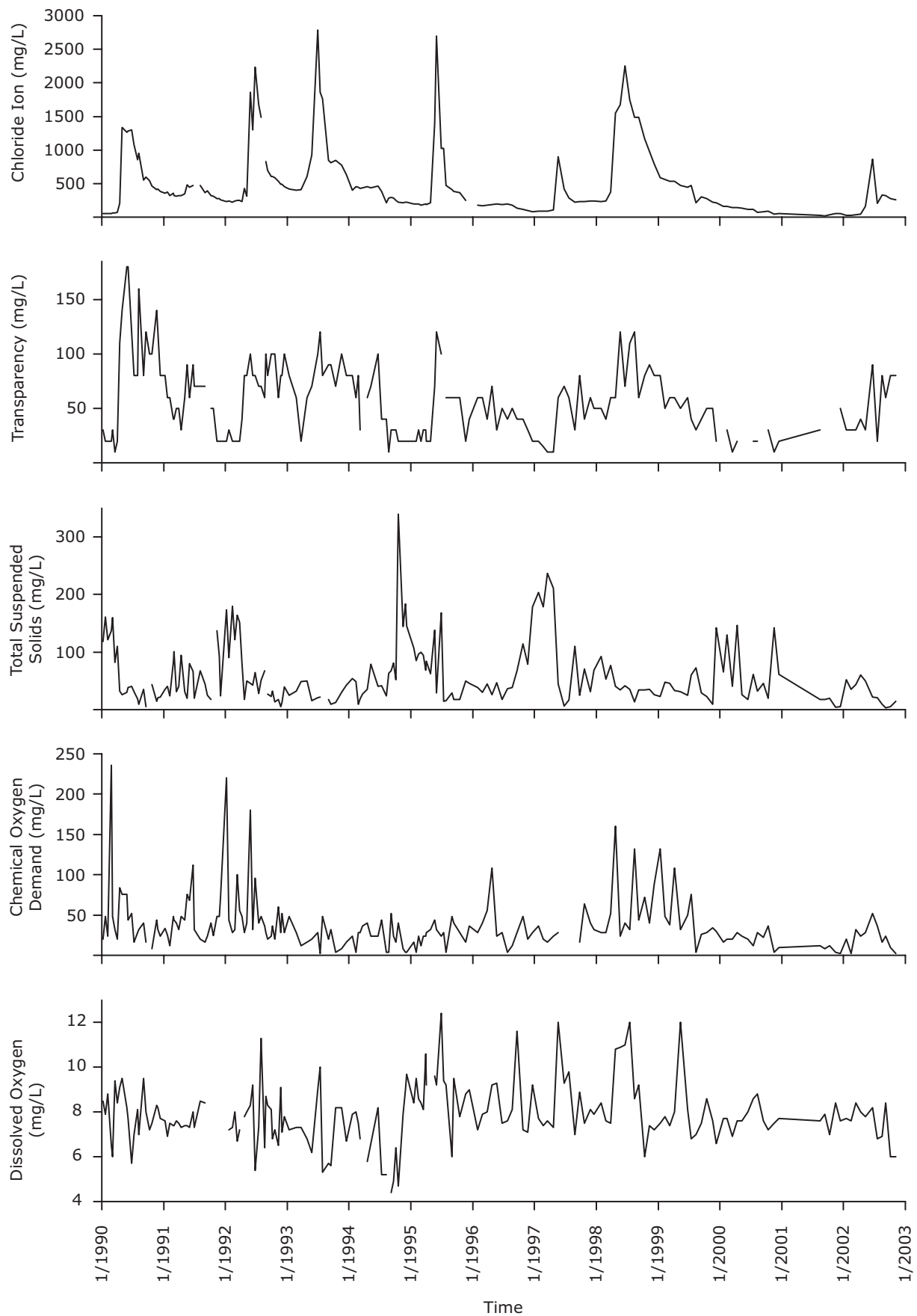


Figure 2. Laguna de Bay Water Quality: Selected Parameters (Source: LLDA monitoring data).

Localized fishkills due to the collapse of blue-green algal blooms also are experienced in the lake.

Total coliforms and fecal coliforms seldom exceed the allowable limit for Class C water of 5,000 MPN/100 ml and 200 MPN/100 ml, respectively. However, because the sampling stations are in open water, the same findings may not be true near lakeshore areas, considering that individual septic tanks in residential areas are common, and sewerage systems are lacking.

Heavy metals, such as cadmium, chromium, lead, copper, iron, nickel, and zinc, are regularly monitored in the lake. The first three are included in the list of parameters for assessment of Class C water. Their in-lake concentrations (LLDA 1999) were below the set criteria of 0.01, 0.05 and 0.05 mg/L, respectively. Lead and nickel concentrations were below the detection limit, while that for zinc ranges between 0.03-0.10 mg/L. The iron concentration is normally high, with an average value of 1.986 mg/L. Preliminary studies (NEDO/LLDA/JEMAI 2000) showed that the level of arsenic ranged between 0.022-0.030 mg/L, compared to the criteria of 0.05 mg/L.

The heavy metal concentrations in the lake sediments are very low, up to only twice the average shale values, except for nickel which has concentrations ranging from 2 to 12 times the average shale values. Based on an assessment in 1999 by the National Institute of Geological Sciences, the lake's overall pollution level derived from sediment data can still be described as very low, corresponding to unpolluted to moderately-polluted levels (I_{geo} values of 0-2).

3.2 History of Lake Degradation

The root causes of rapid deterioration of the resources in the lake and its watershed are well documented (e.g., SOGREAH 1991; Sly 1993; LLDA 1995; LLDA and ERDB 2000). They include:

- Intensified economic activities, resulting in increased urbanization, industrialization and population pressures, mostly in the western zone of the basin, thereby exacerbating the environmental quality problems in the urban sector and the degradation of forest and fishery resources of the lake and its watershed;
- Open access to natural resources use;
- Lack of economic resource pricing policies; and,
- Lack of a common policy objective for management and development of the resources of the lake and its watershed.

These root causes can be further classified into urbanization, industrialization and resource extraction.

3.2.1 Urbanization and Industrialization

The impacts of rapid population growth, urbanization and industrialization, and the concomitant real estate development, are causing severe stress on the lake environment and its watershed. The lake is getting shallower (i.e., average depth of 3 m in 1970s to current average of 2.5 m). Rapid denudation of the forested areas and land conversion have further aggravated this problem. Recent studies have shown that the in-lake siltation rate is between 1.03-1.20 cm/yr. Flash floods and mudslides have become frequent in recent times, resulting in loss of property and death.

Rapid migration to urban centers, and uncontrolled human settlement along river bank and lakeshore areas, has contributed to the growing solid and liquid waste problem. Domestic wastes of a majority of the watershed's 6 million inhabitants ultimately find their way to the lake. The estimated BOD load contribution of 26% from domestic wastes in 1976 (WHO/UNDP/LLDA 1978) has increased to 68% in 2000 (LLDA monitoring data). Unfortunately, the government has no significant program to treat domestic wastes. No centralized sewerage system exists, except for newly-developed housing and commercial subdivisions. Although primary treatment via septic tanks is common in urban residential areas, it is not in rural areas and places occupied by informal settlers (usually along river banks and lakeshore). Waste segregation and recycling is practiced in some places, although indiscriminate open dumping of wastes is a common practice. Laguna de Bay serves as the receptacle of treated, partially treated and untreated liquid waste, with this type of use directly conflicting with all other uses, posing a great challenge to the LLDA and other agencies and stakeholders.

Industrial pollution contributes about 30.35% of the total pollution load to the lake. The number of regional industrial firms has increased five-fold since 1970. There were an estimated 1,538 industrial firms in 1994. Based on the LLDA's record of 3,881 industrial establishments situated mostly in the western side of the lake, about 26% use dry processes, 23% generate wastewater through wet processes, and 45% involve both wet and dry processes. The remaining 6% is still unclassified. Of those firms with wet and dry processes, 34% have installed wastewater treatment facilities, while others have adopted full recycling practices.

3.2.2 Resource Extraction

Illegal fishing practices (e.g., use of fine-meshed nets and *suro* (a device that scours the lake bed)) have occurred since the 1930s. A decline in open water fishery was previously reported in the early-1970s (Shimura and Delmendo 1969; Delmendo and Gedney 1974), with the effects being clearly manifested in the 1980s. Thus, it became difficult to convince fishermen that their common fishing practices were causing the decline in their fish catch. Destruction of the lake bed, especially near littoral areas, was suspected to be the reason for the declining populations of some native aquatic macrophytes (*Hydrilla* sp.).

As previously noted, snail dredging used to support the duck raising industry in some lakeshore towns. The practice continued unabated in the mid-1980s to 1990s. Truckloads of snails are being hauled from the lake to support the land-based duck-raising industry and prawn culture in earthen ponds outside the lake basin. The income from snail harvesting seemed to be high since most fishermen and boatmen in lakeshore towns shift to snail gathering during the peak season. This type of livelihood is no longer observed. Unfortunately, this economic activity was not given due attention in terms of documentation and research, especially on the impacts of excessive snail gathering on the lake's ecology.

Aquaculture operation started in a commercial scale in the early-1970s, with the cultured fish (*Chanos chanos* or milkfish) relying on the natural food in the lake. Two croppings per year was the practice, thereby accelerating the return of investment. This business attracted many businessmen, such that aquaculture structures occupied almost 2/3 of the lake's surface area in 1983. A declining harvest was then observed, due to depletion of natural food, as well as obstructed water movement caused by a disorderly arrangement of fish pen structures. Further, water hyacinth infestation became serious, especially where they were trapped within the structures. Other fish species also were introduced in the lake for the purpose of aquaculture without an assessment of the potential impacts to the lake's ecology. Unfortunately, the organic load to the lake from fish pens and fish cage operation has not been monitored.

The denudation of the forests, and siltation of the lake and its tributary rivers in the area of the Rizal Province, are blamed on quarry operations and limestone extraction. Local communities often complain not only about air and noise pollution, but also the unusual coloration of the river water.

3.3 Economic Valuation of Laguna de Bay Environmental Resources

Economic valuation framework developed to determine the costs and benefits of environmental goods and services has been applied to natural resources valuation on a national

scale under the USAID-assisted Environmental and Natural Resources Accounting Project (ENRAP). Under this project, application of this valuation technique for Laguna de Bay was limited to inland fisheries.

For purposes of providing a reasonable estimate of the economic value of Laguna de Bay watershed environmental resources, the economic analysis undertaken by the Laguna de Bay Strengthening and Community Participation Project (LISCOP) (also discussed in Section 5.4.3) was used. The approach started with an examination of the uses of Laguna de Bay (e.g., fisheries; irrigation; domestic water supply; recreation; bird sanctuary; habitat for a variety of flora and fauna). It is emphasized that the notion of "use" does not imply that absence of an "observable" use translates into no use. All resources have a "use", even if it is not directly observable. Thus, the total economic value can be computed as:

$$\text{Total Economic Value} = \text{Use values} + \text{non-use values}$$

where:

- direct use values = those generated from actual use of the resource for livelihood or communal or reservation; and,
- indirect values = benefits to society resulting from the functions of the ecosystem (e.g., forests act as carbon sinks and provide watershed protection);

Direct use can be further differentiated into:

- Existence values = values to individuals of specific aspects of the environmental resources that are unrelated to any form of current or future use; and,
- Bequest values = the benefits to future generations to be able to use the resources in the future.

A schematic of this approach is presented in Figure 3.

To compute the economic benefits for the Laguna de Bay, direct uses were confined to important direct uses only, and

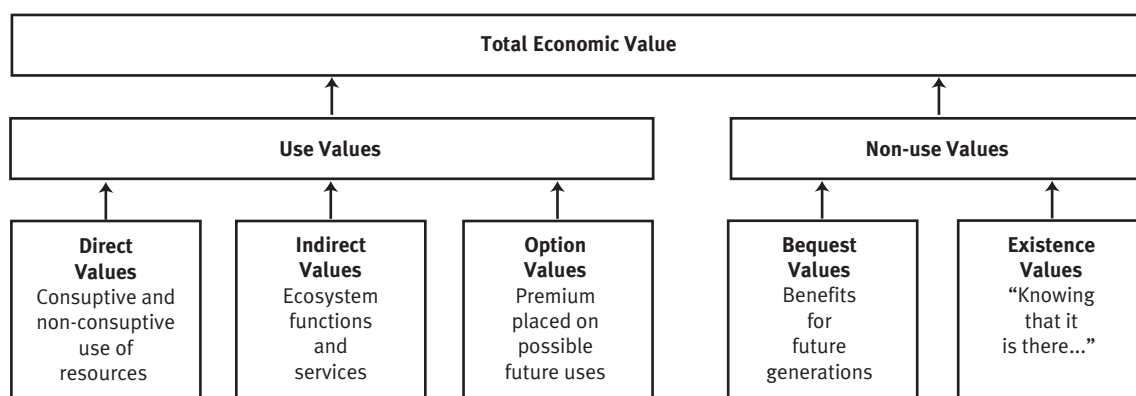


Figure 3. Total Economic Value of Using Laguna de Bay's Resources.

do not include other direct and indirect uses, or non-use values that would normally be included in developing a more comprehensive measure of the total economic value of the environmental good and service (Table 2).

In regard to its fisheries, the total fish catch from Laguna de Bay in 1984 was estimated to be about 116 million metric tons. By 1995, the total catch had decreased to about 24 million metric tons. By 2000, the estimated total fish catch had further declined to about 18 million metric tons. In spite of occasional short-run improvements in total fish catch, the last twenty years have exhibited a strong general trend of declining catch.

Not surprisingly, the declining fish catch has coincided with increased pollution levels in Laguna Lake (Table 3). On the other hand, although insufficient data exist to establish a strong link, it also appears that the introduction of the

Environmental User Fee (see section 4.4.1 for discussion) on BOD in 1997 (Table 4) led to slight fish catch improvements.

The general decline in the weight of fish catch meant a corresponding decline in the market value of the catch. In 1984, the estimated market value of fish catch was around P53 million, declining to approximately PhP28 million in 2000. Thus, the declining quality of the lake has real indirect effects on the economy, with falling incomes and threatened livelihoods.

In the absence of LISCOP, the level of fish catch in the lake was predicted to decrease by 25%. Thus, the avoided cost with the project would be PhP17 million per year (using the December 2003 peso-dollar exchange rate of P55.5/US\$1.00). If the fish catch would continue to decrease at 3.5% per year without the project, the avoided cost with the project also would grow at the same rate. The project's economic benefit, with respect to

Table 2. General Methodology for Computing Benefit from Important Direct Use of Laguna de Bay.

Nature of Direct Use	Method Used to Compute Benefits
Fisheries	Value of fish catch lost without the project
Irrigation	Additional cost of sourcing water without the project
Industrial cooling	No benefits computed, but the benefits equal the additional cost of adopting alternative technologies for industrial cooling
Domestic	Cost avoided in extracting drinking water from alternative source
Recreational activities	Value of recreational benefits lost without the project
Power generation	No economic benefit (for hydropower plants)

Table 3. Water Quality of Laguna de Bay and Fish Catch (Annual average in mg/L, unless stated).

Year	Biochemical Oxygen Demand (BOD)	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Fish Catch (metric tons)
1990	2.10	56	1,011	
1991	2.60	46	750	
1992	2.00	56	1,223	
1993	1.80	34	1,726	44,741
1994	1.60	67	734	18,020
1995	1.80	82	1,113	24,432
1996	1.60	48	368	13,060
1997	2.04	89	555	
1998	2.68	47	2,192	
1999	1.81	39	823	
2000	1.14			

Table 4. Total BOD Loading (metric tons/day).

No. of Firms ^a	1997	1998	1999	2000
222 firms	5,403.29	4,102.38	1,200.37	1,240.51
255 firms		4,431.71	1,515.78	1,278.75
429 firms			1,790.03	1,448.48
628 firms				2,309.08

Note: a) The increased BOD loading for 2000 was due to the increased volume of discharge (industrial park and residential subdivision), and the increased BOD concentration of firms with water pollution cases; only firms those with complete documents are counted.

direct use of the lake for fisheries in net present value terms (i.e., at a 15% discount rate) will be around PhP30.5 million.

The project's benefit with respect to irrigation, domestic water supply and recreation also were determined in terms of the avoided cost of using alternative sources. The computed values were PhP70 million per year for irrigation, PhP0.5 million per year for domestic water supply and PhP30.1 million for tourism over a 20-year horizon. With respect to irrigation (farming activities), the benefit of improved water quality for irrigation (or prevention of its further deterioration) is measured by the avoided cost of using alternative sources, computed as PhP69 million per year.

3.4 Lake and Drainage Basin Resource Conflicts

The current institutional arrangement for managing the Laguna de Bay watershed is characterized by the lack of a coherent, harmonized relationship between and amongst the key stakeholders, which thereby hinders its effective management. Each stakeholder, agency and institution has its own agenda, separately formulated and separately implemented policies, mandates and programs to meet relatively narrow, sectoral or stand-alone goals. This section discusses the evolution of the

stakeholder environment, including their characteristics and motives.

3.4.1 Analysis of Stakeholders

The Laguna de Bay watershed stakeholders can be grouped into the following categories: (a) regulators; (b) policy makers, planners and coordinators; (c) developers (land and water), including infrastructure development and provision of basic services; (d) research and development institutions; (e) resource users (f) local government units; and (g) informal stakeholders (Figure 4). The stakeholders in the last category also may fall into the resource users group.

Table 5 shows the existing and potential areas of conflict between and among stakeholders' categories, as well as the responses, which have been established, or are in the pipeline.

Among the Resource Users/Communities, there are important players who have evolved from the development challenges and issues in the lake watershed, including:

- Formally organized and unorganized fishermen and farmers;

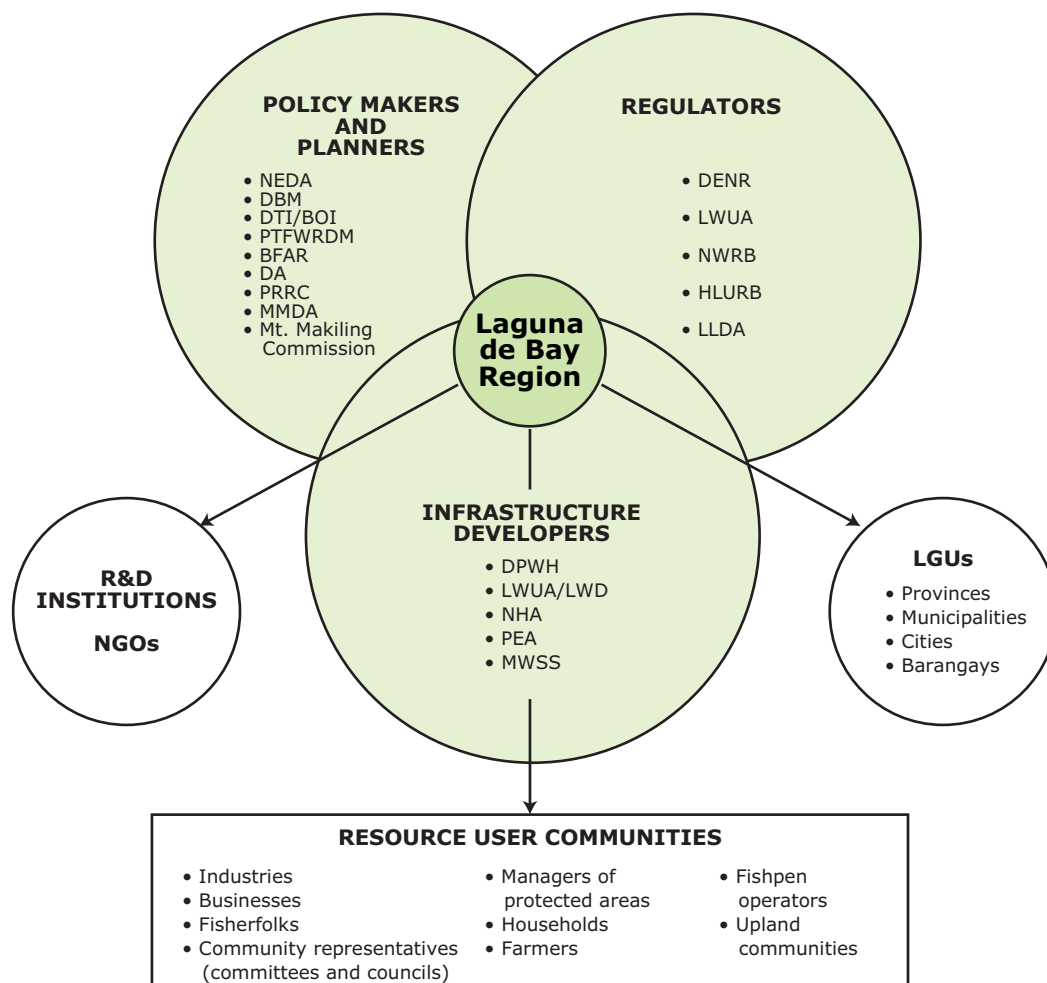


Figure 4. Stakeholders in the Laguna de Bay Region.

- Laguna de Bay fish pen operators' associations;
- Informal stakeholders, including informal settlers (squatters), fish pen poachers, etc;
- Indigenous Peoples, such as the Dumagats and Remontados of the Tanay micro-watershed; and,
- Non-governmental organizations supporting urban poor issues, IP concerns, gender issues, etc.

Except for the Indigenous Peoples, for whom the National Commission on Indigenous Peoples (NICP) was created, there is limited literature or documentation on these informal resource user groups. Recently, organization of the informal settlers' group has been hastened by controversial government projects in the Laguna de Bay area.

The Institutional Re-engineering Studies undertaken for the LLDA by Tetra Tech EM Inc. and PNB Capital and Investment Corporation (LLDA et al. 2001), under a World Bank/Japan-funded project, developed a detailed analysis of the root causes of conflicts in the Laguna de Bay Region, as presented in the following sections.

3.4.2 Conflict among Institutions

The existing institutional arrangements in the Laguna de Bay Region are complex, with no coherent and integrated environmental or development governance system. This has led to a series of separately-formulated and separately-implemented policies, mandates, and programs, each striving to meet relatively-narrow, stand-alone goals. Such arrangements have been inefficient in: (a) creating a widely accepted common objective for managing the natural resources of the lake and its watershed; (b) balancing the different political, economic, and social interests; and (c) focusing government, private sector, and citizen resources on managing this ecosystem. The factors causing and exacerbating the institutional inefficiency detailed above can be summarized as:

- Fragmented, often-conflicting policies in environmental and natural resources management of the lake and its watershed;
- Limited capacities in environmental management, particularly at LGUs;
- Exhausted administrative and civil service, and a weak political will in the central and regional environmental

Table 5. Areas of Conflict and Response for Stakeholders in the Laguna de Bay Region.

Stakeholder Category	Areas of Conflict	Response
Regulators	Coordination, development, monitoring, enforcement of land use plans, issuance of permits/clearances, standard setting, policy development on resource pricing and allocation, market-based instruments	Rationalizing the mandates/functions, streamlining their functions, procedures and requirements (e.g., one-stop-processing of permits), policy and program coordination
Policy makers, planners and coordinators	Inconsistencies in policy setting, and planning; lack of coordination; sectoral policy development approaches result in inconsistencies/contradictions/overlapping; lack of clear responsibility for formulating and implementing commonly acted policy	Institutionalize micro-watershed, participative environmental action planning at the LGU/agency level
Infrastructure developers	Uncoordinated infrastructure development planning by national/regional agencies in relation to the LLDA; inconsistency of infrastructure projects with the strategic policy direction for the management of the lake as set out in the Master Plan; limited public investments in environmental infrastructures	Creation of enabling environment for private sector participation with government as facilitator and catalyst
Research and development institutions	Lack of proper coordination with the LLDA; dissemination of research outputs is limited	The LLDA as clearinghouse to coordinate and integrated R&D activities to (a) ensure focused research agenda centered around priority research areas, (b) minimize duplications and maximize outputs; (c) dissemination of outputs to widest audience/users as possible
Resource users/communities	In addition to using the resources of the lake and the watershed for common good (fisheries, irrigation, drinking water, navigation, recreation, etc.), the lake has served as waste receptacle.	Strengthening regulation, monitoring and enforcement; expansion of MBIs, enhanced IEC activities; application of user fee to households
Local Government Units (LGUs)	Sometimes conflict with the LLDA responsibilities in the management and maintenance of ecological balance within their territorial jurisdiction	Co-management of the watershed with LGUs and stakeholder communities

agencies, thereby preventing these agencies from expeditiously addressing the region's conflicting institutional arrangements;

- Slow devolution of responsibilities and resources from central agencies to LGUs, and inadequate efforts to strengthen the governance and capabilities of LGUs to assume greater responsibility in fulfilling their mandates; and,
- Lack of or, at best, narrow opportunities for community and private sector participation in the management and sustainable use of the region's natural resources.

The LLDA re-engineering study also suggested that limited overlapping of mandates and responsibilities often is not a hindrance. The conflict arises when the objectives of the policies and laws creating those mandates contradict one another. The conflicts also become deeper when the resource base in question is delicate, with limited carrying capacity to satisfy all mandates.

3.4.3 Conflicts among Users

Almost all previous studies about Laguna de Bay highlight the conflicts among the various users, infrastructure developers, and regulators and policy makers, and most current and foreseen problems in managing the lake and its watershed are attributable to them. A set of case studies exist that clearly reflect the root causes of conflicts among the lake users, with the following being representative statements of the conflict issues.

- Development projects to improve the use of lake water for irrigation face increasing salinity and contamination from the Pasig River that will make the lake water unsuitable for agriculture. Pollution from industries, household waste, and transportation within the lake also threatens agricultural enterprises. Although the LLDA has started to implement strict regulations against industrial effluent discharges, the lake's role as a waste receptacle is not likely to decrease.
- The Napindan Hydraulic Control Structure (NHCS) has been the cause of conflicts between the Department of Public Works and Highways (DPWH) and the fishing community. The purpose of the NHCS (to regulate backflow from the Pasig River) has been ignored, to favor fishermen who need the brackish water for the productivity of the lake's aquatic resources. The role of the lake as a buffer against flooding along the Marikina and Pasig Rivers also has exacerbated the conflicts by the impacts of a flooded lake on farms, fishpens, and lakeshore development.
- Use of the lake by fish pen owners constitutes another level of conflict. Fish pens grew from 38 ha in the 1970s, to more than 30,000 ha in 1983, seriously reducing areas available for open fishing and impeding

navigation. To reduce the adverse impacts of fish pens on fish production, the LLDA implemented a zoning plan that reduced the fish pen areas to 10,000 ha and the fish cage areas to 5,000 ha. Nevertheless, the fishermen, fish pen operators, Bureau of Fisheries and Aquatic Resources, and the LLDA continues to debate the wisdom, size, location, and benefits of the structures. Compounding the problem is the weak enforcement of laws on fishing boat registration, illegal fishing, and the role of LGUs in enforcing the laws.

- The lake's potential as a key drinking water source cannot be ignored. The two previous Philippine administrations proclaimed this goal for Laguna de Bay. Increasing emphasis on the lake's role as a drinking water source may eventually challenge all other uses of the lake.
- Quarry operations around the lake and in its watershed are another activity potentially contributing to the lake's pollution and sedimentation. The Mines and Geosciences Bureau (MGB), an office under the DENR, currently regulates quarries over 5 ha in area, while the Provincial Governors control the smaller quarries. However, the authorities for permitting, clearance, and enforcement among DENR, LGUs, and LLDA have not been streamlined. Further, illegal small-scale mining operations continue in the region.
- A large portion of the region's population consists of informal settlers who typically cluster in flood and pollution-prone locations (e.g., shorelands, river banks, embankments, and other areas subject to severe flooding). Most of the areas are environmentally-sensitive areas. The rivers carry solid wastes generated by this large population to the lake.
- Attempts to protect the lake as a protected site have long been ignored in favor of unavoidable demands for water and fish. Nevertheless, a small-scale tourism industry still struggles to survive amidst the lake traffic, and visitors can take historic tours and boat rides to remote pockets where it is considered safe to swim.

3.4.4 The Case of the Northern Lakeshore Project: The Evolution of the Informal Settlers Group

The disputed 9.8-km Metro Manila Flood Control Project: West of Manggahan Floodway (popularly called "Lakeshore Dike Project") is funded by the Japan Bank for International Cooperation (JBIC), for a total of PhP2.9 billion and is being implemented by the Department of Public Works and Highways (DPWH). This project will be located in the northern shores of Laguna de Bay, covering the Municipalities of Taguig, Cainta, Taytay, Pateros and Pasig, with a total drainage area of 39.01 km². It is intended to protect the floodplains from floods, with the design high water level (elevation 13.8 m) corresponding to a 40-year probable recurrence. Some 600,000 inhabitants along the five municipalities will be directly affected by the

project, which was issued a notice to proceed in September 2000, with a target completion date of February 2006. The President of the Philippines, however, ordered suspension of the road dike construction, in response to protests by affected residents and LGUs, calling for a series of consultation meetings among relevant government agencies, LGUs and People's Organizations (POs). A moratorium was issued in 2001 on the construction of the dike, while public consultations were being conducted under the auspices of the National Anti-Poverty Commission (NAPC). There are two opposing groups of stakeholders: (a) the LGUs and residents of the flood-prone areas who are in favor of the project; and (b) the LGUs, residents of the areas where the displaced waters are expected to flow, and their NGO supporters. Those opposed to the lakeshore dike project stressed that if it was built, it would cut through residential areas, turning vast tracts of land into a virtual marsh. Supporters, however, argued that the project was designed not only to solve the Taguig and Metro Manila area flood problems, but would also serve as a road network linking Rizal Province to the South Expressway going to Laguna, Cavite and Batangas Provinces. It also would open about 2,000 ha of prime land in Lower Bicutan, Taguig for industrial development and infrastructure projects.

At the height of the controversy, a number of stakeholders' groups came into being, primarily formerly unorganized, informal settlers, and their NGO partners; these are Taytay *Laban sa* (against the) Lakeshore Dike (TLLD), Pasig *Laban sa* Lakeshore Dike (PLLD), Urban Poor Associates, and Community Organizer Multiversity. Table 6 shows the range of groups and the degree of their opposition/approval of the project.

Except for those that have to keep a neutral position because of their roles in the consultation and project approval process, the remaining stakeholders are strongly motivated to advocate their positions. Determination of these factors within each stakeholder groups should be considered in drawing up their roles and resource commitments in either forging agreements with the government regarding whether or not to proceed with the project construction.

The LLDA position on the proposed project hinges on the results of its study with the Decision Support System/modeling tools established under the Dutch-assisted project on Sustainable

Development of the Laguna de Bay Environment (SDLBE). Although modeling results showed that the dike construction will not greatly affect the lake's hydrodynamics, in terms of the ecological aspects, water quality and sedimentation in the area, the effect may be different than expected. For this reason, the LLDA recommended new studies to update the environmental impact assessment, including the impacts of the loss of the floodplains on the functioning of the lake ecosystem, since this aspect could not be described by the LLDA's modeling tools. Further, a legal study should be done to determine the implications regarding the LLDA's jurisdiction over the covered shoreland areas, especially the Proclamations declaring portions of the lakeshore for socialized housing projects (Proclamations 704 and 458).

To address the affected stakeholder issues and concerns, an inter-agency Memorandum of Agreement was signed on 16 April 2002, calling for studies through the University of the Philippines National Hydraulic Research Center (NHRC) as the lead institution, and with one representative each from the concerned LGUs and five representatives from TLLD and PLLD. The study was meant to review the original dike alignment, and a feasibility study on the polder dike proposed along the lakeshore from Taguig to the west bank of Manggahan Floodway. The study results were presented to the stakeholders on 12 February and to DPWH on 17 February 2003. In a 4 March 2003 inter-agency meeting, the "most optimum plan from the social, environmental and economic viewpoints" was agreed upon, wherein the original alignment at elevation 11.5 m shall be pursued with a polder-cum-road dike along the above-mentioned lakeshore segment, in lieu of not constructing the dike in the original alignment in a socialized housing project in Lupang Arienda. It was the LLDA's position that the selected alternative has far-reaching implications that may prejudice the integrity of the Laguna de Bay environment.

It also was agreed that the affected residents shall be resettled jointly by the National Housing Authority (NHA) and DPWH within Proclamation 704, in coordination with LGUs of Taytay and Pasig and the concerned POs.

The agreement also provides for implementation of the agreed roles and responsibilities and required actions. The DENR and the LLDA have been tasked to closely monitor

Table 6. Opposition and Approval for the Lakeshore Dike Project.

Vehemently Opposed	Opposed, but with open mind	Neutral	In favor, under certain conditions	For the project
Fishpen/cage operators	National Government Agencies including DENR/EMB and UP-NHRC	NAPC	National Government Agencies including NHA, ODAA, MMDA, DPWH and HUDCC	Local Government Units including Taguig, Pasig, Pateros
Informal settlers including UPA, COM, TLLD, PLD and MAPAGPALA	LLDA			
Local Government Units including Taytay				

the project's compliance to the Environmental Clearance Certificate conditionalities, and the proper implementation of its environmental management plan. Among others, the NHA shall ensure that the affected families will not be disenfranchised of their position and lot apportionment, due to the dike construction. The National Anti-Poverty Commission (NAPC) also shall coordinate and monitor the implementation by various implementing agencies of the Kapit-Bisig Laban sa Kahirapan Program (KALAHI) in the provision of livelihood projects in the area.

Finally, after the series of consultations and signing of the MOA, in March 2003, the President approved the resumption of dike construction in three months time, under the belief that the agreed combined roles and actions provided a "win-win" solution to the conflicts among the various stakeholders.

4. Management Environment

4.1 Lake Management Programs and Processes

The more serious and systematic approach to the integrated management of the Laguna de Bay Region was the formulation of the Laguna de Bay Master Plan in 1995, and its subsequent approval by the President of the Philippines in 1996. While a water resources development master plan was formulated in 1974, as a result of the Water Resources Development Studies in 1972-1974, the Master Plan took cognizance of the interacting relationship between and among the various uses of land and water resources and the conflicts among alternative production activities, as well as uses of the lake water and surrounding related land resources, particularly those dictated by urbanization and industrialization. The Master Plan prescribes strategic policies, institutional reforms action programs and management measures to harmonize, integrate and strike a balance between downstream and upstream activities in the watershed, consistent with a lake-basin management approach.

The Master Plan places heavy emphasis on identification, formulation and elaboration of priority programs and projects needed to attain the goals of sustainable development of the Laguna de Bay region. Thus, it represents the most explicit action towards the strengthening of an integrated lake basin management approach. Four flagship programs are currently being pursued: environmental management, watershed management, fisheries development and institutional reform and development.

4.1.1 Environmental Management Program

Water quality monitoring. This activity began in 1973, with initial focus on lake water quality. When the LLDA mandate was expanded to include pollution control, monitoring of industrial effluents also became a regular activity. The LLDA, through its Environmental Quality Management Division, operates its own water quality laboratory, having gradually improved its capability through the acquisition of state-of-the-art laboratory instruments. A pool of well-trained staff runs the

laboratory, performing both the collection and analysis of lake and river water samples. The laboratory also services external clients, thereby generating income for the LLDA.

The lake and the tributary rivers are monitored on a monthly basis. Industrial effluents are collected by Pollution Control Division inspectors trained in the collection and handling of samples. The laboratory analysis results become the basis for evaluating compliance of industrial establishments to existing effluent discharge rules and regulations. Data on the lake and tributary rivers are published annually. The monthly status of the lake and tributary water quality also is posted on the LLDA website, using the Water Mondriaan (see Section 5.6).

Environmental user fee system (EUFS). Implementation of the EUFS started in January 1997, as Phase 1 of the National Program. It was designed to integrate and harmonize command-and-control (CAC) and economic instruments, in order to generate a mechanism to improve environmental enforcement and compliance status of firms located in the Laguna de Bay region. It now is an integral part of the LLDA's Environmental Management Program.

The EUFS focuses primarily on reducing the pollutant load to the Laguna de Bay, making all liquid waste dischargers directly accountable for environmental damages caused by their day-to-day operations, by internalizing the environmental degradation and enhancement costs into their business decisions and actions. The eventual goal of the EUFS is to limit point source wastewater discharges to a level that ensures waterbodies within the Laguna de Bay system would be protected and made suitable for their intended uses.

The fee system is composed of a fixed and variable fee. The former covers the administrative costs of implementing the system, based on the volumetric discharge rate, while the latter depends on whether the BOD concentration is above or below the existing effluent standard of 50 mg/L, regardless of the total BOD load. This scheme has induced firms to be more cost effective in trying to comply with standards, in effect making the EUFS a model mixed regulatory and economic instrument. An enterprise must obtain a Discharge Permit (DP), renewable annually, from the LLDA, the DP being a legal authorization to discharge their wastewater of acceptable concentration under DENR DAO 35 to the lake or its tributary rivers.

The EUFS is meant to cover all water pollution sources from industrial, commercial, domestic and even agricultural sources. The LLDA cautiously implemented the EUFS in stages, with a budget of PhP27 million initially allocated to support implementation requirements.

During the first year of EUFS implementation in 1997, imposition of user fee was based only on the BOD content of industrial wastewaters and applied to around 120 industrial firms within the LLDA's area of jurisdiction. These firms belong to five industrial sub-sectors estimated to account for nearly 90% of the total organic load to the lake; namely, food-

processing firms, pig farms and slaughterhouses, beverage manufacturers, firms engaged in dyes and textiles, and paper and pulp mills. All industries generating process wastewater were covered in the second year. In the third year, residential subdivisions and commercial establishments, including food chains and restaurants that discharge wastewater into the environment, were also covered.

The EUFS is implemented by the LLDA through its Pollution Control Division (PCD) as the lead unit, with support from the Environmental Quality Management Division for analysis of wastewater samples collected by the inspectors. A Public Hearing Committee (PHC) supports the adjudication and litigation of cases, including those related to non-payment of environmental user fees.

Aside from the EUFS, the traditional regulatory system of the LLDA is still in place. All industrial establishments are required to register, with those with wastewater discharges also required to have a Pollution Control Officer (PCO) accredited by the LLDA. The LLDA has developed a PCO training program for accreditation purposes, including lectures on such issues as clean technologies. Aside from generating a modest income for the LLDA, it has also become a vehicle for disseminating the Authority's plans and programs, as well as the pollution laws being implemented in the Laguna de Bay region. The program has gained wide acceptance from the industrial sector, with cases in which they themselves requested a special training schedule.

4.1.2 Shoreland Management Program

It took almost thirty years for the LLDA to assert its mandate on the management of its 140 km² shoreline of Laguna de Bay, the first action being the 1995 issuance of Board Resolution No. 10, Series of 1995, asserting the LLDA's authority and exclusive jurisdiction over Laguna de Bay, banning reclamation projects and disallowing any non-environmentally feasible activities for the lake. The LLDA Board approved the rules and regulations on the use/occupancy of Laguna de Bay shoreland areas on 14 December 1996. Another two years were needed to create a new unit at the LLDA, the Special Concerns Office (later becoming the Special Concerns Division), to take the lead in implementing the rules. The guidelines on the lease of the shoreland were prepared and implemented in 1999.

It is the declared policy of the LLDA under these rules, pursuant to RA 4850 as amended, to: (a) properly manage and control the use and/or occupancy of Laguna de Bay shoreline areas within the context of national socio-economic development plans and policies and environmental concerns; (b) maintain all shoreline areas lying below elevation 12.50 m as buffer zones, in consonance with the Authority's policies, plans and programs for managing the water quality and protection and conservation of Laguna de Bay's water resources; (c) exercise administrative and regulatory control on land use and/or occupancy of shoreline areas within the context of the LLDA's plans and programs, and to manage such uses and occupancy along desirable environmental considerations; and (d) Provide

an administrative system whereby the rights of legitimate titleholders are respected.

The LLDA is evaluating the effectiveness of current policy instruments for shoreline management and control, based on a number of implementation and enforcement issues:

- Development projects/activities have overtaken regulation and control (the law, P.D. 813, defining the shoreline was enacted in 1975, while the policy guidelines were issued in 1996);
- Lack of resources to monitor shoreline activities and enforce the rules and regulations;
- Indifference of lakeshore LGUs, manifested in siting of illegal open dumpsites on shorelines and riverbanks; proceeding with local development activities/projects without needed environmental clearances and permits from the DENR and LLDA; and,
- While policy tools exist (e.g., Shoreline Occupancy Permits, Notice of Violation, Ex-Parte Orders and Cease and Desist Orders), they are insufficient for the purpose of shoreline restoration and environmental regulation and control.

4.1.3 Watershed Development Program

Reforestation and tree planting. The watershed area is three times the size of the lake, and where 66 local government units exercise their respective political mandates. Their responsibility to protect and manage the environment in their areas of jurisdiction as stipulated in the Local Government Code also is important. Within these realities, the LLDA started to link closely with the local officials and the communities as an entry point to a meaningful and practical watershed development program.

Almost all LGUs have a reforestation or tree planting program, in response to the massive CLEAN and GREEN campaign of the national government. To respond to the need for more seedlings and enhance its desire of the LLDA to cooperate with the LGU environmental programs, the LLDA embarked on the maintenance of a plant nursery to support reforestation programs of different towns within the watershed. Similar support is being given to socio-civic organizations and non-governmental organizations (NGOs).

River rehabilitation. In 1996, the LLDA started a River Rehabilitation Program for the rivers and streams flowing through the 24 sub-basins or micro-watershed of the Laguna de Bay basin. This program evolved from a mere physical river clean-up to a more comprehensive and sustainable approach encouraging broad multi-sectoral involvement and support. Various stakeholders within each sub-basin (local government officials, academic institutions, industrial and commercial establishments, religious groups, NGOs, POs, civic organizations, homeowners, etc.) were organized for a River

Rehabilitation and Protection Council (RRPC). A systematic approach is being followed by the Council, including (a) mapping the watershed, (b) comprehensive survey of the river system and its watershed, (c) development of a vision for a healthy river system and watershed and, based on this vision, (d) formulation of a River Rehabilitation and Protection Plan.

River clean-up campaigns also are being sustained that involve the physical clean-up of rivers. The LLDA has organized the *Hukbong Pangkapaligiran* (“Environmental Army”, a volunteer organization consisting mainly of fisherfolk and farmers) to lead the activity. The men and women of the Environmental Army are exemplars of volunteerism who play a vital role in raising environmental awareness and heightening motivation among various sectors to be involved in rehabilitation efforts. The program was so successful it led the LLDA to institutionalize the RRPC, with seed money of PhP50,000 (a little under US\$1,000) being given to support their activity or their registration as a foundation.

The involvement of the industrial sector in the RRPC has narrowed the gap between it and the community, especially those with a preconceived view that industrial establishments pollute the environment. Most successful and active RRPCs are those with active members from this sector, and whose representatives are often elected to higher position in the council.

All the RRPC were federated on 26 June 2001 to serve as an umbrella organization of the River Councils in the Laguna de Bay region. A conference of the RRPC is held every year, whereby each council or foundation presents their accomplishments and updates the other councils or foundations on present projects and future plans and programs. It also serves as an occasion for enriching their knowledge through lectures by invited experts on matters concerning solid and liquid waste management, waste exchange, and other topics of interest

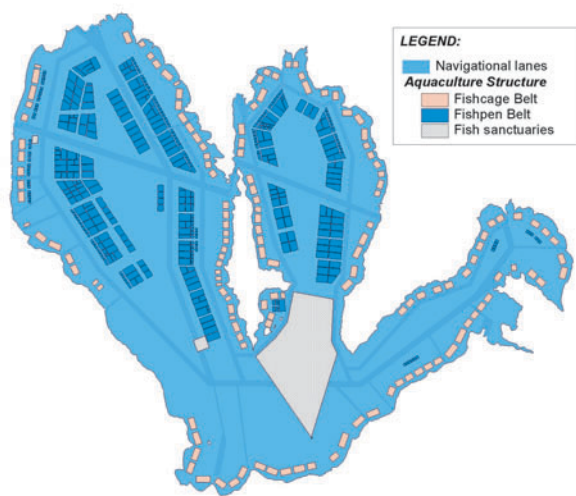


Figure 5. Zoning and Management Plan (ZOMAP) of Laguna de Bay.

directed to enhancing the capabilities of the members to perform their tasks.

4.1.4 Fisheries Development Program

Aquaculture operation. Regulation of aquaculture operation is based on the lake’s Zoning and Management Plan (ZOMAP), considered by far as the most feasible management system for equitable allocation of the lake’s fishery resource. Fish pen belts and fish cage belts were delineated in specified locations in the lake, covering a total area of 100 km² and 50 km², respectively (Figure 5). The area allocation was determined via analysis of the lake’s carrying capacity for aquaculture, which was based on long-term primary productivity data from different locations in Laguna de Bay (Centeno et al. 1987). Limits were set on the maximum area to be occupied for fish pen operation, (i.e., 0.05 km² for a corporation, 0.01 km² for a cooperative, and 0.005 km² for an individual owner). The maximum area for fish cage is 0.001 km². An annual permit is issued, with fish pen owners paying PhP6,000/ha (0.001 km²) and fish cage owners paying PhP4,200/ha. Vacant areas within the fish pen belt are awarded to an operator by bidding.

In keeping with provisions of RA 4850 on the distribution of benefits from fishery to the LGUs, the fish pen fee collected by the LLDA is shared according to the following scheme: (a) from 1983 to May 1996: 20% to lakeshore LGUs, 5% to Project Development Fund (PDF), and 75% to the LLDA; (b) from June 1996 to present: 35% to lakeshore LGUs, 5% to PDF and 60% to the LLDA (Board Resolution No. 15, Series of 1996 dated 27 June 27 1996). From a fishpen fee per hectare of PhP6000.00 (US\$120), every lakeshore municipality currently receives a share of 15%, and an additional 20% if there are fish pens off their shoreline. The LLDA specifies that their share should be used to finance environmental projects.

The guidelines on release and utilization of fish pen fee shares of lakeshore LGUs was defined as early as 1986 under Board Resolution No. PCLL-20, Series of 1986. The release of funds shall be based only on the cost estimates of LGU-proposed programs, projects or activities related to environment, livelihood, river embankment and flood protection works, watershed development and the likelihood for review/approval by the LLDA. The LGUs are required to render a quarterly accounting of funds, indicating the nature of disbursements, its balances and the physical accomplishments. Such a report is a prerequisite to the release of additional and succeeding municipal fish pen fee shares. During June 1996, however, during deliberations on modified sharing of fish pen fees, the Board of Directors (three being local government officials—Governors of Rizal and Laguna and President of League of Mayors), waived the requirements for the release/use of fish pen fee shares, because they were perceived as being cumbersome, hence making the funds inaccessible to the LGUs.

The Fisheries and Aquatic Resource Management Council (FARMC). The President of the Philippines issued Executive Order 240 in 1995, “Creating the Fisheries and Aquatic

Resources Management Councils in Barangays, Cities, and Municipalities and their composition and functions”, in accordance with the policy of the Philippine Government to ensure that management and control over fisheries and aquatic resources shall be effected through the active, extensive participation of the people directly affected. It also called for empowerment of the subsistence fisherfolk through meaningful participation in the management, development and protection of fisheries and aquatic resources for sustainable productivity. Republic Act 8550 (known as the Fisheries Code of 1998) further strengthened the important role of the FARMC by specifying its composition, and the responsibility of concerned government agencies in ensuring that its functions are recognized and institutionalized. It is composed of representatives from the Department of Agriculture, LGUs, NGOs, and fisherfolk, including women and representative from the youth sector. LGU representation is given due importance to ensure that the plans and programs will be incorporated in the municipal or city development plan and given due priority.

Even before the passage of these laws, the LLDA has already established links with fishermen organizations, rendering financial and technical assistance in their operation. Support included financing their training as *Bantay Lawa* (Lake Guard) and deputizing qualified fishermen as Fish Warden, in coordination with the Bureau of Fisheries and Aquatic Resources. Funds from the LLDA development fund also are being given to implement lake clean-up activities, and for the surveillance of illegal fishing activities.

4.1.5 Institutional Reform and Development Program

The proposed LLDA reorganization is consistent with the Public Sector Reform Program and the Water Resources Sector Policies and Directions, as embodied in the Philippine Medium-Term Development Plan 2002-2004, which stipulates “the government shall support the strengthening of existing and efficiently operating river/lake basin authorities”.

Re-engineering the LLDA. Since its creation in 1966, new tasks and demands have emerged for the LLDA, including confronting new challenges such as a rapidly-growing demand for lake water to serve an expanding metropolis and lakeshore towns, as well as to properly coordinate infrastructure development and regulate the multiplicity of resource uses by various sectors. It also must facilitate interaction among various stakeholders, including conflicting interests amidst alarming threats on the lake’s sustainability.

The LLDA was authorized as early as 1983, through Executive Order 927, to undertake a thorough corporate reorganization. Although the Laguna de Bay Master Plan also calls for LLDA institutional and organizational reforms, the envisioned reorganization was not implemented by the LLDA because of changes in the country’s political environment and accompanying administrative and financial constraints. Given the rapid increase in population, settlements, industrial establishments and other economic activities in its basin, the last 15 years witnessed growing concern for more active protection of the lake.

Integrated Water Resources Management and Development Model

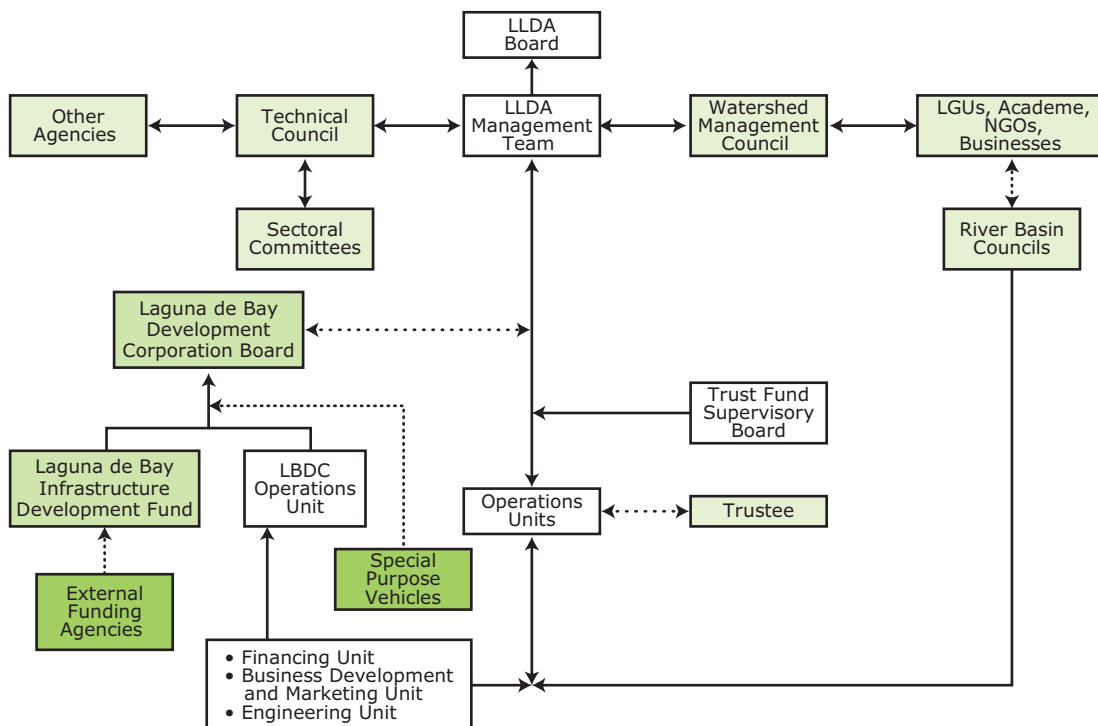


Figure 6. The LLDA Institutional Re-engineering Model.

The re-engineering study for the LLDA was conducted during 2000-2001 through a grant from the World Bank. It is a self-directed effort of the Authority to transform itself into an expanded, effective organization capable of fully discharging its mandated powers and functions, with the purpose of developing the most appropriate institutional model and associated planning and policy framework to enable it to become an effective development authority, while also maintaining its regulatory mandate. An integrated water resources management and development institutional model was recommended (Figure 6), also being the most acceptable option for all Laguna de Bay region stakeholders.

The main characteristics of the institutional model are as follows:

- The primary mandate of the re-engineered LLDA will be policy making, planning and implementing an integrated water resources management, and development of the lake and its river systems, including enhancing water quality and quantity, expanding regulatory responsibilities for monitoring compliance with water standards, and expanding the EUFS;
- The scope includes overall management of Laguna de Bay and its river tributaries, shorelands and aquatic resources, expanding it to include groundwater in the future. In collaboration with LGUs, the scope also includes raw water pricing development and implementation, environmental infrastructure development and coordination of land use planning;
- The level of autonomy will expand from its current status as a Government Owned and Controlled Corporation (GOCC), relying solely on operating revenues, to an investment-oriented development organization through the proposed Laguna de Bay Development Corporation; and,
- The LLDA becomes the apex body in the Laguna de Bay region, with responsibility for coordinating integrated watershed management and development program.

The LLDA Board remains the policy-making body of the Authority in this model. To make the decision-making process more inclusive, two advisory groups support the Board: the Technical Council and the Watershed Management Council. The Technical Council serves as a permanent advisory council to the LLDA for making policy for resolving issues related to institutional arrangements in the Laguna de Bay region, including harmonization and resolution of conflicting and overlapping functions, activities, policies and plans that exist or arise between, and among, the LLDA and other regional government agencies and GOCCs.

The Watershed Management Council will be a multi-sectoral advisory council to support policy and planning activities in the lake watershed among the sectors with stakes in the

region. The Council will serve as a convergence point for review of sectoral policies and programs with implications for watershed resources.

Capacity building. The Sustainable Development of the Laguna de Bay Environment Project, which ended August 2003, was supported by a grant from the Netherlands Government. The three-year project was undertaken to ensure sustainable development of the lake's resources, based upon a sound knowledge of the functioning of the system, its users and the institutional setting. It is specifically directed to capacity building and developing practical and realistic solutions for current problems and issues in the lake basin. Among the project achievements were establishment of an Integrated Water Resources Management Unit, and the establishment of an appropriate GIS/database and state-of-the-art modeling system to support decision-making. All are geared to the transformation of the LLDA into an Integrated Water Resources Management and Development Authority.

Conservation of Laguna de Bay Environment and Resources (CLEAR). CLEAR is a tripartite partnership involving the LLDA, Unilever Philippines, and the Society for Conservation of Philippine Wetlands (SCPW), with the objective of pursuing the lake's membership in the Living Lakes Network. A Memorandum of Agreement was signed in June 2000 to ensure continuity in efforts to conserve the lake's resources, and to empower and educate the watershed communities.

As a private sector partner, Unilever provides funding support for advocacy initiatives and activities that influence and mobilize the business sector towards corporate responsibility. As a collaborating agency, the LLDA coordinates the tripartite partnership's activities, and provides funds for biodiversity studies on the lake and environmental education projects. As an NGO partner, SCPW has been tasked to design and implement advocacy activities for lake conservation, coordinate with other environmental NGOs in the lake region and be the focal point for coordination with other Living Lakes partners around the world.

The idea of joining the network began in November 1999 during Unilever's meeting on Sustainable Water and Integrated Catchment Management (SWIM) in Liverpool, England. The lake's candidacy was formalized in November 2000 at the 5th Living Lakes Conference in Lake Biwa, Japan.

Laguna de Bay was accepted as the 18th member of the Living Lakes Network in August 2001, during the 6th Living Lakes Conference. Its admission to the network was a "breakthrough for Laguna de Bay and a milestone for Philippine environmental history" (Jerry Esplanada, Philippine Daily Inquirer). More importantly, it brought conservation of the lake to the attention of the international community, which can serve as a positive pressure on the government to take serious actions in preventing deterioration of the lake environment.

The Philippine 12th Congress, through House Resolution No.140, commended and congratulated the LLDA, Unilever Philippines and the SCPW in their successful bid making Laguna de Bay the 18th member of the Living Lakes Network, thereby also making protection and conservation of the lake an international imperative.

Partnership with U.S. Agencies, Chesapeake Bay and The Chin River (Thailand). The LLDA forged a partnership with United States agencies (US-AEP, USEPA, USAID, etc.) in August 2002 on sharing of knowledge, experiences, and best practices on community-based environmental management and resource conservation in Chesapeake Bay in the eastern United States, as well as with the Pollution Control Department of the Kingdom of Thailand on Integrated Watershed and Water Quality Management and Public Participation in the Tha Chin River Basin. The LLDA's River Rehabilitation Program, and its partnership with River Councils in the river systems in the lake region, was cited as one of the best practices on community-based resource management scheme during the August 2002 international workshop in Manila.

4.2 Reduction of Lake Stresses

A snap shot analysis of the result of concerted efforts in protecting Laguna de Bay is the maintenance of its Class C status, in spite of growing threats to the lake. The orderly arrangement of fish pens as a result of the revised Zoning and Management Plan of the lake allowed better water movement between the structures, lessening the accumulation of water hyacinth. Also noteworthy is the resolution of conflict between the fish pen operators and fishermen. Improved fish production due to the ZOMAP implementation is difficult to assess because of other environmental factors affecting production and lack of cooperation from fish pen operators to disclose their harvest per cropping season. The latter do not appreciate the importance of their information in evaluating the program and assessing the lake's productivity.

A more objective assessment is presented in terms of implementation of the Environmental User Fee System (EUFS). After the three-year EUFS introductory and implementation phase, there were 914 firms covered as of December 2002.

Table 7. Estimated BOD Reduction in the Lake Due to EUFS Implementation.

Year	Cumulative No. of Firms	BOD Load (metric ton/year)	BOD Loading Reduction (%)
1997	222	5,403	
1998	255	4,432	24.08
1999	429	1,790	65.80
2000	628	2,309	19.08
2001	738	1,687	40.61
2002	914	791	61.30

There was a significant reduction in the BOD load to the lake from 1997 to 2002 (Table 7).

The significant BOD load reduction to the lake during 1997-1999 coincided with the introductory phase of the EUF, reflecting its successful implementation. The reduced BOD load was due to several factors: (a) increased efforts among the regulated sources to treat their wastewater with new or improved treatment facilities; (b) wastewater recycling activities; (c) waste minimization; and (d) voluntary closure or plant relocation.

The actual impacts on ambient lake water quality relating to the reduced BOD load from point sources as a result of EUFS implementation are still undetermined. The LLDA intends to apply its newly-developed Decision Support Systems and modeling tools to achieve full coupling of laboratory analysis database on industrial pollution loads to the waste load model and the GIS-generated information.

4.3 Enabling Environment

4.3.1 Regulatory Powers and Functions

The all-encompassing powers of the LLDA are clear in their authority to pass, approve, or disapprove all plans, programs, and projects proposed by LGUs, and public and private corporations. LLDA also has exclusive jurisdiction to issue permits and collect fees for using the lake water, as well as authority to earmark revenues generated for its own activities.

The LLDA also exercises police powers. Violators of the laws, rules and regulations can be held administratively, civilly and criminally liable. Further, the LLDA can pursue a separate civil action for damages resulting from violations of the law. As specifically provided by law, any damages recovered by civil action shall be earmarked for environmental management.

The LLDA's mandate allows it to introduce a wide range of innovative policies. It was the first agency in the Philippines, for example, to apply the concepts of natural resource pricing in the form of fish pen fees and, more recently, imposition of wastewater discharge fees (EUFS). The LLDA's experience in resource pricing is setting the stage for a comprehensive national implementation of a similar policy by the Department of Environment and Natural Resources (DENR). The LLDA's venture into raw water pricing will establish another policy precedent with potentially wider national application.

The numerous laws, rules and regulations on the protection of the lake environment are presented in Table 8.

4.3.2 Financial Capability

Under the 1999-2000 LLDA Institutional Re-engineering Studies, an assessment of the financial performance, financing and investments of the LLDA was undertaken for the years 1995-1999.

Capitalization. The LLDA was created in 1966 under RA 4850 as a quasi-government agency with a corporate structure and management operations. Of its authorized capital stock of PhP7.0 million, the total issued and outstanding and subscribed capital stock amounted to PhP387.14 million (55.3% of the total authorized capital). Of this quantity, 92.2% is accounted for by the National Government and the remaining by the Rizal and Laguna Provinces, various municipalities and private corporations and individual stockholders. Of the total paid-in capital of PhP173.27 million, 94.12% is paid up by the National Government. The two provinces took up only 14.9% of their combined subscriptions. Calling for additional subscription is a clear option to improve the LLDA's financial position, and the Authority can easily generate PhP312.86 million from this option.

Financing. Under its present mandate, the LLDA is authorized to source its funds from the following:

- National Government subsidies and financial assistance to carry out its social overhead projects, upon recommendation of the NEDA Board;
- Bilateral and multilateral sources through their technical assistance grants or loan facilities;
- Contracted loans through floating of bonds and other debt instruments;
- Sale of stocks and invest in secured debt instruments;
- Public-private partnership; and,
- Build-Operate-Transfer contracts with private entities pursuant to the BOT Law (RA 6957, as amended by RA 7718)

The LLDA also can make recommendations to proper government agencies on the peso or dollar financing requirements of its mandated functions, technical support, the level of priority for certain projects and, accordingly, solicit assistance from the National Government or any of its instrumentalities. The LLDA Charter further allows the Philippine Government to guarantee the payment for principal and interest of the Authority's loans, bonds, debentures and other obligations.

Although the LLDA Charter provides for broad opportunities to expand its financial base, these are nevertheless limited and hampered by the National Government's long, tedious, multi-layered approval process, thus affecting the proper timing and provision of financing for long-term sustainability of the lake and watershed resources.

Flow of revenues through the LLDA mandate/functions. As a GOCC with an enabling Charter, the LLDA can raise revenues and retain the same for its own disposition. The revenue-raising sources of the Authority include the following:

- Processing fees for clearances and permits;
- Reasonable fees from users/beneficiaries of the lake resources (water supply, aquaculture, fish pen fees, etc.); and,
- Administrative fines and penalties for violating pollution control laws, rules and regulations.

The LLDA Board of Directors fixes the fees to be collected, and recommends to the President the approval of the sharing of the fees with LGUs and other government agencies, if necessary. This excludes the fish pen fees, which are addressed under EO 927.

The LLDA Charter also allows it to collect these revenues and earmark the collection for environmental management and development of the lake and its watershed. However, this requisite earmarking for environmental enhancement also limits the Authority's flexibility to embark on initiatives strategic to its mandate. It should engage in pioneering activities/projects, in order not to compete with the private sector. It is prohibited from investing its funds in high-risk endeavors and debt instruments without recourse to commercial banks or investment houses and in highly speculative stocks.

The LLDA revenue performance for the years 1995-2002 is summarized below (Table 9), with the annual percentage growth rate for each revenue item to the total revenue presented in the last row.

Analysis of the above figures on relative contributions of the various revenue sources indicates the following trends.

- No perceptible trend in fishpen fee collections: Except for the windfall collection of fishpen fees in 1996, after the Supreme Court Decision in December 1995 ruling out the authority of LGUs over issuance of fishery permits, and favoring the LLDA's jurisdiction over fishery and aquaculture regulation in the Laguna de Bay area, the 1995-2002 fish pen fee collections can be considered normal levels. Further, in 1997 all registered fishpen structures were fully transferred to the approved 1996 Fish Pen Belt.
- Steady increase in environmental regulation revenues: These revenues primarily consist of Environmental User Fees, processing fees and other environmental permit/clearance fees, wastewater/effluent sampling and laboratory analysis fees, and development clearance fees. The share of revenues from environmental activities to total revenues since introduction of EUFS in 1997 increased from 28% to 46% in 2002, averaging 45% for the 8-year period.
- Remarkable increase in collection of administrative fines and penalties: This represents charges for failure to meet established water and effluent quality standards

Table 8. Summary of Laws, Rules and Regulations for Laguna de Bay Basin Management.

Objectives	Laws and Ordinances
General mandates on lake basin management	<p>1. Republic Act No. 4850: An act creating the Laguna Lake Development Authority, prescribing its powers, functions and duties, providing funds thereof and for other purposes (July 18, 1966)</p> <p>2. Presidential Decree No. 813: Amending certain sections of Republic Act No. 4850, granting the LLDA the exclusive jurisdiction to issue permits for the use of all surface waters of the lake for any project or activity within the region (October 17, 1983)</p> <p>3. Executive Order No. 927: Further amending the original charter of the LLDA, granting it the power to control and abate pollution within the Laguna de Bay Region (December 16, 1983).</p> <p>4. Executive Order No. 121: Creating the Mt. Makiling Reserve Area and Laguna de Bay Commission (August 24, 1993).</p> <p>5. Executive Order No. 149: Streamlining the Office of the President (December 28, 1993).</p> <p>6. Executive Order No. 349: Adopting the Mt. Makiling Reserve Area and Laguna de Bay Region Master Plan, providing for the implementation thereof and for other purposes (July 18, 1996).</p>
Pollution control	<p>1. Presidential Decree No. 984: Providing for the revisions of Republic Act 3931 (“The Pollution Control Law of the Philippines”) and for other purposes (August 18, 1976).</p> <p>2. Presidential Decree No. 1586: Establishing an Environmental Impact Assessment System, including Environmental Management-related measures and for other purposes (June 11, 1978).</p> <p>3. DENR Administrative Order No. 34, Series of 1990: Revised water usage and classification/water quality criteria amending section Nos. 68 and 69 and Chapter III of the 1978 NPCC Rules and Regulations (March 20, 1990).</p> <p>4. Republic Act No. 6969 An act to control toxic substances and hazardous nuclear wastes, providing penalties for violations thereof and for other purposes (July 23, 1990).</p> <p>5. DENR Administrative Order No. 26-92, Series of 1992: Amending Memorandum Circular No. 02 Series of 1981: Appointment/Designation of Pollution Control Officers (June 29, 1992).</p> <p>6. Resolution No. 7, Series of 1993: Approving new schedule of processing fees for environmental permit/clearance (November 4, 1993).</p> <p>7. DENR Administrative Order No. 35-91, Series of 1993: Revised effluent regulations of 1990 revising and amending the effluent regulations of 1982 (December 9, 1993).</p> <p>8. Resolution No. 24, Series of 1996: Adoption of Department Administrative Order (DAO) No.30, Section 3, Paragraph 3.3 (C) of the Department of Environment and Natural Resources (DENR), as part of the policy of the Laguna Lake Development Authority (LLDA) (September 26, 1996).</p> <p>9. Resolution No. 25, Series of 1996: Implementation of the Environmental User Fee System (EUFS) in the Laguna de Bay Region and approval of its work and financial plan for CY1997 (November 19, 1996).</p> <p>10. Resolution No. 33, Series of 1996: Approving the rules and regulations implementing the Environmental User Fee System in the Laguna de Bay Region (December 19, 1996).</p> <p>11. Resolution No. 41, Series of 1997: Adoption of the definition of development activities per DENR Administrative Order No. 96-37, and integration of said definition in the LLDA rules and regulations, thereby clarifying further the development activities required to secure LLDA clearance (March 21, 1997).</p> <p>12. Resolution No. 42, Series of 1997: Approving the administrative fines for violations of the LLDA Rules and Regulations (March 21, 1997).</p> <p>13. Memorandum Circular No. 2, Series of 1997: Inspection and investigation of establishments compliance to environmental quality standards and pollution control rules and regulations (May 2, 1997).</p> <p>14. Resolution No. 64, Series of 1997: Prescribing new schedule of processing fees and other fees for environmental permits/clearances within the Laguna de Bay Region (December 23, 1997).</p> <p>15. Memorandum Circular No. 98-8: Ensuring safe navigation in specified lake areas (December 10, 1998).</p> <p>16. Resolution No. 104, Series of 1999: Adoption of Department Administrative Order No. 51, Series of 1998, pertaining to the Industrial Ecowatch System and its implementing guidelines, of the Department of Environment and Natural Resources (DENR), as part of the policy of the Laguna Lake Development Authority (LLDA) (March 25, 1999).</p> <p>17. Memorandum Circular No. 99-02: Amendment of certain provisions of Memorandum Order No. 97-84, Series of 1997, concerning the simplified requirements for Accrediting Pollution Control Officers (March 29, 1999).</p> <p>18. Resolution No. 106, Series of 1999: Approving the policy guidelines governing all industrial estates/parks within the Laguna de Bay Region (April 25, 1999).</p> <p>19. DENR Administrative Order No. 99-17, Series of 1999: Updating Department Administrative Order No. 35, Series of 1990, otherwise known as the Revised Effluent Regulations of 1990, revising and amending the effluent regulations of 1982 (July 8, 1999).</p>

Table 8. Summary of Laws, Rules and Regulations for Laguna de Bay Basin Management. (cont'd.)

Objectives	Laws and Ordinances
Fishery management	<p>1. Executive Order No. 240: Creating Fisheries and Aquatic Resources Management Councils (FARMC's) in barangays, cities and municipalities, their composition and functions (April 28, 1995).</p> <p>2. Memorandum Circular No. 96-60: Policy guidelines for fish cage operation in the Laguna de Bay (April 28, 1995).</p> <p>3. Rules and Regulations Implementing the Revised Laguna De Bay zoning and Management Plan (ZOMAP) (January 25, 1996):</p> <p>4. Resolution No. 9, Series of 1996: Amending Section 4.3 of the Rules and Regulations implementing the Revised Laguna De Bay Fishery Zoning and Management Plan (ZOMAP) of 1996 (February 29, 1996).</p> <p>6. Resolution No. 15, Series of 1996: Approving the implementation of modified sharing of fish pen fee per R.A. 4850, as amended (June 27, 1996).</p> <p>7. Resolution No. 26, Series of 1996: Approving the co-management approach to attain sustainability of the Seven-Crater Lakes of San Pablo City, by deconcentrating certain administrative functions of the LLDA (November 19, 1996).</p> <p>8. Resolution No. 27, Series of 1996: Approving policy guidelines for fish cage operation in the Laguna de Bay (November 19, 1996).</p> <p>9. Resolution No. 28, Series of 1996: Approving policy guidelines for public bidding of the remaining free fish pen areas in the Laguna de Bay (November 19, 1996).</p> <p>10. Memorandum Circular No. 97-5: Fish pen block verifications (July 15, 1997).</p> <p>11. Resolution No. 70, Series of 1998: Approving the policy framework on the use of Seven-Crater Lakes of San Pablo City (March 30, 1998).</p> <p>12. Memorandum Circular No. 2, Series of 1998: Moratorium in the construction of fish cages in Laguna de Bay (August 19, 1998).</p> <p>13. Memorandum Circular No. 98-06: Policy guidelines for fish cage operation in the Laguna de Bay (October 7, 1998).</p> <p>14. Memorandum Circular No. 7, Series of 1998: Policy guidelines for collection of annual fish pen fees for Winning bidders.</p> <p>15. Memorandum Circular No. 1, Series of 1999: Policy guidelines for fish pen registration in Laguna de Bay (January 25, 1999).</p>
Shoreland management	<p>1. Section 41 (11) of Republic Act No. 4850:</p> <p>2. Memorandum Order No. 204: Creating an effective committee to oversee implementation of short and long term plans for the Mt. Makiling Reserve Area and Laguna de Bay Commission (April 27, 1994).</p> <p>3. Resolution No. 10, Series of 1995: Asserting the LLDA's authority and exclusive jurisdiction in Laguna de Bay concerning issuance of permits for reclamation projects, and disallowing any non-environmentally-feasible activities in the lake (June 29, 1995).</p> <p>4. DENR Administrative Order No. 27-95: Moratorium on the acceptance and processing of all public land applications covering areas immediately adjacent to the Laguna Bay Basin (November 17, 1995).</p> <p>5. Resolution No. 23, Series of 1996: Approving the rules and regulations implementing section 41 (11) of R.A. No.4850, as amended defining and regulating the use /occupancy of Laguna de Bay shoreland areas (December 14, 1996).</p> <p>6. Resolution No. 39, Series of 1997: Approving the increase of rates for the survey of shorelands within the Laguna de Bay Region and areas for aquaculture operation (February 27, 1997).</p> <p>7. Resolution No. 110, Series of 1999: Amending the Administrative Fine for violation of the LLDA Rules on reclamation/landfilling of any portion of the Laguna de Bay and its shoreland</p> <p>8. Resolution No. 113, Series of 1999: Amending Board Resolution No.23, Series of 1996, by adding implementing guidelines governing the lease of the Laguna de Bay shoreland areas</p> <p>9. Resolution No. 42, Series of 1997: Approving administrative fines for violations regarding the LLDA rules and regulations.</p>
Ferry system operation management	<p>1. Resolution No. 66, Series of 1998: Approving the navigational route for the ferry system to be introduced in Laguna de Bay (January 29, 1998).</p> <p>2. Resolution No. 67, Series of 1998: Approving policy framework toward operationalizing a ferry system in Laguna de Bay (February 26, 1998).</p> <p>3. Resolution No. 74, Series of 1998: Approving policy guidelines on the operation of a ferry system in the Laguna de Bay Region (June 19, 1998).</p> <p>4. Resolution No. 75, Series of 1998: Ratification of policy guidelines on the operation of a ferry system in the Laguna de Bay (July 2, 1998).</p> <p>5. Resolution No. 81, Series of 1998: Approving implementing rules and regulations governing the operation of a ferry system in the Laguna de Bay Region (September 12, 1998).</p>

Table 9. Revenue from Operations (million PhP).

	1995	1996	1997	1998	1999	2000	2001	2002
Fish pen/fish cage fees	17.873	44.571	17.054	28.505	25.856	36.938	22.901	39.766
Fish pen repairs/ processing	0.121	0.012	-	0.008	0.022	0.008	0.013	0.211
Survey fee - fish pen	0.039	0.040	0.404	0.718	0.326	0.816	0.642	0.926
Barging fees	0.380	0.437	0.676	0.595	0.352	0.418	0.470	0.046
LLDA clearance fees/ air pollution	7.175	9.210	11.903	16.537	19.746	17.844	17.060	7.192
Discharge permit fees	-	-	6.660	14.798	12.490	13.334	11.964	21.376
Laboratory fees	0.370	0.398	0.223	0.650	0.225	0.126	0.341	0.625
Admin. fines - pollution	1.395	5.914	16.114	33.217	24.649	20.004	14.080	13.762
Shoreland management fees	-	-	-	-	0.112	1.225	2.133	2.194
Survey fees land	-	-	-	-	-	-	0.055	0.193
Water abstraction	-	-	-	-	0.184	1.158	1.607	1.844
Receipts from market	0.488	0.421	0.036	0.025	0.064	0.389	-	0.026
Interest on marketable securities	8.388	11.770	12.470	18.873	15.776	13.940	13.985	7.484
Interest on other bank accounts	0.073	0.143	0.121	0.235	0.167	0.207	0.169	0.103
Miscellaneous	0.261	1.586	3.482	2.937	2.414	3.256	1.394	2.278
Total	36.563	74.502	69.143	117.098	102.383	109.663	86.814	98.026

or other non-compliance with the LLDA rules and regulations. It ranged from a low of PhP1.395 million in 1995, to an unprecedented high of PhP33.217 million in 1998. Over the period 1995 to 2002, administrative fines and penalties contributed an average of 18% to the total revenues of the LLDA.

- Increase in average growth rate in investments in marketable securities: This revenue source contributed an average of 14% to LLDA's total revenues for the period.

4.3.3 Improved Track Record and Experienced Workforce

For about the last ten years, there was a persistent clamor for abolition of the LLDA, due to the impression that it is doing nothing to combat pollution or to address the conflicts between different lake users. This is due to the very limited financial and human resources of the Authority, compared to the enormity of its mandate. It can partly be attributed to lack of an appropriate vehicle for information dissemination and for reaching the different stakeholders. Improvements in the Authority revenue, external funding assistance through grants from international donor agencies, opportunities for further studies and training, and timely implementation of meaningful programs enhanced the LLDA's capabilities. Coupled with a more aggressive information dissemination campaign, networking and linkage with different local and international institutions, and successful implementation of projects with foreign funding, the credibility of the LLDA has improved and,

in spite of fast leadership turnover in the LLDA, it was able to sustain its program due its pool of experienced, well-trained senior staffs and managers.

4.3.4 Cooperation of Stakeholders

With the increased trust in the Authority, there is better and wider stakeholder participation in the LLDA's plans and programs, a concrete example being the involvement of citizens in reporting pollution violations. Consultation meetings also are well attended, compared to the past. The LLDA also has increased its capacity in public consultation and participation, using popular, widely-adopted methods such as the Pair-Wise Comparison and Multi-Criteria Analysis.

5. Lessons Learned and Recommended Initiatives

5.1 Legislated Actions on Environmental Protection are Time-tested Support for Sustainable Lake Management

One of the best things that happened for the management of Laguna de Bay was the Philippine Government's creation of a management authority with specific mandates on the development and environmental protection of the lake and the Laguna de Bay region. Succeeding amendments to the LLDA Charter (RA 4850), through Presidential Decree 813 and Executive Order 927, further strengthened the LLDA mandate in environmental protection and regulation. In spite of these advances, the exclusive authority of the LLDA to issue

permits for the enjoyment of fishery privileges, specifically the operation of fish cages and fish pens, was challenged in court by some fish pen operators and mayors of certain lakeshore municipalities, invoking the provisions of Republic Act 7160, or the Local Government Code of 1991, which granted the municipalities exclusive authority to grant fishery privileges to erect fish corrals, etc. within a definite zone of municipal waters. The case reached the Supreme Court of the Philippines, which ruled in favor of the Laguna Lake Development Authority. A specific paragraph on the decision of Justice Hermosissima Jr. reflected his appreciation of the lake environment, quoted as follows:

“Laguna de Bay therefore cannot be subjected to fragmented concepts of management policies where lakeshore local government units exercise exclusive dominion over specific portions of the lake water. The garbage thrown or sewage discharged into the lake, abstraction of water therefrom or construction of fish pens by enclosing its certain area, affect not only that specific portion but the entire 900 km² of lake water. The implementation of a cohesive and integrated lake water resource management policy, therefore, is necessary to conserve, protect and sustainably develop Laguna de Bay.”

This phrase has become a famous quotation for advocating integrated resource management and sustainable development, serving as an inspiration for the LLDA.

The LLDA also asserted its mandate on environmental regulation when it was sued by a private firm for issuing a cease-and-desist order for violation of the LLDA’s rules and regulations. The court affirmed LLDA’s action as a “practical matter of procedure under the circumstances of the case, and is a proper exercise of its power and authority under its charter and its amendatory laws.” This case further strengthened the LLDA regulatory role in the region.

5.2 Politics in Lake Governance

The policy-making powers of the LLDA are vested in its Board of Directors. Of its ten members, two are ex-officio representatives from the National Economic and Development Authority (NEDA) and the Department of Trade and Industry (DTI), four are elected officials (namely, the Governors of the Rizal and Laguna Provinces, and the Presidents of the Mayors’ League of Rizal and Laguna); four are Presidential appointees, such as the LLDA General Manager, Chairman of the Metropolitan Manila Development Authority, representative of the Office of the President, and representative of Private Investors. The latter is supposed to be selected from among the LLDA private stockholders, but most often is chosen by the President of the Philippines. Furthermore, the Board Chairperson, who should be elected from among the Board members, is almost always designated by the Philippine President. Relevant sectors and lake users have no direct representation in the Board, illustrating how politics could influence policy decision-making processes at the Board level.

To cite a specific example, on 4 March 2002, the Office of the President issued Executive Order No. 75 to create a Board of Advisors for the LLDA, consisting of three fisherfolk representatives from Laguna de Bay, to broaden participation of various resource users in managing the lake. A proposal to amend this executive issuance was submitted to the LLDA Board of Directors, recognizing sectors other than fishery, whose concerns and interests should be represented in the policy decision-making process. Unfortunately, the LLDA Board decided to defer submission of the proposed amendment in deference to the President.

The frequent shifts in the top management of the LLDA have affected implementation of flagship programs. The LLDA General Manager is appointed by the President of the Philippines and, therefore, serves at the President’s pleasure. Processing of the General Manager’s appointment and his tenure at the topmost post in the agency are subject to political underpinnings. Over the last 34 years, the LLDA has been managed by twelve General Managers, an average of only three years for every appointee.

The frequent changes in the General Manager of the Authority, in addition to the presence of other political appointees in the LLDA Board who sit at the pleasure of the President, have resulted in shifting policy and program directions, posing serious implications to the sustainability of development efforts in lake resource management (Nepomuceno 1996). It is the desire of the LLDA work force, and most LLDA stakeholders, that the LLDA Manager be a career professional whose tenure is dependent only on performance.

A worthy initiative of the Department of Environment and Natural Resources is advocating Good Environmental Governance. Started this year, the program requires key officials and middle managers of the different bureaus and agencies under its supervision to undergo a facilitated two-day training workshop on Good Environmental Governance, with one component being stressed is accountability to the people and to the environment.

5.3 Institutionalization of a Re-engineered LLDA

Lost opportunities to re-organize in a timely manner have prompted the LLDA to be more aggressive in pursuing its reorganization on the basis of an institutional model building on a fully integrated water resources management and development institution. One is the proposed wider representation and participation of stakeholders through the Technical Council and the Watershed Management Council, which was adopted by its Board of Directors on 25 January 2001 through Board Resolution No. 157, Series of 2001. Representations made to the Legislative Branch of the Philippine Government resulted in the filing of House Bill 4252, meant to strengthen the LLDA. In fact, President Gloria Macapagal-Arroyo expressed support to the LLDA re-engineering, to make it more responsive in carrying out its

mandates, considering the impacts of its operations on the lives of the people living in its watershed.

Although still facing a long path, the LLDA has already begun operating under the principle of integrated watershed management. Adoption of a framework focused on integrated water resources management has become imperative due to a number of factors, including strategic location and economic-environmental significance of Laguna de Bay, multiple use of the lake water and watershed resources; and inefficiency of the institutional arrangements.

Although the LLDA presently is performing more of a regulatory function than its planning and development roles, its existing Charter contains the developmental function for water resources development purposes. This overarching LLDA mandate has not been realized because of the lack of capacity and mechanisms to enable the Authority to initiate and involve the private sector in capital-intensive infrastructure development projects in the region. Further, the financial flexibility of the LLDA and other government-owned corporations has largely been constrained by the Philippine Government’s multi-layered approval process for fund solicitation through the NEDA/Investment Coordinating Committee.

Performing as a regulator and, to a limited extent, as a developer has overstretched the capabilities of the LLDA, resulting in an inability to accomplish its original mandate as a development agency, as evident in its current business strategy and financial profile. Thus, there is a need to delineate and segregate its regulatory and planning-developmental functions. Further, the LLDA has realized that building institutional capacities for undertaking large-scale infrastructure projects requires that regulatory and policy-making functions must be balanced by a strong, but segregated, development function. This comprised the starting point of the institutional re-engineering program. Previous studies identified potential investments of around US\$381 million to maintain the environmental quality in the Laguna de Bay area (e.g., dredging, embankments, sanitary landfills, sewage and treatment plants). The LLDA urgently needs to develop the capability to leverage and facilitate private sector participation in large-scale environmental and water-related infrastructure projects in the lake area.

The LLDA Re-engineering Program centers on creation of a sustainable management model for the lake and its watershed. The study recommended a commercial approach for building a framework amenable to private sector participation (PSP). To build the LLDA capacity for infrastructure project development and financing, the Board approved a staged process wherein a subsidiary called Laguna de Bay Development Corporation (LBDC) will be created after the LLDA successfully completes a prototype phase (Figure 7).

During the Prototype Phase, the LLDA will create a separate Prototype Project Development Unit (PPDU). If successful, PPDU would be the core of the LBDC, when incorporated. Reasons for adopting this approach include:

- A need to establish an LLDA track record for infrastructure project development;
- Positioning the LLDA for project development for potential PSP and other investors; and,
- A need to determine initial capitalization of LBDC and LBIDF, and the LBIDF legal and tax structure, in relation to the LLDA as Fund Sponsor.

The LLDA will not be the only government-owned corporation in the Philippines with a wholly-owned subsidiary. The LBDC shall be incorporated as a public limited corporation under the Philippine Laws. If properly implemented, the benefit to the LLDA would be the ability to leverage its resources with non-budgetary sources to implement large-scale infrastructure and other projects identified in the Master Plan of 1995, thereby also leading to greater efficiency, lower costs and higher PSP. How financing environmental infrastructure and social development projects will be accomplished through the LBDC is discussed in the succeeding section.

5.4 Financing Environmental Protection and Social Development Projects

The LLDA experience shows that environmental improvements cannot take place solely through soft approaches. The competing demands for scarce water resources of the lake and its river system requires a comprehensive infrastructure development plan, which should ensure that the lake’s water quality is enhanced and maintained at an optimal level, and development needs addressed in an equitable, economically-efficient manner. A concrete example is the domestic waste problem, particularly sewage. Without such infrastructure support as establishment of sanitary sewer facilities, pollution from this source will not be abated and is likely to get increasingly serious because of the increasing water demands of a growing population.

A component of the Integrated Water Resources Management and Development Model for the re-engineering of the LLDA is the provision of a special project trust fund and an infrastructure financing facility.

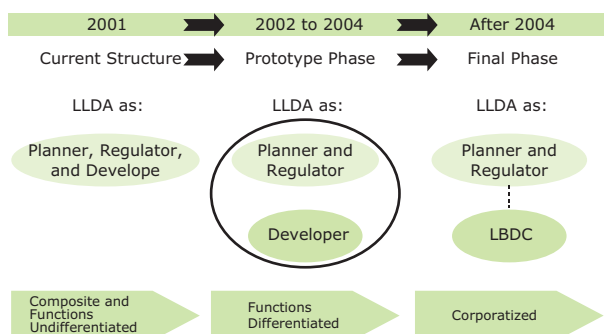


Figure 7. Evolution of the LLDA’s Development Functions.

- Environmental Trust Fund: A certain percentage of the LLDA operating revenue set up in trust exclusively for supporting the implementation of LLDA environmental management projects and activities at the sub-basin or LGU level, and at other environmentally concerned research and academic institutions and NGOs.
- Laguna de Bay Infrastructure Development Fund (LBIDF): A pool of resources from institutional investors, created for the purpose of funding the planning, programming, development and evaluation of recommended projects, and generating revenues by selling the projects to prospective bidders/sponsors for a project development fee.

5.4.1 Operationalizing the LBIDF

The LBIDF will be created to support the planning, development and evaluation of necessary environmental and water-related infrastructure projects. This Fund will initially receive contributions from the LLDA, multilateral agencies and local financial institutions during the initial states, and subsequently from international investors and private equity funds upon development of a specific list of projects. It will be managed by the Laguna de Bay Development Corporation (LBDC).

As the Investment Manager, the LBDC would pose funding proposals to the LBIDF Investment Committee, the Fund's decision-making body. The LBIDF would invest in all development projects undertaken by the LBDC. This structure also will ensure the LBDC has the incentive to maximize the throughput of developed projects. Since the LBDC is positioned as a service provider to the LLDA for project development, with recourse to LBIDF, its initial capitalization will be wholly provided by the LLDA. Over time, its capitalization may be increased by selling additional stocks to other investors at a premium, thereby providing the following revenues to the LBDC:

- Appraisal fees for initial screening of projects proposed to the LLDA;
- Annual management fees for managing and evaluating projects for LBIDF funding;
- Oversight fees for all projects under implementation, including those bid out and those developed for the LLDA; and,
- Carry fees to be paid by the LBIDF at the end of its life, if the Fund earns a return beyond a stipulated threshold.

It is envisioned that LBDC would undertake both non-commercial projects financed by the LLDA and the Government at the central/national and local levels, and commercial projects through private sector financing. Examples of non-commercial projects include solid waste management (landfills, sewage collection and treatment systems, lakeshore

protection works, dredging, etc.). Commercial projects would include water supply systems, central waste treatment and disposal plants, toll roads, eco-tourism, and other commercial/recreational facilities.

To make this framework effective, the LLDA must vest to the LBDC the rights to income from developmental activities. To support the LBDC financing activities, a Laguna de Bay Infrastructure Development Fund (LBIDF) will be created. The LLDA will be the initial contributor to the Fund and, when a more specific list of projects is developed, contributions also will be forthcoming from multilateral agencies, local financial institutions, international investors and private equity funds.

5.4.2 Establishing the Environmental Trust Fund

Historical background. Section 3 of Executive Order 927 of 1983 provides that "fishpen fee will be shared in the following manner: 20 percent of the fees shall go to the lakeshore local governments, 5 percent for the Project Development Fund (PDF) that shall be administered by a Council and the remaining 75 percent shall constitute the share of LLDA." In 1996, through the LLDA Board Resolution No. 15, Series of 1996, the fish pen fee share collection was modified as follows: 35% to the lakeshore local governments, 5% to the PDF, and 60% to the LLDA. The 35% share of the LGUs is further differentiated into 20% shared proportionately by cities and municipalities possessing fish pen and fish cage operations in their municipal waters, and 15% shared equally with all 29 lakeshore LGUs, irrespective of existence of fishpens. The Authority collected PhP21.752 million and PnP50.736 million in fish pen fees during 2001 and 2002, respectively. Thirty-five percent of this latter revenue was disbursed to LGUs for environmental and other projects.

As demonstrated by the LLDA through its PDF, project development and implementation funds, as well as environmental funds, can be an effective mechanism for channeling corporate revenues to help address environmental problems. The Fund has allowed the LLDA to provide financial resources for implementing environmental and social development projects and activities at the LGU level. If not because some of the releases from the PDF to LGUs go to their General Fund (which can be used for maintenance and other operating expenses, rather than implementing concrete projects on the ground), the PDF could provide much-needed financial resources where government financing may be limited or unavailable.

Legal basis. The PDF could be the precursor of the Environmental Trust Fund (ETF), and expanded as the ETF pursuant to the legal authority vested in the LLDA by its Charter. Section 4 (d) of RA 4850 provides that reasonable fees, as determined by the LLDA Board of Directors, shall be collected for processing plans, programs and projects proposed by LGUs in the region, public corporations, and private entities where such plans, programs and/or projects are within the Authority's mandate. Section 3 of EO 927 also empowers the LLDA to collect fees for use of the lake water

and its tributaries for all beneficial purposes, including, but not limited to, fisheries, recreation, municipal, industrial, agricultural, navigation, irrigation, and waste disposal. However, it states that the fees to be collected, and sharing of the revenues with other government agencies and LGUs, if necessary, is subject to the approval of the President of the Philippines, upon recommendation of the LLDA Board (except for the sharing of fish pen fee collections).

In addition, Section 4-A of RA 4850 authorizes the LLDA to collect fees as compensation for damages to the water and aquatic resources of Laguna de Bay and its tributaries, from failure to meet established water and effluent quality standards, or from such other wrongful acts or omissions of a person, private or public, juridical or not, punishable under the law. The money collected should only be used for water quality control and management. Section 4-B empowers the LLDA to collect annual fees for the use of lake water and its tributaries for all beneficial purposes. The law specifically mandates the LLDA to earmark the fees collected for managing and developing the lake and its watershed. Finally, as a government corporation, the LLDA can generate its own revenues and use them to realize its aims and purposes, limited to managing and developing the lake and its watershed.

Principles and objectives of the Trust Fund. The objective of the Environmental Trust Fund is to enhance implementation of environmental management activities in the Laguna de Bay region. Establishment of the Fund shall be in accordance with the following principles:

- The broad scope of the Fund to address a wide range of environmental projects to attain environmental policy objectives inherent in the LLDA Charter and the Local Government Code, and within the priorities of the LLDA mandate;
- Flexibility to adapt to economic, social and environmental situation over time;
- A clear set of criteria for using the Fund;
- Establishment of a Fund Trustee, either a private-sector accounting firm or national development bank, to impose general rules for financial control and accounting; and,
- Publication of Annual Financial Reports and other documents to provide the public information on the fund operations.

Funding sources of the Trust Fund. The Fund shall be generally sourced from environmental charges, clearances and permits collected through the LLDA operational activities, thereby providing a revenue base to finance priority environmental projects in the Laguna de Bay region. Thus, the Trust Fund is a revolving fund replenished by the LLDA through a set-aside percentage of its annual operating revenues, or such other

sources as determined by the LLDA. The Fund is disbursed annually to LGUs or other LLDA partners.

Trust Fund arrangement. The parties to the Trust Fund are: (a) Grantors to the Fund—regulated businesses and facilities required to secure permits and clearances and make payments to the LLDA in the form of environmental fees, fines and penalties, sources of international or domestic grants to enhance the regional environmental management program; (b) Trustee—a bank or other financial entity qualified to hold and invest such funds; and (c) Beneficiary—recipients of the fund, LGUs or other partners.

The LLDA shall have a two-part structure for fund management, consisting of the Management Unit and a decision-making body. The Management Unit, located within the LLDA, will monitor payments made to the trust and oversee the environmental activities undertaken by the trustee and fund recipients. Through the Supervisory Board, the Fund decision-making body, the LLDA shall assume responsibility for monitoring the flow of revenues into the trust fund and informing the trustee on fund disbursements. The Board shall undertake procedures for identifying, preparing and deciding upon projects to be financed through the Fund.

5.4.3 *Financing Co-managed Investments in Watershed Development*

Committed to continually espousing the sustainable development of the Laguna de Bay drainage basin, the LLDA developed the Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) Project, to be implemented over a five-year period, and financed from loan proceeds from the World Bank and an equivalent grant from the Netherlands Government. With the proposed initiative, the LLDA hopes to be able to optimize the level of interactions between the environmental, economic, and institutional dimensions of resource use and management, via a combination of strategic interventions which also form the integral components of the LISCOP, including (a) co-managed investments for watershed development (component 1); and (b) strengthening institutions and instruments (component 2).

Under the LISCOP, the LLDA will be restructured and strengthened to establish it as an effective watershed management agency in planning, regulatory and enforcement activities, as well as facilitating investments in environmental infrastructure. River Councils and communities will be engaged in implementing interventions through a fund that provides finances for supporting small-scale investments to improve environmental quality at the micro-watershed level. A full-scale, follow-up investment project also is planned, that would seek to improve the environmental quality of the Laguna de Bay watershed to enable the sustainable and equitable use of its resources to different users. The ultimate goal is to secure sustainability in effectively managing the basin's water resources, institutional building, and poverty alleviation.

The project has passed the due diligence requirement of the Philippine Government and was approved by the NEDA Board, with the loan and grant negotiations taking place on 4-5 November 2003. The LLDA is preparing the requirements for loan and grant signing in January 2004, expected to be effective in March 2004.

Financing the implementation of micro-watershed environmental improvement sub-projects by the LGUs under the LISCOP Project will be done through the Municipal Development Fund Office (MDFO) of the Department of Finance, for the following reasons: (a) the MDFO is the agency mandated to administer the MDF to finance devolved social and environmental activities to LGUs, and the only government instrumentality authorized to intercept the Internal Revenue Allotment (IRA) of the LGUs in case of loan amortization payment defaults; and (b) the LLDA (a GOCC) is no longer allowed to engage in credit lending, based on the previously-mentioned Executive Order No. 138.

The MDFO, created on 29 March 1984 pursuant to Presidential Decree 1914, administers the Municipal Development Fund (MDF), a special revolving fund aimed at establishing an effective mechanism to make funds available to LGUs from local and international assistance to implement social and environmental projects. Establishment of the MDF is consistent with the Philippine Government's strategic vision of local government autonomy and self-reliance, with the Policy Government Board of MDFO being the approving body for projects funded from the MDF.

Parallel with the LISCOP Project is development of a proposal for GEF funding through the World Bank for project implementation (PDF Block A) of the "Integrated Ecosystems Management of the Laguna de Bay Region".

The general objective of the proposed project is to sustainably manage the Laguna de Bay region for the continuous promotion of its ecological, economic and social functions and services, with specific aims being:

- To integrate management and development of the Laguna de Bay and Mt. Makiling watersheds, including appropriate policies and regulations with active community participation;
- To conserve and use the region's species and genetic diversity in a sustainable manner;
- To strengthen institutional capability and enhance participation of various stakeholders to ensure environmental health, social empowerment and economic productivity;
- To improve water quality via limiting pollution from domestic, industrial, and agricultural sources;

- To improve regional air quality by limiting carbon emission from the use of fossil fuel in power generation; and,
- To establish mitigating measures to control or reduce land degradation and lake siltation.

5.5 Integrated and Demand-driven Monitoring and Research

After the Water Resources Study and the Comprehensive Water Quality Management Program (1971-1978), monitoring of the lake and its tributary rivers became a routine activity. Data was compiled, with comprehensive assessment of the water quality water being limited. No additional parameters were sampled and the sampling stations did not change, in spite of the watershed's fast-paced development. This reality was the basis for the criticism that the LLDA only focused on the lake, rather than its entire drainage basin.

Fish pens and fish cages proliferated in the lake, becoming an important revenue source for the LLDA, through the collection of fish pen fees. Unfortunately, no monitoring program was developed to assess the associated impacts on the lake's ecology and water quality, and on the region's economy. Thus, when the first zoning and management plan was prepared, there was very little quantitative information to assess the impacts, thereby necessitating application of the precautionary principle.

One limitation for pursuing a more demand-driven monitoring and lake research program is the lack of additional funds and needed personnel. Although the LLDA has a pool of trained personnel, the magnitude of the task to monitor the lake and its major tributaries, while at the same time conducting water quality analyses (including those from industrial effluents and outside clients), limited the time available to do a comprehensive assessment of the state of the lake.

To address this concern, research collaboration with international and local academic and research institutions was undertaken. The LLDA also started to assume its role as a "clearinghouse" for research in the lake, to avoid duplication and to market the Authority's research needs.

With the credibility established by the LLDA through the years, local research institutions have taken cognizance of the LLDA capabilities. It presently is an active partner of the University of the Philippines-Environmental Forestry Program in the implementation of the Philippine Millennium Ecosystem Sub-Global Assessment, focusing on the Laguna de Bay ecosystem.

5.6 Developing and Sharing Knowledge

The LLDA has produced a "gold mine" of data on Laguna de Bay since 1973. After the comprehensive water quality assessment reports of 1974 and 1978, the water quality of the lake and

its tributary rivers was reported on a monthly, quarterly and annual basis. However, little effort was made on assessment activities to guide management on planning and decision-making. Most of the reports also were only for office use. As more students and researchers became interested in the lake, however, demands for water quality data also increased. In 1986, the LLDA began publication of annual reports on the water quality of the lake and its tributary rivers. A few years later, the publication improved through the addition of more water quality parameters, as well as a written report on each parameter. Assessment of water quality is based on compliance with the National Criteria (DENR-DAO 34) for Class C water (suited for fishery). However, the LLDA has not yet published a comprehensive ecological assessment of the lake.

Through the Sustainable Development of the Laguna de Bay Environment Project, funded by the Royal Netherlands Government, the “mined” data for 2000-2003 was extracted and transformed into different information sets used in development of a Decision Support System for Laguna de Bay. Training personnel in the hydrology, ecological and water quality modeling and GIS was vigorously pursued, with the vision of making the LLDA a credible center of lake information. One outcome of the project is the presentation of water quality data in a simple schematic diagram that can be easily understood by non-technical people. Inspired by the work of the Dutch painter, Piet Mondriaan, simple lines and colors were adopted to present technical information in an easily-understandable format. By examining colors, people would easily comprehend the current state of the lake and its tributary rivers. The so-called Water Mondriaan (Figure 8) is posted on the LLDA website to promote wide dissemination.

The above activity has somewhat addressed the criticism directed at the LLDA by the fish operators in the lake; namely, the lack of advice on the lake’s condition that could help them make crucial decisions in operating their business. Indeed, a more aggressive approach in disseminating water quality information is needed (e.g., publication in newspapers or through leaflets).

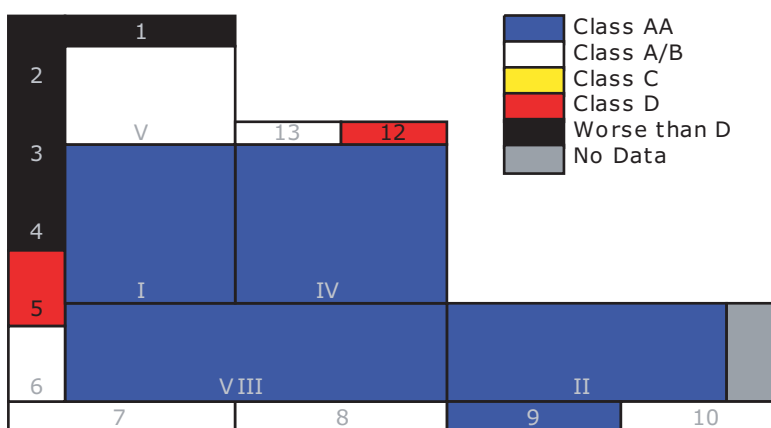


Figure 8. The Water Mondriaan.

5.7 Community Networking and Co-Management for Lake Watershed Development

With a wide jurisdictional mandate, and limited staff to effectively carry it out, the LLDA has long acknowledged that partnership is a key element in managing the lake’s resources (Santos-Borja 2002). The formation of strategic alliances with the LGUs, people’s organizations and non-government organizations is needed to gain wide support in implementing its plans and programs, and its rules and regulations within the region.

The shifting of management orientation towards stakeholders, as co-managers of the lake’s water resources, augurs well for value re-orientation (i.e., common values and a shared vision) and a sense of ownership, as a prerequisite to the desired lake ecosystem orientation among stakeholders. The LLDA and Laguna de Bay are already reaping the early fruits from the shift in the lake management paradigm, as indicated from the experience with the River Rehabilitation and Protection Councils, the Fisheries and Aquatic Resource Management Councils, and the tripartite partnership CLEAR.

5.8 Lessons Learned from Program Implementation

5.8.1 The Environmental User Fee System (EUFS)

The LLDA’s experience in implementing the EUFS provided two important lessons: (a) start simple and build experience; and (b) the battle cry should be “Ready, Fire, Aim” rather than “Ready, Aim, Fire” (Nepomuceno 2001). In other words, it is better to start simple, and fine tune as experience is accumulated.

The appropriate ways forward in regard to pollution charges/ user fees that emerged from the LLDA experience are:

- A simple, modest approach;
- A sector-based pilot run to help understand feasibility aspects, administrative convenience, institutional arrangements, and acceptability by all stakeholders;
- Picking one to two controllable parameters;
- Revising charges based on monitoring results;
- A strong, credible regulatory arm with multi-stakeholder orientation; and,
- Pollution charges at all levels from zero discharge, and increasing when it rises above the effluent standards.

The EUFS created a strong incentive for regulated firms to reduce the biochemical oxygen demand (BOD) concentration in

wastewaters discharged to the lake. Unfortunately, it also created an incentive for firms to dilute their discharges, a potential weakness of the system that highlights the importance of properly-pricing the input water to avoid perverse responses to the EUFS.

Because the EUFS is implemented to complement the existing command-and-control approach for pollution control and abatement, administering it under the existing regulatory system was administratively complex and difficult to enforce. In response to this concern, the LLDA introduced policy refinements and clarifications into existing rules and regulations to ensure effective implementation of the EUFS and enforcement of existing policies and regulations.

It is the LLDA's policy position that Market Based Instruments (MBIs) should not replace traditional regulatory systems. Rather, they are complementary tools for promoting efficient resource use. To make use of the LLDA's unique experience in MBIs, its strategy is to expand the EUFS, using four strategies:

- Revising the existing formula for industrial EUFS, by introducing other parameters (in addition to BOD);
- Exploring arrangements to include households in the EUFS coverage;
- Exploring opportunities for introducing EUFS for raw water extracted from the lake; and,
- Public Disclosure Program.

Drawing on international and local experiences, a public disclosure program will be used to create incentives for pollution control and improve the environmental performance of industrial polluters. Focusing on introducing the concept of public disclosure to LGUs and including them in a program of monitoring and disclosure of environmental performance, the program will encourage them to invest in improving their environmental management performance.

5.8.2 Shoreland Management

In spite of the LLDA's assertiveness in the regulatory field, it was not able to exercise its critical mandate on the 140 km² shoreland area in a timely manner. The 30-year gap from the LLDA's charter enactment to the time that it was able to take action on the shoreland became a window of opportunity for people to claim the shoreland for socio-economic benefits. By the time the necessary actions were undertaken, the LLDA was, and still is, faced with the problems of reclamation of shoreland areas, construction of illegal structures, and dumping of solid wastes and waste from construction work. Informal settlers also found it convenient to settle in the shore land, where they could conveniently put their wastes into the lake.

The delayed action also made it difficult for people, especially the LGUs, to understand why the parts of the lake within their municipality that remain dry at certain times of the year are

not under their jurisdiction. In spite of the dissemination of the Laguna de Bay Shoreland Policy, the LGUs still continue giving permits for shoreland use which, by law, is the LLDA's responsibility.

A very critical and sensitive issue is the interpretation of other governmental agencies on what constitutes the shoreland. By law, the shoreland is public land. Other government agencies in charge of land management, surveys and land titling, however, classify these shoreland areas as alienable and disposable lands, in spite of the fact that DENR Administrative Order No. 97-95 Series of 1995 was approved to prevent this situation from occurring. Resolution of this situation will require action and political will by the top executives of the involved agencies.

In 1999, the LLDA Board allowed qualified individuals or people's association to lease a portion of the shoreland areas, pursuant to their allowable use as long as the area was still untitled, and not covered by any government development plans, programs and projects.

The LLDA's shoreland regulation is a dramatic example of a situation whereby development projects/activities have overtaken regulations and control. Many people, including the LGUs have already put their stake in these areas. Thus, after delineation of the shoreland areas and inventory of their status, there is a need to review the policy on using the shorelands and revising the existing rules in a way that does not adopt the existing situation, but rather adapt the rules in a way that does not compromise the goal of protecting the shoreland and lake from further deterioration.

5.8.3 The Fish Pen Controversy

The conflicts brought about by use of the lake for aquaculture have taught the LLDA many lessons in policy-making and program implementation. The ensuing discussion is based on the analysis presented in Pacardo et al. (1988).

The introduction of fish pen technology in the lake illustrates an ill-conceived policy-making and implementation common to many public agencies. This type of aquaculture operation was introduced in the lake in the early-1970s, with the noble goal of improving the lives of fishermen. However, it ended up in the hands of businessmen because of a failure to quickly implement the necessary financial assistance program to enable fishermen to construct fish pen enclosures. The LLDA failed to set policies to protect the scheme and the lake from such speculators.

The benefits from the industry proved very impressive, gaining the approval of politicians, businessmen, and even the LLDA. Aside from the steady supply of fish in the region, it provided a source of revenue for the LLDA via collection of fish pen fees. While the policies were drawn, the policy-makers remained confident, and unsuspecting of what was actually happening in the fish pens, underestimating the complexity and difficulty of coordinating the tasks involved in implementing the program.

Illegal operation and expansion of fish pens was not controlled, to the detriment of marginal fishermen who rely on open water fishing. In 1983, the conflict was sufficiently critical that it led to the loss of lives and properties. The fish pen controversy raised two essential issues in resource management: (a) the level of “efficiency” in developing and using the lake’s resources; and (b) the issue of “equity” among those who receive the benefit, and those who pay for the consequences of environmental actions (Francisco 1985). The proliferation of fish pens also took its toll on the lake, with fish production negatively affected and the fish harvest declining, thereby severely affecting the livelihood of marginal fishermen.

The fish pen controversy raised national attention to the degree that the President of the Philippines issued instructions to demolish illegal fish pens and rationalize the use of the lake. Although the first Zoning and Management Plan of Laguna de Bay was formulated in 1983, its implementation failed because of lack of cooperation by fish pen operators and the intervention of local officials. In 1996, the ZOMAP was revised and a more organized implementation scheme developed. Unlike the previous plan, whereby fish pens can be constructed anywhere within the fish pen belt, a definite area of specified size was allotted to prevent expansion (Santos-Borja 1997). The strong political will of the LLDA General Manager and the implementing unit were instrumental in successful implementation of the revised ZOMAP. To augment the manpower needed to monitor the lake, the LLDA organized fishermen groups, deputizing them as wardens. The Fisheries and Aquatic Resource Management Councils (FARMCs) were subsequently formed, becoming a partner of the LLDA in resource management. A one-hectare area in the fish cage belt in each lakeshore municipality also was allotted to the municipal FARMCs to generate income they can use to sustain their activities in the lake. This privilege is not yet fully explored by the FARMC, however, pending finalization of the Authority’s implementing guidelines. Maintaining the area for aquaculture is always challenged by requests from prospective fish pen owners to increase the in-lake area for operation so they can have a chance to do business in the lake. The vigilance of fishermen and the fish pen operators themselves should be encouraged in the long run, since they stand to lose if the lake’s capacity to sustain fisheries is exceeded.

One of the areas in which the LLDA has been unsuccessful is in controlling illegal fishing, which is an enormous task, considering the size of the lake and the required manpower. The assistance of the LGUs through the maritime police, FARMC and Fish Wardens are essential, but their assistance could not be sustained because of inadequate funding. A recurring complaint is the intervention of local officials whenever illegal fishermen are apprehended, especially if the fisherman is a constituent. The lack of alternative sources of livelihood, and the responsibility to earn a living, makes it difficult to convince fishermen of the negative consequences of their illegal practices. A cosmetic approach being adopted by the local officials and the LLDA is to seed the lake with fingerlings, although an effective mechanism and institutional

arrangement to adequately address this problem has not been developed.

The shares of the LGUs in the fish pen fees are not handouts, but rather are meant to support environmental projects. Although attempts were made to monitor its utilization, most LGUs did not welcome this move. This again is one issue where political will on the part of local officials, and vigilance on the part of other stakeholders, is needed.

The key lessons presented herein indicate that managing a lake and its drainage basin is always a work in progress with the different stakeholders. Understanding a lake and its environs takes time and, along the way, knowledge is gained and mistakes are made. Examining the latter, however, represents an opportunity for improvement that accrues to the benefit of the entire lake basin.

6. Acknowledgements

This brief was prepared with valuable contributions from Ceazar N. Natividad, Jose K. Cariño, Jacqueline N. Davo, Jun Paul U. Mistica, Alicia E. Bongco, Angelita C. Rivera, Elrem A. Peña and Johnson L. Yu.

7. References

- Adams, G.I. 1910. “Geologic Reconnaissance of Southern Luzon in SOGREAH.” In *Water Resources Development Study*, Vol. 2, 1974.
- BCEOM (Bureau Central D’Etudes Pour Les Equipments D’Outre Mer). 1984. *Laguna de Bay Environmental Reassessment Study. Vol.1*. Asian Development Bank and Laguna Lake Development Authority: Pasig City, Philippines.
- Centeno J.D., A.E. Santiago and A.C. Santos-Borja. 1987. “The Carrying Capacity for Aquaculture of Laguna de Bay, Philippines.” Paper presented at 7th International Symposium, North American Lake Management Society, Orlando, Florida.
- Delmendo, M.N. and R.H. Gedney. 1974. *Fish Farming in Pens: A New Fishery Business in Laguna de Bay*. LLDA Technical Paper No. 2, Laguna Lake Development Authority: Pasig, Metro Manila, Philippines.
- Delmendo, M.N. and R.N. Bustillo. 1969. *Studies on Fish Population of Laguna de Bay*. FAO Indo-Pacific Fisheries Council.
- DENR (Department of Environment and Natural Resources). 1990. *Department Administrative Order 34 1990 Revised Water Usage and Classification/Water Quality Criteria Amending Section Nos. 68 and 69, Chapter 3 of the National Pollution Control Commission’s Rules and Regulations*.

- DENR and UNEP (United Nations Environment Programme). 1997. *Philippine Biodiversity: An Assessment and Action Plan*. Bookmark, Inc.: Makati City.
- Francisco, F.R. 1985. *Management of Lake Resources, Laguna Lake Development Authority, Philippines*. Master's Thesis, University of Otago, New Zealand.
- Gervacio, F.C. 1964. The geology, structures, and landscape development of Manila and suburbs. Cited in C.M.B. Jaraula. 2001. *Changes in Salinity and Sediment Supply in Laguna de Bay During the Past 6,000 years*. Master's Thesis, College of Science, University of the Philippines.
- Jaraula, C.M.B. 2001. *Changes in Salinity and Sediment Supply in Laguna de Bay During the Past 6,000 years*. Master's Thesis, College of Science, University of the Philippines.
- Laguna Lake Development Authority. 1995. *The Laguna de Bay Master Plan*. Pasig City, Philippines, June 1995.
- LLDA, Tetra Tech EM and PNB Capital and Investment Corp. 2001. *Institutional Re-Engineering of the Laguna Lake Development Authority*. LLDA: Pasig City, Philippines.
- LLDA/EDRB (Laguna Lake Development Authority and Ecosystems Development and Research Bureau). 2000. *Inventory of Users of Surface Water and Water Resource Pricing Study. Final Report*. Unpublished.
- Mane, A.M. 1929. "A preliminary study of the life history and habits of kanduli (*Arius spp.*) in Laguna de Bay." *The Philippine Agriculturist* 18(22): 81-108.
- Mane, A.M. and D.K. Villaluz. 1939. "The pukot fisheries of Laguna de Bay." *Philippine Journal of Science* 69(4): 397-412.
- NEDO/LLDA/JEMAI (New Energy and Industrial Technology Development Organization, Laguna Lake Development Authority and Japan Environmental Management Association for Industry). 2000. *Research Cooperation on Toxic and Hazardous Waste Management in the Laguna de Bay Region*.
- Nepomuceno, D.N. 1996. *A Framework Towards Operationalizing a Stakeholders' Convergence Policy in Laguna de Bay*. Master's Thesis, Development Academy of the Philippines.
- Nepomuceno, D.N. 2001. Paper presented at International Workshop on the Introduction of Market-Based Instrument for Pollution Prevention and Control. New Delhi, India
- Pacardo, E.P., B. Bartolome, F.R. Francisco, D.N. Nepomuceno, M.V.O. Espaldon, J. Lamanilao and S.L. Pantindol. 1988. "Basin Approach to Water Resources Management: A Case Study of Laguna de Bay." Paper presented at the 1st Expert Group Workshop on River/Lake Basin Approach to Environmentally Sound Management of Water Resources, Otsu and Nagoya, Japan.
- Palma, A., A. Diamante and R. Pol. 1997. Stock assessment of the major fishery resources of the Laguna de Bay. Bureau of Fisheries and Aquatic Resources: Tanay, Rizal, Philippines.
- Santos-Borja, A.C. 1994. "The control of saltwater intrusion into Laguna de Bay: socioeconomic and ecological significance." *Lake and Reservoir Management* 10(2): 213-219.
- Santos-Borja, A.C. 2001. *Setting Priorities for Biodiversity Conservation in Philippine Inland Waters*. Final Report, Inland Water Technical Working Group, Conservation International: Quezon City, Philippines.
- Santos-Borja, A.C. 2002. "Building Partnerships for Sustainable Lake Management: The Laguna de Bay Experience." In the Proceedings of the International Symposium on Building Partnerships Between Citizens and Local Governments for Sustainable Lake Management, IETC Freshwater Management Series No.3, UNEP International Environmental Technology Centre: Osaka/Shiga, Japan.
- Santos-Borja, A.C. 1997. "The Zoning and Management Plan of Laguna de Bay for Fisheries." Paper presented at the 7th International Conference on Lake Conservation and Management, 27-31 October 1997, San Martin de los Andes, Argentina.
- Shimura T. and M.N. Delmendo. 1969. *Report on the Listing Survey of Duck Farms and Fishing Families of the Fishery Survey of Laguna de Bay*. Philippine Fisheries Commission.
- SOGREAH (Societe Grenebloise D'Etudes et D'Applications Hydrauliques). 1974. *Laguna de Bay Water Resources Development Study. Final Report*. UNDP and ADB: Manila, Philippines.
- SOGREAH. 1991. *Environmental Assessment of Laguna de Bay. Final Report*.
- Sly, G.P. (ed.). 1993. *Laguna Lake Basin, Philippines: Problems and Opportunities*. Environmental and Resource Management Project: Manila.
- Villadolid, D.V. 1934. "Kanduli fisheries of Laguna de Bay Philippine Islands." *Philippine Journal of Science* 54(4): 545-552.
- Villadolid, D.V. and M.D. Sulit. 1931. "A list of plants used in connection with fishing activities in the Laguna de Bay Region and in Batangas Province, Luzon." *Philippine Agriculturist* 21(1): 25-35.
- Wolfe, J.A. and S. Self. 1983. "Structural lineaments and Neogene volcanism in southwestern Luzon." In D.E. Hayes (ed.). *The Tectonic and Geologic Evolution of Southeast Asian*

Seas and Islands, Part 2. Geophys. Monogr. Series 27. AGU: Washington, DC.

WHO/UNDP/LLDA (World Health Organization, United Nations Development Programme and Laguna Lake Development Authority). 1978. *Comprehensive Water Quality Management Program for Laguna de Bay. Final Report, Vols. 1, 3 and 4.* Pasig, Metro Manila, Philippines.

Disclaimer

The findings, interpretations and conclusions expressed in this report are the views of the authors and do not necessarily represent the views of The World Bank and its Board of Directors, or the countries they represent, nor do they necessarily represent the view of the organizations, agencies or governments to which any of the authors are associated. Also, the colors, boundaries, denominations, and classifications in this report do not imply, on the part of The World Bank and its Board of Directors, or the countries they represent, and the organizations, agencies or governments to which any of the authors are associated, any judgment on the legal or other status of any territory, or any endorsement or acceptance of any boundary.