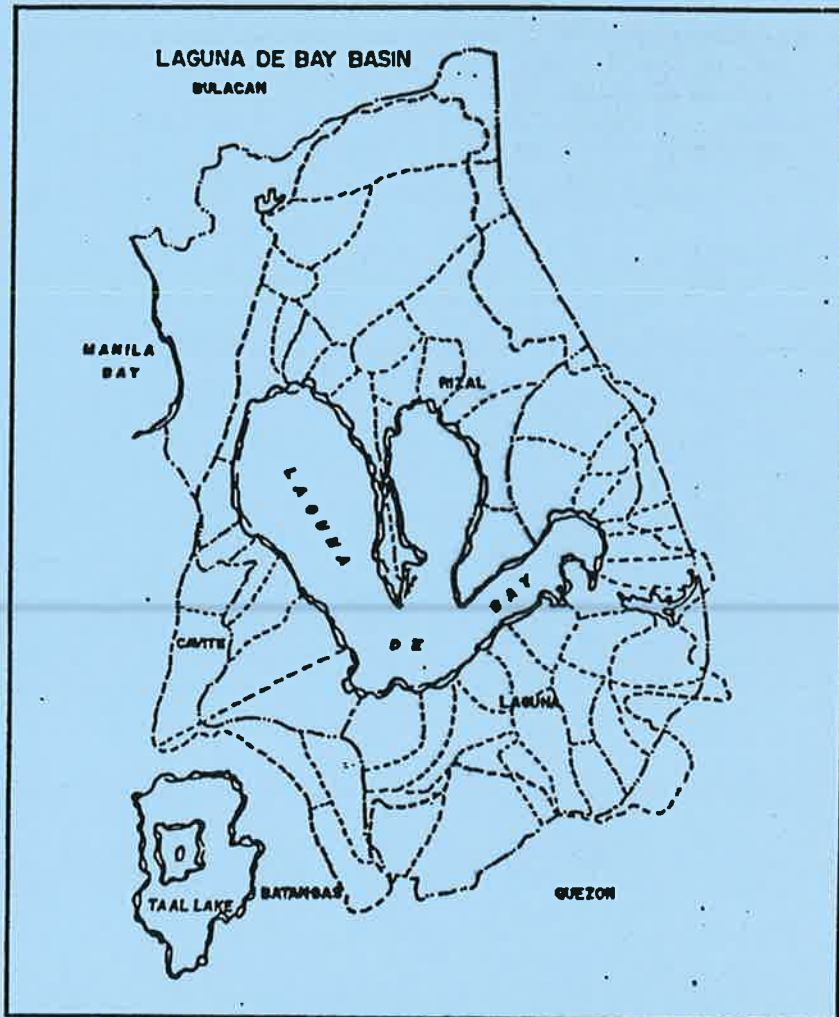


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THE LAGUNA DE BAY MASTER PLAN FINAL REPORT



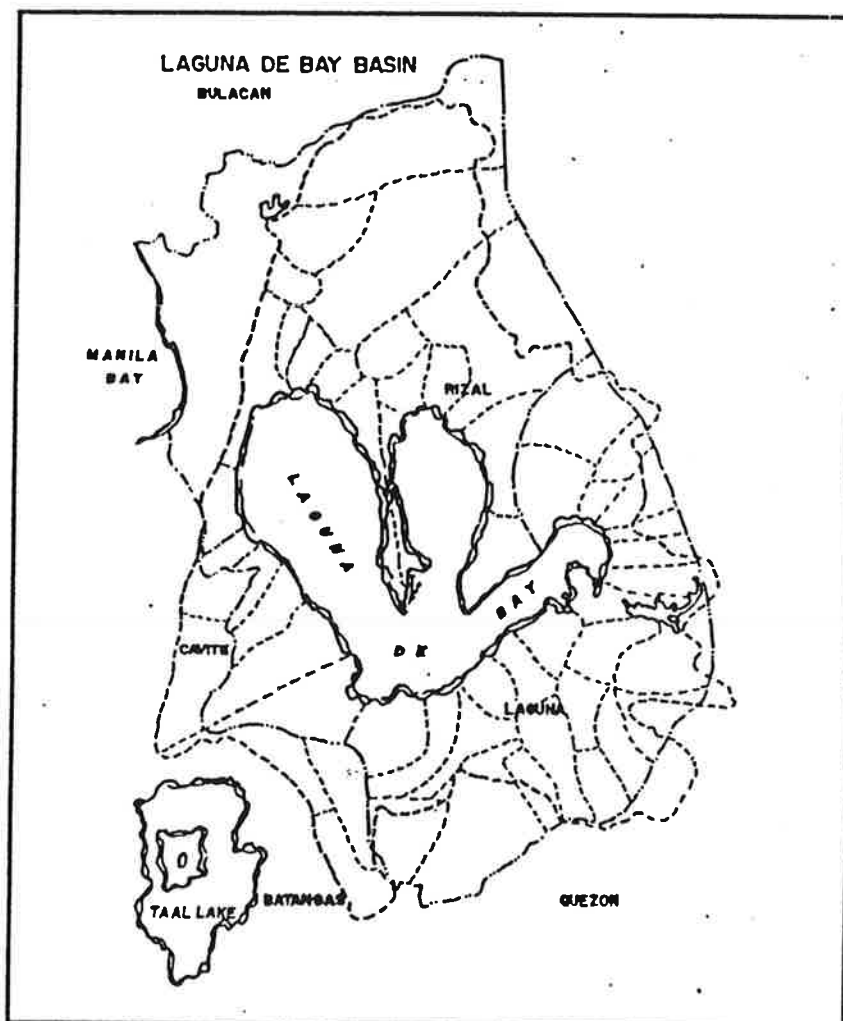
MAIN REPORT

LAGUNA LAKE DEVELOPMENT AUTHORITY
June 1995



THE LAGUNA DE BAY MASTER PLAN

FINAL REPORT



MAIN REPORT

LAGUNA LAKE DEVELOPMENT AUTHORITY
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MAIN REPORT

1.0 INTRODUCTION

The Laguna de Bay watershed region as a natural resource is strategically situated in the midst of the country's center of urban and industrial development. Aside from Metro Manila which lies just west of Laguna de Bay, the region straddles the whole of Laguna and Rizal provinces, parts of Batangas, Cavite and Quezon which compose the CALABARZON area. This configuration makes the region a critical resource in terms of its importance as the main source of agricultural food commodities and industrial raw materials. The lake itself as well as the other smaller lakes in the basin are important sources of livelihood for the fishery sector and serve multifarious purposes - in irrigation, transportation, energy generation and other industrial uses.

The geographic features and location of the basin within the primary growth area of the country make it susceptible to destructive human interventions which in the long-term may cause irreparable damage to its resources including the loss of valuable agricultural and forest lands to urban and industrial growth.

A strategic resource of the Region is the Laguna de Bay, the second largest body of freshwater in Southeast Asia. It has a surface area of approximately 90,000 hectares, an average depth of 2.8 m., a total volume of 3.2 billion cubic meters measured at elevation 11.50 meters above the Laguna de Bay datum set at 10.0 meters below the Mean Lower Low Water (MLLW) and a shoreline of 220 kms. There are 21 tributaries that drain into the lake; 35% of freshwater that drains comes from Pagsanjan River while 15% comes from the Sta. Cruz River. The only outlet of the lake is the Napindan Channel which at its confluence with the Marikina River, forms the Pasig River. This river meanders along a 24-km. long course westward through a major part of Metropolitan Manila, before finally discharging into Manila Bay.

Laguna de Bay Region boundaries include six (6) provinces, and 60 municipalities of which 28 towns are lakeshore and 32 non-lakeshore towns. The actual population of the Region including Metro Manila was approximately 8.3 Million in 1990 and is expected to rise to 12.0 Million by year 2000. The lake is the single most important resource of the Region. At present it is a source of industrial cooling water, irrigation water, and hydroelectric power; a transport route for oil products and the lakeshore dwellers; a source of snails for duck feed; a venue for recreation and most notably a source of fish supply. Also, the lake serves as a huge sink for waste coming from domestic sources (household and service sectors); non-point sources (surface run-off from urban areas, crop lands and forest lands); industries, livestock and poultry production, fishery activities and Pasig River and Manggahan Floodway inflow. The latter is most alarming since its pollution and sediment loads jeopardize the existing and potential uses of the water body.

In the Laguna de Bay Region, groundwater is a common source of water supply, although its reliability to sustain increasing demand has not been established. Moreover, there is an increasing evidence of ground water contamination from leachate of dumpsites, septic tanks, oil depots, etc. This necessitates the

consideration of the lake as an alternative domestic water supply source by the year 2000. However, the water quality in the lake is becoming worse by eutrophication and contamination of toxic and hazardous substances such as heavy metals from industrial wastes and agricultural pesticides. The Laguna de Bay has been undergoing accelerated eutrophication due to increasing nutrient wasteloads from domestic households, expanded agricultural and livestock production, intensive fishpen operations and soil erosion.

The prospect of using the lake as a potential source for domestic water supply remains the core of all management strategies for the Laguna de Bay. The idea was part of the government plan during the Marcos era and reiterated by the Aquino Government in 1989 with the adoption of the "dominant use" policy prioritizing the lake's use as a fresh water source and to upgrade the quality of water in the lake from Class C (suitable for fisheries) to Class A (suitable for domestic supply).

The original intent to upgrade the lake water quality from Class C to Class A meant interfering with nature. The closing of the Napindan Channel through the Napindan Hydraulic Control Structure is seen by some sectors as working against nature because it is perceived to affect fishery productivity. On the other hand, keeping it open would allow the polluted waters of Pasig River to come in during reverse flows.

Recently, the new LLDA Management has recommended a policy shift on the "dominant use" of the lake from domestic water use to fisheries. However, it was pointed out that a multiple use policy can still be possible without interfering with the natural conditions of the lake at Class C. Water supply use may still be possible by locating the intake pumps in areas where treatment may render the extraction of water economically viable.

The Laguna de Bay is indeed a strategic resource for the economic and social development of the Region and of the country. The sustainability of the lake, however, depends upon the sustainability of its watershed resources.

This scenario calls for the evolution of strategic policies, institutional reforms and measures to maintain a balance between downstream and upstream activities in the watershed. Most importantly, this would mean strict adherence to basic ecological principles and genuine participation of the government and the public towards a sustainable environmental and natural resources management program in the Region.

1.1 RATIONALE

Rapid expansion of the economic activities and population growth in the catchment areas of the rivers draining into the Laguna de Bay as well as in the coastal zones are the primary pressures being faced in the Region today, as much as in the past. So far, the scale of interventions in nature is increasing and the physical effects of these decisions spill across regional and national frontiers. Today, the Region faces risks of severe environmental stress that threaten the basis for social progress and human existence.

For the past twenty years or so, the Laguna Lake Development Authority has found a deep public concern for the management of the lake, a concern that has led to multi-sectoral conflicts of varying degrees. The challenge is to ensure that these conflicts and values generated are more adequately harmonized and reflected in the principles and operations of political and economic structures in the Region.

These deepening interconnections are the central justification for the formulation of a sustainable management plan for the Laguna de Bay Region.

1.2 THE IMPETUS FOR THE MASTER PLAN

Following the visit of His Excellency President Fidel V. Ramos to the University of the Philippines at Los Baños and Pila, Laguna sometime in June 1993, the need to address some of the policy gaps and issues associated with the Laguna de Bay Region as well as CALABARZON and other matters pertaining to the quality of the lake and Mt. Makiling Forest Reserve were identified. Rather than adding another agency, the idea was to come out with an ad hoc institution such as a Presidential Commission: (1) in order to generate a Master Plan or a set of policies that the Office of the President may adopt; (2) so that the LLDA as the lead agency in the development and management of the Laguna de Bay Region would be strengthened.

To effectively address the problem, the President issued Executive Order No. 121 on August 24, 1993 which clothed the Mt. Makiling Reserve Area and Laguna de Bay Commission with the authority to determine what development activities may still be allowed in the Region and what should immediately be stopped. The Commission's mandate gave it three objectives: 1) to formulate an Action Plan for the immediate concerns of the Region; 2) to formulate the master plans for sustainable development for the Mt. Makiling Forest Reserve and Laguna de Bay Region under the long-term; and 3) to implement a moratorium on new development activities in the Region.

Being considered as a major activity of the Commission, the parameters for the formulation of the Master Plan for the Region have been set by the Office of the President and shall henceforth be observed as follows:

- 1.2.1 As its overall framework, the Master Plan should provide the vision for the development of the Laguna de Bay Region consistent with the national goals under the Philippines 2000, particularly with the sustainable development thrusts of the Medium Term Development Plan.
- 1.2.2 Towards this vision, short and long term objectives should be set in the Plan together with the strategies and mechanism to attain them.
- 1.2.3 Discussion on: (a) potentials of the region, including alternative uses for lake; (b) the attributes and characteristics of the Region; (c) assessment of the present state of the lake Region, including its implications on the other sectors and to national life; (d) issues affecting the Lake, including policy and structural concerns; and

(c) status of the existing government's initiatives to address these issues, to serve as basis for the Plan objectives and activities.

- 1.2.4 Central part of the Plan should be the discussions on the specific programs and measures to be implemented, including concrete government interventions to address the issues and concerns on Laguna de Bay (such as environment degradation, water pollution, management problems, etc.).
- 1.2.5 Inclusion of the appropriate organizational framework for effective Plan administration. This should clearly define the role and responsibilities of the concerned agencies in the implementation of the Plan. Part of this, should be the system for monitoring and reviewing the Plan implementation to ensure the attainment of the Plan objectives.
- 1.2.6 The Plan objectives and activities for Laguna de Bay Region should be complementary with those in Mt. Makiling Reserve Area to allow their integration into the blueprint for development of both areas as envisioned in Executive Order No. 121.

1.3 OBJECTIVES

The formulation of the Master Plan for the Laguna de Bay Region is focused on the sustainability of the Lake as the most vital regional resource. To ensure its sustainability, however, it is equally essential that attention is given towards the conservation and management of the watershed areas from which downstream environmental problems originate.

Therefore, the ultimate objective of the Master Plan should be the development of strategies and programs for the protection, rehabilitation and enhancement of the environment and natural resources in the Laguna de Bay Region in order to ensure an efficient, equitable and sustainable development. More specifically, the Master Plan shall endeavor to attain the following:

- 1.3.1 To develop and implement an environmental management program for the Laguna de Bay which would monitor and address water quality issues, define policy measures to address environmental pollution problems and identify infrastructures for environmental enhancement;
- 1.3.2 To identify strategies and programs for implementation towards the management of Laguna de Bay watershed focusing on the critical catchment areas where soil and water resources need to be protected and/or restored to ensure the adequate flow of clean and adequate freshwater into the Laguna de Bay;
- 1.3.3 To formulate and implement policy measures and development projects for the conservation, management and enhancement of the fishery resources towards a more equitable access and utilization without sacrificing the ecological integrity of the lake;

- 1.3.4 To develop and implement policy measures and strategies for an agricultural development program in order to ensure the long term sustainability of primary production areas, minimize agricultural pollution and enhance productivity;
- 1.3.5 To identify mechanisms and institutional arrangements which could be operationalized to manage the utilization of lake basin resources, resolve conflicts and interests among agencies and among stakeholders, delineate powers and responsibilities, and ensure public participation in decision-making;
- 1.3.6 To design strategies and programs towards an effective and sustained implementation of an information, education, and communication program in order to ensure public awareness and understanding of government policies, plans, programs, and projects as well as the basic problems and issues in environmental management;
- 1.3.7 To develop and implement a community development program which would focus on organizing the marginalized sector thereby facilitating the implementation of alternative livelihood projects, the advocacy towards their partnership in environmental management and their participation in decision-making processes in managing the Laguna de Bay resources;
- 1.3.8 To identify policy and technical concerns which could be the subject of a research and development agenda that would lead towards the formulation of alternative developmental strategies and/or the resolution of environmental and developmental problems and issues in the Lake region.

1.4 **METHODOLOGY**

To determine the influence of various factors on the environmental conditions in the study areas and their ultimate effect in the Laguna de Bay water quality, the Master Plan Project has focused on the investigation of four components described hereunder. This analysis served as a basis for coming up with the recommended development programs and projects which form the central focus of this Master Plan.

1.4.1 **LAND RESOURCE COMPONENT**

This component deals with the investigation of the natural and physical attributes of the lake watershed and includes agriculture, industries, built up areas, forest areas, pedology/ geology, land use, protected areas, reserve areas and natural parks.

1.4.2 WATER RESOURCE COMPONENT

This component is of fundamental importance in the implementation of measures for the rehabilitation of the Laguna de Bay environment and for sustaining development activities. This includes the lake and its tributaries, air and water quality, chemical and biological attributes, fisheries, pollution, lake uses, benthos, hydrologic and hydraulic conditions. The conflicting and competing uses and the associated socio-economic and environmental problems are also investigated.

1.4.3 SOCIO-ECONOMIC STRUCTURES/PLANNING AND DEVELOPMENT COMPONENT

This component deals with the investigation of the sociological and economic aspects in the study area. This includes demography, political and economic structures, regional economy and existing programs and projects.

1.4.4 INSTITUTIONS AND INSTITUTIONAL ARRANGEMENTS

This component deals with an analysis of existing institutional arrangements in managing the Laguna de Bay Region and its basin resources. Legal and policy instruments, inter-agency coordinations, organizational problems and structural constraints are investigated to come up with appropriate institutional changes. Of major importance are the institutional issues and constraints within LLDA - the agency mandated to manage the development of the Laguna de Bay Region.

The project components and corresponding activities of the Master Plan Project was prepared by an integrated team headed by the Project Manager, the LLDA Technical Support Staff and the Project Staff specifically hired for the purpose.

The first activity undertaken by the project staff included the collection of data and information based on major studies conducted on Laguna de Bay Region since the 70s and a multi-sectoral consultations with stakeholders. The second phase was the analysis and synthesis of the recommendation of these studies by the LLDA technical support staff. The third phase involved the presentation of the LLDA divisional concerns, projects and activities. The last phase was the formulation of specific programs and strategies for the development of the Laguna de Bay and its watershed basin.

1.5 ORGANIZATION OF THE REPORT

1.5.1 REPORT STRUCTURE

This is the Final Report of the Master Plan for the Laguna de Bay Region. To achieve the objectives set forth, the Master Plan has focused on the development and formulation of different programs and projects. Ten appendices are attached

to this report. Nine (9) programs are proposed to address specific sectoral issues and concerns in the Region. These are as follows:

- Appendix A** - Environmental Management Program
- B** - Watershed Management Program
- C** - Fisheries Development Program
- D** - Agriculture Development Program
- E** - Cottage Industries Development Program
- F** - Institutional Development Program
- G** - Lake Environmental Education and
Communication Support Program
- H** - Community Development Program
- I** - Research Agenda

Appendix J contains a compilation of the proposed plans and programs of the different agencies concerned with the Laguna de Bay Region.

1.5.2 ORGANIZATION OF THE FINAL REPORT

The remaining part of the Final Report is structured in the following order. In Chapter 1 the overview of the Master Plan is presented. This includes the rationale and impetus for which the Master Plan was formulated. The policy statement expressed under Executive Order No. 121 issued by the President on August 24, 1993 as translated in the parameters set forth by the Executive Department was presented. Following from the parameters identified, the ultimate objective of the Master Plan is the development of strategies and program, for the protection, rehabilitation and/or enhancement of the environment and natural resources in the Laguna de Bay region in order to ensure an efficient, equitable and sustainable development.

Chapter 2 presents the general overview of the Laguna de Bay Basin. It describes the general features of the lake and its watershed in terms of its origin, geology, topography, climatology, location, hydrology and land uses.

The socio-economic profile of the lake region is also presented focusing on the demography and regional economy. This chapter highlighted the central focus of the regional resource which is the lake itself and the multifarious uses for which it is intended.

A special treatment of the existing institutions and institutional arrangements in managing the Laguna de Bay is presented in Chapter 3. The evolution of Laguna Lake Development Authority as a special regional agency was presented. The policy and legal framework (Republic Act 4850 and its amendments) were clarified whereby the mandates, jurisdictions, powers and functions of LLDA were defined. The second part of this chapter deals with the institutional issues

and concerns facing LLDA as it manages the resources of the Laguna de Bay region.

Chapter 4 presents the regional development issues, problems and constraints. These include environmental concerns such as water quality issues, pollution and declining fisheries; constraints on land resources focusing on land use and conversion, deforestation, urbanization, land titling of shorelands and ground water contamination; and; socio-economic concerns such as conflicting uses of the lake, lake fishery problems, livelihood and skills training.

Chapter 5 is the presentation of the proposed regional development plans and programs. A regional development framework, as a guide to the development of sectoral program formulation, is presented as the first part of this chapter. The overall plan is presented based on sectoral program areas namely: Environmental Management, Watershed Management, Fisheries Development, Agricultural Development, Cottage Industries Development, Institutional Development, Lake Environmental Education and Communication Support, Community Development and Research Agenda. The objectives, strategies and components for each program are also presented. The details and profiles of the project components for each program are annexed in the appendices of the Master Plan.

Chapter 6 contains a summary of the implementation schedule of the proposed programs and projects in the Master Plan. A summary of the estimated costs for the implementation of the proposed programs and projects is presented in Chapter 7.

2.0 THE LAGUNA DE BAY BASIN

2.1 GENERAL OVERVIEW

2.1.1 ORIGIN OF LAGUNA DE BAY

Varied opinions have been advanced by early geologists regarding the origin of Laguna de Bay (Fig. 2.1). The idea that the bay was formerly a volcanic crater or that it originated through subsidence of a volcano, remains unresolved. The most generally accepted theory, however, based on recent findings, is that the basin was once part of Manila Bay. The drill cores uncovered various layers of marine shells which are of the same species as those shells living in Manila Bay waters today. Remnants of almost identical species of marine shells were also found in the upper shores of the town of Bagumbayan (Luneta Park), and in the Marikina fault in Pasig-Marikina river junction (SOGREAH, 1974).

2.1.2 GEOLOGY

The Laguna de Bay watershed is underlain almost entirely by Quarternary (Pliocene-Pleistocene) clastic, pyroclastic and volcanic rocks, except for the extreme northern portion of the region, which is occupied chiefly by Tertiary rocks and a few erosional remnants of Cretaceous rocks. A group of volcanic cones and small crater-lakes characterizes the southern Laguna de Bay watershed. These volcanoes experienced intermittent eruptions, both quiet and explosive types of varied intensities, during the Pleistocene time. They ejected large volumes of volcanic and pyroclastic materials, particularly tuff and agglomerate that blanketed extensive areas of the older Tertiary rocks (SOGREAH, 1974).

2.1.3 TOPOGRAPHY

The surface feature of the area is characterized by mixed topography. The area is 35% gentle, 45% rolling, 15% steep and 5% very steep (Pacardo et.al., 1988). The northern part of the watershed is characterized by a series of rolling hills with high to moderate reliefs. Among these are the Binangonan peninsula, Talim Island, Jalajala peninsula and the Famy valley, which is flanked to the east by the Caliraya plateau (SOGREAH, 1974). However, the southern portion of the watershed can be described by the presence of a group of volcanic cones with numerous smaller cinder cones and crater lakes. Some of the prominent features of this part are Mt. Banahaw, the highest in the whole region at elevation 2165 meters, Mt. San Cristobal, Mt. Nagcarlan and Mt. Makiling. The major part of the remote places or thinly inhabited areas is covered mostly with forest which includes most of limestone hills. The lower land areas and valleys are normally planted to seasonal rice, vegetables, fruit trees, and other short-season crops.

2.1.4 CLIMATOLOGY

The prevailing climatic conditions are the Type I for the Rizal province and Metro Manila, having two pronounced seasons (i.e. dry from November to April and wet from May to October) and Type IV for the Laguna and Cavite provinces (i.e. having an even distribution of rainfall throughout the year (NEDA, 1987). In the cool season (December to February), the lowest air temperatures and peak

wind velocities occur, causing high water turbidity that even with the presence of large amounts of free nutrients, primary production and fish growth is at its lowest for the year.

2.1.5 LOCATION

Today, Laguna de Bay covers almost one half of the 190,000 ha. total area of all existing lakes in this country. It is known as the second largest inland body of water in Southeast Asia next to Lake Toba in Indonesia (Santos-Borja, 1994). It has a total surface area of about 90,000 has. and an average depth of 2.8 m. Laguna de Bay stands unique in the sense that it is right in the middle of its upper watershed. It lies just east and generally south of Metropolitan Manila. The lake has a total volume of 3.2 billion cubic meters with a shoreline of 220 km. There are 21 tributaries that drain into the lake; 35% of freshwater that drain comes from Pagsanjan River while 15% comes from Sta. Cruz River. The only outlet of the lake is the Napindan Channel which at its confluence with the Marikina river, forms the Pasig river, which meanders along a 24 km. long course westward through a major part of Metropolitan Manila, before eventually discharging into Manila Bay (Francisco, 1985). Other lakes in the region also include the Seven Crater Lakes of San Pablo City with a total surface area of 289.6 has. and Tadolak Lake in Los Baños with only 22.6 ha. area.

Laguna de Bay Region occupies 1.3% of the total land area of the Philippines. It encompasses the whole provinces of Rizal and Laguna, the cities of San Pablo, Pasay, Caloocan, Quezon, Manila and Tagaytay, the towns of Tanauan, Sto. Tomas and Malvar in Batangas, the towns of Silang and Carmona in Cavite; Luchan in Quezon province and Marikina, Pasig, Taguig, Muntinlupa and Pateros in Metro Manila. To sum it up, Laguna de Bay Region boundaries include 6 provinces, 60 municipalities of which 28 towns are lakeshore covering 177 barangays and 32 non-lakeshore towns.

Laguna de Bay is a trilobate lake with three corporate bays: the West Bay, Central Bay and East Bay that converge towards the South carving out what resembles a large bird or dinosaur. The West and Central Bays are separated by Talim Island, the largest and most populated of the nine islands within the lake. It is bordered by the ruggedly high Sierra Madre mountain ranges on the Northeastern portion, the high Caliraya volcanic plateau in the East and the chains of mountains of Laguna and Batangas province to the South and Southeast, which includes Mt. Banahaw and Mt. Makiling.

2.1.6 HYDROLOGY OF THE LAKE

The hydrology of the lake has a natural stage regime which in the dry season results in a minimum lake elevation of about 10.5 m. controlled by mean sea level in Manila Bay. At the end of the dry season, the lake level may drop below the level of high tide in Manila Bay, resulting in the intrusion of seawater up the Pasig River. With this diurnal reversal, the highly polluted waters of the Pasig River system are carried into the lake. The tidal influx is also the primary cause of elevated salinity in the lake during this part of the year (Francisco, 1985).

During the wet season, precipitation results in an annual mean high water elevation of 12.5 m. and a peak elevation which may reach as high as 14.6 m. for a 100 year recurrence interval. During extremely wet years, widespread flood damage occurs along the lakeshores because the land is relatively flat for several kilometers inland in most areas. Also during this period, the Marikina river floods the Pasig River and overflows into the Laguna de Bay via the Napindan Channel because the Marikina river can generate floodflows of about 2000 m³s to 4000 m³s, and because the Pasig River bank full channel capacity varies from as little as 50 m³s to only about 750 m³s. Depending upon the tide and local inflow, the Marikina river causes flooding in and around Metropolitan Manila.

2.1.7 LAND USE

The total basin area of the lake is about 382,000 has. and this is commonly referred to as the Laguna de Bay Region. The land being used for agriculture is approximately 198,640 has. which comprises 52% of the total land resources. At present, the forest area includes only 73,000 has. Extensive deforestation has been reported (BCEOM, 1984) where 54,000 has. between 1966 and 1977 had been transformed into unproductive grassland, with serious erosion hazard, involving sediment transport and siltation problems thus, the remaining forest cover is only 19,000 hectares.

Moreover, around 83,620 has. is now being used for industries; 26,740 has. as built-up area, and 14,000 has. as lakeshore area. The drainage basin includes about 3,600 square kms. of land composed of: urbanizing suburbs, spilling over from the Metropolitan Manila area; flatlands bordering the lake which are intensively farmed, predominantly for rice and sugarcane production; mountainous areas where bananas and coconuts are grown, and where timber is harvested and a large patch of hilly scrub and grassland in the lake's denuded northern side (Francisco, 1985).

The lake region is also endowed with rich natural resources within its inland basin. The Mt. Makiling Forest Reserve (MFR) approximately situated 6 kilometers from South Bay and 20 kms. from Talim Island is the nearest resource of its kind to the seat of government. It is a 4,244-hectare resource designated primarily as a training laboratory under Republic Act 6967 for the advancement of scientific knowledge on natural resources. It serves as a wildlife sanctuary and a pool for genetic diversity. As an educational resource, the MFR has been the setting of floristic studies in the country by internationally famous botanists. It is also the home of various academic, research and tourism institutions such as the UP Los Baños (UPLB), International Rice Research Institute (IRRI), Boy Scouts of the Philippines (BSP), National Arts Center (NAC) and "Pook ni Maria Makiling". (A Master Plan for the Mt. Makiling Reserve Area is currently being prepared by a counterpart Committee).

As a natural resource, it is considered a very important watershed providing irrigation, industrial and domestic water supply to numerous population of its surrounding communities. The Reserve serves as an important catchment area for Laguna de Bay. Along with forest lands, other resources include extractive opportunities for both metallic and non-metallic deposits. Geothermal potential has also been established. The Mt. Makiling-Banahaw geothermal resources is already developed and is being utilized to supplement the nation's energy needs.

The natural resource endowments of Laguna de Bay Region being affected by rapid urbanization of Metropolitan Manila, such as rapid population growth, intensive agriculture, and industrialization, present a challenge to development planning. The lake is the single most important resource of the region and to which all aspects of resource exploitation are vitally linked. (For greater detail of this subject, see Gedney, 1973; Lee and Adan, 1976 and Francisco, 1985).

2.2 SOCIO-ECONOMIC PROFILE

2.2.1 DEMOGRAPHY

The Region represents about 1.3% of the country's land area, where about 13.8% of the nation's population is concentrated. In 1990, the actual population of the region, including Metropolitan Manila, was 8.3 million (Table 2.01) with a growth rate of 3.13% and a population density in 1992 of 23.36 per ha. (LLDA, 1992). As of 1990, the population of 6.4 million in the non-lakeshore areas will reach 10 million by the year 2000 (Table 2.02). URSI projections (1989) also reveal that the 2 million lakeshore population will change significantly.

Based on the 1985 NSO Family Income and Expenditures Survey, the average annual family income in the Basin ranges from P35,000 to P116,566. The main Basin areas, Rizal and Laguna, have average annual family incomes of P38,547 and P41,249 respectively. These would generally apply to the lakeshore areas with individual incomes per lakeshore municipality within these baseline levels. The average annual family incomes in Rizal and Laguna are significantly higher than the national average. In 1985, the national income for the country stood at P31,052 (MEIP, 1994).

By the year 2000, the projected population by city, province and municipality is 12 million. This growth and distribution is strongly influenced by the region's proximity to Metro Manila. The more densely populated municipalities are located within or close to Manila. The rate of increase in the province of Rizal and Laguna which, comprise the main portion of the region, was 5.8% and 3.9% respectively. The high population growth rate is largely attributed to in-migration from the other regions of the country which results mainly from the perceived economic opportunities in Metropolitan Manila (Francisco, 1985).

2.2.2 LAGUNA DE BAY BASIN ECONOMY

Because Metropolitan Manila is almost totally urbanized, the spill over into the rapidly urbanizing suburbs of Rizal and Laguna provinces has now resulted in the expansion of the Metropolis. This expansion was concentrated in the Western Bay and has since extended to the southern extremity of the lake. At present, the province of Rizal is about 85% urbanized while Laguna province is 50% urbanized. This rapid urbanization, coupled with the high rate of in-migration, is associated with the region's growing economic and social problems, as well as, the worsening environmental problems.

In terms of economic output, selected economic indicators reveal that Laguna de Bay Region produces a Gross Regional Domestic Product of P101.3 billion (GRDP, Region IV), a potential labor force of 6.1 million in 1990 NCSO and is projected to reach 8.5 million by the year 2000 (Table 2.03). In addition, the total number of industrial establishments is increasing rapidly with a total number of 1,481 (LLDA, 1994). The high trade export receipts of US\$ 257.073 million covers 41.14% export receipts in the whole Region IV not to mention the output of P38.84 billion from industrial establishments of local and foreign investments (Sectoral Performance Report, 1991). All these factors led to the suitability of the region for economic development.

In the early 80's, the region also produced more than 60% of nation's total manufacturing. In the region itself, the projected manufacturing and services for the year 2000 account for almost 86% while primary production (agriculture) accounts for only 6.6% (see Table 2.04). The economic significance of this large difference in output should not, however, be over emphasized, for with more than three-fourths of the land in agrarian use, agriculture still retains considerable socio-economic importance. Again, this should be fully appreciated when considering the present trend of rapid urbanization that is continually reducing the area of agricultural land.

2.3 EXISTING AND POTENTIAL USES OF THE LAKE

Studies conducted since 1967 have established existing uses and indicated development potentials for the lake's natural resources. Because of its proximity to Metropolitan Manila, the resources and their use contain unique potentials for economic development. At present it is a source of industrial cooling water; a source of irrigation water; a source of hydroelectric power; a transport route for oil products and the lakeshore dwellers; a source of snails for duck feed; a venue for recreation and most notably a source of fish supply. The lake is intended in the future to be a main source of domestic water supply for the region especially Metropolitan Manila.

2.3.1 FISHERIES

The fisheries of Laguna de Bay have been an outstanding economic resource from the lake since historic times, providing food for the lake basin population and the means of livelihood for approximately 17,000 fishermen residing in the various municipalities around the lake (LLDA Registration of Fishermen, 1992). In 1970, the LLDA introduced an innovation in aquaculture technology to improve fish productivity of the lake. Better known as the fishpen culture, this innovation proved to be highly profitable.

Today, the fishpen industry averages an annual yield of 6.7 metric tons/ha/cropping. The industry attracted private investors which subsequently saw the lake teeming with fishpens. With about 13,701 has. of the lake surface devoted to fishpen culture in 1994, approximately 91,809 tons of fish was produced from the lake (LLDA, 1994).

The boom in the lake fishery production has led to continuing conflict in the region. The large scale fishpen culture has threatened the economic conditions of fishermen dependent upon open water catch. Because investment in fishpen culture requires considerable amount of capitalization, the marginal fishermen could not afford to establish their own fishpens. Traditional fishermen are battling for fishing grounds in the open water and this has been a major social conflict since the early eighties.

Aside from lake occupancy, the fishermen are also demanding for the removal of the fishpen structures which, according to them, are affecting water circulation and contributing to water pollution. This affects the distribution of nutrients such as nitrate and phosphate which are essential for the production of natural food in the lake.

Fishpen ownership is also an issue in the fisheries of Laguna de Bay. Because fishpen industry has proven to be highly profitable, the small fishermen question the legitimacy of fishpen ownership, thereby demanding for proper allocation and distribution of the aquaculture area to include fishermen through cooperatives. To date, there are 62 fishpens owned by fishermen cooperatives, equivalent to about 2,382 has.; 187 structures owned by corporations or about 10,485 has. and 104 fishpens belong to individual-owners or an equivalent area of about 833 has (LLDA, 1994).

2.3.2 TRANSPORT ROUTE

The lake also provides a transport route for lakeshore dwellers. In 1982, there were over 4,162 motorized and non-motorized watercraft operating on the lake as a form of transport for lakeshore communities which are not easily accessible by road (Centeno, 1982). In addition, 19 barges are using the lake for barging an average of 73,078 US bbls. of oil and oil products daily.

Residents from Talim Island travel by boat to various destinations around the lake. The major routes, however, are the wharfs in Binangonan and Cardona in Rizal province and Calamba and Sta. Rosa in Laguna.

2.3.3 RESERVOIR FOR FLOODWATER

The increased magnitude and uncontrolled flood in Metropolitan Manila paved the way for the construction of the Manggahan Floodway. This floodway was constructed to connect Marikina River with the Laguna de Bay with the objective of easing up and mitigating the floods in Metropolitan Manila, thus making the lake as a reservoir of flood waters.

As designed, the Manggahan Floodway has an estimated capacity of 2,400 m³/sec although the actual volume capacity during floods is only 2,000 m³/sec which is then diverted to the lake. With the length of about 9 km. from the Manggahan Floodway gate to the lake, it usually takes 8 hours to return to its normal level. These estimates serves to contain the volume of water being poured down by both the upper and lower Marikina River which has a capacity of 800 m³ and 2,000 m³ respectively.

As a complement to this floodway, the Napindan Hydraulic Control System (NHCS) was constructed in 1983 not only to regulate saline water intrusion from Manila Bay but also control the inflow of polluted water to the lake.

Simultaneous operation of these structures lessen the flood flow conditions in Metropolitan Manila by diverting peak flows of the Marikina River for temporary storage into Laguna Lake (Lee and Adan, 1976). The construction of these structures has made the lake a floodwater reservoir (Francisco 1985).

2.3.4 POWER GENERATION

A pump storage hydroelectric power station has been operating in Kalayaan, Laguna, about 60 kms. southeast of Manila. The plant exploits the head between the Laguna de Bay and the existing Caliraya Reservoir (a man-made lake near Kalayaan) which currently produces 300 megawatts of electricity. The Kalayaan plant have an expected generating capacity of 3,000 megawatts.

2.3.5 RECREATION

The lake provides a source for recreational activities not only among lakeshore dwellers but also among tourists local and foreigners alike, although not on a commercial scale.

However, recent findings show that water quality of the lake has made a significant flux that the water quality has deteriorated. According to the Environmental Management Bureau (EMB) classification of surface water, Class C is only proper to boating, sailing and the like activities.

2.3.6 WASTE SINK

The lake serves as a huge sink for waste coming from domestic sources (households and service sectors); non-point sources (surface runoff from urban areas, croplands and forest lands); industries, livestock and poultry production, fishery activities and Pasig River and Manggahan Floodway inflow.

The actual population of the Laguna de Bay region in 1990 was placed at 8.3 million. Seventy six percent (76%) resides in non lakeshore municipalities while twenty four percent (24%) are located in lakeshore areas. Almost 80% of the population resides in urbanized areas of the region. Due to increasing demand for residential areas, more subdivisions mushroomed in the region. By 1989, around 1,898 subdivisions were developed, most of these are concentrated in the West bay.

It was estimated that 60% of the total households discharge their solid and liquid wastes directly into the tributary rivers of the lake, thus, domestic sources account for 70% of the organic wastes discharged into the lake and for the highly pollutive leachate from solid wastes.

For croplands, average fertilizer application is estimated as follows: palay - 72 kg. (irrigated), 48 kg. (non-irrigated) and corn - 89 kg. Of this, 20% is estimated to end up in the lake. With the completion of the irrigation projects in the region, pollution from croplands is expected to increase.

Sedimentation of the lake is attributed to the continuing soil erosion due to deforestation and also to poor agricultural practices within the basin. The sedimentation rate is estimated at 1.5 million m³/year (SOGREAH 1991) with the Marikina River as a major contributor of silt to the lake through the Manggahan Floodway.

There are 1481 (LLDA 1994) industries in the lake today. Of these, 63% undertake pollution control measures or have wastewater treatment facilities. In 1989, a survey by URSI revealed that 41% of the industries located in the region discharged increasing number of toxic and hazardous substances.

Artificial feeds such as rice bran, bread crumbs, ice cream cones also contribute to pollution in the lake. From 35,000 has. of fishpen in 1983 to 10,701 has. to date, all of them are suspected of using artificial feeds, one can just imagine the pollutants generated.

Pollution also comes from the backflow of Pasig River bringing 930 tons or almost 20% of the total annual pollution Nitrogen load to the lake while Phosphorus was estimated to be 420 tons (MEIP 1994).

2.3.7 WATER SUPPLY

A basic need everywhere, providing water supply is a problem in a country with an expanding economy and a growing population. The massive population expansion, aggravated by uncontrolled urbanization, placed heavy demands on domestic water supply.

In the region, groundwater is a common source of water supply, but its reliability to sustain increasing demand has not been established. In fact, receding groundwater level brought about by excessive extraction (overpumping) has been found to be an incipient problem in some municipalities in the region (LLDA '78). Also, there is an increasing evidence of groundwater contamination (from leachate of dumpsites, septic tanks, etc.) thus making it imperative to use the lake as a domestic water supply source. The potential volume of water that can be abstracted from the lake for domestic use is about 161.5 million cubic meters annually. It has been programmed to be tapped as a new water source for the year 2,000. Utilizing the irrigation pumps of NIA located at Putatan, Muntinlupa, the MWSS project could provide water to Muntinlupa, Parañaque, Cavite City and nearby municipalities. Approximately, 1.6 million people (1995) will be served by the said project initially.

At present, the MWSS project to supply for domestic water requirements of Taytay, Angono, Binangonan and Cardona in Rizal province is underway. Called the Rizal Province Water Supply Improvement Project, it is expected to be fully operational by August of 1996. With a capacity of 1,100 liters per second, it is being constructed from a Protocol Loan of 54 million French Francs. Once the

project is implemented, it is projected that about 36,000 m³/day would be abstracted. This abstraction would result in a drop in water level of about 0.04 mm per day representing about 28% of the average annual inflow of water in the lake estimated at about 4.6 billion m³/year.

2.3.8 IRRIGATION

The existence of extensive inland areas around the lake allows for another beneficial use of lakewater. The lake has sufficient water for the year round irrigation of farmlands in 28 lakeshore towns as well as for some areas of adjacent Quezon and Cavite provinces. The potential area that can be irrigated using lakewater is 102,456 has. Through irrigation, crop production will be intensified in the region to more than two crops per year and will facilitate the attainment of self sufficiency in rice production. It is estimated that about 230 million m³ /year will be abstracted from the lake to irrigate all targeted agricultural areas.

It should be noted, however, that with the present trend of urbanization, agricultural areas which are targeted for irrigation are now rapidly converted into industrial land uses. Such trends in land development should be reviewed and adequate policies should be formulated and implemented to rationalize development directions in view of investments already made in certain irrigation projects.

2.3.9 INDUSTRIAL COOLING WATER

Aside from the demands for domestic water supply, the lake is also being used as a source of cooling water for the industries around the lakeshores. More than 2.04 billion cubic meters of lakewater is used annually for industrial cooling. Seventy percent (70%) is used by the power generating plants of the National Power Corporation (Malaya TPP, Sucat TPP and Kalayaan HPP), four percent (4%) by the Phil. Petroleum Corporation refinery in Pililla, Rizal and the rest by some industries surrounding the lake.

Cooling water is recycled back into the lake taking with it some pollutants which could be considered negligible, although, thermal pollution results in the process. Thermal pollution measurement is reported to result in about 2°C rise in the temperature in areas near the discharge points of the thermal power plants.

3.0 INSTITUTIONS AND INSTITUTIONAL ARRANGEMENTS IN MANAGING LAGUNA DE BAY

3.1 EXISTING INSTITUTIONAL ARRANGEMENTS IN LAGUNA DE BAY

In view of the imperatives for socio-economic development and in recognition of the potential of the lake as a resource, the Philippine government enacted in 1966 a law that would control the use of Laguna de Bay. Republic Act 4850 and its subsequent amendments provide the broad policy and management framework for the once unregulated and underutilized resources of the lake. To understand the institutional arrangements and the policy decision-making process in Laguna de Bay, it is essential to examine the origin and implications of the Act.

3.1.1 THE EVOLUTION OF A LAKE MANAGEMENT AGENCY: A HISTORICAL TREATMENT

The problems brought about by rapid urbanization, pollution from industrialization and a growing population, have led to the evolution of a resource management institutional framework for Laguna de Bay. In the early 1960s because of perceived threats from the rapidly changing character of the lake region, political leaders in the area sought the enactment of legislation to control and manage the resources of the lake. The specific problems perceived were socio-economic in nature and dealt mainly with the observed decrease in fish yield; the proliferation of industries along the lakeshores; deteriorating water quality as a result of pollution and algal bloom; poor living standards and a rapidly increasing population growth. In view of these problems, and through the initiative of former Congressmen Frisco F. San Juan (Author) and Wenceslao Rancap Lagumbay (Co-Author), a Bill was presented to the House of Representatives of the Philippine Congress. During deliberations, the proposed Bill gained favorable acceptance. This motivated Senators Helena Benitez and Lorenzo Sumulong to present the Bill to the Philippine Senate. In the Senate, there were practically no arguments presented against the Bill. Hence, on 18 July 1966, through a concerted effort, the Bill was finally approved by the Philippine Congress as Republic Act 4850, thereby creating the Laguna Lake Development Authority (LLDA), (Francisco, 1985).

The move to seek the enactment of R.A. 4850 was precisely intended to create an instrument to facilitate rational utilization of the lake resources. It was perceived that the creation of an "Authority" would facilitate cooperation and coordination and a pooling of resources among national government agencies, local governments and the private sector. In response to the problems in the region, as well as national goals for economic development, the LLDA was created. By virtue of R.A. 4850, a policy was declared which gave LLDA the task to:

"... lead, promote and accelerate the development and balanced growth of the Laguna de Bay area and the surrounding provinces, cities and towns hereinafter referred to as the region, within the context of the national plans and policies for social and economic development."

(Section 1, R.A. 4850, 1966.)

The LLDA was created as a quasi-government agency with powers and functions to act as a corporation. Thus, on 06 October 1969, the first stockholders meeting was held with the subsequent election of its Board of Directors and the subsequent election of the Rizal Provincial Governor, Isidro Rodriguez, as Chairman of the Board (LLDA Annual Report, 1980).

The Act conferred upon LLDA the jurisdiction to execute its powers and functions in the Laguna de Bay region. As defined by the Act, the region comprised the provinces of Rizal and Laguna including San Pablo City and the cities of Manila, Pasay, Quezon and Caloocan. Through this empowering legislation, LLDA established the legal and administrative bases of its operation and slowly developed its technical capabilities. On 16 March 1970, LLDA took over the function as Cooperating Agency for the "UNDP Feasibility Survey for the Hydraulic Control of Laguna de Bay Complex and Related Development Activities" (LLDA Annual Report, 1980).

The findings of the UNDP paved the way towards a more responsible role for LLDA in terms of planning and development in the region. The study recommended further evaluation of vital programs which included lake fishery, lake water quality, water supply, industrial estate planning and irrigation. Among the major issues that justified the need for in-depth studies of the lake were those related to water quality hazards which hindered utilization of the lake's resources for development purposes. Although these studies mainly outlined specific technical matters, the recommendations explicitly considered institutional matters.

In 1968, while the UNDP studies were being initiated, a growing concern for environmental awareness had been developing amongst leaders and politicians in the country. In August 1969, the Seventh Congress of the Republic of the Philippines in their first session endorsed and approved a House Joint Resolution which sought the establishment of a comprehensive system of "environmental planning" as one way through which social and economic policies enunciated in Congress may be achieved.

Two years later, on 14 October 1971, in accordance with the policies on Environmental Planning, Senator Helena Benitez introduced in the Philippine Senate a proposal to amend Republic Act 4850. The proposed amendment sought to add in the "declaration of policy, a statement that:

"It shall also be the policy of the Authority (LLDA) to carry out the development of the Laguna Lake area with due regard and adequate provisions in all the developmental projects within the area for environmental management and control, preservation of the quality of human life and ecological systems and the prevention of undue ecological disturbance, deterioration and pollution."

(Senate Paper No. 561; 1971: Seventh Congress, Third Special Session.)

The move to amend R.A. 4850 was finally realized on 17 October, 1975, by the issuance of Presidential Decree (PD) 813 based on the following considerations:

1. the urban expansion of Metro Manila, combined with the current and intended uses of the lake, had created deep concern among the

government and the general public over the impact of development on the Laguna de Bay and its tributaries;

2. the continuing deterioration of the lake induced by inflow of polluted water from Pasig River and industrial, domestic and agricultural wastes from urbanizing and built-up areas around the lake;
3. the floods in Metro Manila and the lakeshore towns were being influenced by the hydraulic system of Laguna de Bay and its river systems;
4. the deficiencies and ambiguities in the provisions of R.A. 4850 were found to impede the accomplishment of the Authority's goals; and
5. there were other government agencies exercising varying degrees of jurisdiction and control of the lake, resulting in problems of coordination, planning and management, thereby creating a constraint on the Authority to plan and implement its objectives.

On 16 December 1983, despite PD 813 which had already strengthened the charter for lake management, the President issued Executive Order No.927. The national government felt the need to further improve the institutional capabilities of LLDA to rationalize the allocation of resources in response to the demands of various users. The Executive Order further defined certain functions and granted additional powers to LLDA. This more significantly included the Authority to modify and improve the organizational structure, the extension of the scope of jurisdiction and the power to issue standards, rules and regulations pertaining to aspects of pollution control. (The preceding discussions were based from Francisco, 1985).

3.1.2 THE POLICY AND LEGAL FRAMEWORK

For Laguna de Bay, the legal rules for managing the resources evolved in three major stages:

The first stage was the creation of a lake management agency through the enactment of R.A. 4850. The Act was passed to rationalize the uncontrolled and underutilized resources which was threatened by the spillover effects of urbanization, industrial pollution and a growing population. The Act provided the necessary decision-making process at the regional level to facilitate cooperation and coordination among different sectors. The Laguna Lake Development Authority was created by this Act to promote and accelerate the development and balanced growth of the Laguna de Bay area.

The second stage was the proclamation of PD 813 which sought to amend R.A. 4850. The Presidential Decree was issued to remedy the deficiencies and ambiguities in the previous Act which were found to impede the accomplishment of the objectives defined for the LLDA. This amending Decree provided a better-defined statutory system for the decision-making process. The power to issue necessary permits or clearances in the use of the lake, as well as the power to

institute necessary legal proceedings, was defined at this level for the LLDA to implement. As an expression of the central government's basic policies, the amendment defined the relationship of LLDA with the NEDA and other central government agencies. This reinforced the integration of the LLDA with the central decision-making body in government. The third stage was the issuance of Executive Order No. 927 which further defined certain functions and specified additional powers for the LLDA. The Executive Order provided the LLDA with the authority to modify and improve its structure. (This was, however, not realized up to the present administration). It also extended the scope of its jurisdiction. A strengthened statutory system was defined which granted the LLDA the power to issue standards, rules and regulations pertaining to specific aspects of pollution control.

Within the provisions of the three statutory stages mentioned above, there are several institutional mechanisms which specifically define the limits of policy decision-making by LLDA. The significant role given to the President and the strong influence of the National Economic and Development Authority on the policy decision-making process in Laguna de Bay clearly indicate these limits. A review of the provisions of the legislation, particularly PD 813, explicitly shows the strict reference to the need for approval of NEDA and other central government agencies, and/or the President on practically all actions undertaken by the LLDA.

More recently, through Executive Order 149 (28 December 1993) the administrative supervision over LLDA was transferred to the Department of Environment and Natural Resources. This recent move remains an institutional question in terms of its constitutionality.

The essential provisions of the policy and Legal Mandates of LLDA are presented below.

3.1.2.1 COMPREHENSIVE SURVEY AND DEVELOPMENT PLANNING

The amending legal framework (PD 813) specifies for the LLDA to undertake a comprehensive survey of the physical and natural resources and potential of the region, particularly the socio-economic conditions, the development of resources and the regional problems. On the basis of this survey, the Authority is compelled to draft a comprehensive and detailed plan with the objective of promoting the region's rapid socio-economic development. The implementation of such a plan as required by PD 813, is subject to the approval of the National Economic Development Authority (NEDA). Furthermore, the implementation of plans relating to fisheries are specifically subject to the prior consensus of the Bureau of Fisheries and Aquatic Resources (BFAR) in order to make it consistent with the national fisheries plan (P.D. 813 Section 2(a), 1975).

LLDA was, however, not successful in this respect due to inherent institutional constraints such as lack of resources and trained personnel to undertake regional planning.

a. Coordination of Plans

The legal framework bestowed upon LLDA the power to approve or disapprove all proposals and development activities within the lake region. Relating to the approval of proposals, LLDA is granted the authority to issue necessary permits or clearances, provided such proposals are in consonance with those of the Authority and provided that these will not contribute to the unmanageable pollution of Laguna de Bay. In the implementation of this policy, LLDA is empowered to exact fees from proponents for the processing of such plans, programmes and projects. Furthermore, the LLDA is granted the right to institute necessary legal proceedings against those who implement any project/plan/program in the region without the necessary clearance from the Authority. However, for disapproved proposals, the LLDA may refer the proponents to appeal to NEDA within fifteen days from its decision. These mechanisms were intended to facilitate the coordination of plans and procedures, with respect to Laguna de Bay, between the LLDA, the national and local government offices and public corporations for the purpose of drawing up a Laguna de Bay development plan. For integration, this development plan becomes binding upon all parties concerned upon approval by the NEDA Board. (P.D. 813 section 2(d), 1975).

In respect to the above, there are overlapping functions and lack of coordination with the permit system of the DENR, DTI and the HLURB and the Local Government Units.

b. Infrastructure Financing

When so required within the context of the development plans and programs in the region, the LLDA is compelled to plan, finance and/or undertake infrastructure projects such as river, flood and tidal control works, waste water and sewerage works, water supply, roads, port works, irrigation, housing and related works. For any project financed wholly or in part by the LLDA, it is authorized to collect reasonable fees and tolls from beneficiaries in order to recover costs of construction, operation and maintenance of the project. However, the amounts of such fees and tolls are subject to the approval of the NEDA Board. Infrastructure projects which are classified by NEDA as "social overhead capital projects" can be undertaken by the Authority with financial assistance from central government. However, such projects shall be subjected to such terms and conditions that may be imposed by the government, upon the recommendation of the NEDA Board. (P.D. 813 section 2(f), 1975).

The major infrastructure projects so far completed are the Manggahan Floodway and the Napindan Hydraulic Control Structure. However, it is sad to note that LLDA did not play a major role in these projects. The irrigation projects of NIA and the power projects of NAPOCOR should also have yielded some income to LLDA in terms of user fees due from water derived from the lake. However, up to this point, such fees from abstracting lake waters have yet to be completely agreed upon through a Memorandum of Agreement.

c. Lake Fisheries

For the purpose of effectively regulating and monitoring activities in Laguna de Bay, the Authority was granted exclusive jurisdiction to issue a new permit for the use of lake waters for any project or activities in or affecting the lake including navigation, construction and operation of fish pens, fish enclosures, fish corrals and the like. To achieve this purpose, it can impose necessary safeguards for lake quality control and management and to collect necessary fees for said activities and projects. Fees collected for fisheries may be shared between the Authority, other government agencies and local government authorities in such proportion as the President may determine. Subject to Presidential approval, the Authority was also empowered to promulgate rules and regulations which govern fisheries development activities in Laguna de Bay. (P.D. 813 section 3(k), 1975).

While the above provision has been exercised, the recent enactment of the New Local Government Code (RA 7160) created some degree of confusion as to the authority of Local Government Units over municipal waters and fishing grounds. The Central government, the legislature and ultimately the Supreme Court have yet to act on the issue to resolve such legal impasse.

d. Water Quality Standards

The legal framework specifies that LLDA should act in coordination with existing government agencies in establishing water quality standards for industrial, agricultural and municipal waste discharges. These standards are to be enforced in cooperation with said existing agencies, or they can be separately pursued by the Authority. Penalty actions are provided elsewhere in the Act for the enforcement of such standards. Any conflict on the appropriate water quality standard to be enforced is to be resolved through the NEDA Board (P.D. 813 section 3(n), 1975).

So far LLDA has been cooperating with the DENR through the EMB along this line. The LLDA has yet to develop its own water quality standards for the lake in view of its unique characteristics and its huge assimilative capacity. While coordination exist, it should be clear with DENR regional offices that LLDA is the Authority in the Lake Region.

e. Financial/Managerial Control

The key influence of the legal framework is embodied in the provisions of Section 25, PD 813. For budgetary control, the Authority has to submit audited financial statements to NEDA within sixty days after the close of the fiscal year. For management control, the NEDA may at its own instance, initiate a management audit of the authority when there are reasonable grounds to believe that the Authority has been mismanaged. The NEDA reserves the right to take appropriate measures as may be required should the audit indicate mismanagement. (P.D. 813 section 25, 1975).

This provision was never observed, however, the necessary administrative action has been traditionally exercised by the DBM.

f. Organizational Structure

The legal framework also defines the structure at the organizational level. Executive Order 927 allowed the Authority to modify its structure, providing for the creation of the position of Deputy General Manager; upgrading the existing divisions into departments; and, regrouping departments into offices. More significantly, the composition of the Board of Directors for the Authority has been increased to ten members consisting: a representative of the office of the President; the Secretary of Economic Planning; the Secretary of Natural Resources; the Secretary of Trade and Industry; a representative of Laguna Province; a representative of Rizal Province; a representative of the Governor of the Metro Manila Commission; the President of the Laguna Lake Federation of Mayors Inc.; a representative of the private investors; and the General Manager of the Laguna Lake Development Authority. The General Manager for LLDA and the representative of the private investors are both appointed by the President. (E.O. No. 927 section (1) and (5), 1983).

Organizational restructuring has yet to be realized. Since its creation in 1969, LLDA has remained with its organizational framework, albeit with limited changes. Due to the magnitude and scope of its functions and the expectations of the general public for it to accomplish its objectives, it is important that central government should act to upgrade and strengthen the organizational capability of LLDA.

g. Scope of Jurisdiction

To effectively regulate and monitor activities in the Laguna de Bay region, the Authority is granted exclusive jurisdiction to issue permits for the use of all surface water for any project or activities affecting the said region. For clarity of purpose, it was defined that the term "Laguna de Bay Region" shall refer to the Provinces of Rizal and Laguna; the cities of San Pablo, Pasay, Caloocan, Quezon, Manila and Tagaytay; the towns of Silang and Carmona in Cavite Province; the town of Lucban in Quezon Province; and the towns of Marikina, Pasig, Taguig, Muntinlupa and Pateros in Metro Manila. (E.O. No. 927 section (2), 1983).

While the jurisdiction of LLDA is clearly defined, it lacks the recognition it deserves from the LGUs, regional offices of the Central government as well as national agencies who should recognize it as special agency in charge of a special sub-region essential to national development.

3.1.3 THE ORGANIZATIONAL STRUCTURE AND OPERATIONS OF LLDA

While policies are expressed and relationships are defined by the legal framework, the organizational structure gives meaning and substance to those policies and relationships. In effect, it puts institutions into form. The institutionalization of the legal and policy framework is characterized by the functional and structural nature of the policy-decision making system at the organizational level within LLDA.

To give essence and substance to the mandate of its empowering Act, the LLDA sought a lead role in the region. Taking off from the findings and recommendations of the UNDP studies in Laguna de Bay, the LLDA, in cooperation with various international agencies, undertook in-depth studies on lake fisheries, water quality, water supply, industrial estate planning and irrigation. These comprehensive studies resulted in the formulation of various programs and projects (Fig. 3.01).

3.1.3.1 The LLDA Board of Directors

Structurally, the LLDA is directed by a Board of Directors (Table 3.01) which sets the policies for the operational level. The Board of Directors acts to exercise the corporate powers vested in the Authority. One of the major functions of the Board of Directors, as set forth in the legal framework, is

"to formulate, prescribe, amend and repeal rules and regulations to govern the conduct of business of the Authority"

(P.D. 813, Section 25.A(a), 1975)

Based upon this function, the LLDA formulated rules and regulations for the management and use of resources in Laguna de Bay. A major example of policy which have been formulated and implemented is the "Rules and Regulations Governing the Construction and Operation of Fishpens or Fish Enclosures in Laguna de Bay" issued in 1976 and in 1983 the Lake Fisheries Zoning and Management Plan (ZOMAP). To ensure the implementation of these rules and regulations, the LLDA can enlist the assistance of the judicial system through its corporate powers. Penal provisions have been provided to give legal status to the organizational policies. Likewise, the organizational set-up of LLDA includes a Legal Division which is charged with operationalizing the judicial process.

One of the striking aspects of the LLDA Board is the apparent dominance of central government representation. Of the ten members that constitute the Board, four members are direct representatives of central government agencies. Another two members indirectly represent central government. The General Manager of LLDA and the representative of private investors, are both subject to Presidential appointment. The remaining four members are representatives of the local governments in the region. Apart from these local government representatives, who are indirectly elected by the public, there is no representation for interest groups from the region. The absence of such representation in the policy-decision making process neglects one of the essential component in institutional arrangements for resource management.

3.1.3.2 The LLDA Divisions

To carry out its activities, the Authority was originally organized into seven divisions under the direct supervision of a General Manager and assisted by an Assistant General Manager. These divisions are: the Administrative Division, Legal Division, Finance Division, Project Management Division, Engineering and Construction Division, Environmental Protection Division and the Planning

and Project Development Division. In 1990, the Corporate Management Services Office, the Lake Management Division and the Community Development Division were created thereby modifying the organizational structure to address the problems in the fishpen industry and the lakeshore communities. **Figure 3.2** presents the existing organizational structure.

The agency should have been reorganized. However, this did not materialize due to central government inaction. More recently, a new proposal is in the process of being finalized for submission to and approval by the Office of the President.

3.1.4 OTHER CENTRAL GOVERNMENT AGENCIES IN THE LAKE REGION

In Laguna de Bay, central government agencies also play an important role in the policy-decision making process. Although the influence of these agencies is indirect, their role has been explicitly or implicitly defined in the legal framework. The National Economic Development Authority (NEDA) and the DENR are the most significant government agencies which strongly influence the policy-decision making process in Laguna de Bay.

Other central government agencies involved in the management of the lake's resources mainly assist or advise the Authority in its activities. **Figure 3.3** shows the various agencies operating in the lake in various areas of concerns and in varying functional activities.

3.1.5 PUBLIC INVOLVEMENT AND INTEREST GROUPS

It has been pointed out that representation of legitimate interest groups in the policy-decision making process is an important social value in institutional arrangements. Furthermore, a criterion for an "ideal" arrangement is one that would provide legislative and institutional mechanisms not only to permit but to ensure public access and involvement.

In the lake region, the only vocal sectors are the fishermen and farmers who are relatively better organized. Their concerns are primarily on lake fisheries and inundation of agricultural areas. These concerns are largely socio-economic and partly environmental. More recently a growing concern on environmental issues have shown an increasing participation from communities affected by industrial pollution. Such involvement are, however, very limited.

The lake management agency is perceived as a non-political entity in the region. It is not an arena of political activity to most people. Generally, views from the public are aired through the existing local government units, such as the Municipal Council or the Provincial Board. The absence of a formal relationship between LLDA planning units and local government planning units accounts for low participation of various groups of the population in the policy-decision making process of LLDA. An institutional mechanism should therefore be developed to allow public input in the policy-decision making process (Francisco, 1985).

In the lake, the impetus for public involvement comes from public agencies, especially from professionals within these agencies who are trained to perceive and anticipate changes that may take place. Depending on the political significance of any activity, professionals normally press the need to include situational analysis, needs analysis, socio-economic surveys, perception assessment, etc. in their recommendations. Results of consultative discussions are then reported to decision-makers through the operational level of the decision hierarchy. Depending on the strength of recommendations as well as the political significance of the proposal, appropriate policy changes are instituted (Francisco, 1985).

3.2 INSTITUTIONAL ISSUES AND CONCERNS

3.2.1 NATIONAL VS. REGIONAL VS. MUNICIPAL CONCERNS

In general, the resources of the lake area will be managed within the concept of an integrated lake basin approach to resource management. The ultimate objective is to ensure that social and economic development activities put primary consideration on the conservation and protection of the lake ecosystems and environmental conditions of the whole lake basin.

However, in the process of development and resource utilization, there are conflicting interests that come to play within government between and among the interest of the central government, the regional interest, and the local municipal interest. This could be illustrated using three examples below.

3.2.1.1 Dominant Use Policy

According to government policy, the lake is programmed to be the source of domestic water supply in the near future not only for the regional populace but also for Metropolitan Manila where the seat of central government is located. However, if we are to listen to the fishermen population around the lake, it should be for open lake fisheries and that it should be free from fishpen structures. On the other hand, certain municipal governments would insist that the fishpens remain because they provide income to the local government through their share in fishpen fees.

3.2.1.2 Flood Control

In order to protect Metropolitan Manila from flooding, the Manggahan Floodway was constructed to divert floodwaters from the Marikina River into the lake thereby protecting the residents of communities around the Pasig River which include Malacañang Palace. Such diversion of floodwaters would result in the inundation of lakeshore municipalities in Laguna de Bay causing damage to agricultural lands, as well as health and properties of the regional population.

3.2.1.3 Solid Waste Management

Garbage disposal is one of the biggest problems in Metropolitan Manila today. Ironically, it is also one of the growing concerns in the Laguna de Bay Region. The absence of space for additional dumpsites in the Metropolis led to the construction of the San Mateo Sanitary Landfill in Rizal and the Carmona Sanitary Landfill in Cavite. Both sites are within the lake watershed basin, however, such dumpsites are not intended for the lake region populace. At present, many municipalities suffer from lack of solid waste disposal system and the solution to the problem requires a regional approach. Unfortunately, no municipality would at their own expense accept the garbage of other municipalities considering the detrimental effects to health and environment. Yet the sanitary landfills in San Mateo and Carmona are proof of how the interest of the region is sacrificed for Metro Manilans. At what social and environmental cost this would take and at whose expense?

3.2.2 DELINEATION OF POWER, AUTHORITY, RESPONSIBILITY AND JURISDICTION

Institutional problems associated with the confusion over the delineation of power, authority, responsibility and jurisdiction can be seen as both functional and territorial.

3.2.2.1 Functional

Several government agencies have some degree of jurisdiction in the Laguna de Bay basin. Some agencies include the basin in the scope of their activities and there is complexity of roles among agencies. In many instances, there is overlapping or duplication of functions while in some cases there is fragmentation and virtually lack of coordination. For example, there is too much overlapping in terms of planning and regulatory functions yet there is limited coordination in the enforcement of laws.

The overlapping responsibilities of major agencies can be seen in Fig. 3.3 (Malayang 1993) as well as in Fig. 3.4 (URSI 1993). In terms of functional responsibilities, there is confusion in development planning, enforcement of laws as well as setting of environmental standards. Likewise, coordination problems exist in terms of project implementation such as in infrastructure development, fishery resources development, water resources, socio-economic development and environmental management.

Certainly, within such a maze of overlapping roles and responsibilities there is likelihood of confusion and hiding from responsibility. When there is lack of caring, for whatever reason, these conditions are characteristic of both agencies and individuals. However, within the interest of these same agencies and personnel, there also lies enormous opportunities, although one must caution that recognition of potential may lead, also to competition for resources. The key to developing such opportunities seems to be meaningful and balance participation. If agencies and organizations feel that they have an active role in decision making, the realization of mutual gain can turn confusion and irresponsible

attitudes into a cooperative application of their shared resources. Similarly, recognizing that opportunity for personnel achievement lies within shared interest provide a powerful stimulus to develop a cohesive human resources.

3.2.2.2 Territorial

The above confusion pertaining to power, authority, responsibility and jurisdiction is also affected by territorial or spatial factors. For one thing, the lake is within various political jurisdictions. Foremost is the fact that it is a "special sub-region" in Region IV, however, it is not treated as such by the regional offices of national government agencies. Its concerns are treated either as a provincial concern of Rizal or Laguna province but never as a lake region.

Secondly, the topographical basin boundaries of the lake transcends several provinces which include also certain towns in Batangas, Cavite, Quezon and Metro Manila. While there are upstream and downstream implications of socio-economic activities in certain localities, these are not addressed as a lake region/lake basin concern but as local municipal or provincial concern by people who have neither regard nor accountability on the impacts of certain decisions on the lake.

A third concern is the lack of perception by the regional population on the ecological principles of managing the lake and its watershed basin. The basic fact that everything in the watershed basin drains into the lake is not recognized by people and decision-makers when they disregard the environmental implications of human activities. The denudation of forest, the inadequately planned construction of subdivisions, the indiscriminate dumping of garbage in open lots or rivers and many others create pressure on the ecology of the lake and its watershed.

From the foregoing issues raised, it is therefore essential that institutional arrangements which clearly define power, authority, responsibility and jurisdiction over certain functions and territories be developed. Where there are inconsistencies and confusion, these should be adequately and appropriately addressed. Central to this would be the role of LLDA as the agency mandated to manage Laguna de Bay. However, extremely essential to this issue is how government agencies, central or local regard the LLDA as the coordinating agency that would orchestrate and link all activities in managing the Laguna de Bay and its watershed.

3.2.3 SECTORAL CONFLICTS OF INTEREST

A major part of institutional problems in Laguna de Bay arise out of sectoral conflicts and interest pertaining to access to and allocation of regional resources. Because the lake has the character of a common property resource, it can accommodate multiple uses which are at times conflicting and competing. For example, as earlier pointed out, there is a conflict between small fishermen engaged in open lake fishing with those of the fishpen operators who have now occupied a large portion of their traditional fishing ground. Likewise, there is competition for space in the lake among groups of fishermen because of the limited space and increasing pressure brought about by their growing population.

Another issue of conflict is the dominant use of the lake which according to central government should be for domestic water supply while the fishermen and fishpen operators want it to be for fisheries.

Such sectoral conflicts and interests should be properly studied so that appropriate policy instruments and institutional arrangements are developed to properly and equitably allocate and provide access to regional resources.

3.2.4 PUBLIC PARTICIPATION IN DECISION-MAKING

The process of decision-making in Laguna de Bay is characterized by the inadequacy of public participation in the LLDA. While the composition of the Board of Directors include both local and central government, it cannot be safely assured that there is adequate public participation. It has always been pointed out that there should be sectoral representation among fishermen, farmers, industry, and others within the LLDA Board.

Moreover, there is a common perception among the basin populace that there is very little public participation due to a limited consultation process. As such policy decisions are perceived to be ineffective because these are not seen to represent a shared vision or common purpose of the various stakeholders in the lake region. These issues need to be addressed to the highest levels of the decision hierarchy both in the legislative and executive branches of government.

3.2.5 ORGANIZATIONAL CONSTRAINTS OF LLDA

While LLDA was mandated through R.A. 4850 to manage the development of the Laguna de Bay Region, it has inherent organizational constraints which need to be addressed. These institutional constraints which limit the responsiveness of LLDA as a regional development agency are presented below.

3.2.5.1 Organizational Strengthening and Restructuring

This is long overdue. The current organizational structure of LLDA is no longer responsive to meet its enormous task. Since its creation in 1969 as an office, the agency was never reorganized except for minor modification in staffing pattern. It operates with very limited manpower due to frequent turnover of personnel which is affected by the relatively low compensation and limited incentives. Position classification of its technical staff has to be upgraded and compensation schemes must be improved to make the agency a more attractive employer. A comprehensive reorganization program should be finalized to address this issue.

3.2.5.2 Frequent Changes in Top Management

For the past 25 years since it was organized, the LLDA has had ten (10) General Managers. Simply put, there was on the average a change of administration every

2 1/2 years. The frequent change in the top management play a vital role in the operation of LLDA. Such a change in management have also been to a large extent influenced by changes in the Presidency of the country. For every change in the country's top leadership, there is an automatic change in LLDA management since this is a politically appointed office. If this trend is not corrected (not only in LLDA but in many government agencies), there will never be a continuity of efforts in the management of the Laguna de Bay Region.

Neophytes appointed to LLDA would normally require about two (2) years to learn the ropes. But more often than not, General Managers would impose on their views without consideration of previous plans and programs. By the time they get to appreciate the issues and match these with their intentions, they are already on their way out for a change to a new administration.

Moreover, the sad part is the coterie of advisers and cordon sanitaire that normally accompany every change in LLDA management. Many of the original and technically trained senior staff get boxed out in the decision-making process where policy decision more often than not are made with very limited or inappropriate technical bases. This brings about failure in policy implementation and frustration among senior personnel. The worst effect would be the exodus of such trained personnel for whom the government have spent time and resources to educate and prepare for such technical expertise.

Furthermore, because such political appointees lack the appropriate technical background and foresight, discontinuity of programs and misguided planning normally result in overspending, overspread deployment of resources (due to politicking and accommodation of proteges) and lack of focus or attention to strategic issues.

3.2.5.3 Lack of National Government Financial Subsidy

While the LLDA has a corporate character, its revenues are not adequate to support its social overhead projects. Revenues from regulatory functions are not also adequate to support its environmental quality monitoring efforts. Socio-economic development efforts, such as community organizing, public information, education and motivation campaign for environmental awareness, river clearing operations, cooperatives development are activities that require financial resources which LLDA has been subsidizing on its own in the past two decades. National government subsidy is essential for LLDA to meet its social commitments and developmental objectives.

3.2.5.4 Equipment Upgrading

There is a need for extensive replacement and rehabilitation of laboratory and field equipment and facilities in order for LLDA to effectively undertake its monitoring activities as part of its regulatory functions. Monitoring and surveying equipment, water crafts and transport vehicles are inadequate and laboratory equipment are outmoded, although the LLDA laboratory used to be among the best in Asia in the 1970s. Moreover, LLDA need to keep abreast with updated technology in monitoring, surveying and laboratory analysis.

It should be noted that at present LLDA does not have any watercraft to patrol the 90,000 hectares of surface water to monitor activities in the lake.

3.2.5.5 Inadequate/conflicting Quasi-judicial Authority

Related to overlapping, duplication and fragmentation amongst government agencies, LLDA is perceived to be weak in terms of its quasijudicial authority. Its ability to enforce its regulatory functions has been questioned due to conflicts with other agencies and inadequacy of its policy instruments. Moreover, this has been exacerbated by various institutional constraints such as those earlier identified.

There is a need to streamline the permits and licensing system in view of limited manpower and monitoring equipment. Considering the huge volume of water and the expanse of the lake region, it is also essential for LLDA to develop a separate environmental quality standards. Such standards should be tied up with the assimilative capacity of the lake. The regulatory function should also be reviewed to look into the appropriateness of fees, fines and penalties imposed on use of environmental resources and violations of environmental laws. This should all be tied up with a package of economic incentives and disincentives to ensure equity and efficiency in resource use as well as compliance with rules and regulations for managing the lake basin and its resources. A primary example is the appropriateness of the P5,000 administrative fine imposed by LLDA.

Another issue is the absence of police powers to ensure enforcement of rules and regulations promulgated by LLDA. While many are of the opinion that enforcement could be achieved through coordination with relevant police agencies, still many believe the LLDA should be granted with limited police powers akin to an environmental police.

Another area of concern is the formulation and approval of developmental plans. Other government agencies and LGUs prepare plans and programs without due regard to LLDA's thrusts and directions. While the R.A. 4850 provides such mandate for LLDA to approve plans and programs within the region, such was never really exercised apart from individual business proponents who are required to secure LLDA clearance as a form of approval.

In view of the foregoing, there is an important necessity to undertake a thorough review of LLDA's legal mandates and come up with a legislative agenda to correct, reinforce and/or strengthen the authority of LLDA in the region.

4.0 DEVELOPMENT ISSUES, PROBLEMS AND CONSTRAINTS

4.1 ENVIRONMENTAL CONCERNS

4.1.1 WATER QUALITY ISSUES

The water quality monitoring of Laguna de Bay and its tributaries started in 1973 as part of the Water Quality Management Program of the LLDA. Lake sampling (Figure 4.1) is done twice a month while sampling of major tributaries is done once a month (Sampling Stations). Through this regular monitoring program, the relative environmental quality of the lake and its basin is established. Various parameters are measured to provide indicators on the state of environmental quality of not only the lake itself but the level of environmental degradation in the watersheds where pollutants and nutrients originate and which are transported through surface run-off into the rivers and streams that drain into the lake. Presented below are major water quality issues and indicators which amply describe the state of the environmental quality in the lake and its watershed basin.

4.1.1.1 Eutrophication

Eutrophication is the process of aging by a body of water due to the presence of excessive nutrients which results in abundant plant growth like algae.

The cultural eutrophication of the lake happens as a result of increasing nutrient wasteloads from domestic households, expanded agricultural and livestock production, intensive fishpen operations, and soil erosion from denuded watersheds.

The level of eutrophication is normally measured by the nitrogen and phosphorus levels which determine the flow of nutrients into the lake. A review of literature on nitrogen losses and environmental quality of the lake made in 1972 (SOGREAH, 1973) revealed that nitrogen flows out directly with run-off water under conditions where the rate of nitrogen application is high; the topography is sloping; the rainfall is intense; plant cover is low; and, the soils have low rates of infiltration.

A trend analysis of data shows that the average nutrient load for the period of 1978-1984 has increased by 10.8% for nitrogen and 24% for phosphorus. Maintaining these increased rates, total inflow of nutrients to the lake today should be about 5,500 t/year Nitrogen and 1,200 t/year Phosphorus (SOGREAH, 1991).

Water quality monitoring of the lake and its tributaries shows that the major cause of increase of nutrients to the lake was mainly resulting from tremendous deterioration of the two rivers namely the San Pedro River and Morong River. In San Pedro River (between 1973 and 1983), yearly loads increased by 400% for nitrogen and 600% for phosphorus. In Morong River, such increase was a result of draining effluents from hog farms (SOGREAH, 1991).

More recently, the San Cristobal River (Calamba, Laguna) is said to have deteriorated much and is now considered as one of the major sources of nutrient loading.

Eutrophication results in the general deterioration of water quality as indicated by algal blooms and subsequent die-offs resulting to oxygen depletion and the occurrence of fishkills thereby causing a reduction in the lake's fish productivity.

4.1.1.2 Salinity

During dry months a flow reversal takes place in the Pasig River, with the result that saline and polluted water from Manila Bay and Greater Manila Area enter the lake in large quantities, causing an increase in lake salinity and rendering the lake unsuitable for water supply and irrigation. This backflow further results in an advanced settling of suspended solids due to autoflocculation as a consequence of high salinity. Such an occurrence is extremely desirable among the fishery sector. However, this conflicts with the other uses of the lake such as for drinking water and irrigation.

According to the 1990 Philippine National Standards (Revised Water Quality Criteria) for Drinking Water, the maximum permissible level of total chloride content should not exceed 250 mg/l. Generally, however, the present average concentration of chloride in the lake in 1990 is above this threshold limit (see Table 4.01).

The salinity of the lake water is at the forefront of the conflicting demand for water of the fishermen and the farmers. An adequate amount of saline water is needed for fishery but not for dry season irrigation for rice and vegetable production and for sources of drinking water. With the construction of the NHCS, the salinity of the lake can be decreased to an acceptable level for water supply if it is operated in accordance with the agreed rule curve. The problem, however, lies in the need to establish the optimum level of saline water to be allowed in order to avoid conflict with fisheries. This has to be technically determined.

4.1.1.3 Turbidity

Turbidity is a measure of the suspended particle such as silt, clay, organic matter, plankton, and microscopic organisms which in water are usually held in suspension by turbulent flow and random movement.

There are three (3) major factors which account for high turbidity. These include mineral turbidity from the streams and the lake sediments; turbidity due to high algal concentrations; and, turbidity from detritus.

Excessive turbidity interferes with the penetration of light thereby reducing photosynthesis, leading to a decrease in the primary production upon which the fish food organisms depend. As a result, fish production decreases.

TURBIDITY is generally presented as increasing in the lake since the last decade. Two main reasons explain this problem. The first is a physical reason. Because of its shallow depth, the bottom sediments of the lake can easily be resuspended in water as a result of wind induced currents. The second is a chemical reason. With

the closing of the NHCS, saline water is prevented from entering the lake. Presence of salts in water is essential to help the flocculation of colloids thus increasing sedimentation and increasing transparency of water.

Inorganic turbidity of the lake, measured as SiO_2 , is increasing rapidly in recent years. This is due to sediments transported from denuded catchment areas. Some studies (JICA, 1991) reveal that seasonal variation of turbidity is conspicuous. There are indications that turbidity is inversely correlated with rainfall, that is; when rainfall is higher, turbidity is lower, and vice versa. This seem to indicate that the turbidity of the lake is caused not much by direct river inflow containing large amounts of sediments but rather mainly by stirring up effects of water currents caused by river inflow and winds.

In 1994, the annual mean values of lake turbidity ranged from 58 to 84 mg/l SiO_2 presented a minimum average of 12 mg/l and a maximum value of 263 mg/l SiO_2 . It was also observed that the lake exhibited peak turbidity at the start of the 4th quarter of the year which could be attributed to the strong wind condition.

The annual turbidity values for all the rivers monitored were all below 50 mg/l SiO_2 except for T_2 (San Pedro River) which exhibited an average of 52 mg/l SiO_2 (LLDA, 1994). The turbidity of water for recreational purposes is recommended to be from 5 to 50 JTU (Jackson Turbidity Unit) (Inland Water Directorate Water Quality Sources Book, 1976).

4.1.1.4 Toxic and Hazardous Substances (THS)

"HAZARDOUS WASTES" are residual substances discharged to the environment which constitute a substantial present or potential danger to living organisms and human health. "TOXIC WASTES" are residuals which contain substances which can be lethal to living organisms.

The Laguna de Bay Basin has experienced intensified use by new and expanding agro-industrial activities and a general rural to urban transformation. This has undoubtedly contributed to the widespread perception of a diminishing level of water quality in the lake and this condition can be expected to continue for sometime in the future.

The predominant contributions of THS wastes (principally heavy metals and agricultural pesticides) are derived from the sub-basins of Laguna flowing into West Bay, encompassing Metro Manila and the western shoreline.

Results of a survey in 1989 (URSI) covering 70 THS are presented in Table 4.02. According to these results the most abundant THS discharge in the lake are:

	1989	2010 (Projected)
PHENOL	: 7.9 tons/day	49.5 tons/day
Methyl-alcohol	: 0.8 tons/day	5.2 tons/day
2-4 Dimethyl-Phenol	: 0.8 tons/day	5.0 tons/day

The toxic substances can settle in the sediments where the concentrations may increase to unacceptable level. In the lake water itself, aquatic organisms may magnify the heavy metal and pesticides up to 1,000 times of their initial concentration. Those concentrated toxic substances will eventually find their way through the food chain thus adversely affecting human population. According to the surveys and analysis results, the THS levels still remain consistent with the expected use of the water and safe consumption of fishery products. But, even if each THS is below the recommended limit, it does not mean a zero-toxicity effect on the water.

The cumulative effect on aquatic organisms and the phenomenon of biological magnification is a continuous process. The threat of THS is certainly most serious and can definitely hamper the use of the lake water for domestic purpose. The safe consumption of fishery products also becomes a major threat.

The effects of metals in water and wastewater range from beneficial to troublesome to dangerously toxic. Some metals are essential, others may adversely affect water consumers, wastewater treatment systems, and receiving waters. Some metals may be either beneficial or toxic depending on their concentrations.

The results of analysis of lake water samples collected in 1984 shows that zinc, lead, copper, cadmium, chromium and arsenic met the Class "C" standard. (Table 4.03), whereas the results of analysis of all lake sediments (also collected in 1984) indicated that chromium alone met the Clay standard of 90 mg/kg of dry weight while lead met the standard only in stations I, VI, and VII (Table 4.04). All the other metals as copper, zinc, and manganese were found exceeding the maximum allowable Clay standard (LLDA, 1987).

The 1988 monitoring results in the lake indicated that arsenic, lead, cadmium, chromium and mercury met the Class "C" standard. Results for sediment analysis show that only copper failed meeting the Clay standard (Tables 4.05 and 4.06). (LLDA, 1988)

4.1.1.5 Water Quality Assessment

Presented below are discussions and observations on these parameters.

i. Temperature

The temperature is defined as the condition of a body which determines the transfer of heat to, or from, other bodies. The temperature of a water is primarily a reflection of the climatic regime; however, man can modify water temperatures. Water used for cooling in power plants transfer heat into receiving waters. The discharge of many industrial wastes may also elevate water temperature above ambient levels in limited area. Based on observations, industrial cooling water discharged from the NPC Thermal Power Plants show an increase of about 2°C in temperature.

Increasing water temperature decreases the solubility of oxygen in water while increasing the oxygen demand of fish. Higher temperature increases the solubility of many chemical compounds and may influence the effect of pollutants on aquatic life.

ii. Nitrate

Nitrate (NO_3) is the principal form of combined nitrogen found in natural waters. The highly soluble nitrate ion, which is the most stable form of combined nitrogen in surface waters, results from the complete oxidation of nitrogen compounds. Nitrogen compounds come from chemical fertilizers from cultivated lands and drainage from livestock feed-lots, as well as domestic and industrial waters.

Excessive concentrations of nitrate in drinking water are considered hazardous to infants, who may develop methaemoglobinaemia.

In surface waters, nitrate is a common nutrient taken up by plant and converted into cell protein. Since nitrates stimulate plant growth, aquatic organisms (such as algae) flourish in the presence of nitrates and excessive amounts of nitrate may result in the prolific growth of aquatic plants.

The nitrate concentrations in the lake had annual means ranging from 106 to 201 ug/l to 495 ug/l. The criteria for Class "C" water is 10,000 ug/l (Table 4.01). The annual means of nitrate concentrations for tributaries ranged from 124 ug/l to 621 ug/l. Pagsanjan River showed the lowest nitrate level while San Juan exhibited the highest nitrate level which indicates the presence of high domestic wastes (Table 4.07).

iii. Dissolved Oxygen

Oxygen is one of the gases that is found in natural surface waters. The oxygen dissolved in water may be derived from either the atmosphere or from photosynthesis by aquatic plants (phytoplankton). Dissolved oxygen (D.O.) concentrations yield no adverse physiological effect on man, however, ample amounts of dissolved oxygen available is essential to the fish and other aquatic organisms for growth and survival. Insufficient dissolved oxygen in surface waters may contribute to an unfavorable environment for aquatic life and the absence of dissolved oxygen may give rise to odoriferous products of anaerobic decomposition or may cause fish death due to suffocation. It is therefore important that D.O. levels in the lake should be maintained within acceptable standards.

Supersaturation of D.O. during daytime is also observed in some portions of the lake especially during algal blooms. This may cause "gas bubble" disease in some fish species.

For Class "C" waters the minimum D.O. standard is set at 5 mg/l. The annual mean values for daytime dissolved oxygen of the lake ranged from 6.1 to 6.8 mg/l. (Table 4.01). For tributaries, in terms of annual averages, the following rivers met the D.O. requirement: Sta. Cruz River, Pagsanjan River and Bay River (Table 4.07).

iv. pH: (Alkalinity or Acidity)

The pH of natural water is usually governed by carbon dioxide, bicarbonate, carbonate equilibria and lies in the range between 4.5 and 8.5. The pH of water

may be affected by humic substance, by changes in the carbonate equilibria due to the bioactivity of plants and in some cases, by hydrolyzable salts. The effect of pH on the chemical and biological properties of liquids makes its determination very significant, e.g. for controlling corrosion and for the control of water or waste-treatment processes. Moreover, the pH of water may influence the species composition of an aquatic environment and affect the availability of nutrients and relative toxicity of many trace elements.

The annual mean values for the pH of the lake ranged from 7.8 to 8.4 (Table 4.01) which was more on the alkaline side. The permissible range of pH for Class "C" and Class "A" waters is 6.5 to 8.5. For tributaries, the annual mean values ranged from 7.8 to 8.0.

v. Total Dissolved Solids

Total dissolved solids (TDS) which is an index of the amount of dissolved substances in water, consist mainly of carbonates, bicarbonates, chloride, sulfates, phosphates, and possibly nitrates of Ca, Mg, Na, K, with traces of Fe, Mn, and other substances.

High concentrations of TDS limit the suitability of water as a drinking source and for irrigation. High surface run-off and overland flow contribute dissolved materials to receiving bodies of water. Significant contribution to the TDS loads are anthropogenic in the form of municipal and industrial effluents, agricultural run-off, and aerosol fall-out.

Observations in the lake show that the TDS annual mean values ranged from 609 mg/l to 841 mg/l (Table 4.01). The annual average TDS concentrations in all the rivers monitored were below the minimum permissible TDS limit for Class "C" water which is 1,000 mg/l.

vi. Inorganic Phosphate

Inorganic phosphate, a non-metallic element occurs in numerous organic and inorganic forms and can be present as a dissolved or particulate species. It may occur in surface or ground water as a result of leaching from minerals or ores in natural processes of degradation of organic matter, and as an element of municipal sewage and industrial effluents.

The discharge of excessive amount of phosphates to streams or lakes may result in an over-abundance of algae. Upon decay, dead algae compete for the dissolved oxygen endangering fish life and giving off unpleasant odor. Phosphates seldom exhibit toxic effects upon fish and other aquatic life and may be beneficial to fish culture.

The annual averages for inorganic phosphate ranged from 60 ug/l to 90 ug/l were recorded in 1994. The maximum standard for inorganic phosphate allowed for lakes and reservoirs is 100 ug/l. The phosphate concentration in all rivers exceeded the desirable concentrations except for Tg which exhibited an annual mean value of 97 ug/l, (LLDA, 1994). These concentration levels are contributing to lake eutrophication.

vii. Coliform

The coliform group includes all the aerobic and facultative anaerobic gram negative, non-spore forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C.

High counts of coliform bacteria, especially fecal coliform indicate the presence of animal wastes, which may support pathogenic organisms. Such waters are unsuitable for domestic, recreational, agricultural and some industrial applications.

Observations of MPN (Most Probable Number) of coliform are highly variable in the lake and the Class "C" standard of 5000 MPN/100 ml is exceeded 6% of the time in all the lake stations monitored. For tributaries, all the rivers exceeded the standard for Class "C" and Class "A" waters of 5000 MPN/100 ml. This, therefore indicates that human and animal wastes finding its way into the lake is quite high.

The San Pedro River (Laguna) at all times yielded the highest coliform density of 24×10^9 MPN/100 ml. (LLDA, 1994). It should be noted that this river is the most polluted among all lake tributaries.

4.1.2 ENVIRONMENTAL POLLUTION

Inimical to the sustainability of the lake and its resources is the worsening situation of the quality of the environment in the region. The growing development pressures brought about by population growth, industrialization, urbanization and increasing resources utilization result in environmental degradation, most notable of which is pollution. It is estimated that domestic sources account for 29.83% of the total pollution in the lake while 30.35% comes from industrial sources. Agricultural waste on the other hand account for about 39.82% of lake pollution sources (Figure 4.2).

4.1.2.1 Industrial Pollution

Industrial pollution contribute about 30.35% to the degradation of water quality and the resulting economic and environmental effects. As of 1994, there are 1,481 industrial establishments in the lake basin, mostly concentrated on the western shore. These are dominated by the chemical products, food processing and metal sectors. About 32% are classified as wet industries, discharging wastewater directly or indirectly to the lake. Of these, 69% have wastewater treatment facilities (Table 4.08). According to the 1988 classification, 11% were highly pollutive, 59% pollutive while the remaining 30% are non-pollutive (Table 4.09).

In 1988, total daily wasteloads from industries reported by LLDA were as follows: BOD = 405 MT, TSS = 988 MT, oil and grease = 8 MT (Table 4.10). Based on the NEDA projected growth for the manufacturing sector until the year 2000, the generation of pollutants from industries within the Laguna de Bay basin is assumed at an average of 10% annually (NEDA Region IV, 1992).

The threat of toxic and hazardous substances (THS) is certainly the most serious which can definitely hamper the use of the lakewater for domestic purpose and the safe consumption of fishery products. The survey of URSI (1989) showed that 41% of the industries located within the Laguna de Bay basin, discharged THS which exceed the chronic criteria for the protection of aquatic life (Table 4.11). The total THS loading in kg/day is presented in Table 4.02 and projects these values to the year 1995, 2000 and 2010. Also shown in Figure 4.3, are the areas with possible high THS.

The lakewater being used for industrial cooling purposes generate thermal pollution upon the discharge of water. This form of thermal pollution affects the solubility of dissolved oxygen in water. This will have concomitant effects on aquatic life and on the existing water quality. In addition, the wastewater contains chlorine (Cl) which affects the primary productivity of the lake. In a 1973 survey near Sucat, the total number of phytoplankton dropped from approximately 1 million/ml to about 200,000/ml (BCEOM, 1984).

Barging and oil transport operations in Laguna de Bay (Figure 4.4) poses the risk of collision and oil spills which is obviously dangerous to water quality. As of 1991, the volume of fuel being transported each day is as follows: 50,000 barrels from Sucat to Malaya; 1,300 barrels from PPC refinery to Pililla Gas Turbine; 3,300 barrels from PPC refinery in Pililla to Manila and 15,000 barrels from Sucat to PPC refinery.

4.1.2.2 Domestic Waste

Of the 8.4 million present population at the Laguna de Bay Region, about 60% of the total households discharge liquid and solid wastes directly into the lake or into the tributary rivers of the lake (LLDA, 1994). Except in plush housing developments, no piped domestic sewerage system exists in the Laguna de Bay Region. Wastewater is mostly discharged directly into the ground, open drains, tributaries and Laguna de Bay.

Seventy six percent (76%) of the basin residents are in non-lakeshore municipalities while twenty-four percent (24%) are located in lakeshore areas. Almost eighty percent (80%) of the population reside in urbanized areas of the region. Due to increasing demand for residential areas, more subdivisions mushroomed in the region. In 1989, around 1,898 subdivisions were developed, most of these are concentrated in East Bay.

Domestic sources of pollution account for about 70% of the organic wastes discharged into the lake and for the highly pollutive leachate from solid wastes.

4.1.2.3 Agricultural Pollution

a. Fertilizers and Pesticides Application

Fifty two percent (52%) of the total land area of Laguna de Bay Region is devoted to agriculture which includes 30,000 ha. of irrigated rice paddies (Figure 4.5).

The principal crops grown in the area include rice, sugarcane and coconut. Significant quantities of Nitrogen, Phosphorus and Potassium base fertilizers and Organo Chlorine and Organo Phosphorus pesticides (principally insecticides and herbicides but includes fungicides and molluscicides) are applied to agricultural areas to enhance the quality and quantity of production of these crops. Various proportions of these chemicals may reach rivers and lake via irrigation water and/or from runoff during rainfall and thus add to the pollution load. It is noted that DDT is widely used unofficially despite its undesirable persistence in the environment (LLDA, 1978). Agricultural return flow is of great concern in Laguna de Bay because of relatively high fertilizer application in rice paddies and the fact that the rice paddies are located in the lowlands bordering the lake. Agricultural return flow is a significant source of Nitrogen inflow to the lake in view of large scale irrigation projects under implementation. Agricultural pollution is more difficult to control than a point source pollution because the former cannot be economically collected for treatment. Nitrogen is presently the most damaging pollutant which result in the proliferation of algae which influence eutrophication.

Nitrogen from agricultural sources is about 60% of the total in 1975-76 and 53% of the projected total in 2000 (SOGREAH, 1974).

b. Livestock Wastes

About 5% of the Nitrogen in chicken waste may be introduced to the lake due to washdown from chicken production. Likewise, about 25% of duck waste is washed into the lake from commercial sources and that 50% is added from backyard farms. For swine production, about one-third (1/3) of the swine waste enters the lake from commercial farms away from the lakeshore and two-thirds (2/3) of the waste enters the lake from those farms that are near the lake. Approximately one-fourth (1/4) of the commercial farms are in the latter category. It is assumed that 5% of the waste from backyard farms enter the drainage system. For cattle, it is assumed that 5% of the waste reaches the lake.

This trend will continue if nothing is done until it reaches massive proportions since the demand for food is increasing exponentially.

In 1975, animal pollution generation is estimated at 38,500 MT BOD, 10,000 MT of Nitrogen and 3,500 MT of Phosphorus. This will increase to 112,500 MT of BOD, 24,500 MT of Nitrogen and 10,200 MT of Phosphorus by the year 2000 (LLDA, 1978).

4.1.2.4 Unmanaged Volume of Solid Waste

The rapid urbanization of the region and the residential, commercial and industrial encroachment occurring principally along the northern and western shores of the lake pose a serious problem on solid waste management and will become worse when its population grows to more than 11 million by the year 2000. It is estimated that by that time, the refuse coming from the households/residential establishments, commercial, industrial and other sources will be 6,362 tons per day.

Presently, the total solid waste generation is estimated at 5,565 tons/day or 2.3 million tons annually for Metro Manila Area (MMA) and 392 tons/day and 473 tons/day for Laguna and Rizal respectively. The existing solid waste disposal system numbering 7 in Metro Manila and 21 for Laguna and Rizal resulted to 76% collection in Metropolitan Manila and 191 tons/day and 98 tons/day collection in Laguna and Rizal respectively (JICA, 1991).

Overall, about one-third (1/3) of the solid waste generated in the basin is collected. The remaining two-thirds (2/3) are either composted, thrown on vacant lots, scattered on streets, which will eventually find their way to sewers and other water courses carried by storm water runoff and subsequently discharged to Laguna de Bay. This indiscriminate disposal of domestic waste contributes around 30% of the pollution load of the lake. Aside from health problems, garbage impedes the flow of water and contributes further to the flooding of low-lying areas.

The Nitrogen inflow into the lake from solid waste was estimated in 1989 to be 3,000 MT (Lopez, 1989). As urbanization and industrialization increases, more wastes will enter the water courses because less and less land would be available for satisfactory disposal methods.

4.1.3 FISHERIES PROBLEMS AND ISSUES

The fisheries in Laguna de Bay is a major concern in resource management. It is both an advantage and a problem which has to be properly addressed to maximize its beneficial uses. The deterioration of water quality due to lake pollution has quantitatively and qualitatively affected the fishery of the lake. On the other hand, the fishery activities are also seen as a cause of water quality deterioration. Aside from pollution there are other problems related to fisheries which have to be addressed to make fishery resource utilization more efficient.

4.1.3.1 Fishery Activities as Sources of Pollution

Practices in open fisheries and aquaculture are also identified as sources of pollution. In the operations of fishpens and fishcages, pollutants come from non-biodegradable nets and twines, decaying bamboo materials, inorganic feeds, fish fecal matters as well as organic wastes, suspended solids, nutrients, toxic and hazardous substances discarded by fishpen caretakers staying in guardhouses in the lake.

In open lake fishing, discarded nets and other fishing gears as well as gasoline and oil spills from boats also contribute to pollution loading in the lake. Moreover certain fishing practices such as snail gathering which involves scraping of the sediments allows the release of nutrients and toxic and hazardous substance that have accumulated in the lake bottom. However, it was reported by MEIP (MEIP, 1994) that no estimates has been made of the contribution of fishery activities to the pollution of the lake.

4.1.3.2 Fishery Problems in Laguna Lake

a. Fishpen Industry

i. Uncontrolled Stocking of Fingerlings

The uncontrolled stocking of fishpens resulted to low fish productivity and mass mortality of fish stocks. In 1977 survey (LLDA, 1978), the stocking density of milkfish in the lake per hectare ranged from 100,000 to 1 million fingerlings. It shows that more than 76% of the fishpen have stocked at a maximum of 250,000 fingerlings/hectare while 23% have stocked to as much as 1 million fingerlings/hectare. The maximum fingerlings mortality recorded in the Central, East & South Bays were 60%, 90% and 80% respectively. Most of the operators attributed the mortality to the synergistic effect of improper handling and transport of fingerlings.

It was pointed out in one of the studies (SOGREAH 1991) that the excessive fishpen development in 1984 did not only involve area development but also over supply of fingerlings. As reported, oversupply reaches 50,000 to 60,000 fingerlings/ha. instead of 4,000 to 5,000 fingerlings/ha. as recommended by the LLDA. As the potential food production of the Lake become exhausted, fish productivity in the lake is also expected to decline.

ii. Poor Site Selection and Uncontrolled Fishpen Construction

Many of the enclosures are constructed indiscriminately which resulted in the blocking of local access to communities, river outlets, navigational channels and obstructing lake circulation pattern. The proliferation of fishpens reduced the area available for open fishing and caused other problems like the recurrence of algal bloom and dense growth of water hyacinth.

iii. Practice of Inappropriate Fish Culture Schemes by the Fishpen Operators

The production potential of the fishpen must be optimized in order to maintain a well balanced food chain. However, report shows that the monopoly of milkfish culture in fishpens discriminates the introduction of other high quality species, either in mono or polyculture (LLDA, 1978). Milkfish by feeding habit is a herbivore and is expected not to convert all the feed produced in the lake into usable fish flesh, thus, there is a need for a polyculture method of fish culture.

The balance utilization of feeds in the lake is not attained due to lack of technology know-how or study on the use of the different fish species of varying behavior and feeding habitat. The introduction of inappropriate polyculture scheme could have also resulted in food competition and ecological imbalance in the lake as it disrupts various linkages in the food chain/trophic levels.

Moreover, the introduction of exotic species such as Clarias batrachus resulted in the displacement of native hito Clarias macrocephalus. The proliferation of golden snail in the lake may result in the extinction of aquatic macrophytes. Lately, the African giant catfish (Clarias gariepinus) a voracious predator endangers the native fish in the lake such as the dulong, ayungin and shrimp.

b. Open Lake Fishery

The main problems identified by (SOGREAH, 1991) has been the over-exploitation of the lake fishery resources through the following:

i. Increase Fishing Pressure

Table 4.12 presents the evolution of fishermen population over the years. The increase in total number of fishermen resulted in declining fish catch due to the corresponding increase in fishing activities.

ii. Illegal Fishing Activities

The fishing practices of fishermen is influenced by the growing competition for fish catch. As such, practices such as electro-fishing, use of poisons, use of fine meshed nets and push nets became rampant.

iii. Continuous Snail Gathering Activities

The snails are usually collected by dredging or trawling operations. SOGREAH (1991) reported that about 160,000 to 180,000 tons of snails are harvested annually. This represents about 2.0 tons of snails per hectare per year. The effect of this intensive snail gathering thru dredging include the destruction of benthos and rooted plants and increased lake turbidity.

4.1.3.3 Other Related Problems to Fisheries

a. Algal Bloom

SOGREAH (1991) categorized the lake as hypereutrophic due to high nutrient inflows from various sources. The high levels of phosphate and nitrogen influenced the occurrence of algal bloom. Identified bloom forming algae in the lake include Microcystis, Anabaena and Oscillatoria species-all blue green algae.

The damages caused by algal bloom to fisheries include:

- i. Low market value of fish due to tainted flesh and mud-like bad taste.
- ii. Massive fishkills due to oxygen depletion during occurrence of algal respiration at night time and algal die-off and decay. Fishstocks trapped in fishpens and fishcages usually die of asphyxiation.

LLDA (1978) stressed that the magnitude of losses due to algal bloom is expected to increase in proportion to the pollutants input.

b. Proliferation and Massive Growth of Water Hyacinth

This problem is also influenced by the eutrophic condition of the lake. Water hyacinth (a floating aquatic plant more commonly referred to as waterlily) usually abounds along the shorelines, in-between fishpens/cages and in tributary streams and rivers. The distribution and dense accumulation of water hyacinth depends on the direction of wind and wave action. The problems to fisheries caused by the thick accumulation of water hyacinth include:

- i. Poor productivity due to poor water circulation;
- ii. Difficulty in lake navigation;
- iii. Fishkill due to death and decay of the aquatic plant;
- iv. Destruction of fishpens/cages structures; and
- v. Increase water losses due to over transpiration.

c. Occurrence of Fish Diseases

The fish diseases which caused considerable losses to lake fisheries include the epizootic ulcerative syndrome (EUS) locally referred to as "kurikong" and fungal infection.

EUS maybe caused by a bacterium known as Aeromonas hydrophila which commonly affects bottom feeding fresh water species such as mudfish, carps and "gouramy". The occurrence of this disease is observed to occur in poor water quality characterized by low temperature, low productivity, strong winds and high turbidity.

Fungal infection on the other hand develop when the fish suffer bruises, wounds and loss of scales during handling and transport of fishstocks. Fungus attacks the injured parts initially, and then later spreads to other healthy parts of the body causing death to fish.

d. Siltation and Sedimentation

Rapid siltation leads to accelerated aging of the lake and the continuous turbid condition of the water which in turn results in poor fishery production. (MEIP, 1994) attributed the sedimentation of the lake to the continuing soil erosion due to deforestation and also poor agricultural practices within the basin. JICA (1991) noted that 47% of the basin is susceptible to soil erosion with Marikina having the largest erodible area.

4.2 CONSTRAINTS ON LAND RESOURCES

The following problems and issues discussed were established from the major studies undertaken on the Laguna de Bay and its basin resources. During the multi-sectoral consultation on the proposed master plan these were validated in the workshop/discussion.

4.2.1 LAND USE

The Laguna Lake region comprises a number of catchment areas. Land use activities in these areas, such as those related to the forest cover, agriculture, urban development, energy production, mining, and lake draw-down affect both the watershed and the lake.

The traditional land use pattern in the Basin - the series of small compact urban centers in Metro Manila contained by vast rice paddies, coconut, sugarcane plantations and orchards in the rest of the Basin has been rapidly changing due to physical social and political factors among which include the following: (1) population growth (in-migration for economic opportunity), (2) the creation of Metro Manila as a political entity in 1975 and adoption of the intermediate urban area system for urban expansion, (3) Presidential proclamation of a dispersal policy for industry whereby major industrial development could no longer be located within 50 km radius from the Luneta Park, (4) construction of the South Super Highway which promoted corridor movement from Manila south to Calamba, and (5) the suitability of much of the area for economic development thereby accelerating industrial expansion (URSI, 1989). These factors have contributed to the continuing encroachment of built-up areas into agricultural lands and heavy deforestation in the upland areas of the watershed. The western rim of the lake gives evidence of urban sprawl-- suburbanization and strip development north of Manila to Montalban and southeasterly as far as Los Baños. Industrialization and growth of major urban centers in the northwestern and southwestern portions of the basins are generally influenced by the economic growth fostered by Metro Manila.

All types of industries in the basin are clustered in the north from Manila to Marikina and Antipolo along the western growth corridor from Muntinlupa south to Calamba. Agro-industry (which includes livestock raising, particularly hogs and poultry) is principally centered in two locations-- in the northern area around Montalban, San Mateo, Angono and Baras in Rizal Province and the southeast focused on Sta. Cruz, Pila and Victoria in Laguna Province.

The Basin is also rich in industrial materials. At least ten municipalities currently have some form of mining, quarrying or extractive activity underway. Several municipalities are the source of significant water or power supply. Montalban and Tanay dams supply water to Manila, Pililla and Cavinti which are centers of electric power generation and Bay which is the center of geothermal development (URSI, 1989).

In 1974, SOGREAH suggested a land zoning for the lakeshores. This was a result of the proposed rule curve and thus, probable lake levels due to the flooding effect on the lake. The extent of potential flooding along the Laguna lakeshore, defined as the area between 10.5 m and 14.6 m above LLDA datum level, was calculated in 1975 to be 26,000 has. The land use in this area consisted in the same year of 1,992 has. residential, 14,478 ha. agricultural, 323 has. industrial and 102 has. commercial consisting 63% of the total, with the rest being marshes and swamps. Rapid urbanization in the flood plains has increased the potential for flood damage (JICA, 1991). More than 14,000 has. are subject to flooding every year. Present observation of the lakeshore concludes that the development which occurred along the shoreline does not respect the 12.5 m. limit nor the basic recommendation regarding land occupation (SOGREAH, 1991).

4.2.1.1 Irrational Land Use

a. Settlements and Urban Development

Due to its proximity, the development of the Láguna de Bay region has been influenced by the growth of Metro Manila in socio-economic and physical terms. Especially, the urbanization in the provinces adjacent to Metro Manila has been mainly caused by spillover of the population economically linked to it (JICA, 1991). The suburbanization in the areas in the region has taken forms of private subdivision of lands, government-sponsored low cost housing and site and services programs, and spontaneous development of residential areas in existing towns. Five main directions are identified:

- i. Along the road from Metro Manila to Bacoor and Rosario in Cavite;
- ii. Along the Aguinaldo Highway toward Dasmaringas in Cavite;
- iii. Along the Manila South road and the South Superhighway to the south in Laguna;
- iv. Along the road from Marikina to Montalban to the north of Rizal; and
- v. Along the road from Cainta to Tagaytay/Angono to the east in Rizal.

Some environmental issues related to human settlements are those affecting their location, expansion and issues related to their management, regulation and maintenance.

The absence of a regional land use plan, concrete land ownership structures and explicit government intervention strategies are perhaps the main factors contributing to "illegal" settlements and chaotic urban sprawl in the Region today. These situations are mainly characterized by primitive facilities, overcrowding/congestion and poor sanitation linked to an unhealthy environment.

Proximity to basic services and facilities and sources of livelihood remain to be logical consideration for determining the location of rural and urban communities in the Region. The uncontrolled physical expansion of urban communities make provision for housing, roads, water supply, sewers and public services prohibitively expensive in financial, technical and environmental terms. Lately, urban communities have been built in the most productive agricultural lands resulting in permanent loss of precious land resources. In general, urban growth have often preceded the establishment of a solid and diversified economic base to support the build-up of housing, infrastructure and employment.

In the Philippines, there are neither explicit urban development policies nor are there organizations specializing in urban development. Recently, however, the importance of urban development in economic development has been recognized, and a physical framework for Luzon has been established by NEDA. However, the physical framework is nothing more than indicative at best.

4.2.2 DEFORESTATION/DENUDATION

The watershed covers an area of about 382,000 has. Originally, it was covered by dense equatorial forest. Now, little of the original forest cover remains, except in reserves. But even in these areas, illegal cutting and land clearing continue. Between the mid-1940s and mid 1980s, forest cover decreased from about 53% to about 8% of basin cover (URSI, 1989) and is now estimated to be less than 5% (FMB, 1989). Forest cover persists only on the steepest slopes and in the most isolated highland areas of the basin.

Forests are crucial for maintaining and improving the productivity of agricultural lands. Yet agricultural expansion, a growing timber demand, and woodfuel demand have destroyed much forest cover. Growing populations and the decreasing availability of arable land lead poor farmers in the region to seek new land in forests to grow more food. There is nothing inherently wrong with clearing forests for farming: provided that the land is the best there is for new farming; it can support the occupants expected to settle upon it; and, it is not already serving a more useful function, such as watershed protection. But often forests are cleared without forethought or planning. Deforestation most severely disrupts mountainous areas, upland watersheds and the upland ecosystems that depend on them. The uplands influence precipitation and the state of their soil and vegetation systems influence how this precipitation is released into the streams and rivers and onto the croplands of the plains below. The growing numbers and the severity of both floods and droughts in many parts of the Region have been linked to the deforestation of upland watersheds.

4.2.2.1 Loss of Biodiversity

Uncontrolled development activities in the Laguna de Bay Basin have substantially reduced the population and number of flora and fauna species in the region. This is because of the modification of the natural environment caused by extensive urban and industrial development and agricultural area expansion.

Forests in the basin are a rich source of forest products; timber for construction, furniture and fuel wood. Also, many species of forest vegetation have important medical applications and some are in demand for landscaping.

From 1946 to 1977 alone, a considerable hectarage of forest land of about 14,800 has. had been denuded in the upland towns of Rizal bordering the foothills of the mountains (BCEOM 1984). As a result, sizeable areas of unproductive grasslands are now found in these areas.

Of the 21 species of dipterocarps, most are now rare or endangered; bamboo areas have been depleted and many species of palms are rare or endangered because of the loss of natural forest habitat. For animal species: as many as 11 of the 35 mammal species are now endangered as a result of habitat loss and 77 species of birds are endangered and those migratory ones no longer visit the area (URSI, 1989).

In addition to the development impacts, many species of wildlife have been affected by the continued capture and collection by poachers. These harmful

practices still continue inspite of the conservation laws and area isolation of the national parks and watershed reservation in the region.

4.2.2.2 Erosion

Increasing economic activities in the Region have often extended into marginal lands prone to erosion. Erosion makes soil less able to retain water, depletes it of nutrients, destroys the soil profile and reduces the depth available for plant roots to take hold. As a result, land productivity declines.

Laguna de Bay has lost much of its fertile lakebed where fish feeds. This could be attributed to the denuded watershed in the upland towns of Rizal and Laguna. During the monsoon rains, flashfloods bring down the eroded topsoil down the Laguna Lake and to the valleys below, causing siltation. This process has reduced the yield of the once fertile farmlands of Rizal, rendering the water in the lake to become shallow and causing the water in the river to rise and inundate the towns around the lake including Metro Manila.

4.2.3 LAND CONVERSION

Conversion of forest to agricultural lands and into other uses has been a persistent issue in the Laguna de Bay Region. This conversion is a problem in that the best agricultural soils become irreversibly lost. We may note that some countries have adopted strategies to save their best soils for agriculture. For example, in Korea, only rocky hilly land not suited for agriculture can be converted into cemeteries. Still very limited information on land conversion is presently available for the Region. The Calabarzon Master Plan study noted that if municipality/city land use plan had been approved by June 15, 1988, land transaction in conformity with the land use plan are not subjected to the Comprehensive Agrarian Reform Program (CARP). If municipalities/cities do not have land use plan, land conversion from agricultural land to other uses must follow the DAR Administrative Order No.1 and No.2, series of 1990 as amended by DAR Administrative Order No. 12, series of 1994. However, due to the requirements imposed by DAO No. 12 which are tedious enough for any land developer to comply, a serious implication could be illegal conversion and red tape in the bureaucracy.

Expansion of urbanized area from Metro Manila has been applying conversion pressure on prime agricultural lands. Similar problems are observed around other secondary towns. Land use plans of provincial governments are only indicative, and effectiveness of existing laws and regulations to control land use is still uncertain.

Two schools of thought exist on the conversion of land uses in the Philippines. One, based on CARP, tries to seek regulation of transactions of agricultural use. The other argues that agricultural land should be converted to other uses of higher economic returns. The latter tends to be supported by those promoting land development for urban/industrial uses.

Conversion from rural to urban land is continuing at a rapid rate. Between 1975 and 2000, urban areas could more than double in size. In particular, land

conversion for some industrial estates has been drawing serious attention of people. Future land conversion will be subject to the relevant administrative orders under CARP, although a few individual cases may remain to be an issue. A real issue in this conversion is the absence of land use plan for most cities and municipalities in the Region which are official, detailed enough and providing effective tools for regulating future land use.

4.2.4 INCREASING CONCERN ON GROUND/SURFACE WATER DUE TO CONTAMINATION FROM MULTIPLE SOURCES

Water pollution directly and indirectly endangers human health and economic activities. There are serious health implications brought about by water-borne diseases such as typhoid, cholera, hepatitis, poliomyelitis and gastroenteritis. While most sources of pollution have been identified, both surface and groundwater still continue to be threatened by nutrient and toxic contaminant loadings due to settlement and urban development, industrial development and agricultural practices.

About 52% of the total land area of the region is used for agriculture and livestock production. In 1976, the total pesticide applications in the basin amounted to 104,00 kg. (dry form) and 184,000 l (liquid form) and are expected to increase by 20 % to 25%. The annual load to the lake of nitrogen increased from 3,492 tons in 1973 to 6,200 tons in 1978 and phosphorus from 942 tons to 1,600 tons in the same period. By the year 2000, nitrogen loading is estimated to increase to 11, 200 t/a and phosphorus loading is expected to increase to 29,000 t/a (WHO 1978).

Extensive deforestation of the watershed has also resulted in decreasing recharge of the aquifers which further affects the highly sensitive groundwater system. This situation has increasingly threatened the quality and quantity of the groundwater which has been deteriorating rapidly.

The absence of a piped domestic sewerage in the region further placed the surface and groundwater resources into a very alarming stage. Most wastewater from domestic and agricultural sources and from industrial establishments are all discharged directly in open drains, streams, rivers or infiltrated into the ground. The presence of numerous wet industries, which are concentrated in the northwest and the west part of the basin, further endangers the quality of ground/surface water. Of the total 344 wet industries, only 48 industries or merely 14% have acceptable effluent quality, while the remaining 86% have either non-acceptable or unknown effluent quality.

4.2.5 UNCONTROLLED URBANIZATION OF THE WATERSHED

Urban development, particularly in the southern shore communities, will further increase the loading of nitrogen and phosphorus in the lake. Problems in slope stability and soil erosion are expected because construction during development stage often proceeded without due care for slopes and vegetation.

The rapid deterioration of the watershed resulted to sediment input to the lake of approximately $1.5 \times 10^6 \text{ m}^3/\text{a}$ (BCEOM 1984). This increased sediment input

to the lake will shorten its life span by about 700 years (Environment Resources Ltd. 1985).

4.2.6 PRIVATIZATION/TITLING OF LAKESHORE AREAS

Back in the 1920s, life along the Laguna lakeshore was prosperous due to abundant fish catch for small fishermen. Settlements gradually encroached upon the lakeshore to a degree so alarming that in 1936, the government issued a law to stop titling of lakeshore lands. During the 1960s, industries expanded on the shore of Pasig River and moved on to locate along the coastal towns of Laguna de Bay. People speculating of greater economic returns brought about by industrialization and urbanization have strategically located on prime lakeshore areas. Thus, the cycle continued as attested by the present alarming number of squatters, land speculators and the like on valuable lakeshore areas.

4.3 SOCIO-ECONOMIC CONCERNS

4.3.1 CONFLICTING USES OF LAGUNA DE BAY

a. Open Fisheries vs. Aquaculture

Over the years, there was a consistent debate on the conflict between the two types of fishery - aquaculture which is evidenced by the fishpens and fishcages and open fishery which allows fishermen to fish in open areas.

Aquaculture and open water fishery are conflicting with each other with respect to lake occupancy. In 1983, the aquaculture industry reached its peak with approximately one third of the lake occupied by the fishpens, scattered all over. As a result, small fishermen found themselves almost displaced from their main occupation. In 1986, the total fishpen area was reduced from 30,000 has. to 6,000 has. However, fishermen view the lake as an open resource.

Proliferation of fishpens had likewise caused a reduction in snail production, thereby, affecting the duck raising industry. The clamor then was for the immediate and complete dismantling of the fishpens to increase the area for open fishing. Presently, the Zoning and Management Plan for Laguna de Bay is partly implemented and needs further review. The total area occupied by fishpens as of 1994 is approximately 13,701 has.

Because of the opportunities and potential of the fishing industry in Laguna de Bay, this became the dominant use. As such, the resource was viewed by some sectors primarily for fishery and claimed that the entry of saline water is very relevant to fishery production. This runs counter to the water quality needed for irrigation and water supply. Presently, the species of fish that thrive in the lake are predominantly brackish which in layman's term is a combination of saline and fresh water.

b. Fisheries vs. Irrigation

On the other hand, the National Irrigation Administration is implementing large scale irrigation projects by abstracting water from Laguna de Bay. Included in these projects are the 11,500-hectare farmland in Rizal and Laguna provinces including 1,280 has. of additional arable land along the East Bay area of the region. To be irrigated are 13,160 has. in Cavite Friar Lands from a pumping station located in Putatan, Muntinlupa, Metro Manila.

The use of the lake for irrigation depends both on the quantity and quality of the lake water. A dependable volume of water should be made available to ensure the viability of these irrigation projects. The water requirements would be adequately supplied by operating the Napindan Hydraulic Control Structure and the Manggahan Floodway based on a rule curve formulated for such amount of water drawdown. In addition, the control structure is important in preventing the backflow of saline and polluted water from Manila. While salinity is perceived as vital to fish nutrient growth, it is detrimental to irrigation development if it exceeds the acceptable level. Obviously, the water needed for irrigation will be freshwater.

c. Fisheries vs. Water Supply

The Laguna de Bay was originally intended to be tapped for water supply in the year 2000. Based on the LLDA mandate, it will be tapped as a source of domestic water supply for Metro Manila and many of the provinces around the lake after the present sources have been exhausted. Utilizing the irrigation pumps of NIA located at Putatan, Muntinlupa, this MWSS project could provide water to Muntinlupa, Parañaque, Cavite City and other municipalities. In addition, nine municipalities of the Province of Rizal will abstract water from the lake for domestic use, also under MWSS Water Supply Project.

To make the lake suitable for water supply, the water quality criteria of the lake will have to be upgraded from Class C to Class A which means more stringent effluent standards. Support structures such as interceptors would have to be constructed to control pollution loading from communities and agricultural runoff. Likewise, large scale aquaculture will have to be phased out due to their use of extreme fertilization, intensive feeding, storage of potentially hazardous materials such as oil, improper sanitation practices and regulation of lakeshore development. Most importantly the Napindan Hydraulic Control Structure shall be operated effectively to control saline intrusion which contradicts with the need of fisheries.

There are already existing infrastructure facilities to harness the water quality requirement for irrigation and water supply and the fishery sector is claiming that the operation of these facilities is detrimental to their industry. These conflicts point to the need to come up with a water resources allocation plan. A tentative water balance is presented in Table 4.13.

d. Power Generation vs. Fisheries

The lake is also used to generate power. The Kalayaan Pump Storage Power Plant is presently generating 300 megawatts of electricity for the Luzon grid. The

plant generates power by releasing water from the Caliraya reservoir to turn its turbines. Water is pumped from Laguna de Bay using excess electricity for subsequent operation and thereby producing electricity.

Although water abstraction of this power plant is considered negligible, the release of water causes thermal pollution resulting in the death of aquatic plants which are very vital for fishery production.

e. Power Generation vs. Irrigation

Power generation is in conflict with irrigation with regard to water quantity, especially during summer, when irrigation water is much in demand and lake elevation is at 10.5 m. A lake elevation lower than 10.5 m. during the months of April, May and June will affect the plant's pumping capacity.

f. Waste Sink vs. Other Beneficial Uses

With the horrendous garbage problem in Metro Manila and other municipalities, one alternative is to "kill" the lake altogether and use it as a refuse area. The lake serves as a huge waste sink for industrial, agricultural and domestic wastes. This use of the lake is perceived as removing the economic burden for communities and industries to provide waste treatment facilities which according to them is counter productive because of the huge investment costs involved in putting them up.

The continuing pollution of Laguna de Bay poses a threat to the thriving fishery industry. Cases of fishkill and fish diseases have been reported in several parts of the lake and these were attributed to pollution. Likewise, the plan to use the lake as a domestic water supply might not push through because of the continued deterioration of water quality. Thus, new and possibly, inexpensive and sufficient sources of water should be explored to fill in the increasing demand for water in the communities.

h. Flood Reservoir vs. Other Beneficial Uses

The lake is used as reservoir of flash floods coming from the Marikina River. The Manggahan Floodway was constructed to divert the flood water from Metro Manila to Laguna de Bay at the expense of the surrounding communities that will be inundated when water at the Marikina River reach beyond tolerable level and diverted to the bay.

However, since the hydraulic regime of the Laguna de Bay is being controlled by the Hydraulic Control Structure, the rise and fall of the lake elevation between 10.50 m. and 12.50 m. should be viewed as merely tidal fluctuation. In addition, since the surrounding communities have been used to this "normal" lake elevation, the rise of water higher than 12.50 m. is perceived as flooding.

In diverting water into the lake, sediment transport should be minimized and the water quality should be of the strictest requirement for the aforesaid uses. Thus, the operation rule curves for the Manggahan Floodway and Hydraulic Control Structure should be observed. This has implications on the fishing industry in terms of salinity requirement.

i. Navigation vs. Fishery and Domestic Water Supply

The lake is being used as a navigation route by residents of Talim Island and other people in Laguna and Rizal for lack of alternative land transport network and/or to evade the hassles of traffic. It is also used to transport oil and oil products and other manufacturing inputs using barges.

This use is in conflict with the aquaculture industry because of the obstruction of fishpen structures to the navigation channel. Oil spills and leaks, likewise, are detrimental to the water quality of the lake, which in the end will affect the fishery industry.

4.3.2 FISHERIES OF LAGUNA DE BAY

4.3.2.1 Proliferation of Fishpens

In 1973, when fishpen culture of milkfish (*Chanos chanos*) had just begun, 4,800 has. of the lake surface area were occupied by fishpens and fishcages. The technology which was originally for the small fishermen, attracted instead several businessmen and entrepreneurs because of promising high yield and profits. The area of fishpen increased rapidly to as high as 35,000 has. in 1983 or 1/3 of the lake surface (SOGREAH, 1991 p.26). In addition, stocking of fishpens was not regulated. This resulted in several problems, such as, slow fish growth and lower yield, reduction of open lake for traditional fishermen and fish catches and navigation difficulties.

The huge investment cost involved in putting up a fishpen and the opportunities it offers, caught the interest of big capitalists at the expense of small fishermen. Thus, the fishpens in the lake area are now controlled by big businessmen whose residences are outside of the lake basin.

Proliferation of fishpens affected the fishery yield of the capture fishery since the area for open fishing decreased. In addition, fishery production was affected by the fishpen structures.

Mounting environmental problems and socio-economic unrest forced the gradual demolition of fishpens and fishcages in 1986 through the implementation of the lake Fishery Zoning and Management Plan (ZOMAP). The primary purpose of the ZOMAP is to rationalize the distribution of fishpens in accordance with navigation requirements and to reduce the total fishpen area in accordance with the lake's carrying capacity. In 1989, the total fishpen area went down to 5,700 has. As of 1994, LLDA records show a total of 11,518 has. aside from the structures registered with the Local Government Units which is approximately 2,000 has. The mushrooming of fishpens in the 1990's may be attributed to the unclear implementation of R.A. 7160 otherwise known as the Local Government Code.

The clamor now of the small fishermen is the dismantling of big fishpen owned by corporations, the owners of which are politicians, retired military personnel and other influential persons with strong connections to the government.

Fishermen associations are pushing for the proper allocation of the allowable area to include fishermen cooperatives. Table 4.14 shows that only 17% of the total fishpen area of 13,701 has. are owned by fishermen cooperatives while 10,485 has (76%) is owned by corporations. By policy, LLDA allows only 5 has. for cooperatives and individuals and 50 has. for corporations.

4.3.2.2 Increasing Fishermen Population

In 1963, full-time fishermen numbered 6,511 and part-time fishermen, 6,489 or a total of 13,000 fisherfolks. Due to the declining fishery yield of 796 kgs./ha./yr. to 434 kgs./ha./yr., the fishermen population decreased to 9,813; 7,674 of which are full-time fishermen and 2,319 part-time fishermen (T. Ingledow, 1970 p. 473). The increase in full time fishermen and the decrease in part-time fishermen suggests an increasing specialization and increased mechanization. The latter is supported by the increase in use of motorized bancas. It is also construed that the decrease in part-time fishermen is due to the shift in occupation in the area particularly in municipalities where more industries are being established.

In succeeding years, it can be noted in Table 4.12 that the total number of fishermen has been increasing. This can be attributed to the increasing population around the lake area (from natural birth to migration) brought about by the attraction of the lake for fishery resources. In 1990, LLDA recorded a total of 17,901 small fishermen highly dependent on Laguna de Bay for their livelihood.

4.3.2.3 Declining Fishery Productivity

In the early sixties, the Laguna de Bay had a low fish productivity of approximately 434 kgs/ha./yr. resulting in average gross return of P45,000,000.00. The most disturbing was the declining fish yield on the lake from 796 kgs./ha. in 1963 to 434 kgs./ha. in 1968, of which most of the species caught in the lake were silver perch (Therapon plumbeus), white goby (Glossogobius gurius), mudfish (Ophicephalus striatus), all with low commercial value (T. Ingledow, 1970).

In 1970, a UN fishery study recommended the introduction of fish species with high market value, through fishpen culture to improve the fishermen's income and to satisfy the increasing demand for fish in Metro Manila. During that time, fish thrived solely on the natural food in the lake. An ecological balance existed which was found ideal for culturing fish in captivity. The ideal conditions delivered their promise of high fish production (Table 4.15).

The new technology was soon followed by the increase in population, industrialization, new agricultural technology using commercial inputs and the deforestation of the watershed. In addition, infrastructure facilities were constructed such as the Napindan Hydraulic Structure and the Manggahan Floodway.

It can be stated that hand in hand with the expansion of fishpens is the increase in capture fishery which reached its peak in 1984 at 230,000 metric tons. The demolition of fishpens in 1986 was accompanied by a dwindling fishery production that fell to 47,700 metric tons in 1988. Thus, the total fishery production more or less paralleled to the growth of the fishpen industry.

In some ways it can be implied that the presence of fishpens in the lake contributed to the fishery yield of capture fishery because of accidental tearing and natural demolition of aquaculture structures by typhoon (MEIP, 1994). On the other hand, the increase in number of fishermen in Laguna de Bay which compete with each other for fish produced in the lake should be noted also. Furthermore, the increasing pollution of the lake and the presence of infrastructure facilities are also factors to the decreasing fishery population.

4.3.3 LIVELIHOOD OPPORTUNITIES

The small fishermen sector remains to be highly dependent on the lake fishery resources for their livelihood despite of dwindling fishery catch in terms of volume and value. Unfortunately, because of their low income and lack of collaterals, they are considered non-bankable and, therefore, have limited or no access to existing credit lending facilities. Furthermore, they have limited technical and entrepreneurial skills to enable them to engage in other agribusiness ventures and micro-enterprises, aside from fishery.

Therefore, the role of the government, through the LLDA and other concerned government agencies and financial institutions, is to provide new opportunities and a conducive environment to enable fishing households to expand their income opportunities. Along this direction, the LLDA in the past launched and implemented a fishpen development project for small fishermen of Laguna de Bay with financial assistance from the Asian Development Bank and OPEC and a livelihood development program jointly with the Provinces of Rizal and Laguna. However, in 1988, Cabinet Resolution No. 29 was issued by limiting government agencies authorized to engage in credit lending. Unfortunately, LLDA was not included.

Because the LLDA is authorized by its Charter to extend financial assistance, this policy issue should be resolved immediately so as to bridge the income gap of small fishing households to at least meet the poverty line.

4.3.4 SKILLS TRAINING NEEDS

The package for livelihood assistance should be able to provide fishing communities/households, aside from technical skills for specific types of projects to be implemented, skills in project identification and entrepreneurial skills for small fishermen in managing their selected micro-enterprises or agro-based small-scale industries.

5.0 DEVELOPMENT PLAN FOR THE LAGUNA DE BAY BASIN

The development plan for the Laguna de Bay region shall be based on a proposed regional development framework which would focus on the natural resource attributes and the current development trends in the region. Using the proposed regional development strategy a package of proposed programs and projects are formulated in response to the development problems, issues and constraints earlier identified. It should be noted, however, that the development plan proposed in this Master Plan should still undergo a series of continuing consultation to gain advocacy and acceptability. The institutional changes propounded in this Master Plan are essential. The adoption of such would determine the attainment/accomplishment of the target programs and projects.

5.1 PROPOSED REGIONAL DEVELOPMENT FRAMEWORK

In view of the ultimate objective of ensuring the sustainability of Laguna de Bay as a vital resource for the Lake region and the Metro Manila area and in consideration of the problems and issues associated with population growth, urbanization and industrialization which collectively create environmental pressures on the lake and its watershed, a regional development strategy is hereby proposed.

It is suggested that the lake and its watershed be zoned into three major areas, the industrial, watershed protection and shoreland zones in order to ensure the sustainability of the lake and its resources (Fig. 5.1). Since it is already an existing reality that the western corridor of the Lake region is utilized as an area for industrial activities, it is recommended that this area be maintained as such and therefore to be designated as the **Industrial Zone** (Fig. 5.2). However, the spill over effects of industrialization and urbanization should be controlled and their expansion be limited up to a delineated area. To be effective in this aspect, it is essential to mark the possible extent of industrialization and urbanization through natural and distinguishable topographical and geomorphological boundaries.

The foot of Mt. Makiling to the south end of the lake presents a natural boundary for industrial development. Since this area is a national park, it would be a good delineating point for controlling the expansion of industrial activities and urban growth.

In the northeastern part of the lake, the ridges of the hills dividing the Municipalities of Binangonan and Cardona, Rizal, present a natural topographical boundary to mark the limit for high density urban development and industrialization. The ridges dividing the two municipalities should likewise be projected up north to the hills and mountains of the towns of Teresa, Antipolo, San Mateo and Rodriguez (Montalban) in Rizal Province.

While the above area as described can be designated as an industrial/urbanization zone, it should be clarified that this shall be within the context of an ecologically sound and controlled level of industrial development.

Based on the above delineation, the areas from Cardona, Teresa, Antipolo, San Mateo and Rodriguez in Rizal Province, up to the upper watershed of the Sierra Madre Mountain ranges, down to the Banahaw and Makiling mountains in the south end of the lake shall then be designated as a **Watershed Protection Zone** (Fig. 5.3). These areas shall be rehabilitated and conserved in order to ensure that the annual water balance and recharge of the Laguna de Bay is ecologically sustained.

It should be noted that the watershed protection zone is the natural reservoir of the lake since the vegetative cover in these areas are still relatively thick. Moreover, about 35% to 45% of the freshwater flowing into the lake comes from the major tributaries in these areas namely: Pagsanjan and Sta. Cruz Rivers. In order to ensure that freshwater and a balanced hydrologic cycle is maintained, rehabilitation and restoration of forest cover in these areas must be undertaken. It should be noted, however, that while this boundary is set, it should not be construed that no amount of industrialization would not be allowed in this area.

The delineation of the watershed into two prominent zones should likewise be reflected in the manner by which the lake resources should be allocated. Fig. 5.4 shows the proposed lake resources management zones. As such, the East Bay of Laguna de Bay should be conserved to allow a freshwater status and a quality that would sustain various uses such as domestic water supply, irrigation, power generation and fisheries. The Central Bay and parts of West Bay from Binangonan and around Talim Island shall be designated for aquaculture since these areas are more protected from winds and where higher primary productivity is observed due to seawater intrusion influence. The western side of the West Bay shall be kept open and restricted from aquaculture in order to allow for a more rigid water quality monitoring as well as to enable rehabilitation work in the area. In-depth studies on the effects of salinity and industrial pollution must be undertaken in this area.

The South Bay shall be further studied since the potential for aquaculture is poor due to its rocky bottom. A proposed reclamation project is being considered in this area, however, an environmental and socio-economic impact study need to be undertaken to ensure that the project will not result in adverse social and environmental impacts. All open areas shall be allowed for lake fishing.

The land and water interphase consisting of areas which are alternately submerged and exposed as a result of rising and lowering of lake water level should be considered as a natural buffer zone. These areas located between elevations 12.5m down to 10.5m elevation, called the **Shoreland Areas**, which is approximately 14,100 has. should be protected and its use regulated and controlled (Fig. 5.5). A Shorelands Policy is being finalized by LLDA to regulate use of these areas.

As presented in the CALABARZON Master Plan, the tourism potentials of the region can be linked to existing **Tourism Circuits** (Fig. 5.6) and the agricultural potentials of the watershed basin can be delineated accordingly into **Agricultural Sub-regions** such as lowland, upland, agro-forestry and coconut plantation agricultural areas (Fig. 5.7).

5.2 PROPOSED LAGUNA DE BAY REGIONAL DEVELOPMENT PROGRAMS AND PROJECTS

Presented below is a compendium of proposed programs and projects which are intended to address the development problems, issues and constraints earlier identified in the major studies on the Laguna de Bay Region which the planning team reviewed exhaustively. Such problems and issues were also validated through a consultation process with various sectors.

It should be noted that some of the proposed programs and projects were likewise identified in the past major studies. Moreover, many of these are new ideas brought about by recent technological trends as well as new developments which are based on new paradigms attuned to more recent common concepts such as resource management, non-structural approaches, ecosystems approach and the most over-used term called "sustainable development". The Master Plan carries with it the potential to reconcile human affairs with natural laws and for both to thrive in the process. Simply put, it is a plan that works with nature and not against it.

Unlike past recommendations where programs mainly focused on resource utilization (water supply, power generation, irrigation, land development, etc.) and infrastructures (spillways, floodways, control structures, reclamation, etc.), the present Master Plan would emphasize more on resource management through reassessment (reinventory) of available resources, development of information-based decisions, policy review, institutional approaches (such as public participation, strategic communication support and community development) and with little emphasis on structural solutions. Moreover, emphasis would be given on drawing more attention on the watershed domain (especially the upland areas, agriculture and lake shoreland areas) and on public involvement in decision-making (through information, education and community organizing) as well as organizational development (through LLDA reorganization, capability building and networking).

The proposed programs and projects will be presented in detail in the attached sectoral programs (Appendices A-I) where project profiles have been tentatively outlined. It should be noted, however, that traditional concerns such as education, social services, utilities, health, telecommunications, industrial development and the like were not dealt with. It is presumed that these sectoral concerns can be addressed by relevant sectoral agencies and that coordination and integration can be resolved through appropriate institutional linkages. Of main focus in this Master Plan are resource-based sectoral concerns which are essentially tied-up to the management of the most vital regional resource which is the lake itself.

Presented below are the brief descriptions of the general program framework and the component projects for each sectoral concern.

5.2.1 ENVIRONMENTAL MANAGEMENT PROGRAMS

5.2.1.1 OBJECTIVES

The overall objective of the Environmental Management Program is to formulate, improve and implement developmental and regulatory programs for the Laguna de Bay Region which would address water quality and environmental degradation issues, resource utilization and allocation and policy measures for environmental protection. Specifically, the program is aimed to:

- a. Systematize environmental quality (especially water quality) data processing and information packaging to assess accurately the suitability of the lake and its watershed resources for all its present and intended beneficial uses.
- b. Evaluate the inputs of development activities on the lake's water quality and quantity as important tools for environmental planning, legislation and management.
- c. Prevent the continuous discharge of pollutants, determine the pollution loading from various sources and improve environmental quality in the Region particularly Laguna de Bay.
- d. Re-assess environmental programs earlier recommended by previous studies, specifically major infrastructure projects and technical surveys.
- e. Identify mechanisms and institutional arrangements which could be operationalized to manage the utilization of lakewater specifically for domestic water supply and resolve conflicts of interests among agencies and stakeholders.
- f. Define policy measures for environmental protection through an effective licensing, permitting and levying system and controlling land development through an efficient land use planning.

5.2.1.2 STRATEGIES

a. Resource Inventory

This is concerned with the establishment of an environmental data base system which is essential for an effective environmental management program. This will also serve as guide to planners and policy makers for making rational decisions towards environmental management. Of similar importance is the development of an Industrial Data Base for pollution sources for effective industrial environment management.

b. Environmental Monitoring

i. Water Quality Monitoring

This will include regionwide monitoring activities concerning river and lakewater quality and surveillance, fish diseases, lake productivity and other

inland waters in the region. These monitoring activities will not only be the bases for the license, permit and levy systems of the Laguna Lake Development Authority but also for the success of the proposed environmental programs.

ii. Ambient Air Monitoring

This strategy will involve the monitoring of emissions from industries and disposal sites to determine deleterious effects to the environment and human health and institute possible mitigation measures.

iii. Monitoring of Land Use Changes

This strategy will involve the monitoring of land use changes through a system of permits and licensing for development projects such as the conversion of agricultural lands to industrial or residential purposes. Proper land use zoning shall be implemented in coordination with the LGUs. Urbanization and industrialization shall be regulated and monitored in order to protect the encroachment of critical areas such as prime agricultural lands, forest reserves and lake shorelands activities.

c. Policy Review and Development

This will include the re-assessment of the existing licensing and permitting system of the Laguna Lake Development Authority. Gaps will be identified for amendment and further strengthening of the regulatory function of the said agency.

Another strategy is the application of economic incentives and disincentives in the pollution control and abatement program. This will not only penalize violators but also provide some form of reward to firms that meet the standards.

Further is the development of a framework for resource allocation in the region for rational management of lake resources and its watershed.

d. Infrastructure Development

A strategy for environmental amelioration through the construction of infrastructure will be pursued. This will include the Parañaque Spillway which will prevent flooding in the Laguna de Bay, the Underwater Petroleum Pipeline which will reduce the risk of oil spill and the Regional Interceptor which is vital to domestic and industrial wastewater management.

e. Regionwide IEC/Community Development

The success of any program depends on the level of participation of stakeholders. Making the difficult choices in achieving sustainability in environmental management depends on the widespread support and involvement of an informed public and of NGOs, the scientific community and industry. Their rights, roles and responsibilities in environmental management must be expanded. There must be a no-nonsense Information, Education and communication campaign to be complemented by an effective community organizing methods to ensure the success of the projects.

5.2.1.3 PROGRAM COMPONENTS

a. Water Quality Monitoring Programs

The proximity of Laguna de Bay to Manila makes the basin conducive to rapid development and susceptible to pollution. The lake's use as a waste sink for the whole basin threatens its other uses, such as fishery, irrigation, industrial and most importantly domestic water supply. In order to detect/assess the continuous degradation of the lake water quality, a comprehensive water quality monitoring program for Laguna de Bay has been ongoing since the seventies with the following objectives:

- to systematically collect water quality data needed to assess accurately the suitability of the Lake for all its present and intended beneficial uses
- to evaluate the impact of the development activities on the lake's water quality trends that will serve as important tools to environmental planning, legislation and management

To attain the above objectives, the following programs are being implemented:

i. Laguna de Bay Sampling and Monitoring

The LLDA has been monitoring the water quality of the lake since it was started by SOGREAH in 1973. Originally, there were 9 established sampling stations in the lake representing the West, Central and East Bays. Later, it was reduced to 4 stations in 1983 since the data generated did not vary significantly. In September 1986, another station was added at the South Bay. Monitoring is conducted regularly on a bi-monthly basis.

ii. Laguna de Bay Primary Productivity Studies

The LLDA conducts lake primary productivity (LPP) measurements regularly (at least twice a month) in four selected stations located at the West Bay (Binangonan, Rizal), Central Bay (Cardona and Pililla in Rizal) and at the east bay (Sta. Cruz, Laguna). LPP data are very useful in assessing the quantity of natural food supply in the lake and predicting the potential fish yields or the lake's carrying capacity.

iii. Tributary Rivers Water Quality Monitoring Program

There are quite a number of tributary rivers around the lake wherein the effects of uncontrolled development and industrialization on their water quality is strikingly visible. It is, therefore, necessary to have a continuous baseline information on the various lake tributaries to identify which water course(s) need rehabilitation to improve water quality.

iv. Fish Diseases Monitoring Program

The monitoring of fish diseases is a continuing activity of the LLDA. The occurrence of fish disease such as the EUS or epizootic ulcerative syndrome (locally known as "kurikong") affects the livelihood of fishermen in the lake

v. Sampling and Monitoring of Other Lakes in the Region

There are also lakes within the Laguna de Bay Region aside from Laguna Lake. At present, the LLDA continuously monitors the water quality of Tadalac Lake in Los Baños, Laguna and the seven lakes of San Pablo City which include Sampaloc, Calibato, Mohicap, Palakpakin, Bunot, Pandin and Yambo Lakes.

vi. LLDA Laboratory Upgrading Project

The Environmental Laboratory of the LLDA plays an important role in the management of Laguna de Bay Region especially with respect to water quality. It was established in 1973 as a Water Quality Laboratory with UNDP funding. Through the years in its operation, additional demands on laboratory services have been manifested.

In support of the above programs, it is essential however, that the current laboratory facilities (of LLDA) be upgraded. Top-of-the-line analytical equipment need to be acquired to improve efficiency and ensure reliability. In view thereof, a laboratory upgrading program is also proposed.

b. Pollution Control Programs

An effective Pollution Control Program must be carried out to prevent the discharge of pollutants and improve the quality of the environment particularly in the Laguna de Bay Region. To assess the performance of the program, the various wastes generated and those eventually reaching the lake should be characterized to be able to determine the pollution load in the lake on a regular basis. Decrease in the pollution with a concomitant improvement of water quality is a good indicator of an effective control program.

To achieve this objective, the following are needed:

i. Industrial Waste Management

1. Waste Minimization Project within the Laguna de Bay Region

This proposed strategy for industrial wastewater pollution control aims to encourage and promote the adoption of waste minimization strategy focusing on improved processing techniques and clean technologies. This approach provide opportunity cost benefits to firms, through the realization of a reduction in production of waste and treatment costs. Waste treatment can be in some form of improved efficiency in the manufacturing process, recycling and waste exchange, or adoption of different technology.

✓ 2. **A Project for the Upgrading of the Self monitoring System for Industries**

The project will review the sampling and flow measurement techniques used by industries and the analytical techniques used by laboratories. Fifteen plants in the region which submitted self-monitored data will be randomly chosen as a pilot group for the project. This project will later be institutionalized to include all industries with wastewater treatment facilities as well as emission source installations.

✓ 3. **Pilot Common Wastewater Treatment Facilities Project**

The project involves the entire design, construction and operation of a common treatment facility (CTF) to serve industrial enterprises located in close proximity to one another, particularly those which are small to moderate in size. The CTF could also be applied to industrial enterprises with similar wastewater characteristics.

This CTF will serve as a model for similar groups of industries. In the future, it will be applied to adjacent industries unable to put up their own wastewater treatment facilities.

✓ 4. **Air Quality Management Project**

All industries that are sources of combustion-derived pollutants, such as soot, fly ash, carbon monoxide and oxides of nitrogen and sulfur account for numerous toxic health effects.

The contribution of the industrial sector in the air emission loading in the Laguna de Bay Region is not yet established. The goals of this project are to quantify the air emissions burden from industrial activities, identify mitigation techniques to improve air quality and recommend techniques in monitoring, testing and reporting to ensure compliance with existing air quality emissions standards.

✓ 5. **Study for the Introduction of Economic Incentives and Disincentives to Promote Water Pollution Prevention and Abatement in the Laguna de Bay Region**

Wastewater is always an add-on to a firm's operating costs and as such, there is always a reluctance to provide the necessary treatment facilities. Only 69% of the wet industries within the Region are provided with wastewater treatment facilities. The project focuses on the use of economic incentives and disincentives to stimulate industrial activities to reduce the total loads of pollutants in the lakewater and to ensure adequate funding for the implementation of environmental management programs.

6. **Pollution Control and Rehabilitation of Laguna de Bay through Biotechnology and Ecotechnology**

This program will be a technical cooperative research between the National Institute for Environmental Studies - University of Tsukuba (Japan), the University of the Philippines at Los Baños and the Laguna Lake Development Authority. It shall focus on the following alternative strategies to rehabilitate the lake:

- o control of point sources of pollution (e.g. electroplating, piggery, human and household wastes before they are discharged into the lake.
- o improve the sediment quality through the degradation of its nutrients and other organic substances
- o remove organisms such as *Microcystis* sp. and pollutants (usually at low levels) from the water to render it potable

7. **Wastewater Treatment Plant Operators Training**

One of the major findings of the Waste Minimization Study conducted by the Metropolitan Environmental Improvement Program (MEIP) that needed immediate action is the limited experience and knowledge of firms' treatment operations staff in the operation, maintenance and supervision of treatment facilities. This training program aims to provide adequate technology to industries to meet standards and reduce environmental pollution risk.

8. **Industrial Pollution Source Database Project**

Environmental management, protection and conservation is the major concern of LLDA. To ensure that such concerns can be effectively addressed, an Environmental Database Management Program, particularly an Industrial Pollution Source Database, is proposed to be established.

ii. **Agricultural Waste Management**

Agricultural waste pollution contributes about 50% of the total nutrient loading in Laguna de Bay (SOGREAH, 1974). This comes from waste nitrogen and phosphorous coming from fertilizer used in agricultural farms and from wastes generated by livestock and poultry animals. The raising of ducks along the lakeshore is specifically one of the biggest contributors of pollution since almost 100% of duck wastes flow directly to the lake. The use of pesticides and other chemicals contributes to pollution through air drift of chemicals or through run off from pesticide treated farms which contaminate the water system and Laguna de Bay.

The management and control of agricultural pollution specially excess nutrient loading of nitrogen and phosphorous and contamination from agro-chemicals will be instituted in the region as a priority concern for both the environment and agriculture sectors. Because of the underlying effect of the problem to environmental integrity which ultimately manifest in the declining productivity of the lake and the resultant pollution in irrigation systems and other agricultural resource base, a program for the minimization of agricultural waste has been included as a component of the Agricultural Development Program under this Master Plan.

iii. Domestic Waste Management

Lack of sewerage facilities is the main culprit in the mismanagement of domestic wastewater in the Region. The separation of storm drainage from sewer water shall be recommended. The re-assessment of the Regional/River Interceptor Studies are strongly recommended for possible infrastructure development in the very near future.

iv. Solid Waste Management

One of the most visible environmental problem that plagues the Region is solid waste. It is recommended that a study should be undertaken to create or define the entity that will manage solid waste at the regional level. Included proposals are the Rehabilitation of the Disposal Sites and the use of solid waste for power generation.

v. Toxic and Hazardous Waste Management

Toxic and Hazardous Wastes (THW) cause adverse effects not only on the environment but also to human health. Although lesser in quantity, they are difficult to handle and require special equipment/gadgets and modern technology to dispose. The proposal includes the creation of a comprehensive database for THW detected in the Region and the design of the necessary facilities for its management.

The rationale, program description and the estimated annual budget for the Pollution Control Programs identified above are presented in Annex 3B.

c. Re-assessment of Earlier Major Recommendations on Environmental Management

It is recommended that the environmental programs earlier recommended in previous studies be immediately reviewed and prioritized for immediate implementation. Presented in Annex 3C are the project profiles of technical surveys and major infrastructure projects which were earlier reiterated by SOGREAH in 1991.

i. Technical Surveys

These projects are necessary to have a reliable information data base required in lake management.

1. Bathymetric Survey
2. Hydrological Re-assessment
3. Topographic Survey of Lakeshores
4. Extension of Telemetric Network

ii. Infrastructure Projects

Various infrastructure projects have already been identified in previous studies which are seen as essential components for the rational management of the Laguna de Bay environment. Feasibility studies have in fact already been prepared for these projects. This Master Plan also recommends that these projects be reviewed and the feasibility studies earlier made be updated.

1. Re-assessment of Interceptor Study
2. Re-assessment of Petroleum Pipeline Project
3. Re-assessment of Parañaque Spillway Project

d. Water Resources Management Programs

i. Framework for the Formulation of a Water Resources Utilization Policy

The various uses of the water resources of the lake which would affect the volume of the resource include irrigation, industrial cooling, power generation and domestic water supply. While it has been established that about 4 billion m^3 is displaced annually from the lake, about 1 billion m^3 is probably lost to evapotranspiration and discharged to Pasig River. Effectively, about 3 billion m^3 is available for utilization before it drains into Manila Bay.

The development and utilization of the Laguna de Bay water resources has created problems and issues which threaten not only the sustainability of the these activities but also the life of the lake itself. The conflicting economic uses of the lake affect both the quality and quantity of the resources available. It is for these reasons that a Water Resources Utilization Policy needs to be formulated in order to optimize the economic beneficial uses of the lake. This will ensure the equitable access and efficient utilization of the resources; and in order to reduce or resolve potential social conflicts arising from competing uses. A tentative water balance is presented in Table 4.13

ii. Study on the Laguna de Bay as Potential Domestic Water Supply Source

The worsening water shortage that plagues the Metropolitan Manila Area and its suburbs necessitates tapping the Laguna de Bay as the next source of raw water for domestic consumption. This study will determine the potential of the lake; although the lake has sufficient quantity, tertiary treatment costs are very expensive. This study will also look into the modelling of salt water intrusion as an essential factor both for water supply and fisheries.

The rationale, project description and estimated cost are discussed in Annex 30.

iii. Groundwater Management Project

Groundwater is an important resource for the people of Laguna de Bay Region. It is a common source of water supply, but its reliability to sustain increasing demand has not been established. Also, there is an increasing evidence of groundwater contamination (from leachate of dumpsites, septic tanks, etc.), thus it is necessary to conduct a study to determine the degree of contamination and a rational management system.

5.2.2 WATERSHED MANAGEMENT PROGRAM

5.2.2.1 DEVELOPMENT OBJECTIVE

The general objective of the Laguna de Bay Region Watershed Management Program is to enhance the capabilities of the LLDA and other government agencies in the management of the natural resources within the Laguna de Bay Region Watershed and river catchments towards a more sustainable and socially equitable basis.

More specifically, it shall attempt to achieve the following:

- a. To reexamine the critical watershed environment and development issues and to formulate appropriate and responsive proposals for dealing with them.
- b. To propose a new form of regional cooperation on these issues which will influence municipal, provincial and regional policies and institutional restructuring for the direction of the needed changes in watershed management in the Region.
- c. To raise the levels of commitment to action of individuals, local communities, NGOs, businesses, institutions and the government for the promotion of improved catchment management practices in the Region.
- d. To explore and fully understand the constraints of LLDA's operations, the socioeconomic and technical features contributing to the management of the lake water quality and using these considerations, to direct the needed changes for LLDA and the areas under its jurisdiction.
- e. To ensure the availability of high quality water through the development of improved upland farming and forest management practices that offer short-term productive benefits and sustainability.
- f. To enumerate the goals for the environmental quality of the Laguna de Bay Watershed Region commensurate with the various uses and define the necessary steps to achieve the goals.
- g. To provide a schedule for action and achievement of the watershed management goals.

5.2.2.2 PROGRAM IMPLEMENTATION STRATEGIES

The development of a sustainable watershed management program for the Region commences with adherence to the basic ecological principles and processes. The LLDA identified rapid siltation and sedimentation as among the major causes of accelerated eutrophication of the lake which in turn result to poor fishery production and deterioration of the lake water quality. MEIP (1994), attributed the sedimentation of the lake to the continuing soil erosion due to deforestation and irrational land use practices in the Basin. The program requires more than the identification and installation of remedial anti-erosion technologies designed to reduce downstream sedimentation. It shall proceed with the following strategies:

a. Development of Improved Land Management Practices

It is concerned with the development of improved land management practices for a range of alternative land uses (agriculture, livestock, forestry, wildlife, tourism, etc.), suited to the biophysical and socio economic circumstances of the specific catchment area. Primary consideration goes to the identification of practices that when adopted, would provide economic benefits (e.g. livelihoods) to users of the catchment while sustaining the natural resources of the area (catchment protection). To operationalize this strategy, separate projects on a pilot and integrated approach shall be established in the Pagsanjan subwatershed and portions of the Marikina watershed.

b. Policy Review

In addition to catchment management practices for field level implementation, it is equally an important strategy to consider whether there is a need to change the policy and institutional environment (and if so how) so as to enable such technological options to achieve the design objective of productive and sustainable catchment development.

Policy review will include studies to cover the inclusion of upland farmers in the watershed and critical forest reservations to develop partnership with upland communities for an integrated watershed management and protection intervention.

c. Socioeconomic Approach

Effective catchment management requires that attention should first be directed to identify the ultimate cause of the degradation. Experience suggests that this will, more often than not, have a socio-economic (e.g., poverty, security of land tenure, limited access to improved technologies) rather than biophysical origin. This will be addressed in the social and cultural characterization component of the program.

d. Operational Watershed Management Planning System

The strategy entails the operationalization of a watershed management planning system aimed at increasing the effectiveness of watershed management technology-related activities. The management strategy will largely depend on the processes of the various sectors involved. It shall therefore include systematizing these processes for the preparation, implementation, monitoring and evaluation of watershed management strategies of the different sectors in the Region.

The proposed establishment of the Watershed Management Council operationalizes this strategy by enlisting the different concerns especially those of the marginal sectors.

e. Decentralization

In support of decentralization, the program will veer away from centrally-planned and centrally-managed watershed development strategies, and will focus on regional and community participation -- from the inception to the implementation and evaluation of watershed management projects.

f. Management Reorientation

Most importantly, the program calls for a massive reorientation of LLDA's management and technical capabilities in the light of current watershed management directions in the Region. The systematic and participative processes of watershed management planning give assurance of better focused, more effective and sustained support and assistance to the task of watershed management of LLDA, DENR, and other concerned agencies.

5.2.2.3 PROGRAM COMPONENTS

In line with the above strategies and options, the following primary and support components should be undertaken for the program to be effective and successful. Each component is briefly described and presented as separate project proposal for implementation by LLDA and other coordinating agencies in the Region.

a. Primary Development Components

i. Establishment of a Regional Watershed Management Council

Central to coordination is the consolidation and synchronization of development efforts and concerns of the different lake stakeholders. This shall be operationalized through the establishment of a **Watershed Management Council**, a regional consultative and recommendatory body for the implementation of plans and programs on watershed management in the Region.

Corollary to this, a **Watershed Management Program Office** shall be established within LLDA to provide oversight function and overall coordination of the activities of the LLDA, DENR, LGUs and other agencies. It shall provide

the logistical and administrative support for the other components at the regional level, and facilitate coordination with Project Managers and administrative staff at the local level. It is also tasked with the overall evaluation of results of the activities, their wide dissemination and for follow up activities. One task involves the consolidation of watershed development and rehabilitation plans for the individual catchment areas.

ii. Regional Watershed Resources Information System

Before any development plan is evolved, a detailed investigation and inventory of existing resources should be undertaken within each specific river catchment. A major activity of this component is spatial analysis to include aerial photo survey, mapping out of the extent and degree of soil erosion, present land uses, vegetative cover and the census of forest occupants.

A major output of this component will be a regional ecological profile to include a regional land-use map and the establishment of a regional watershed management information system which could serve as basis for land use planning in the Region.

iii. Pilot Upland Management Project (Pagsanjan and Marikina Subwatersheds): Managing the Lake from the Uplands

This project will be a showcase to address in a pilot and integrated approach the country's Medium Term Regional Development Plan. It shall be responsible for such concerns as poverty alleviation in the marginal uplands, employment generation, equitable distribution of wealth through security of land tenure, enhancement of ecological balance, resources depletion and overall sustainable and economic development.

There are two sites selected for this Project. One would be the upland areas of the **Pagsanjan River Subwatershed**, the second largest of the 21 sub-basins covering 43,800 hectares in the Region and one of the biggest contributors of pollution loading to Laguna lake. The other one is the **Marikina Watershed** (forest reserve) which occupies a total of 55,400 has. In the latter, LLDA would serve as support agency to DENR in implementing specific action projects in the area.

The project will also serve as an opportunity to conduct policy review and research studies on various aspects of lake as well as watershed management.

iv. Development of a Policy Framework for Watershed Resources Protection

This component shall be implemented on a multi-agency and multi-sectoral approach and shall be pursued with a very strong environmental awareness strategy. Focus shall be given on the river systems of the watershed by strict enforcement of anti-pollution measures, implementation of effective waste collection and disposal system, protection on further encroachment of lake shoreland areas and demonstration of soil and water conservation measures through vegetative as well as structural means.

A precondition for the effective implementation of this component is the organization and mobilization of upland communities, lowland dwellers and

relevant stakeholders groups which have particular interest in the watershed resources.

This component should be strongly linked with the Community Organization Program of the Master Plan.

v. Regional Land Use Planning Project

A workable and environmentally sound land-use scheme shall be evolved in this component. This is intended to strike a balance between land supply and demand in the Region to achieve optimum land utilization.

The Project will pursue such specific concerns as:

1. Exact location of deforested and heavily eroded areas requiring immediate attention
2. Development and land acquisition along the lakeshore which are closely linked to lake management and protection
3. Detailed land use of municipalities vital to population forecasts, location of large infrastructure projects like spillway, interceptors, etc.
4. Proposed areas for development

vi. Laguna de Bay Shorelands Management Project

This Project shall address the issues and concerns on the use and occupancy of the lake shorelands. Specifically, it shall focus on the formulation of policies, rules and regulations towards management and protection of the same.

b. Support Component

Supportive development components of great importance to make the program viable shall be pursued. Activities will focus on the following areas:

- i. Policy reorientation/strengthening
- ii. Institutional and manpower development/training/ education
- iii. Research

5.2.3 FISHERIES DEVELOPMENT PROGRAM

5.2.3.1 OBJECTIVES

In order to address the problems and issues in lake fisheries, it is essential to establish that the ultimate objectives in formulating the Laguna de Bay Fisheries

Development Program is to ensure the sustainability of its resources. Specifically, the program aims to achieve the following;

- a. To develop and implement policy measures in conservation, management and development of lake fisheries and aquatic resources.
- b. To maximize and enhance productivity of the fishery resources and thereby, help fisherfolks obtain best returns on their investments without sacrificing its ecological integrity.
- c. To alleviate poverty among municipal fisherfolk by strengthening on-going projects through the provision of support facilities and services.

5.2.3.2 STRATEGIES

Fishery development in Laguna Lake is a complex task that requires the input and support of many agencies both in public and private sector particularly those in the field of research and technology. This development should focus both on regulation in resource use to ensure sustainability and development of other potentials to maximize benefits.

a. Coordination in the Enforcement of Policies and Regulations

The existing fishery rules and regulation set by BFAR through the Fishery Code spells out the conditions under which open fishing may be lawfully allowed. The LLDA in cooperation with the Philippine Coast Guard, BFAR and several fisherfolks association has been implementing fishery regulations and policies in Laguna Lake in order to protect and conserve its aquatic resources. But considering the area coverage, the wide scope of responsibilities and the limited manpower of the above agencies, the mission cannot be fully accomplished.

In this aspect, the role of the local government units (LGUs) is very vital especially with their devolved powers. They are in the better position to monitor fisherfolks activities in areas close to their jurisdiction. A strong linkage and coordination at the operational level is also necessary. One way of doing this is through the participation of fishermen organizations and the federation of mayors league represented in the Board of LLDA. This approach will ensure consistency and can avoid incongruity and duplicity particularly in the matters of enforcement.

b. Development Of Other Fishery Potentials And Strategies For Fishery Development

The waters of Laguna de Bay is an essential and renewable natural resource which supports and promotes the socio-economic development of the lake region. While the lake is utilized for various uses, nobody seems to be concerned with the trend of going-on development . Moreover, very little attention is given on the development of its other potentials in fishery production since everyone seems to be content with the fishpen industry in the lake. Presented below are development potentials to further optimize lake fishery use.

- i. Aquarium fish production
- ii. Land-based aquaculture/hatcheries
- iii. Polyculture technology
- iv. Post harvest technology
- v. Freshwater pearl culture method
- vi. Research on the propagation of indigenous species

5.2.3.3 PROGRAM COMPONENTS

In order to improve the fishery productivity in Laguna Lake, five elements of sustainable fishery development approach should be emphasized. First is fishery law enforcement in order to prevent illegal fishing methods such as electro fishing, chemical fishing and the use of fine meshed nets. Second, is the management of the fishery resources. This involves research and development to maintain the existing and restore the endemic freshwater aquatic species in the lake. Third is the enhancement of fish production. This involves the introduction of new technologies in aquaculture. Fourth is the efficient utilization of fish and other fishery products through the development of proper post harvest technologies which include proper handling, storage and processing of fish and related products. Fifth is the provision of support services and institutional building for credit, financing and marketing purposes.

To operationalize the above fishery development approaches, the sub-programs are presented below:

a. Fishery Regulation

Fishery production in Laguna de Bay has decreased drastically. There are several arguments to explain this phenomenon such as pollution and siltation. However, among the major reasons are over fishing and illegal fishing activities. These activities not only cause depletion of fish resources but also destruction of natural fish habitats. Fishery regulation shall include the following components:

i. Rationalization of the Fishpen Industry

The proliferation of fishpens in Laguna de Bay brought about ecological and social problems. At present, there is a growing concern among fishpen operators and open fishermen on the low fish production. This decline in production is somehow attributed to the decrease on availability of natural feeds in the lake. This may also be due to over fishing and conflict of use among snail gatherers, illegal fishers and fishpen operators.

1. Action Plan for the Demolition on Illegal Fishpen

To address the problems on illegal aquastructures in the Laguna de Bay, the LLDA has come up with OPLAN LINIS LAWA likewise known as the Action Plan for the Demolition of Illegal Fishpens.

The action plan involves three important phases, the pre-dismantling, dismantling and post operational review. The first phase includes fishpen inventory for

demolition, organization of inter-agency Task Force on Illegal Fishpen (TFIF), notification/advice to fishpen owners for demolition and coordination with the LGUs and all concerned agency for the implementation of the demolition plan.

The second phase will focus on the Actual Demolition/Dismantling operation to include the disposal of the dismantled fishpen materials.

The third phase will be the post operational activities. This will involve evaluation and preparation of Final Accomplishment Report on the number of fishpens removed, the corresponding area covered and monitoring of the demolished fishpens.

However, the conflict which lies between LGUs and LLDA regarding issuance of permits for fishpen and fishcage structures must be resolved first before LLDA could execute the demolition of the illegal structures.

2. Reformulation of the Zoning and Management Plan (ZOMAP)

The ZOMAP which was prepared to reassess and redirect the policies and regulations of the LLDA on development and utilization of fishery resources in the lake remains unimplemented. Taking into consideration the existing situation of the lake, the ZOMAP seems inapplicable due to basic flaws which have been identified over the years. The technical bases of the ZOMAP need to be reconsidered. Primary production as basis of fish production need to be reassessed. The conversion factor from primary production seems to be unrealistic. The carrying capacity for lake aquaculture need to be reconsidered in order to determine the recommended area for fishpen culture. Likewise, various environmental features need to be considered in formulating the ZOMAP, these include: bathymetry and geological features of the lake bottom; wind velocity and directions vis-a-vis fishpen belts; lake water circulation in relation to nutrient dynamics; pollution loading from tributary rivers; social acceptability from lakeshore communities and the fishermen sector; and others.

From the above considerations it is thus essential that the fishery zoning and management plan be reviewed and reformulated. As such it should also consider a transition plan to democratize ownership of the fishpens by providing greater access and privilege to small fishermen. This strategy could be affected by a temporary phase-out of the fishpens while the ZOMAP is being reviewed and the policies are being set in place.

A redistributive policy framework should be adopted to give priority to small fishermen cooperatives and to people's organization rather than big-time capitalists many of whom do not even come from Laguna de Bay. Such would jibe with the Social Reform Agenda of the Ramos Administration.

ii. Community Mobilization Project for Law Enforcement on Illegal Fishing (Bantay Lawa Project)

The over-all responsibility in the implementation of fishery rules and regulation in Laguna de Bay remains with BFAR. While this is so, the public expects LLDA to be responsible in enforcing anti-illegal fishing and piracy operations. Thus, there is confusion regarding law enforcement as far as Laguna de Bay is concerned. Therefore as part of this Master Plan, LLDA formulated a proposed Executive Order to further strengthen the powers, functions and coordinative

authority of LLDA stating the inclusion of the exclusive jurisdiction over fisheries in Laguna de Bay Region in its mandates.

In this case, LLDA shall have the full responsibility over fisheries in the region. Regular patrolling system and other activities pertaining to lake fisheries law enforcement shall be implemented to control illegal fishing. Training aspect of this project shall be integrated under the Community Development Program of the Master Plan.

iii. Training/Seminar on Deputation, Conservation and Protection

To ensure effective public participation it is essential to equip the people and make them aware of their important role in the community particularly on environmental protection. The fisherfolks around the lake are not an exemption to this. Lack of such awareness may further result in total degradation of the lake region and the continuous destruction of fishery resources in Laguna lake. It is therefore necessary that proper training and seminar be given to accredited groups of fishermen on the essentials of environmental conservation and protection.

Community organizations and formation of Resource Management Councils (RMC) will be tremendously effective in helping the government in enforcing rules and regulations once proper orientation and training are provided.

b. Fishery Management

For a region greatly dependent on its fishery resources for food and work for its people, the management of such fishery resources is a matter of great concern. The following components will be given priority to ensure an efficient and effective management of fishery resources.

i. Establishment of a Fisheries and Limnological Research Center

The Research Center project aims to develop appropriate information and technologies which support lake management strategies. This will ensure that facilities and human resources are available for research and programs, which will strengthen the database on the lake characteristics and dynamics. The Center shall provide reliable information on natural lake productivity and on factors affecting lake production.

ii. Resource Assessment/Inventory of Aquatic Fauna

Assessment of the aquatic fauna is essential because this will provide information on indigenous species that may be utilized for aquaculture technology instead of importing exotic species which may otherwise adversely affect the local fish population. Consequently, this systematic survey is needed because this provide information on the status of endangered species which are important for conservation purposes. Special attention should focus on the benthic fauna as these are not yet well understood in the lake.

iii. Research on the Propagation of Indigenous Fish Species

The modification of the natural environment due to uncontrolled urbanization and industrialization has led to substantial reduction of indigenous species present in

the lake. This substantial reduction has a great impact on the lake's fish production in the municipal and commercial fishery sectors.

Previously, there were about 25 species in the lake, however, some experts claim that less than 15 species can only be found in the lake at present. This clearly manifests the loss of bio-diversity in the lake.

It is therefore recommended that research should be made on the propagation and reintroduction of the indigenous species to restore the productivity and the ecological balance of the lake.

iv. Establishment of Additional Fish Sanctuaries

The five thousand hectares of fish sanctuary located at Talim point fronting the towns of Laguna may not be equitably located. At present, LLDA divided the lake into six (6) zones for fishery management purposes. It would be more practical and manageable if eight (8) hectare-sanctuaries will be put up in each zone. Fishermen association within each zone with the assistance of an LLDA Field Officer and the concerned LGU Officials will do the monitoring and related activities to manage the sanctuary.

c. Aquaculture Development Program

For the past years, aquaculture development in Laguna de Bay focused only on fishpen and fishcage culture specifically on milkfish, carp and tilapia species. There is really a great need to develop the fishery industry, thus, the proposed program encourage the introduction of new technologies such as presented below:

i. Freshwater Pearl Culture

The focus is on the culture processes of freshwater pearl as an income generating project. It is a model project to develop for technology transfer to people's organization and cooperatives in the region. Studies are already available on the technology of freshwater pearl culture. It would be ideal to try this in Laguna de Bay.

ii. Freshwater Aquarium Fishes Production

Traditional fishfarmers must be encouraged to include in their operation the production of aquarium fishes. One strategy to increase the awareness of the fishfarmers is to put up various freshwater aquarium fishfarms within the region coupled with well defined marketing channels extending to international markets. The LLDA has to extend the necessary support for the development of the industry by establishing projects for aquarium fishes aimed at showcasing the promising venture the industry has to offer. The project to be established must operate on a commercial scale and shall become a consolidation center once the production of aquarium fishes in the region proliferates. Working arrangements are underway to jointly implement the project with UPLB, PCAMRRD, DOST and the Private Sector. (LLDA, 1995).

iii. Polyculture of Macrobrachium sp. and Tilapia sp

A study on polyculture of Tilapia sp., Cyprinus carpio and Macrobrachium sp. was done by Guerrero and Gonzales in 1977. The feasibility study on the polyculture of the said species found out the freshwater shrimp (Macrobrachium sp.) did not affect the growth and survival of the fish (Tilapia sp. and Cyprinus carpio). The rearing of different species of fish of proper number and species combinations resulted in the efficient utilization of all the available food niches/zone in the pond/lake area. Due to the freshwater shrimp's potential as a cheap source of protein, the project also aims to maximize the use of the region's resources to provide an alternative income generating opportunity to fishermen organizations. This will also encourage fishfarmers to practice the technology introduced, particularly polyculture for the improvement and optimization of the fishery industry.

d. Development of Post harvest Technologies

Being endowed with the 90,000-hectare surface area, the region's major source of income is fishing. One of the constraints to future fishery development is the lack of post harvest technologies to ensure rational management and maintain or improve the quality of the fish produce. The quality of the fish greatly affects its price, and therefore, it must be preserved to ensure best return on investment. In order to achieve this, the following activities should be given priority:

i. Survey of Market Needs of the Fishery sector

Surveys on the social acceptability as far as value added products is concerned, is a very important factor to consider to determine what facilities should be given priority so as to promote the wider acceptability of products. This will further identify other needs of the region that must be provided such as support services.

ii. Rehabilitation of Selected Existing Ports

In 1987, there were 61 landing sites around the Laguna lake. Sixteen (16) of these were located in the lakeshore communities of Rizal, 14 in Laguna and 31 in Talim island. Only 48 of these landing sites including 14 in Rizal, 4 in Laguna and 30 in Talim island are with landing structures, the rest have none, most of them are government funded and maintained.

These sites are primarily used to handle cargo and passenger boats. They are not provided with facilities for the convenience of passengers, traders and the using public like adequate berths, passenger sheds, landing, repair and beaching areas and handling facilities.

Generally, the rehabilitation of selected existing ports around the Laguna de Bay (**Annex 2 Figure 5**) shall benefit all the lakeshore communities of Rizal, Laguna and Metro Manila. This will include installation of cold storage - ice plant; small-time canning, smoking, drying, salting factories to develop the value-added products.

The rehabilitation of the above existing ports shall be coordinated with DPWH, BFAR and the Philippine Ports Authority for possible funding and implementation.

iii. Seminar/Workshop/Training on the Proper Handling and Processing of Fish

The activity will provide awareness to the fisherfolks on the value and importance of post harvest technology. The said technology includes handling and processing of fish.

The seminars/trainings will include demonstrations on proper fish handling and processing. This will involve washing, pre-chilling and icing in order to prolong the freshness of the fish. Processing, on the other hand, will include canning, smoking, deboning, fish curing, drying, salting(fermenting), etc. These technologies will also provide the fisherfolks a supplementary source of livelihood when there are surplus of fish caught during the peak months making available the processed product with longer shelf life at affordable prices during lean months.

iv. Improvement of fish transport systems

Taking into consideration that fish is highly perishable, fish transport systems should be given attention so as to maintain the quality of the fish catch. The implementing agencies will endeavor to ensure the essential infrastructure for the transport systems. Farm-to-market roads, bridges and ports needing repair and construction should be identified. LLDA can coordinate in this activity with DPWH and LGUs for the speedy construction and repair of such infrastructures.

e. Institution Building and Support Services

i. Fisherfolk Cooperative Formation

In line with the national goal for fishery development, cooperativism development should be promoted. Formation of more fisherfolk cooperatives will enhance community development through its collective efforts. Organized fisherfolk groups will have the opportunity and the proper training to acquire built-in mechanisms for capital formation. It will also enable government institutions as well as other funding institutions (private and foreign) to offer services to the clients more effectively. This project will be integrated with the Community Development Program.

ii. Funding and Credit Facilities

The proposed development plan particularly on fisheries should be implemented by increasing government budget allocation for credit in order to meet the vast demand of small fisherfolks. Guarantee funds should be increased to encourage private financing institutions to provide loans to fisherfolk groups and cooperatives. One important thing that funding or lending agencies should do is to open more branches or offices within the lake region to increase visibility and accessibility to fisherfolk cooperatives.

The LLDA for its part should strengthen its financial capability and allocate subsidy to finance projects of fisherfolks and farmers. Consequently, its Livelihood Development Program which was deferred temporarily should be reviewed. In the meantime, LLDA will initiate efforts to link-up with existing

credit facilities of other government agencies implementing livelihood assistance/funding projects.

iii. Marketing Assistance

To avoid problems on wastage and over production, marketing information should be extended to producers for them to be aware where to market their harvest. At present the Bureau of Agricultural Statistics has an on going marketing information services program in other regions. This should be enhanced by other concerned institutions in order to have adequate information on the current operation among producers and cooperatives in the region.

5.2.4 AGRICULTURE DEVELOPMENT PROGRAM FOR LAGUNA DE BAY REGION

Considering the basin and Laguna de Bay as a resource critical to the environment and its present exploited state, there is a need to direct development approaches towards a holistic ecological view. It is in this context that the development of the basin should be directed towards the protection of the environment and preservation of its resources without prejudice to the economic growth planned for the area. Thus, this Master Plan will adopt programs in line with resource management principles, where agricultural economic activities will be harmonized with resource protection and ecological balance.

5.2.4.1 DEVELOPMENT OBJECTIVES

The primary objectives for the development of agriculture in the region are:

- a. To promote the long-term sustainability of agriculture through proper and judicious utilization of agricultural lands;
- b. To conserve and protect agricultural production areas of the region from random and haphazard land conversion;
- c. To minimize pollution loading of agricultural waste into the water systems of the basin through development of alternative farming technologies and waste management systems, and
- d. To enhance production and economic viability of the agriculture sector through the development and dissemination of efficient farming technologies and delivery of support services.

5.2.4.2 DEVELOPMENT STRATEGIES

a. Land Use Reassessment and Prioritization

As immediate measure, a study on priority land uses for the remaining agricultural resources should be conducted. This study should include options for the presently underutilized grass and shrub lands in the region particularly found

on the northern side of Laguna de Bay for possible agricultural expansion with recommendations on their proper management and utilization. Land zoning should be completed and adhered to for each municipality in the region and strict implementation of DAR regulations on land conversion should be made to control loss of agricultural lands. The LLDA for its part should come out with criteria that will define the environmental impact of land conversion in terms of effects on soil stability especially on sloping areas, levels of ground water reserves, surface water contamination that may affect the quality of irrigation and domestic water sources of agricultural communities and waste management and disposal.

b. Application of Efficient Farm and Land Management Techniques

Farm management techniques should be developed to shift from subsistence farming and monoculture which are inefficient in terms of production and resource utilization. Farming technologies such as crop diversification, integrated farming, and incorporation of livelihood activities in farming activities should be encouraged.

Soil and water management can best be achieved through the cooperation of farmers. Intensive information dissemination on applicable technologies should be conducted with the aid of the Department of Agriculture and Laguna Lake Development Authority stressing the benefits, not only on the environment, but also on the economic sustainability of farm areas. Additional researches on technology development and application should also be conducted.

c. Development and Promotion of Alternative Farming Technologies

Alternative practices and technologies such as organic fertilizer and pesticide free farming will be promoted to minimize the utilization of pollutive agro-chemicals in farm areas especially near the lakeshore and water systems of the basin.

The shift from commercially prepared agro-chemicals should be achieved through the institutionalization of the different agricultural practices developed and applied mostly by independent farmers who pioneered on organic farming. To ensure viability of these practices, researches on their application and management should be conducted and given attention by the different agricultural institutions especially the Department of Agriculture. Extensive information and extension campaign should also be conducted.

d. Regulation and Monitoring of Agricultural Pollution

Agricultural pollution will be minimized through a regular monitoring of agricultural waste generation and disposal. The use of fertilizer, pesticides, herbicides, fungicides and other agri-chemicals should also be monitored and regulated particularly in farms near the lake. Alternative methods of pest control and fertilizer application should be developed and institutionalized.

To prevent contamination of irrigation waters, regular monitoring of water sources should be conducted due to their susceptibility to pollution. This may occur because of the presence of industrial establishments, agricultural pollution and urban development in surrounding areas.

e. Continuing Research, Development and Dissemination of Technologies

Research and development on agricultural production will focus on innovative agricultural technologies and alternative farming methods including the raising of non-traditional but economically promising crops. This will complement existing research programs of the various agencies, particularly the Department of Agriculture. In addition, the ecological ramification of progress in agricultural techniques and practices should be well established as basis for future policy development and technology enhancement.

Methods for effective agricultural extension and information dissemination will be developed as a means for community development. Primarily, the Department of Agriculture with its network of extension workers should intensify its information and technology transfer programs. Intensive extension will also be conducted to promote community participation in the implementation and promulgation of environmentally concerned programs.

f. Enhancement of Delivery of Agricultural Support Components

Basic to agricultural development is the availability of support services that could ensure not only productivity but the realization of fair returns on the farmers' efforts and investments. To attain projected development, i.e. increased and sustained production and income of farmers above the level of poverty, development of support services and structures should be provided through a sustained regional development program.

A redefinition of policy and development strategies especially in the promotion of farming practices that will enhance agricultural resource base should accompany the basic package of support services.

g. Policy Development and Institutional Capability Build-up

Certain institutional deficiencies could be attributed to the implementation of agricultural programs in the region particularly on reconciling the environmental priorities of the watershed with agri-industrial development. Specific policy issues for instance should be resolved such as priority land uses, extensive agri-modernization against environmental repercussions, distribution of institutional responsibilities among involved agencies and organizations, and others.

The resolution of policy conflicts and gaps should provide the overall directions for effective agricultural development while an institutional framework based on a clear definition of responsibilities and inter-agency coordination system should facilitate the delivery of services required by the sector.

The Laguna Lake Development Authority, as the main agency responsible for the development and management of resources within the region should (in cooperation with the DA and the LGUs) take an active role towards this end.

5.2.4.3 PROGRAM COMPONENTS

a. Agricultural Spatial Development

The framework for spatial development of agricultural areas will follow those laid for the designation of development zones in the basin area where the western corridor including Metro Manila will be maintained as urban and industrial zone. The eastern half of the basin will be designated for resource management and protection of the watershed.

Applied to agricultural development, this will mean that land conversion will be more liberally allowed west of Laguna de Bay towards Metro Manila under specific rules and environmental standards and subject to reassessment of land use and prioritization. The remaining agricultural lands in the province of Rizal should also be reassessed immediately in view of the rapid urbanization of the province to determine lands that could still be used for agricultural cultivation. Prime lands occurring on the south and east sides of the lake will be placed under protected agricultural areas and will be maintained for primary production purposes.

The reclassification of forest areas dominated by grass and shrublands especially on the northern side of Laguna de Bay should also be considered. The northern tip of the basin dominated by high reliefs of the Sierra Madre mountains and the Marikina Watershed as well as the mountains of Jalajala peninsula and Talim island will be excluded from extensive agricultural activities and other forms of land conversion to protect the environment. The same will apply to Mt. Makiling, Mt. San Cristobal, Mt. Banahaw and other areas of high reliefs with slopes of 25%. These areas are susceptible to environmental degradation which can destroy natural bio-diversity, destroy soil profile due to soil erosion and cause flash floods and siltation of water systems and eventually, dry up the water sources of Laguna de Bay.

Corollary to spatial development and land use reclassification, the framework will take into account the overall ecological implication of agricultural land conversion on designated urban and industrial zones to complement resource management and minimize environmental hazards that may be created.

i. Basic Strategies

1. Land use assessment;
2. Identification and maintenance of Agriculture Protected Areas;
3. Environmental planning and monitoring of designated Urban and Industrial zones;
4. Inter-agency coordination on the implementation of land conversion rules and regulations;
5. Agricultural integration with urban and watershed protection

ii. **Land Use Assessment Targets and Measures for Agricultural Areas**

1. **Laguna de Bay Regional Development Zones:**

WEST LAGUNA DE BAY - Urban and Industrial Zone

EAST LAGUNA DE BAY - Watershed Protection Zone

2. **Breakdown of Regional Assessment Zones:**

Metro Manila

North-west shores from Taguig and Muntinlupa radiating towards Manila Bay covering the urban centers of Metro Manila.

- o Urban and industrial center

Rizal Province

Includes the north shores from Taytay to Tanay; the upland areas of Rizal and lowland areas along the periphery of Metro Manila boundary except Talim Island and upper Marikina watershed.

- o Land use assessment and prioritization to rationalize land conversion of lowlands agricultural areas;
- o Assessment of land use in the upland areas and grasslands to determine possible areas for agricultural production and pasture expansion and/or forest protection;
- o Agricultural integration with watershed protection;
- o Agri-urban integration for remaining agricultural lands (agri-industries, processing, markets, etc.)

East Laguna

Includes prime agricultural lands along the shores of East Bay from Sta. Maria and Mabitac down to Pila. Also includes upland agricultural areas in the Marikina and Sta. Cruz Sub-watershed areas.

- o Agricultural protected areas
- o Institution of agricultural development programs and support services
- o Technology support on soil and water conservation

West Laguna

Covering the lakeshore towns of San Pedro, Biñan, Sta Rosa and Cabuyao, includes prime lands especially along the lakeshore, but internal and external threat of urban growth mostly as spill-over of Metro Manila threatens agri-development.

- o For immediate assessment and prioritization of land-use for the short to medium-term to remedy the chaotic conversion of agricultural lands;
- o Agri-urban integration for remaining agricultural lands (agri-industries, processing, markets, etc.)
- o Assessment of environmental effects of conversion

Cavite - Carmona, Silang, Tagaytay

Upland agriculture area.

- o Agri-integration with soil and water conservation
- o Land prioritization of land-use for Carmona, Cavite which is a designated industrial zone for Cavite province

South Laguna and Batangas

Includes prime agricultural lands of the lakeshore towns from Calamba to Victoria and upland agricultural lands upstream towards Batangas and Quezon, except high reliefs of the different mountain systems in the area.

Prime agricultural lands along the shore and upland production areas.

- o Agricultural protected areas
- o Institution of agricultural development programs

Marikina Watershed and Sierra Madre Mountains

Includes the northern tip of Sierra Madre Mountains towards the regions boundary with Quezon province, covering Rodriguez, Antipolo, Tanay, and Jalajala peninsula up to slope of 25%.

- o Watershed Protection
- o Production Forest
- o Agro-forestry and sustainable agriculture will be allowed subject to strict application of conservation and protection measures in suitable areas.

Other high relief areas

Slopes more than 25% includes Sierra Madre Mountain and other mountain systems within the watershed basin including Talim island in the Central Bay, Jalajala peninsula, Mt. Makiling, Mt. Banahaw, San Cristobal, etc.

- o Strictly protection and production forest

Lakeshore areas

Extends ²⁰22 kilometers from end to end covering some 14,100 has. presently utilized for various activities including agriculture and poultry.

- o Protection and buffer zone
- o Controlled agricultural activities

iii. Breakdown of proposed agricultural zones

Based on the foregoing rationalization of land use, the region's agricultural lands could be re-designated as follows:

1. Agriculture Protected Area (APA)

- o **Primary Agricultural Area**
Lowland agriculture area
Rice, corn and other primary crops
- o **Secondary Agricultural Area**
Lower Upland Agriculture area
High value crops, industrial crops
- o **Agro-Environment Protection Area**
Agro-Watershed Protection Areas
Integrated Upland Agriculture
Pasture and grazing,

Lakeshore Protection Area
Regulated agriculture

2. Urban and Industrial Conversion Zone

- o Short-term agriculture utilization
- o Conversion area

3. Watershed Protection Area

b. Agricultural Resource Management for Sustainable Development

Resource management shall integrate environmental concerns with agricultural production with the objective of protecting and conserving existing agricultural resources of the region. Environmental effects of agro-modernization and

extensive use of farm inputs should be properly investigated to minimize damage to the general ecosystem of the basin area especially in the pollution status of the lake and other water systems. Agricultural activities that will prove to have adverse effect on the environment will be discouraged and alternative technologies will be developed in the short to medium term. Research and studies will also be directed towards the development of measures to counter or minimize these harmful environmental effects.

Agro-modernization will be promoted through the development of alternative cropping systems with marketing and industrial potentials. Non-productive and marginal cropping systems such as monoculture of rice and corn in unsuitable lands and shifting cultivation in upland areas will also be phased out in favor of more efficient farming methods. Soil and water conservation measures will be adopted for marginal and sub-marginal lands in hilly and upland areas. Viable technologies for the application of organic farming technologies will be developed to minimize production cost and environmental damage.

i. Basic Strategies

1. Crop diversification
2. Integrated Farming System
3. Soil and Water Conservation Systems
4. Establishment of Organic Farming Technology

ii. Implementation Targets

The introduction of efficient farming methods will be instituted throughout the Laguna de Bay region and sustained as the main strategy for development. The dissemination of these practices which will be the basis for encouraging farmers to adopt new practices will be anchored on the implementation of pilot projects where the technologies and approaches discussed will be showcased. Three sites have been selected for the purpose:

1. Pagsanjan Sub-watershed Integrated Agriculture Project;
2. Marikina Sub-watershed Integrated Upland Agriculture Project;
3. Nagcarlan Integrated Natural Agriculture

The three projects will also be implemented with programs on organic farming system, waste management and pollution control as standard components of implementation.

c. Agricultural Ecosystem Protection and Waste Management

Waste management is critical for the protection of the basin's ecology because of the significant effect of pollution to its hydrologic resources particularly the Laguna de Bay. Since all waterways in the basin drain ultimately to the Lake, wash down of agricultural waste contribute to the deterioration of its waters. Pollution occur from excess nutrient loading from nitrogen and phosphorus content of fertilizers, as well as from animal manure produced in poultry and livestock raised either commercially or small-scale production. Chemical residues

from pesticides used in rice, corn, vegetable and fruit trees are also washed to the water. Decaying agricultural waste products such as rice hulls, corn and coconut by-products, sub-quality fruits and vegetables and domestic wastes from farmers' households are also contributory to pollution.

Waste minimization will be effected through intensive information and education campaign among farmers and rural population to apply proper methods of waste disposal and handling of agro-chemicals. Technology on compost preparation and application will be disseminated among farmers to utilize waste products.

i. Basic Strategies

1. Monitoring and control of agri-chemical utilization

- o Survey of fertilizers and pesticides
- o Implementation of control measures
- o Conduct of research studies and information dissemination

2. Livestock and poultry waste management

- o Survey and monitoring of livestock and poultry waste producing areas;
- o Regulation and control of animal waste loading;
 - Commercial Livestock and Poultry Farms
 - Duck Farms
 - Backyard Animal Raising

3. Policy Measures

Recommended measures that should be adopted for the control of agricultural wastes loading in Laguna de Bay include the following:

- o Regulation of pesticide and fertilizer use in farms located along the lakeshore and water tributaries. Agro-chemicals found to have harmful effects and pollutive qualities will be banned from being used in the region. The use of organic fertilizer and pest control will be encouraged among farmers through technology development and extensive information and education campaign;
- o Institution of levy on every sale of fertilizer and pesticide in the region which will be determined to have harmful and pollutive effect. The amount will go to a fund for the clean-up and rehabilitation of the lake and other water systems;
- o Improvement of the system in the regulation of commercial livestock and poultry farms by requiring the installation of waste management facilities and institution of waste management programs;

- o Regulation of duck raising along the lakeshore by controlling the number of farms and total population of ducks, requiring owners to install waste collection and disposal systems and environmental monitoring. A recommendation for the phase-out and banning of duck raising along the lakeshore will be the subject of a policy study on the matter;
- o A policy study should also be conducted to prohibit the raising of livestock and poultry along creeks, rivers and other water systems including backyard animal raising to minimize water pollution;
- o Promotion of composting and natural pest control as alternative agricultural production technologies, and
- o Institution of award schemes where farmers adopting environmentally friendly inputs and technologies, and soil and water conservation measures will be cited and given incentives for their participation in resource protection and conservation.

4. Research Development and Information Dissemination

Research and information extension are recommended to be conducted on the following fields:

- o Periodic inventory of the different types and brands of agro-chemicals and assessment of effects of major chemical and pollutive substances on quality and quantity of aquatic life (vegetation and fishery), water resources and effect of consumption of contaminated water, vegetation or animals and fish. The study will include recommendations for storage, handling and disposal of the chemicals;
- o Identification, development and dissemination of alternative and innovative technologies for the use of substitute fertilizer and pest control measures; e.g. composting and natural pest control;
- o Periodic inventory of livestock and poultry farms and backyard raised animals and assessment of amount of pollution loading contributed by these sources;
- o Development of a prototype waste management plan for livestock (hogs, cattle, goat, etc.), poultry (chicken and ducks); Development of systems for controlling waste loading from backyard livestock and poultry; other agricultural waste products.

ii. Implementation Targets

1. Control Points Establishment

Pilot control points and study areas will be established in identified critical areas to monitor agricultural pollution and implement control measures.

The areas identified for this purpose are as follows:

- o Los Baños
agri-chemical and fertilizer waste monitoring;
- o Antipolo/Teresa
livestock waste monitoring and management
- o Cardona/Taguig/San Pedro (Lakeshore)
Duck waste management

2. Formulation of management and control systems

This will involve the formulation of applicable policies and guidelines on waste management, setting-up of institutional coordination systems, and review and formulation of recommended waste management measures.

3. Implementation and enforcement of waste management measures

Waste loading will be monitored through the established control points. Waste management measures will be instituted for commercial farms and utilization of agri-chemicals will be regularly monitored. Punitive and or incentive measures based on approved policies and guidelines will be instituted to regulate agricultural waste generation.

In addition to these projects, a pilot site for the promotion of compost utilization will also be identified to establish a cooperative compost facility for the purpose of utilizing agricultural waste materials. The compost that will be produced will be retailed to members and to other interested farmers. Individual compost pits will also be promoted among farmers and communities through extension and effective community mobilization.

d. Alternative Livestock and Poultry Development

The region with its grasslands and savannahs could be a potential area for livestock industry. Market-wise, the viability of the livestock and poultry industry in the region could be based on the presence of extensive institutional buyers such as restaurants and hotels in addition to a wide domestic consumer base. So far poultry and hog production industry has a wide distribution throughout the region. Cattle is based mostly in Batangas province where it is being raised thus, accounting for it being one of the Livestock Key Production Areas (KPA) for the Medium-Term Livestock Development Program of the Department of Agriculture.

Supporting the livestock program, expansion of grazing lands into the existing grasslands could be allowed to correct the problem of insufficient supply of meat and milk products. Where feasible, livestock industry can be established in appropriate areas notably in grasslands found throughout the northeastern side of Laguna de Bay. The utilization of these areas for livestock grazing, however should be based on recommendations on appropriate land-use and bio-diversity survey to avoid environmental displacement.

To complement the main livestock and poultry programs implemented by DA, alternative programs will also be developed and promoted. Among these are exploration on the feasibility of raising small ruminants (goat, sheep, deer) for meat and dairy. Quail will also be considered as another option instead of chicken mainly to supply institutional needs for meat and eggs.

i. Basic Strategies

1. Goat and Other Small Livestock as source of meat and dairy
2. Quail Production
3. Small animal dispersal program
4. Program Assisted Livestock and Poultry Development Project
5. Small Livestock Research and Demonstration Farm

c. Agricultural Support Program

Agricultural production remains a significant economic factor in the region. However, despite overall growth a reverse trend in agriculture have become prevalent where basic and secondary crops including rice and corn have registered low productivity. Several factors could account for this trend including low soil fertility, inadequate irrigation water, lack of appropriate technologies to adopt new and efficient methods of production, and lack of capital to purchase farm inputs. Agricultural support services in the area of transportation, post harvest processing, storage and marketing, research, extension and community participatory approaches should also be given much needed attention to improve the performance of agriculture sector and keep pace with the overall growth in the area. The strengthening of the sector is a necessary condition to maintain its viability as the primary source of food and raw materials for the region's population and industries.

i. Basic Strategies

1. Agricultural Modernization
2. Agricultural Input Assistance
 - o Planting and Animal Stocks
 - o Fertilizer and Pesticides
 - o Feeds and Veterinary Supplies

3. Capital Procurement
Credit and Guarantee Facilities
4. Infrastructure and Support Facilities
 - o Development of Irrigation Facilities
 - o Development of Post-harvest Facilities
 - o Farm to Market Transport Facilities
4. Marketing Support

ii. Implementation Targets

The provision of necessary interventions and support services in the course of agricultural development would be pursued adequately and applied equitably to benefit more areas and farmers. While special attention would still be focused on priority projects for food production sufficiency, the great potentials of raising non-traditional crops in otherwise marginal croplands would tip the balance for more attention to be directed to these areas.

f. Research and Technology Development

The concern of research in agriculture is to balance at least three interests in the sector: a) income generation for farmers; b) food sufficiency requirement of the region; and c) environmental conservation. The objective of research and technology development would be to reconcile these interests through the formulation of technology packages that will support an increase in production and income and extricate the common farmers from subsistence farming without disavowing the environment.

The basic flaw of nationally implemented agricultural programs is that it failed to consider the inherent bio-diversity and physiographic characteristics for specific implementation areas so that environmental considerations are often neglected. Programs and researches likewise tend to concentrate on lowland crops specially rice and corn. Then, again, these are focused mainly on increasing production rather than promoting environmental stability which could spell the difference in agricultural sustainability.

Thus, the role of research and development is crucial at this point as the balancing factor for the various interventions persisting in the sector.

i. Areas of agricultural research

1. Crops and livestock production
2. Agro-environmental research
3. Agro-based livelihood and support activities
4. Policy research

g. Information, Extension and Community Development

Agricultural development in the region will be anchored on effective dissemination of information and technologies through extension work and empowerment of farmers for them to effectively participate in the various development programs.

The Department of Agriculture with its network of Farm Technologists and Agriculturist will be the main instrument in the dissemination of technologies and promotion of community empowerment. The LLDA on the other hand with its information programs can facilitate extension work through the production of relevant materials for public dissemination by appropriate media such as print, broadcast, audio-visual, and other forms of communication. There are also other agencies, NGOs and private groups which conducts researches and disseminate information on applied technologies and community development. These groups can be tapped to assist in this activity. Inter-agency linkage and coordination will be strengthened with LLDA as the coordinating agency to institutionalize these tie-ups.

i. Basic Strategies

1. Information and Extension Needs Assessment
2. Community Development and Mobilization
3. Institutional Build-up

ii. Implementation Arrangement

The implementation of a comprehensive program for Information, Education and Coordination (IEC) and detailed strategies for Community Development and extension are covered by the over-all programs for Lake Environmental Education and Communication Support Program, and Community Development Program for Laguna de Bay under this Master Plan.

h. Institutional Arrangement for Agricultural Development

To achieve a holistic development of the region, Laguna Lake Development Authority (LLDA) must assume an active role in the overall management of the system. This should include visible participation not only in lake management but also in providing interventions in land resources, especially in the watershed's forest and agricultural lands.

Certain institutional deficiencies could be attributed to the implementation of agricultural programs in the region particularly on reconciling the environmental priorities of the watershed with development. While the Department of Agriculture (DA) is the main agency involved in the sector, its primary concern is production thus, conflict with the environmental concerns of the watershed may occur. On the other hand, LLDA has been mandated to lead in the management and development of the environment and natural resources in the Laguna de Bay.

i. Strengthening LLDA's Role in Agricultural Development

1. Institutional Role of LLDA

2. LLDA could participate in the following development aspects:

- o Research and development particularly on environment programs and projects for agriculture;
- o Development and formulation of information campaign materials and strategies to promote technologies and alternative programs;
- o Community development and empowerment of farmers for a participatory approach in the implementation of programs and development interventions;
- o Land capability assessment and rationalization of land-use especially involving agricultural land conversion;
- o Pilot design and implementation of projects for viability assessment of alternative agricultural programs which are not covered by regular programs of DA.
- o Conduct of policy studies and reformulation of operating guidelines for the achievement of the goals set in this master plan.

ii. Organizational and Human Resources

Organizational and human resource restructuring should be adopted for LLDA to provide it with institutional capabilities not available in its present organizational structure. This will involve an organizational change and restructuring to include personnel with expertise in agricultural development (crops, livestock, poultry, etc.), community development and information and extension activities. This will be augmented by appropriate trainings and relevant short courses for existing personnel complement who will be involved in the implementation of the programs under this plan.

iii. Institutional Linkage

The Laguna de Bay region is a cauldron where Government Institutions, Non-Government Organizations, People's Organizations, Business and Private groups intermingle to form the different interest bodies in the area, in a relationship that range from complementary to contrasting policy and priorities. The agriculture sector is an area where conflicting priorities is not only apparent but also real.

Resolution of concerns and priorities for Laguna de Bay would be achieved more through institutionalization of strong linkages and coordination among the many agencies and groups operating in the region. LLDA, in accordance with its mandate would be at the center of this effort by focusing on the policies and operation of the different agencies to synthesize an institutional arrangement towards a uniform goal which is the development and sustainable management of Laguna de Bay.

5.2.5 COTTAGE INDUSTRY DEVELOPMENT PROGRAM

5.2.5.1 OBJECTIVES

While industrialization is taking place in the Laguna de Bay Region, a predominantly agricultural economy still prevail in other areas. This underscores the significance of cottage industries' promotion and expansion to improve the quality of life and spread its benefits especially among the lakeshore dwellers.

The Laguna Lake Development Authority conceives its corporate mission in consideration of the regional economic setting, so that development approaches will pay particular regard to:

- a. Generally accelerating the pace of development, expansion and regulation of cottage industries;
- b. Generating employment opportunities to the unemployed and the underemployed;
- c. Providing additional income to sub-marginal households and alternative livelihood to the marginal fisherfolks/farmers;
- d. Maximizing the utilization of abundant raw material resources by training manpower in craft skills for production of saleable quality cottage products; and
- e. Choosing projects appropriate to local industry needs and available raw materials.

The Authority, being the prime mover of development in the Laguna de Bay Region, shall coordinate with the Department of Trade and Industry and take the initiative in the cottage industry development within the basin, especially in the identification of target beneficiaries and linking them with appropriate agencies in the extension of training skills and the monitoring of activities to ensure the sustainability of the said endeavor.

5.2.5.2 STRATEGIES FOR IMPLEMENTATION

The development of cottage industry in Laguna de Bay Region depends largely on the sustainability of raw materials, the existing market conditions, manpower development and the government support available.

The following measures will relate to the survival and growth of cottage industry in the region:

a. Intensification of Manpower Development in the Region

While technical/vocational schools and manpower training centers are available in different parts of the region, they serve only those who voluntarily enrol and avail of the course/training for employment purposes or business endeavor.

There is a need to develop a rational training program in Laguna de Bay Region based on the needs and requirements of the existing industries and would-be entrepreneurs. This involves the strengthening and integration of manpower training activities of related agencies particularly for skilled workers.

The intensification of manpower development in the region will answer the problem of unemployment and prevent importation of skilled workers from other localities/regions.

b. Establishment of a Cottage Industries Display Center

One of the reasons for slow paced development in the cottage industry is the marketing of its produce. Most of the products of this sector are marketed locally, among the neighborhood and sometimes for personal consumption because of marketing constraints.

There is a need to have a showcase of the region's major products to facilitate the promotion and marketing of cottage industries. The establishment of a display center would be of great assistance to the local producers and manufacturers of the region as far as marketing is concerned. It would also offer export opportunities because it will be a venue for negotiations between the producers and the buyers.

c. Formation of Fishermen's/Farmers' Association

This involves the process of evolving, maintaining strengthening fishermen/farmers association in the coastal areas of Laguna Lake. This will develop organizations capable of managing and sustaining projects that will be implemented in the Region of which they are the target beneficiaries.

d. Development Communication Support

This will be supported by a development communication strategy to:

- i. create awareness on the program and inform prospective fishermen/farmers-beneficiaries of what can they benefit from the program;
- ii. generate local participation both on the institutional and target client level; and,

- iii. inform, educate and motivate beneficiaries on lake conservation and promote their active participation in the environment program of LLDA.

e. Inter-agency Coordination/Linkages

The program calls for the assistance of many agencies and institutions involved in cottage industries development. It, therefore, requires efficient and effective institutional linkages between and among the target beneficiaries, various agencies and organizations and the Authority.

5.2.5.3 PROPOSED DEVELOPMENT PROJECTS FOR COTTAGE INDUSTRIES

Basically, cottage industry development is a mandated function of the Department of Trade and Industry and its attached agencies. However, being the agency with legal jurisdiction over the Laguna de Bay Region, the LLDA shall be involved in the implementation of projects herein identified to support other projects already being implemented primarily by DTI and other agencies.

The development potentials of cottage industries propelled the Authority to translate these strategies into projects that would support and encourage the target beneficiaries to deviate their livelihood ventures into land-based activities.

a. Laguna de Bay Livelihood Training Program

There is a need to develop a rational training program in Laguna de Bay Region that would address the demand for appropriate skills of the industries and other community based business activities. This will be made possible through the proposed Laguna de Bay Livelihood Training Program. The skills training program shall include the inventory of manpower resources in the region, the profiling or development of data base of these resources, integration of skills training of different agencies, manpower training and on-the-job training to enable the trainees to apply the knowledge they acquired.

b. Trade House Arts and Crafts Center

To further boost cottage industry development in the region, a Trade House Arts and Crafts Center which will function as a venue for promotion of all major products in the locality shall be established. Artworks of famous artists in the region shall likewise be displayed in this establishment. In addition, raw materials shall be provided in the center to facilitate procurement and assure of continuous supply to the users. The presence of a display center in strategic places in Laguna de Bay Region (one in Rizal and another one in Laguna) will facilitate the marketing of cottage industry products and increase the demand of the same because of a systematic marketing system.

The community organizing and communication component of this program shall be dealt with elsewhere in the Master Plan.

5.2.6 INSTITUTIONAL DEVELOPMENT PROGRAM

5.2.6.1 OBJECTIVES

The institutional development program for the Laguna de Bay Master Plan should focus on the following major objectives:

- a. Development of mechanisms or institutional arrangements to resolve conflicting interest between and among the Central Government, Regional interests and Municipal level interests;
- b. Delineation of LLDA's jurisdiction, powers, authority and responsibility vis-a-vis other government entities operating in Laguna de Bay Region and development of a coordinative structure;
- c. Development of mechanisms or institutional arrangements to create a venue for resolving conflicts and interests among sectors/stakeholders;
- d. Development of mechanisms or institutional arrangements to ensure public participation in decision-making process;
- e. Reorganization and strengthening of LLDA as the agency mandated to manage the Laguna de Bay and its resources.

5.2.6.2 INSTITUTIONAL DEVELOPMENT PROGRAM COMPONENTS

Presented below are Institutional Development Components which have to be implemented to address the institutional problems and concerns in order to ensure an efficient and equitable approach to the management of the Laguna de Bay and its watershed.

- a. **Restructure the Decision-making Process, Ensure Public Participation and Strengthen the Coordinative Powers of the Laguna Lake Development Authority**

This project will attempt to give impetus in restructuring the decision-making process in the development of the Laguna de Bay Region. It shall address the overlapping of powers and functions among multifarious agencies operating in the Laguna de Bay Region. This project however will focus on the Laguna Lake Development Authority-Board of Director's composition and its consequent reconstitution that will provide a responsive forum in the management of the lake. This will also involve the development of coordination scheme for proper implementation of policies and programs that will directly or indirectly affect the Laguna de Bay Region.

b. Proposal to Reorganize the Laguna Lake Development Authority

This project aims to address the lack of proper response in the region's development. This is so because of the increased environmental degradation and the apparent lack of proper organizational set up for this purpose. Fortunately the reorganization of the agency has already been allowed under E.O. No. 927. Its operationalization would allow the formation of a more responsive structure for LLDA.

c. Proposal to Strengthen the Financial Resources and Fiscal Capability of the Laguna Lake Development Authority

This project will attempt to strengthen the financial resources of the Authority by maximizing its capabilities in order to adhere to its corporate mandate of making the same a self-sufficient government owned and controlled corporation. This will also create investment opportunities and other financial support and assistance to qualified organizations as may be developed by this project.

d. Human Resources Development Project

The LLDA has through the years suffered rapid personnel turn-over primarily because of the exodus of the same due to lack of career development opportunities and low salary among others. This project therefore will attempt to address personnel capability build-up both in the management and rank and file levels. This will also complement other development projects covered by the Master Plan.

5.2.7 LAKE ENVIRONMENTAL EDUCATION AND COMMUNICATION SUPPORT PROGRAM

5.2.7.1 OBJECTIVES

The general objective of this program is to increase the effectiveness of IEC activities in support of LLDA's development thrusts. It aims to strengthen development communication both internal and external to support the agency's various projects by increasing the capabilities of its public information unit, to systematically design, plan, implement, and evaluate IEC strategies.

In order to achieve the general objective, the program shall be directed at attaining the following specific objectives:

- a. To update the skills of LLDA staff through training program on IEC strategies and techniques, particularly those involving communication planning and management, which consider audience, message, media and response-mechanism factors.
- b. To create a Public Information Unit that will strengthen the information, education and communication capability of LLDA;

- c. To instill public awareness and understanding of the policies, plans, programs and projects of the LLDA and other government agencies in the Laguna de Bay;
- d. To clarify certain perceptions and information, misunderstanding, misrepresentations relating to the policies and plans, programs and projects of government on Laguna de Bay.
- e. To properly inform the concerned sectors on the implications and consequences on the lake and its environment of activities on the use of the lake and its resources as well as what government is prepared to do to respond to such consequences;
- f. To harness and mobilize the resources of other agencies, the private sector, lakeshore communities and local government units in undertaking information, education and communication campaigns;
- g. To formulate an immediate action program to help address and clarify issues and conflict, relative to the Laguna de Bay in order to ensure sustainable development in the region.

5.2.7.2 STRATEGIES FOR IMPLEMENTATION

a. Conceptual Framework

The IEC Program approach borrows heavily from Michael Porter's Information for Competitive Advantage (IFCA), translated by Development Academy of the Philippines into the phrase "Information for Mission Accomplishment (IFMA) (Carreon, 1989). IFMA simply states that information and its appurtenant technology and systems plan can be used to enable a government agency to accomplish its mission with greater impacts and results. Applied to the LLDA program, this requires:

- i. An understanding of the reason for being of the LLDA and the workflow that should result in the accomplishment of its mandate;
- ii. Definition and classification of the Authority's functions into primary and support functions and identification of organizational units that undertake them;
- iii. Identification of activities which are critical to mission accomplishment and their related problems and issues;
- iv. Identification of information technology/systems interventions;
- v. Prioritization of issues based on the strategic thrusts of LLDA;
- vi. Determination of the strategic responses to the kind of receipt, processing, storage and transmittal of information necessary for the performance of strategic functions such as hardware, software,

human resource and other organizational requirements, media, and substance.

b. Participatory Approach

A participatory approach to formulation and implementation shall be applied in the IEC program. Lessons from both failures and successes in environmental and developmental efforts have shown that citizen's participation is an important decisive factor. Absence or lack of it has caused failures. Its active presence has resulted not only in efforts meeting immediate targets but also in the assured sustainability of positive trends that have been initiated.

Incorporation of the participatory approach to communication research, planning and management of the IEC program of LLDA will ensure support from beneficiaries. It will also facilitate immediate feedback on the social and institutional impacts of development projects being implemented in the region.

5.2.7.3 PROGRAM COMPONENTS

a. Organizational Development Project

i. LLDA IEC Organizational Development Project

A great part of a successful information campaign rests on the capability of LLDA being the lead agency involved on the conservation, protection and management of the Laguna de Bay Region. It is therefore essential to focus on organizational development activities to address the technical capability requirements of LLDA as a lead implementing agency. It is also necessary to undertake IEC programs for the General Public through formal and non-formal means in order to facilitate acceptance and understanding of the IEC programs.

The LLDA IEC Organizational Development Project shall include the following;

1. Formalization of LLDA IEC Unit - The Public Information Unit

The establishment of a Public Information Unit (PIU) which shall collect, review and integrate all relevant information on the problems, issues, programs, projects and other areas of concern within the Laguna de Bay Region is essential. There is an urgent need to formalize and regularize this unit to perform its task effectively.

This project shall include Mobilization, Training and Capability Building and Networking and Linkages with other government agencies, NGOs and people's/sectoral organization.

2. Mobilization

The Public Information Unit will be mobilized by undertaking the following activities: First, the consolidation and updating of relevant information, issues,

programs and projects about LLDA operation and activities in the Laguna de Bay Region through publication of pamphlets hand-outs, primer, films, videos and other research materials for the General Public. Secondly, the PIU will maintain a **PUBLIC ASSISTANCE DESK** hand in hand with a **QUICK RESPONSE DESK** that will cater to the needs of LLDA's clientele in terms of handling complaints and respond to the issues raised by media as well as monitor other controversial issues that need immediate attention and action. Thirdly, it shall conduct consultative meetings and/or symposia to orient, increase and develop the level of awareness of decision-makers and top government officials, employees, industries and the basic sectors towards policies that are formulated by LLDA.

3. Training and Capability Building

The capability of the IEC unit staff can be strengthened by providing them with additional training on IEC work, particularly on the theory and practice of effective communication. Two categories of training needs are seen to be most urgent: that involving the planning, organization and management of IEC campaigns, including how to conduct clientele profile; and training in technical skills, such as writing, broadcasting and audio-visual production.

4. GO/NGO/PO Networking and Linkages

The LLDA will establish linkages and networking of communication with various government and non government agencies, environmentally oriented organizations and academic institutions for a multi-disciplinary approach to public information campaign.

o LLDA Tie-Up with PIA

The weak linkages among the various PO/NGO/GO units can be strengthened by establishing strong linkage of LLDA Public Information Unit with the Philippine Information Agency (PIA). Through proper networking, a smooth flow of information exchange in terms of research and development will be carried on to information officers of each local government unit, environmental NGOs and the academe.

o LLDA Tie-Up with Marketing Information System

A tie-up with the Bureau of Agricultural Statistics(BAS) is also seen necessary to LLDA operation. The Agricultural marketing Information System or AGMARIS is a system encompassing the four functions of an information system, namely, data collection, data processing, data analysis, and information dissemination. LLDA will also study the application of this system for fisheries and socio-economic development.

ii. IEC Facilities/Infrastructure Development

This sub-component shall include four major facilities/infrastructure development projects to address the problem on consolidating information materials for the Laguna de Bay Region.

1. Equipment Acquisition

The acquisition of equipment for IEC is an important factor in order to facilitate effective implementation of the IEC projects. These will include the procurement of audio-visual equipment. Printing and reproduction facilities shall be rehabilitated and upgraded to provide quality printing of information material.

2. Establishment of an Audio-Visual Room at LLDA

One major component of a good IEC is the establishment of an audio-visual room at LLDA. Features on environmental and developmental concerns can be presented in this audio-visual room. Education and training activities can likewise be conducted in this facility once established.

3. Establishment of a Clearing House/Central Library

To ensure sustainable management of the Laguna de Bay, there should a multi-sectoral effort to establish a clearing house or central library where all research data, files, information about the Laguna de Bay region and its watershed will be stored for an effective and immediate access to accurate information.

4. Establishment of a Mini-Museum for Indigenous Freshwater Species of Laguna de Bay

A mini-museum shall be established to serve as venue for exhibits of freshwater indigenous fishes and aquatic plants and other technologies for the development of fisheries in the region. This mini-museum will display the biodiversity of aquatic species in the region to create an awareness and to promote and preserve the ecological integrity of aquatic resources in Laguna de Bay.

5. Establishment of a Regional Training Center

The existing LLDA Administration Building located in Calauan, Laguna will be transformed into a Regional Training Center for the conduct of seminars/workshops and other conferences on issues relevant to the lake and its watershed as well as concerns for the development of the region.

b. Environmental Consciousness Promotion Project

i. Institutionalization of "Laguna de Bay Month"

LLDA shall coordinate with the various environmental NGOs and LGUs to facilitate these activities through the launching of annual "Laguna de Bay Month" every October to coincide with the LLDA Anniversary. With the support of local officials, LLDA will initiate efforts to institutionalize this annual celebration and shall undertake the following activities.

1. Environmental Contests

Environmental consciousness requires creative ways to encourage massive participation. The conduct of different contest and activities will be institutionalized as a means to public involvement. Various environmentally related themes can be highlighted through the following activities: Poster-

Making, Essay-Writing, Jingle-Writing, Poetry-Writing Contests. Moreover, the student sector will be enjoined through activities such as Inter-High School Trivia Contest on Environment, Tree-Planting Activities and Recycled Toy-Making Contest and others.

2. Environmental Concerts and Cultural Presentations

Through primary and secondary sponsorships/donors from business industrial firms, top government officials and others, environmental concerts will be launched by LLDA to feature environmentally-conscious artist. These artists will be chosen on the basis of the environmental message that most of their songs convey to the audience. Cultural group/talents whose main concern is to save the environment from further degradation will be part of the concert as guest performers. The proceeds will be used for sustaining an effective IEC Campaign in the region.

3. Environmental Motorcade and Rallies on Laguna de Bay

LLDA will mobilize the different sectors including youth, socio-civic organizations, LGUs, environmental NGOs and industrial firms to participate in the crusade to stop the further deterioration and degradation of the Laguna de Bay resource and its watershed.

ii. Environmental Education Curriculum Integration

The promotion of environmental education is considered as one of the major strategies in LLDA's strategy for sustainable development. Environmental education will enable citizens to understand and appreciate the complex nature of the environment as well as the importance of properly managed environment in economic development. The LLDA will coordinate with the Department of Education, Culture and Sports (DECS) and the assistance of other existing projects such as the Lake Environmental Social Mobilization Project of UPLB in order to integrate environmental education in school curriculum in all levels within the Laguna de Bay Region.

c. IEC Materials Production Project

A multi-media environmental communication program shall be launched to produce and disseminate various information materials subdivided into print and audiovisual production. These materials shall include discussions on environment-friendly technologies on agriculture, fishery and manufacturing. Eco-tourism projects, alternative livelihood programs and community development will also be given emphasis.

i. Print Production

The Print Production sub-component will facilitate and coordinate the production of brochures, primers, comic books, posters and other print materials for regional and community campaigns.

1. Primer on Laguna de Bay

The production of this primer will cater to the immediate information needs of students, local government units and other sectors of the current situation in the Laguna de Bay Region in terms of its water quality, existing and potential uses as well as ways to preserve the lake's ecological balance and other basic information.

2. 'Likas Kayang Pag-Unlad' Comics

This major IEC Pilot Project will be one of the sub-components which will be piloted under the on-going San Cristobal and Diezmo River Rehabilitation Program. The said comics will feature different stories with special focus on the past and present situation of the San Cristobal and Diezmo River and the Laguna Lake. Later on, this comics will be institutionalized to feature other areas and concerns in the Laguna de Bay Region.

3. Publication of a regular LLDA Newsletter

The project envisioned is the resumption of a regular LLDA monthly newsletter wherein the Authority acts as the publisher. The said material will not only feature plans and programs for the Laguna de Bay but also the views, aspirations, and commentaries of the General Public. Initially, this paper will be produced quarterly.

4. Community Posters on Saving Laguna de Bay and Its Environs

Posters on the above-mentioned theme will be conceptualized by the Public Information Unit with the help of LLDA staff. These will be constructed as billboards, along roads and highway or disseminated for posting in the central, regional, municipal and community level as part of printed IEC campaign.

ii. Audio-Visual Production

The Audio-Visual sub-component will facilitate and coordinate audio-visual productions such as film, videos or slides to support the IEC plan and environmental campaigns.

1. Mobile Exhibit on Laguna de Bay Region Ecosystem

Another major activity is the conduct of Mobile Photo Exhibit of the Laguna de Bay Region Ecosystem. This will be in coordination with non-government organizations. Other government agencies who may wish to participate. The said exhibit aims to present the problems and issues such as the result of human activities that are hazardous to the environment. On the other hand, it will propose plans and programs on how to counter such environmental degradation and the ways to mobilize public participation. Different educational institutions in the area will be invited to view such exhibits to promote interactions and understanding.

2. Public Affairs Radio Program: 'LINGAP-LAWA'

Since radio is the most effective medium that can reach even the remotest areas in the region, it will be used to inform the public on issues and concerns about Laguna de Bay. Likewise it can be a medium for technology transfer and for values reorientation towards sustainable development. Environmental plugs and jingles will be played from time to time to stimulate listeners attention. The Radio Programs will be utilized as a venue in increasing community participation, particularly the involvement of upland farmers and fishermen on relevant activities.

3. Documentary Film on Laguna de Bay Region

In cooperation with the Philippine Information Agency, the LLDA-Public Information Unit will produce documentary films on the Laguna de Bay Region with the working theme "work with nature and not against it". It will feature the past, present and future regional plans and programs for the region. The lake's physical description, dominant use policy, and other prominent issues on social, political and economic aspects will be highlighted in the documentary film. These films will be used to clarify LLDA's position on various issues pertaining to its mandate.

4. Press Conference/Media Briefing

In order to promote transparency of governance, LLDA will see to it that a regular meeting and interview with news reporters, writers will take place. The said media briefing will tackle the issues and problems concerning the operations and highlight the various policies, programs and projects of the agency towards sustainable management of the Laguna de Bay Region.

5. TV/Radio Plugs

Since the power of radio and television has been proven to be the most effective means of communication, LLDA will engage in the contractual production of supplementary materials through frequent environment radio/tv plugs. This will add to the task of raising public awareness and instill environmental consciousness through songs and commercials with messages on conservation of the Laguna de Bay and its resources. Sponsors will be identified to support these plugs through integration and commercial advertisements.

5.2.8 COMMUNITY DEVELOPMENT PROGRAM FOR LAGUNA DE BAY REGION

5.2.8.1 DEVELOPMENT OBJECTIVE

The community development program aims to improve the condition of marginalized sectors and help provide alternative livelihoods to reduce pressure on lake and other regional resources. This program will ensure the participation of different sectors to achieve sustainable development in Laguna de Bay region. Specifically, the objectives are:

- a. To organize the marginalized sectors into associations and cooperatives and to facilitate the formation of alliances/federation

in order to promote their active participation in protecting the environment and managing the Laguna de Bay Region and its resources.

- b. To educate and train the marginalized sectors to manage organizations, implement livelihood projects and manage the environment towards sustainable development in the Laguna de Bay Region.
- c. To mobilize the various marginal sector in protecting and in rehabilitating the aquatic, land and forest resources; in addressing the problems of industrial, agricultural and domestic wastes and in adopting alternative technologies to ensure the sustainability of the Laguna de Bay Region.
- d. To develop and implement alternative livelihood projects among marginalized sectors for them to become self-reliant thereby reducing the pressures on the natural resources of the Laguna de Bay Region.

5.2.8.2 STRATEGIES

A full and concerted effort of the government agencies, Local Government Units and NGOs is needed to organize a well-knit community development program in the region. This program should focus mainly on people oriented and participatory strategies.

a. Grassroots Community Organizing

One strategy to be used in promoting active participation in environmental management is through grassroots community organizing focusing on marginalized sectors.

The grassroots community organizing strategy starts with people where they are. Meaning from their situation the community organizers (CO) will try to awaken the consciousness of the people. This involves certain stages. First, the immersion process. Second is the interaction which makes the CO and the people determine the community potentials and problems. Third is the core group formation which identify, recruit and mobilize community members as leaders. And fourth is the formalization of the community organizations wherein organizational policies are formulated and ratified.

b. Formation of Alliances and/or Federations

Another strategy that will be used is Alliance/Federation Building. The organized marginal sectors will be formed into Federations/Alliances so that each sector is collectively well represented in any decision making and policy formulation process.

The organizations shall be consulted and mobilized to attempt the formation of one umbrella regional organization for each sector. The existence of an umbrella

alliance or federation would then ensure the representation of sectoral members in policy formulation and decision making processes. Such an alliance/federation would also serve as a network of information and feedback.

c. Capability Building

Capability building through skills training and information, education campaigns will also be used as strategy to mobilize the people towards self reliance and people empowerment. This will include training, skills development, seminar workshop for constituents on leadership value orientation team building, interpersonal communication, meetings and continuing dialogue with the various sectors on several lake issues.

d. Community/Sectoral Mobilization

The protection, rehabilitation and enhancement of aquatic, land and forest resources would require all organized groups to be vigilant and to actively participate in programs towards sustainable development. Thus, the community development strategy would include the mobilization of organizations/associations from the marginalized sectors to participate in campaigns towards a rational management of natural resources in Laguna de Bay. Sectoral organization shall then be transformed into environmental pressure groups who will advocate issues and link up with existing NGOs.

5.2.8.3 PROGRAM COMPONENTS

The Community Development Program shall implement specific programs and projects on a sectoral basis. Such programs and projects shall be drawn largely from the sectoral programs identified in the Master Plan.

Basically the Community Development Program would therefore be mainly a support program to ensure the implementation of specific sectoral programs and projects identified in the Master Plan.

The details of each program area shall be presented below:

a. Community Organizing Project

The basic organizing technique shall be commonly applied to all the four sectors, although each sector has specific issues and concerns to be addressed. Once organizations/associations are formed, these would be linked-up to bigger groups or larger formations to form sectoral alliances or federations.

In Laguna de Bay, the approach will be two pronged - basic organizing for the marginalized communities and alliance/federation building for organized groups. Each marginal sector shall be approached based on the sectoral strategies earlier identified.

i. Basic Organizing

Basic Organizing shall be undertaken as a regular activity of the Community Development Division of the Laguna Lake Development Authority. This would focus on communities where LLDA projects and those projects identified under the Master Plan shall be implemented. Efforts shall initially target communities which were beneficiaries of the Damayan sa Lawa Project of LLDA. This will later be expanded to include upland communities. Target will be set to a minimum of at least twenty (20) organizations per year evenly distributed in the region. Depending on the situation this could be increased later on. The set target would at least focus on five (5) organizations per sector. Within a period of massive and directed organizing, a minimum of at least 100 organizations shall be formed in five years.

It should be noted, however, that this basic organizing effort will complement those existing in other government agencies, NGOs and POs already operating in the lake region.

ii. Alliance/Federation Building

To further speed-up the process of basic organizing, as well as ensure the attainment of people empowerment in the lake region, the LLDA shall deliberately embark on the formation of alliances or federations of people/sectoral organizations. It shall pursue this by providing the forum and opportunity for dialogues among existing POs and sectoral organizations such as those of the fishermen.

Through regular dialogues, workshops and sectoral consultations, the venue will be provided for organized groups to meet and develop camaraderie and unity. Confidence building among various organizations shall be developed by linking the community organizing strategy with the campaigns identified under the other components of the Master Plan. Organized groups will be tapped to participate, for example in the Bantay Lawa Brigade to protect the lake fisheries or in the Bantay Kapaligiran to combat environmental pollution. They could also be involved in the IEC campaign strategies proposed in this Master Plan.

Initiatives will then be pushed for sectoral groups to form a region-wide organization where they shall identify their leaders and spokespersons who shall then represent them in policy formulation and decision making processes. It should be noted, however, that these efforts are to be initiated without any intention to control, coopt or manipulate the groups and structures. They should evolve through pluralism and democratic processes.

Alliance/Federation Building as a program component shall not be a specifically separate program component. It shall be employed as an underlying goal and strategy in all the efforts to be undertaken in the Master Plan. It should be a conscious effort among implementors of projects and field workers of the LLDA. LLDA shall exert all efforts to facilitate the achievement of this goal without directly influencing the outcome of such formations.

b. Skills Training/Capability Building

The Community Development Program shall provide capability and skills trainings to the sectoral organizations that shall be organized. In addition to technological skills which are to be provided by sectoral agencies and those that are identified elsewhere in this Master Plan, the Program would include specific trainings which would provide the organization members the skill to run their organization. Mainly the trainings would focus on the main areas identified below:

i. Leadership Training and Value Orientation

Once the organizations are formed, they shall be given Leadership Training Courses to provide them the skill to manage their organizations. Topics on basic management, leadership principles, running meetings, democratic processes and the like shall be inculcated. Positive Filipino values towards more productive outlook will also be included. The Moral Recovery Program of the government could be included in this training.

ii. Training on Organizational Management and Development

In addition to Leadership and Values Orientation, more advanced courses shall likewise be given to the leaders and members of the sectoral/community organizations.

In community organizing, the total development of organization lies within the members' capability to self manage the organization. The trainings will enhance the capability of the organization to develop and improve their community. The organization must therefore be equipped with different skills as foundation. These include participatory planning, bookkeeping, financial management, team building and project development and implementation, monitoring and evaluation and others.

The above skills would ensure that the organizations will become independent and self reliant. It should be emphasized, however, that for them to be stable and sustainable, their organization should have the capability to build-up their capital and financial resource base.

iii. Technological Skills Training for Livelihood Development

In conjunction with the other development programs in the Master Plan, the Community Development Program will be linked-up with the proposed technological training programs to be implemented. These technological skills would provide the alternative and supplementary sources of livelihood for the marginal sectors being targeted.

The technological skills trainings shall be coordinated also with existing/ongoing livelihood training programs of other government agencies and NGOs. Linkages shall be established to provide access for the organizations/associations in trainings provided by NGOs and other agencies.

Efforts shall also be exerted to identify donors and sponsors from the industrial and business sectors, politicians and LGUs who would be interested to fund the holding of trainings for livelihood skills identified.

**c. Mobilization Program
(Bantay Lawa/Bantay Kapaligiran Project)**

The mobilization program under the community development component shall evolve out of the existing and proposed programs of LLDA. The four (4) sectors namely: the Fishermen, Farmers, Upland Dwellers and the Urban Poor shall be involved as partners in various campaign programs focusing on specific sectoral concerns. Since LLDA, through the Bantay Lawa Program as well as the Bantay Kapaligiran through San Cristobal-Diezmo River Rehabilitation Project has reactivated the involvement of various sectors, the Mobilization Program shall be institutionalized under the Community Development Division as a regular function.

Henceforth there shall be a continuing effort to recruit, train, deputize, and mobilize more volunteers to become Bantay Lawa and Bantay Kapaligiran members. These groups shall be formed in the municipal level to help LLDA and government in its campaigns to protect, rehabilitate and/or enhance the environment and natural resources in Laguna de Bay. They shall become the core in advocacy and IEC campaigns at the grassroots and community levels.

Membership to the Bantay Lawa/Bantay Kapaligiran shall be voluntary. Only minimal operational budget tied-up to specific LLDA projects shall be provided. The training component for would-be members before they are to be deputized shall be provided as part of the regular budget of the Community Development Division.

i. Bantay Lawa

For the initial year, 100 volunteers for the Bantay Lawa will be deputized. Priority municipalities shall be identified in the region wherein five (5) volunteers for existing fishermen association in each municipality will be recruited and trained in 5 batches before they will be deputized. They shall be pre-qualified based on the guidelines set by the BFAR for deputy fish wardens. This volunteers once deputized will form the core who will lead the campaigns to protect the fishery resources in their localities.

ii. Bantay Kapaligiran

For the Bantay Kapaligiran, 100 volunteers each for the Bantay Lawa and Bantay Kapaligiran will be deputized in 5 batches - for the initial year. Priority municipalities shall be identified in the region wherein 5 volunteers per municipality will initially be recruited. At least one volunteer per sector will be selected and the fifth member shall come for the LGUs either at the Barangay or Municipal level. These 5 municipal volunteers will serve as the core in the area who will eventually lead in the various environmental campaigns and IEC activities to be undertaken in their localities.

Eventually, the scheme will be worked out to get the support of the LGUs in continuing the expansion/increase of memberships for both the Bantay Lawa and Bantay Kapaligiran. The ultimate goal is to organize such groups of volunteers in all municipalities and if possible, all barangays in the Laguna de Bay Region.

5.2.9 RESEARCH AGENDA

5.2.9.1 THE PROPOSED RESEARCH PROGRAM FOR THE LAGUNA DE BAY BASIN

In order to ensure the sustainable use and development of the Laguna de Bay and its watershed, it is essential to undertake a continuing research programme (both basic and applied). The following proposed areas for research are presented for prioritization by policy-makers, scientists and researchers. A wider scope of consultation needs to be done in order to gain support for the financial and human resources necessary to finalize and implement this research program. In order to undertake this research agenda, the Laguna Lake Development Authority should appropriate funds annually to finance its implementation. It should also identify fund resources from other government agencies such as the DOST and from multilateral and bilateral funding agencies. It is recommended that LLDA earmark at least P5.0 Million annually to partly support the research agenda.

a. Fishery Studies

- i. Documentation, survey, and assessment of mass fishkills.
- ii. Technical studies for the improvement of fisheries of Laguna de Bay.
- iii. Fishery resources assessment of Laguna de Bay.
- iv. Ecological monitoring of Laguna de Bay in relation to fisheries.
- v. Study on the impact of toxic and hazardous substances fish health.
- vi. Comparative analysis of benthos inside and outside of fishpens.
- vii. Ecological impact assessment of the introduction of exotic fish species in Laguna de Bay.
- viii. Study on breeding of freshwater aquarium fishes.
- ix. Research on polyculture schemes towards maximum utilization of lake resources.

b. Limnological Studies

- i. Comparative Primary Production Studies of the three bays of Laguna de Bay (both in the open water and in fishpens).
- ii. Effects of salt concentration on turbidity and primary productivity.
- iii. Simulation modelling of salt water intrusion.
- iv. Limnological and water quality studies to define the operational effects of the Napindan Hydraulic Control Structure on human health and lake primary productivity.

- v. Comprehensive physico-chemical survey of the Laguna de Bay.
- vi. Research on water quality gradients in Laguna de Bay.
- vii. Research studies for the rehabilitation of major river systems in Laguna de Bay to focus initially on the following:
 - San Cristobal River
 - Pagsanjan River
 - San Juan River
 - Biñan River
 - Morong

c. Ecological Studies

- i. Study of the biotic structure of Laguna de Bay.
- ii. Study on the influence of turbidity on growth of rooted aquatic plants.
- iii. Study on the development of models that better predict the effects on water and soil loss by removing specific portions of forest cover.
- iv. Study on the correlation between vegetation and soil permeability, watershed rehabilitation, water supply and soil erosion.
- v. Development of productive utilization of aquatic plants.
- vi. Special studies on water hyacinth control and utilization.
- vii. Development of ecological modelling.
- viii. Survey and monitoring of benthic community in Laguna de Bay.
- ix. Impact of snail dredging on the benthic fauna and its effects on the food chain.

d. Pollution Control Studies

- i. Survey and inventory of all emission sources within the Laguna de Bay Region.
- ii. Survey and inventory of all point sources of wastewater pollution within the Laguna de Bay Region.
- iii. Survey and inventory of all solid wastes dump sites and environmental impact assessment of each.
- iv. Survey and inventory of fertilizers and pesticides used in agricultural farms.

- v. Undertake a study on the amount of agricultural wastes generated and the various methods practiced for its disposal.
 - vi. Studies on the utilization and impacts of toxic and hazardous substances in Laguna de Bay.
 - vii. Assessment/control of waste discharges into Laguna de Bay.
 - viii. Evaluation of microalgae for feeds and biomedication/waste treatment.
 - ix. Research on causes of sharp variations in Nitrate and Phosphorus.
- e. **Toxicological Studies**
- i. Study on the biological indicators of Laguna de Bay and its tributaries for water quality assessment.
 - ii. Study on the effects of heavy metals and other pollutants on the aquatic life of Laguna de Bay.
 - iii. Ecological assessment of toxic and hazardous wastes in Laguna de Bay.
 - iv. Study on the effects of unassimilated feeds in Laguna de Bay.
 - v. Study on the levels of radionuclides in freshwater biota.
 - vi. Assessment of the impacts of pesticides used in agriculture.
 - vii. Long term epidemiological studies and well designed aquatic studies for assessing health impacts of the specified toxic and hazardous substances.
 - viii. Continuing review of emerging and improved technologies including costs for containment, processing, and treatment of sediments and toxic and hazardous substances.
 - ix. Pesticide residue analysis of lakewater, the lake sediments, fish and other aquatic fauna in the lake.
- f. **Erosion, Siltation and Sedimentation Studies**
- i. Characterization and measurements of lake sediments in Marikina Watershed Subsystem and Pagsanjan River.
 - ii. Laboratory research on bacterial activities (denitrification, BOD, etc.) on sedimented algae and planktons.
 - iii. Environmental impact studies on dredging of Laguna de Bay.

- iv. Study of runoff outside of the riverbeds and corresponding solid transport capacity.
- v. Development study on preliminary measures to reduce erosion in the Pagsanjan River Watershed and in other major tributaries.
- vi. Bathymetric survey of the lake to follow-up progression of sedimentation and establish future reference.
- vii. Research on the effects of inorganic turbidity from sediment resuspension on algae.
- viii. Study on the existing and potential future erosion and sedimentation patterns in areas of large potential erosion, the west border to the Caliraya Plateau, recent volcanoes in the southern region of the basin, the east border of the Marikina Valley, Binangonan, Talim and Jalajala areas.
- ix. River gauge meters versus flow calibration in measuring surface runoff.

g. Hydrological and Hydrographical Studies

- i. Flood risk assessment of major population centers using geographic information system (GIS).
- ii. Reassessment of the general operations of the hydraulic system through mathematical modelling.
- iii. Establishment of telemetric network of different gauging stations in Laguna de Bay.
- iv. Survey and inventory of flood prone areas for the preparation of a flood protection plan.
- v. Reassessment of total water requirements of various water uses in the region in order to determine water balance and appropriate water resources allocation.
- vi. Reassessment of the need for the Parañaque Spillway.
- vii. Continuing meteorological and water quality modelling and prediction.
- viii. Environmental impact assessment of the Napindan Hydraulic Control Structure.

- h. Agricultural Studies**
 - i. Crops and livestock production alternatives.
 - ii. Agro-environmental research on sustainable farming techniques.
 - iii. Soil and water conservation in agriculture.
 - iv. Agricultural waste minimization studies.
 - v. Food processing and preservation methods.
 - vi. Agricultural policy studies on pesticides and fertilizer pollution, livestock waste management and land conversion.

- i. Policy Studies**
 - i. Policy study on inclusion of upland farmers in watershed areas and critical forest reservations.
 - ii. Study on the role of public policy in accounting environmental factors of technologies developed by commercial organizations.
 - iii. Policy study on the regulation of snail dredging in Laguna de Bay.
 - iv. Policy study on the ban of toxic fertilizers and pesticides in Laguna de Bay.
 - v. In-depth policy analysis of existing legal mandates and institutional frameworks of LLDA and Laguna de Bay.
 - vi. Policy study on existing licensing systems and procedures.
 - vii. Policy study on the imposition of processing fees, fines and penalties in LLDA.
 - viii. Policy analysis of existing land uses and developmental patterns in Laguna de Bay watershed.
 - ix. Development of data based management and information system in Laguna de Bay.
 - x. Land use policy for locating water-dependent and water related industrial establishments.
 - xi. Policy review on the devolution of regulatory functions and implementation of quarrying activities and other community based programmes to LGUs.

- xii. Policy study on the inclusion of the shoreland areas in the National Integrated Protected Areas System (NIPAS).
 - xiii. Policy studies to monitor and control agricultural wastes.
- j. **Socio-economic Research Areas**
- i. Socio-economic impact assessment of the Fishpen Industry.
 - ii. Socio-economic study of the fishery sector in Laguna de Bay.
 - iii. Social effects of the reduction of snail harvest on the fishermen communities.
 - iv. Undertake continuing production research which include breeding of new fish species.
 - v. Survey and packaging of alternative livelihood project for marginalized sectors in Laguna de Bay.
 - vi. Socio-economic study of the upland communities in the Laguna de Bay watershed.
 - vii. Economic valuation of pollution and its effects.

5.2.9.2 Current and Proposed Research Agenda under the DOST

The list of programs and projects which have been identified and funded by the DOST is presented in Appendix I.

6.0 IMPLEMENTATION COSTS

6.1 FUND SOURCING

The availability of funds to finance the Programs and Projects identified in this Master Plan remains one of the major issues. While LLDA is the government agency mandated to manage the Laguna de Bay Region, its current financial resources would not warrant the allocation of funds to undertake the programs and projects identified. It is therefore assumed that central government agencies operating in the lake basin would consider the area as a special sub-region where relevant sectoral concerns would be picked-up for consideration in their individual planning and budgeting. In this case, public funds could be allocated through general appropriations to the sectoral departments of the central government.

Another approach would be through direct national subsidy to the LLDA. Government could appropriate special funds to finance the development programs and projects identified. Inasmuch as the agency still remains a Government Owned or Controlled Corporation, the government can guarantee the securing of loans for LLDA to implement the projects. In certain areas, LLDA can enter into joint ventures (through BOT or through BOO) with private investors (local or foreign), to implement some of the projects which could be privatized in the future.

The LLDA, through its Board of Directors can also look into the disposition of unsubscribed capital stocks and the collection of unpaid subscribed capital stocks. The government can also work by legislation to increase LLDA's capitalization or look into the possibility of floating of bonds to attract investors and raise funds for the projects.

In recognition of the fiscal autonomy of the LGUs and in consideration of their financial capabilities, LLDA can jointly implement some of the programs identified. More specifically, these would include resource inventory types of activities where the outputs would be extremely useful for local planning activities. Likewise, some of the infrastructures and livelihood related activities which would benefit local communities can be jointly funded and implemented with the LGUs.

A consultation process shall be undertaken to resolve this issue. Towards this end, the proposed programs and projects shall be presented to various sectors and potential investors for possible consideration.

6.2 INDICATIVE PROGRAM COSTS

An indicative program costs is presented in Table 6.1. It should be noted, however, that there are costs which are not yet readily available due to the needed studies which have yet to be undertaken. For other programs and projects which otherwise should have been part of regular operations of certain agencies or the LLDA itself, these are noted as part of regular budget appropriations. There are also some which are considered for institutionalization which should be

considered part of regular operating budget of the sectoral agency concerned or of the regular LLDA unit expected to perform the function.

Attempt was also made to distribute the indicative (estimated) programs and projects costs on a yearly schedule up to year 2000, which is the set timeframe of the Master Plan. As stated above, some of the projected costs are not yet available. There are also hidden costs which the planning team may have overlooked.

In sum, the indicative cost for the Master Plan is estimated to be approximately P405.3 million. This estimate does not include the resultant cost projections which could be obtained from proposed studies which are yet to be undertaken, especially the identified infrastructure projects.

7.0 IMPLEMENTATION PROCESS

7.1 IMPLEMENTATION STRATEGY

The Master Plan shall be jointly implemented by Laguna Lake Development Authority and the relevant central government agencies through their sectoral concerns. The programs and projects identified shall be operationalized with LLDA as the central coordinating agency in the Laguna de Bay Region. Specific sectoral programs will be coordinated primarily with DENR and its attached agencies for Environmental Programs; with the DAR and DA and its attached agencies for Agriculture and Fisheries; with DTI for Cottage Industry and other livelihood projects; with PIA for Communication Support Programs; and with DOST for Research and Development.

It is also assumed that the support and cooperation of all LGUs, NGOs, POs, and research and academic (especially UPLB) institutions shall be enlisted. Networking and linkages would be a key factor in the operationalization of this Master Plan. LLDA shall henceforth play a proactive role in monitoring and coordinating development projects in the region. Regionwide programs and projects consultation will be done regularly on a sectoral and, if need be, bilateral basis with agencies, organizations, associations and institutions to facilitate implementation of activities and encourage counterpart funding.

Upon approval of this Master Plan, LLDA shall embark on a sectoral consultation to fine-tune the details of the proposed programs and projects. Multilateral and Bilateral Agencies and funding institutions shall also be consulted for possible assistance and link-up.

Regional leaders and politicians will also be urged to render support through legislative means for the effective implementation of the project. Additional legislations and/or fund appropriations can be facilitated through this political support.

7.2 IMPLEMENTATION SCHEDULE

The overall components of the Master Plan is expected to be implemented for a period of five (5) years. However, the initial two years would require a massive outlay of not only financial but also human resources. The immediate component of the programs and projects are expected to take-off between 1996 and 1997.

Presented in Table 7.1 is the summary of programs and the specific project components and the target schedule of implementation. Detailed scheduling are presented in the project profiles which are attached in the appendices of sectoral development programs.

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Table 2.01 ACTUAL AND PROJECTED POPULATION BY CITY, PROVINCE AND MUNICIPALITY (1975-2000)

CITY, PROVINCE MUNICIPALITY	POPULATION					
	1970	1975	1980	1990	1995	2000
METRO MANILA						
Calocan	274,453	397,201	467,816	761,011	764,310	900,190
Manila	1,330,788	1,479,116	1,630,405	1,598,918	2,184,038	2,407,547
Marikina	113,400	168,453	211,613	310,010	419,501	526,984
Muntinlupa	65,057	94,563	136,679	276,972	412,709	596,519
Pasay	206,283	254,999	287,770	366,623	413,587	466,739
Pasig	156,492	209,915	268,570	397,309	562,471	719,638
Patros	25,468	32,821	40,288	51,401	74,516	91,468
Quezon	754,452	956,864	1,165,865	1,666,766	2,108,832	2,569,449
Taguig	55,257	73,702	134,137	266,080	808,643	1,471,724
Total	2,901,650	3,667,634	4,343,223	5,695,090	7,748,607	9,750,258
LAGUNA						
Alaminos	16,649	18,504	20,615	27,492	28,506	31,758
Bay	16,881	19,363	22,960	32,630	38,280	45,391
Binan	58,290	67,444	83,684	134,946	159,860	198,353
Cabuyao	32,117	36,505	46,286	67,171	94,350	119,627
Calamba	82,714	97,432	121,175	173,959	233,103	289,907
Calauan	19,747	23,370	25,259	32,832	31,892	34,470
Cavinti	10,462	11,463	13,222	15,175	20,291	23,404
Famy	4,651	5,222	5,241	7,951	5,298	5,318
Kalayaan	6,957	8,501	10,247	13,156	17,946	21,632
Liliw	14,638	15,907	17,436	21,975	22,963	25,170
Los Banos	32,167	38,351	49,555	66,404	106,910	138,144
Luisiana	11,494	12,346	12,199	14,283	11,768	11,628
Lumban	13,289	14,842	17,360	19,831	27,779	32,492
Mabilac	6,377	7,415	8,543	11,477	13,065	15,052
Magdalena	7,650	9,071	10,433	13,489	15,873	18,257
Majayjay	12,316	13,182	13,699	15,921	15,375	15,978
Nagcarlan	25,057	27,493	30,637	37,806	42,395	47,244
Pacte	11,601	14,733	16,383	20,639	22,527	25,050
Pagsanjan	14,556	16,188	19,489	25,097	34,008	40,943
Pakil	7,229	8,375	9,048	13,477	11,409	12,326
Pangil	8,118	9,263	10,519	15,256	15,404	17,493
Pila	15,551	18,399	20,962	27,549	30,999	35,317
Rizal	6,539	8,097	7,510	9,529	5,992	5,558
San Pablo	105,517	116,607	131,655	162,102	189,485	213,938
San Pedro	32,991	43,439	74,556	156,943	376,956	646,984
Santa Cruz	47,114	52,672	60,620	76,827	92,411	106,356
Santa Maria	12,575	13,731	15,744	20,585	23,733	27,212
Santa Rosa	41,335	47,639	64,325	94,996	158,355	213,820
Siniloan	12,413	14,306	17,220	22,825	29,533	35,351
Victoria	12,741	13,810	16,522	21,911	28,292	33,848
Total	699,736	803,750	973,104	1,374,234	1,904,758	2,488,021

Table 2.01 ACTUAL AND PROJECTED POPULATION BY CITY, PROVINCE AND MUNICIPALITY (1975-2000)

CITY, PROVINCE MUNICIPALITY	POPULATION					
	1970	1975	1980	1990	1995	2000
RIZAL						
Angono	12,127	17,574	26,571	45,439	91,834	138,854
Antipolo	26,508	40,944	60,912	204,919	328,555	552,985
Baras	7,166	9,722	11,196	16,880	17,100	19,692
Binangonan	52,296	63,215	80,980	127,421	170,236	218,076
Cainta	20,714	36,971	59,025	126,680	240,193	383,473
Cardona	16,880	21,266	24,503	32,958	37,482	43,187
Jala-jala	8,115	9,276	11,945	16,318	25,507	32,846
Montalban	20,882	31,176	41,859	67,011	101,668	136,625
Morong	18,970	21,058	24,858	32,165	40,890	48,258
Pililla	15,052	18,985	23,222	32,771	42,498	51,982
San Mateo	29,183	38,955	51,910	82,289	122,833	163,683
Tanay	23,247	33,382	40,443	58,196	71,918	87,139
Taytay	46,717	58,274	75,828	112,163	167,068	217,395
Teresa	9,381	13,394	14,781	20,610	19,865	21,922
Total	307,238	414,192	556,033	975,850	1,477,647	2,116,118
BATANGAS						
Malvar	14,169	15,581	18,028	21,253	27,910	32,287
Santo Tomas	31,935	37,452	43,010	58,209	65,141	74,898
Tanauan	61,910	66,703	74,020	92,754	101,149	112,244
Total	108,014	119,739	135,058	175,216	194,200	219,339
CAVITE						
Carmona	20,123	51,004	65,513	28,247	138,835	178,329
Silang	38,999	44,809	52,723	93,790	85,883	101,051
Tagaytay City	10,907	13,388	16,447	23,739	30,493	37,450
Total	70,029	109,201	134,683	145,776	255,211	316,840
QUEZON						
Lucban	23,157	23,044	25,826	30,130	36,354	40,743
GRAND TOTAL	4,189,824	5,137,560	6,167,927	8,396,296	11,616,777	14,931,319

Sources:

- UES International Inc. (1989) for projections
- Bureau of Census (1990) for Metro Manila 1990 population (May 1)
- NSO IV (lifted from the Aquino Administration : Major Development Programs and Projects - 1986-1992)

Table 2.02. POPULATION PROJECTION FOR THE LAGUNA
NON-LAKE SHORE COMMUNITIES (1975-2000)

PROVINCE/MUNICIPALITY	1990 ACTUAL	1995	2000
RIZAL	501,539	813,114	1,258,688
Antipolo	204,919	328,555	552,985
Cainta	126,680	240,193	383,473
Montalban	67,011	101,668	136,625
San Mateo	82,289	122,833	163,683
Teresa	20,640	19,865	21,922
LAGUNA	404,237	447,579	500,878
Alaminos	27,492	28,506	31,758
Calauan	32,832	31,892	34,470
Cavinti	15,175	20,291	23,404
Famy	7,951	5,298	5,318
Liliw	21,975	22,963	25,170
Luisiana	14,283	11,768	11,628
Magdalena	13,489	15,873	18,257
Majayjay	15,921	15,375	15,978
Nagcarlan	37,806	42,395	47,244
Pagsanjan	25,097	34,008	40,943
Rizal	9,529	5,992	5,558
San Pablo City	162,102	189,485	213,938
Santa Maria	20,585	23,733	27,212
METRO MANILA	5,152,038	6,527,255	7,682,015
Caloocan	761,011	764,310	900,190
Manila	1,598,918	2,184,038	2,407,547
Marikina	310,010	419,501	526,984
Pasay	366,623	413,587	466,739
Pasig	397,309	562,471	719,638
Pateros	51,401	74,516	91,468
Quezon	1,666,766	2,108,832	2,569,449
BATANGAS	175,216	194,200	219,339
Malvar	24,253	27,910	32,287
Santo Tomas	58,209	65,141	74,808
Tanauan	92,754	101,149	112,244
QUEZON	30,130	36,354	40,743
Lucban	30,130	36,354	40,743
CAVITE	145,776	255,211	316,840
Carmona	28,247	138,835	178,329
Silang	93,790	85,883	101,051
Tagaytay	23,739	30,493	37,460
TOTAL	6,408,936	8,273,713	10,018,503

Sources: URS International (1989) for projections
 Bureau of Census (1990) for Metro Manila population (May 1)
 NSO IV (lifted from The Aquino Administration: Major
 Development Programs and Projects - 1986-1992)

Table 2.03. LABOR FORCE PROJECTIONS, LAGUNA DE BAY (1975-2000)

	1975	1980	1990	2000
Potential Labor force	3,753,400	4,662,800	6,115,000	8,518,600
Economically Active:				
Number	2,167,800	2,718,400	3,626,200	5,145,200
%	58.0	58.0	59.0	60.0
Employed	1,957,900	2,481,900	3,383,200	4,903,400
%	90.0	91.0	93.0	95.0
Unemployed	209,900	236,500	243,000	241,800
%	10.0	9.0	7.0	5.0
Economically Inactive:				
Number	1,585,600	1,944,400	2,488,800	3,373,400
%	42.0	42.0	41.0	39.0

Source:
 NCSO Integrated Census of the Population and Its Activities Report (1975)

Table 2.04. EMPLOYMENT DISTRIBUTION BY INDUSTRY GROUP , LAGUNA DE BAY BASIN (1975-2000)

SECTOR	1975		2000	
		%		%
Agriculture	163,400	8.3%	323,600	6.6%
Industry	649,600	33.2%	1,505,300	30.7%
Mining	7,200	0.4%	16,600	0.3%
Manufacturing	500,400	25.6%	1,159,100	23.6%
Electricity	15,600	0.8%	36,100	0.7%
Construction	126,400	6.5%	293,500	6.0%
Services	1,144,900	58.5%	3,074,400	62.7%
Commerce	281,900	14.4%	756,300	15.4%
Transportation	156,700	8.0%	421,200	8.6%
Services & Others	706,300	36.1%	1,896,900	38.7%
Total	1,957,900	100.0%	4,903,300	100.0%

Source:
 NCSC Integrated Census of the Population and Its Activities Report (1975)

Table 4.01. WATER QUALITY OF LAGUNA LAKE

LAGUNA LAKE					
PARAMETERS	STATIONS*				
	I	II	IV	V	VIII
pH (units)	8.0	7.8	8.4	8.0	8.0
Temperature (C)	29.6	29.5	29.2	29.8	29.6
Nitrate (Ug/l)	190.0	106.0	201.0	150.0	144.0
Inorganic Phospate (Ug/l)	76.0	60.0	90.0	88.0	65.0
Dissolved Oxygen (mg/l)	6.8	6.2	6.7	6.1	6.6
Total Dissolved Solids (mg/l)	790.0	609.0	841.0	796.0	719.0
Turbidity (mg/l of SiO)	72.0	58.0	56.0	84.0	66.0
Chloride (mg/l)	353.0	274.0	384.0	353.0	317.0

NOTE: Mean Values

Source: LLDA, 1994

* sampling stations at lake, see Fig. 1

TABLE 4.02. TOTAL THS LOADS IN KG/DAY IN LAGUNA BASIN (URSI, 1989)

THS CONSTITUENT	1989 Existing Conditions	1995	2000	2010
2 Acrolein	36.200	61.300	95.200	229.600
4 Benzene	1.110	1.890	2.930	7.060
6 Carbon Tetrachloride	2.550	4.320	6.710	16.180
7 Chloroethane	19.300	32.800	50.900	122.700
8 1,2,4 - Trichlorobenzene	0.720	1.210	1.880	4.540
10 1,2 - Dichloroethane	20.900	35.500	55.100	132.900
11 1,1,1 - Trichloroethane	11.800	19.900	30.900	74.600
12 Hexachloroethane	0.008	0.013	0.020	0.048
13 1,1 - Dichloroethane	2.290	3.880	6.020	14.520
14 1,1,2 - Trichloroethane	0.140	0.240	0.370	0.890
15 1,1,2,2 - Tetrachloroethane	0.320	0.540	0.830	2.010
16 Chloroethane	0.170	0.280	0.440	1.050
21 2,4,6 - Trichlorophenol	0.630	1.070	1.660	4.000
23 Chloroform	1.400	2.370	3.680	8.870
25 1,2 - Dichlorobenzene	1.590	2.700	4.200	10.120
26 1,3 - Dichlorobenzene	3.700	6.280	9.750	23.510
27 1,4 - Dichlorobenzene	3.360	5.700	8.850	21.350
29 1,1 - Dichloroethylene	2.910	4.940	7.670	18.510
30 1,2 - Trans-dichloroethylene	1.570	2.660	4.130	9.960
31 2,4 - Dichlorophenol	0.350	0.600	0.930	2.250
32 1,2 - Dichloropropane	0.070	0.119	0.184	0.444
34 2,4 - Dimethylphenol	782.000	1,326.000	2,059.000	4,966.000
38 Ethylbenzene	42.900	72.800	113.000	272.500
43 Bis(2-chloroethoxy)methane	0.000	0.000	0.000	0.010
44 Methylene Chloride	242.000	410.000	636.000	1,535.000
45 Methyl Chloride	0.040	0.070	0.110	0.260
55 Naphthalene	10.730	18.200	28.260	68.140
64 Pentachlorophenol	2.830	4.790	7.450	17.950
65 Phenol	7.804.000	13,233.000	20,549.000	49,546.000
66 Bis(2-ethylhexyl)Phthalate	72.000	122.000	190.000	458.000
67 Butyl benzyl Phthalate	5.340	9.060	14.070	33.920
68 Di-n-Butyl Phthalate	2.200	3.730	5.800	13.970
69 Di-n-octyl Phthalate	1.920	3.250	5.040	12.160
70 Diethyl Phthalate	7.760	13.160	20.440	49.280
71 Dimethyl Phthalate	1.370	2.330	3.620	8.730

TABLE 4.02. TOTAL THS LOADS IN KG/DAY IN LAGUNA BASIN (URSI, 1989)

THS CONSTITUENT	1989 Existing Conditions	1995	2000	2010
85 Tetrachloroethylene	19.900	33.700	52.400	126.200
86 Toluene	167.000	282.000	439.000	1,057.000
87 Trichloroethylene	4.410	7.480	11.620	28.010
88 Vinyl Chloride	0.002	0.003	0.005	0.011
106 PCB	0.190	0.330	0.510	1.220
114 Antimony	4.930	8.360	12.980	31.300
115 Arsenic	3.600	6.100	9.470	22.820
118 Cadmium	20.300	34.400	53.400	128.900
119 Chromium (hexavalent)	165.000	280.000	435.000	1,049.000
120 Copper	181.000	306.000	475.000	1,146.000
121 Cyanide	108.000	183.000	284.000	684.000
122 Lead	324.000	549.000	853.000	2,056.000
123 Mercury	19.000	32.000	49.000	118.000
124 Nickel	264.000	447.000	695.000	1,675.000
125 Selenium	0.820	1.390	2.160	5.210
126 Silver	110.000	187.000	291.000	701.000
128 Zinc	297.000	504.000	782.000	1,886.000
901 Acetone	108.000	184.000	285.000	687.000
904 Barium	12.500	21.200	32.900	79.400
906 Bromoform	0.210	0.350	0.550	1.320
912 Cresols	0.780	1.330	2.060	4.970
913 Cumene	0.500	0.840	1.310	3.160
914 Dichlorodifluoromethane	0.240	0.410	0.640	1.530
915 Ethyl Acetate	1.510	2.560	3.980	9.590
916 Ethyl Ether	1.060	1.790	2.780	6.700
918 Formaldehyde	9.290	15.740	24.450	58.950
922 Isobutyl Alcohol	6.750	11.440	17.760	42.820
925 Methyl Alcohol	816.000	1,383.000	2,148.000	5,179.000
926 Methyl Ethyl Ketone	2.550	4.330	6.720	16.200
927 Methyl Isobutyl Ketone	1.210	2.050	3.180	7.680
931 N-Butyl Alcohol	40.700	68.900	107.000	258.100
939 P-Chloro-M-Cresol	4.840	8.200	12.740	30.710
946 Tetrahydrofuran	16.600	28.200	43.700	105.400
951 Trichloromonofluoromethane	1.970	3.340	5.180	12.500
955 Xylene	43.400	73.600	114.300	275.700

TABLE 4.03. Heavy Metals on Water (1984)

YEAR	HEAVY METALS (Ug/l)							
	WATER SAMPLES							
	STATION							
1984	CLASS "C" STANDARD	I	II	III	IV	VI	VII	B
As	50	13.0	12.0	11.0	13.0	9.7	11.0	13.0
Cd	10	0.64	0.88	0.36	0.38	0.29	0.35	0.64
Cr	50	24.0	7.0	3.0	2.0	2.0	2.0	2.0
Cu	20	4.2	4.0	5.2	5.2	5.7	5.0	5.4
Pb	50	3.8	3.5	3.5	3.8	2.2	2.3	5.0
Zn	200	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0

Source: LLDA, 1984

Table 4.04. HEAVY METALS ON SEDIMENTS (1984)

		HEAVY METALS (mg/kg of dry weight)									
		Sediments Samples									
		STATIONS									
YEAR	CLAY STANDARD	I	II	III	IV	VI	VII	A	B		
1984											
Mn	850	1570	1420	1590	1920	1590	1560	2320	2240		
Cr	90	13	14	13	20	13	13	13	13		
Cu	45	123	113	119	128	112	112	132	112		
Pb	20	16	25	23	23	16	15	35	23		
Zn	95	113	101	119	137	108	103	116	116		

Source: LLDA, 1984

Table 4.05. HEAVY METALS ON WATER (1988)

YEAR JULY 1988	HEAVY METALS (ug/L)				
	Water Samples				
	STATIONS				
METAL	CLASS "C" STANDARD	I	II	IV	VIII
Arsenic (As)	50	16	14	12	12
Lead (Pb)	50	8	4	11	7
Cadmium (Cd)	10	1.3	0.67	1.8	1.2
Chromium (Cr)	50	<1.	2	<1.	2
Nickel (Ni)		2	5	42	15
Mercury (Hg)	2	0.05	0.05	0.05	0.05

Source: LLDA, 1988

Table 4.06. HEAVY METALS ON SEDIMENTS (1988)

YEAR JULY 1988	HEAVY METALS (mg/kg of dry weight)				
	Sediments Samples				
	STATIONS				
METAL	CLAY STANDARD	I	II	IV	VIII
Lead (Pb)	20	15	15	15	15
Cadmium (Cd)		<0.	<0.	<0.	<0.
Chromium (Cr)	90	9.8	8.2	9.8	8.3
Copper (Cu)	45	120	102	107	110
Nickel (Ni)		14	14	17	12
Mercury (Hg)	0.4	0.089	0.085	0.074	0.082
Zinc (Zn)	95	85	84	86	92

Source: LLDA, 1994

Table 4.07. WATER QUALITY OF TRIBUTARY RIVERS

TRIBUTARY RIVERS 1994						
	T2	T3	T5	T6	T8	T9
pH (units)	7.5	7.6	7.4	7.4	7.3	8.0
Nitrate (ug/l)	131.0	191.0	621.0	308.0	124.0	171.0
Inorganic Phosphate (ug/l)	874.0	297.0	328.0	305.0	97.0	247.0
Dissolve Oxygen	1.1	2.3	3.8	6.0	7.3	6.0
Total Dissolved Solids (mg/l)	497.0	381.0	298.0	211.0	154.0	352.0
Turbidity (mg/l SiO2)	52.0	31.0	15.0	23.0	19.0	32.0
Chloride (mg/l)	47.0	32.0	20.0	22.0	34.0	37.0

Legend: T2 - San Pedro River
 T3 - San Cristobal River
 T5 - San Juan River
 T6 - Santa Cruz River
 T8 - Pagsanjan River
 T9 - Bay River

Note : Mean Values
 Source : LLDA, 1994

Table 4.08. NUMBER OF INDUSTRIAL PLANTS AND WASTEWATER TREATMENT FACILITIES (1994)

YEAR	NO. OF INDUSTRIES		WASTEWATER TREATMENT FACILITIES	
	TOTAL	WET	NUMBER	%
1980	592	341	115	33.7
1981	645	351	133	37.9
1982	744	399	153	38.3
1983	824	414	173	41.8
1984	876	429	183	42.7
1985	978	464	208	44.8
1986	1,013	480	218	45.4
1987	1,053	496	226	45.6
1988	986	323	201	62.2
1989	1,054	343	232	67.6
1990	1,155	391	247	63.2
1991	1,211	405	285	70.4
1992	935	442	268	60.6
1993	1,429	449	282	62.8
1994	1,481	467	323	69.2

Source: LLDA, 1994

Table 4.09. INDUSTRIAL ESTABLISHMENTS BY CLASSIFICATION AND BY LOCATION, LAGUNA DE BAY BASIN 1988

CLASSIFICATION	GEOGRAPHICAL LOCATION				TOTAL	PERCENT
	WEST BAY	CENTRAL BAY	EAST BAY	SOUTH BAY		
HP/EH	23			4	27	2.3
HP/H	59	3	3	8	73	6.3
HP/NH	17	4		2	23	2.0
P/EH	5		1	1	7	0.6
P/H	311	31	9	40	391	33.6
P/NH	212	18	17	46	293	25.2
NP/H	89	4	4	8	105	9.0
NP/NH	185	8	5	24	222	19.1
UNIDENTIFIED	23			1	24	2.1
TOTAL	924	68	39	134	1,165	100.2
	79.3	5.8	3.3	11.5	100.0	

Note:

HP/EH - Highly pollutive, extremely hazardous

HP/H - Highly pollutive, hazardous

HP/NH - Highly pollutive, non-hazardous

P/EH - Pollutive, extremely hazardous

P/H - Pollutive, hazardous

P/NH - Pollutive, non-hazardous

NP/H - Non-pollutive, hazardous

NP/NH - Non-pollutive, non-hazardous

Source: Valerio, 1990

Table 4.10. POTENTIAL POLLUTION LOADS FROM INDUSTRIES,
LAGUNA DE BAY BASIN, 1988. (VALERIO, 1990)

INDUSTRY/SECTOR	1988 NUMBER OF FIRMS	1988 POLLUTANTS (kg/day)			1988 POLLUTANTS (metric ton)		
		BOD5	TSS	O & G	BOD5	TSS	O & G
Food Processing	134	11,904	6,743	2,595	3,143	1,780	685
Beverage	6	774	445	6	204	117	2
Distillery	6	357,324	946,899	236	94,334	249,981	62
Tobacco	0						
Textile	172	916	2,143	2,655	242	566	701
Pulp and Paper	30	2,525	22,007	99	666	5,810	26
Chemical & Pharmaceutical	97	11,904	1,564	1,558	3,143	413	411
Metal	89	70	129	175	19	34	46
Non-metal & Mineral	102	17,856	1,188	170	4,714	314	45
Rubber, Plastic and Synthetics	81	236	4,553	86	62	1,202	23
Timber & Wood	94	55	415	6	14	110	2
Electrical & Electronics	56	138	1,231	26	36	325	7
Transport & Equipment	55	1,055	407	783	278	107	207
Power	7						
Leather/Miscellaneous	78	216	230	8	57	61	2
TOTAL	1,007	404,973	987,954	8,403	106,912	260,820	2,219

TABLE 4.11. PROPORTION OF INDUSTRY TYPES EXCEEDING THE CHRONIC CRITERIA FOR EACH OF THE TOXIC AND HAZARDOUS SUBSTANCES

TOXIC AND HAZARDOUS SUBSTANCES	INDUSTRIES EXCEEDING CRITERION (Percent of Total)
METALLIC	
Chromium	95
Lead	95
Copper	95
Cadmium	93
Zinc	93
Mercury	76
Silver	73
Nickel	68
Arsenic	24
Selenium	10
Antimony	3
NON-METALLIC	
Cyanide	41
Phenol	22
Toluene	15
1,2 dichlorobenzene	15
Tetrachloroethylene	12
2,4 dichlorophenol	12
1,3 dichlorobenzene	7
2,4,6 trichlorophenol	7
1,1,2,2 tetrachloroethane	7
1,2 dichloroethane	5
1,4 dichlorobenzene	5
Pentachlorophenol	5
Carbon tetrachloride	5
1,1,1 trichloroethane	5
2,4 dimethyl phenol	5
Chloroform	2
Acrolein	2
1,2,4 trichlorobenzene	2

Note: 41 industry were surveyed.

Source: URSI, 1989

Table 4.12. EVOLUTION OF FISHERMEN POPULATION

YEAR	(1) 1963	(2) 1968	(3) 1978	(4) 1983	(5) 1986	(6) 1990
Full-time	6,511	7,674	4,144	5,184	N.A.	15,912
Part-time	6,489	2,139	984	3,436	N.A.	1,179
TOTAL	13,000	9,813	5,128	8,620	16,975	17,091

Sources:

- (1) Delmendo, 1967
- (2) Shimuri and Delmendo, 1969
- (3) Mercene, 1980 (unpublished report)
- (4) LLDA survey, 1983
- (5) COMELEC list of registered voters
- (6) LLDA survey, 1990

Table 4.14. TOTAL FISHPEN AREA AND TYPE OF OWNERSHIP AS OF DECEMBER 1994

YEAR	NUMBER	A R E A			%
		REGISTERED	EXCESS AREA	TOTAL	
Individual	104	694.6693	138.6893	833.3586	6.08%
Cooperative	62	1,674.7746	707.7900	2,382.5646	17.39%
Corporation	187	9,149.1671	1,335.8971	10,485.0642	76.53%
TOTAL	353	11,518.6110	2,182.3764	13,700.9874	100.00%

Source: LLDA, 1994

Table 4.15. LAGUNA DE BAY FISHERIES PRODUCTION 1961-1994

	1961-63*	1968**	1971	1973	1976	1979	1980	1981	1982	1983
Area ('000 ha)										
Fishpen										
Legal							10.40	15.30	25.00	35.00
Illegal										
Total Fishpen										
Fishcage										
Open Water										
Production ('000 mt)										
Aquaculture										
Fishpen							37.20	56.30	60.60	82.40
Fishcage							37.20	5.80	4.40	3.50
Total								62.10	65.00	85.90
Capture Fisheries										
Fish	82.80	39.06		20.72	27.36	15.43	14.40	20.40	19.20	13.30
Shrimp	19.10	27.55		23.60	16.00	7.78	7.40	4.30	3.80	1.00
Molluscs	247.77	96.68		77.56	36.23	159.39	179.70	158.40	193.60	207.20
Total	349.67	163.29		121.88	79.59	182.60	201.50	183.10	216.60	221.50
Total Fish Production							51.60	82.50	84.20	99.20
Production (kg/ha)										
Fishpen	3.57	3.68	2.42	2.35	2.83	1.86	3.57	3.68	2.42	2.35
Fishcages			45.40	37.14	48.26	34.35	51.69	51.69	45.40	37.14
Open Water	0.18	0.27	0.30	0.24	0.49	0.41	0.18	0.27	0.30	0.24

Source:

Delmendo (1986)

LLDA (1994)

* Delmendo, Medina N., An Evaluation of the Fishery Resources of Laguna de Bay, 1966 - mimeographed.

** Shimura, Tsugiharu & Delmendo, Medina N., "Report on the Listing of Duck Farms and Fishing Families of the Fishery Survey of Laguna de Bay (September to November, 1968)", May, 1969 - mimeographed.

Table 4.15. LAGUNA DE BAY FISHERIES PRODUCTION 1961-1994

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Area ('000 ha)											
Fishpen											
Legal	22.10	18.60	11.90	10.60	8.10	4.70	2.90	3.90	4.20	4.50	11.50
Illegal	28.90	9.20	7.00	2.60	2.00	1.00	2.50	2.20	2.00	5.60	2.20
Total Fishpen	51.00	27.80	18.90	13.20	10.10	5.70	5.40	6.10	6.20	10.10	13.70
Fishcage	0.10	0.20	0.70	0.70	0.70	0.10	0.11	0.15	0.28	0.24	0.63
Open Water	38.90	62.00	70.40	76.10	79.20	84.20	84.49	83.75	83.52	79.66	75.67
Production ('000 mt)											
Aquaculture											
Fishpen	81.80	51.60	41.00	28.30	19.60	35.63	33.75	38.13	38.75	63.13	71.88
Fishcage	4.50	5.50	4.50	11.10	11.20	1.00	1.10	1.50	2.80	2.40	6.30
Total	86.30	57.10	45.50	39.40	30.80	36.63	34.85	39.63	41.55	65.53	78.18
Capture Fisheries											
Fish	29.60	25.50	34.80	19.20	16.90						
Shrimp	8.30	7.90	16.10	8.00	5.20						
Molluscs	192.10	164.80	149.40	162.50	131.30						
Total	230.00	198.20	200.30	189.70	153.40						
Total Fish Production	115.90	82.60	80.30	58.60	47.70						
Production (kg/ha)											
Fishpen	2.83	1.86	2.17	2.14	1.94	6.25	6.25	6.25	6.25	6.25	6.25
Fishcages	48.26	34.35	15.86	15.86	16.00	5.00	5.00	5.00	5.00	5.00	5.00
Open Water	0.49	0.41	0.25	0.25	0.21						

Source:

Delmendo (1986)

LLDA (1994)

* Delmendo, Medina N., An Evaluation of the Fishery Resources of Laguna de Bay, 1966 - mimeographed.

** Shimura, Tsugiharuru & Delmendo, Medina N., "Report on the Listing of Duck Farms and Fishing Families of the Fishery Survey of Laguna de Bay (September to November, 1968)", May, 1969 - mimeographed.

LAGUNA LAKE DEVELOPMENT AUTHORITY
 MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST					REMARKS
	1986	1987	1988	1989	BEYOND	
1. ENVIRONMENTAL MANAGEMENT PROGRAM						
1 WATER QUALITY MONITORING PROGRAMS						
1.1 Laguna de Bay Sampling and Monitoring Program						Regular activity. Annual operating cost
1.2 Laguna de Bay Primary Productivity Studies						Regular activity. Annual operating cost
1.3 Tributary Rivers Water Quality Monitoring Program						Regular activity. Annual operating cost
1.4 Fish Diseases Monitoring Program						Regular activity. Annual operating cost
1.5 Other Lakes Sampling and Monitoring Program						Regular activity. Annual operating cost
1.6 LLDA Laboratory Upgrading Project	18,442,000	3,847,000	3,815,000			
2 POLLUTION CONTROL PROGRAM						
2.1 Industrial Waste Management Program						
2.1.1 Waste Minimization Program	1,184,000		1,184,000			Intend to be institutionalized
2.1.2 Upgrading of Sewerage Monitoring System for Industries Project	342,000		342,000			24 weeks. Intend to be institutionalized
2.1.3 Pilot Common Wastewater Treatment Facility Project	1,378,000		1,378,000			Cost estimator design and construction intend to be institutionalized
2.1.4 Air Quality Management Project	5,590,000		5,590,000			
2.1.5 Study for the Introduction of Economics Incentives and Dis-Incentives to Promote Water Pollution Prevention and Abatement in the Region	948,000		948,000			
2.1.6 Pollution Control and Rehabilitation of Laguna de Bay Through Bacteriology and Ecotechnology	48,000,000		48,000,000			Joint project of UPLB LLDA & Tishubun University
2.1.7 Wastewater Treatment Plant Operators Training Program	546,000		546,000			6 weeks. Intend to be institutionalized
2.1.8 Industrial Pollution Source Database Project	1,340,000		1,340,000			
2.2 Agricultural Waste Management Program						See Agricultural District Program
2.3 Domestic Waste Management Program						See interceptor Project
2.4 Solid Waste Management (SWM) Programs						
2.4.1 Solid Waste Management Improvement Project	5,840,000		5,840,000			Cost do not include R & D design, construction & start
2.4.2 Hospital Waste Management Project	1,950,000		1,950,000			Eight months
2.4.3 Proposed Closure Plans for the Open Disposal Sites and Rehabilitation of Abandoned Sites	4,000,000	1,500,000	2,500,000			PHP2.5 million for the first year PHP1.5 million for the first year
2.5 Toxic and Hazardous Waste (THW) Management Program						To be integrated with on-going DDUH project
3 RE-ASSESSMENT OF MAJOR RECOMMENDATIONS ON ENVIRONMENTAL MANAGEMENT						
3.1 Technical Surveys						
3.1.1 Bathymetric Survey	9,350,000		9,350,000			Component of Water Resource For.
3.1.2 Topographic Surveys of Lagoons	9,350,000		9,350,000			Frame work. Permission except Telemetric Network
3.1.3 Hydrographic Re-assessment	6,000,000		6,000,000			
3.1.4 Assessment of Telemetric Network	3,740,000		3,740,000			

LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST				REMARKS
	1996	1997	1998	1999	
3.2 Infrastructure Projects					
3.2.1 Re-assessment of Interceptor Study	7,500,000				
3.2.2 Re-assessment of Petroleum Pipeline Project	3,740,000				
3.2.3 Re-assessment of Paranaque Spillway	9,350,000				
4. WATER RESOURCES MANAGEMENT PROGRAM					
4.1 Framework for the Formulation of a Water Resource Policy	3,460,000				
4.2 Study on the Laguna de Bay as Domestic Raw Water Supply Source	2,800,000				
4.3 Groundwater Management Project	4,916,000	2,200,000	1,000,000		
TOTAL	173,766,000	7,547,000	4,815,000		2.818 million for the 1st year/2.0 million for the last year
2. WATERSHED MANAGEMENT PROGRAM					
1. ESTABLISHMENT OF WATERSHED MANAGEMENT COUNCIL	32,113,000	4,827,000	5,310,000	5,840,000	6,424,000
2. WATERSHED RESOURCES INFORMATION SYSTEM	23,276,000	11,638,000			
3. PILOT UPLAND MANAGEMENT PROJECT (MARIKINA-PAGSANJIAN SUB-WATERSHED): MANAGING THE LAKE FROM THE UPLAND					To be integrated w/ the LLDA Institutional Dev't Initial year will focus on LLDA's on going San Critical Drainage River Rehabilitation Project
4. DEVELOPMENT OF A POLICY FRAMEWORK FOR WATERSHED RESOURCES PROTECTION					Complementary projects to DENR Watershed Rehabilitation Program in Region IV
5. REGIONAL LAND USE PLAN	14,200,000	7,100,000			Integrated within each component/line of the Program; for integration in Agency Protection budget
6. LAGUNA DE BAY SHORELANDS MANAGEMENT PROJECT					To be integrated with Provincial/Municipal Land Use Planning
7. SUPPORT COMPONENT					Budget allocation in LLDA annual appropriation
TOTAL	69,589,000	28,450,000	5,310,000	5,840,000	6,424,000
J. FISHERIES DEVELOPMENT PROGRAM					Integrated in all component/line of the program
1. FISHERY REGULATION					
Rationalization of Fishpen Industry					
Reformulation of the Fishery Zoning and Management Plan	5,000,000				On regular LLDA budget appropriation
Action Plan for the Demolition of Illegal Fishpen					Provide LLDA corporate fund
Community Mobilization Project for Law Enforcement (on Illegal Fishery (Banua Law Project))	400,000	400,000			Continuing activity at LLDA. Intend with Community Development Program

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Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST					REMARKS
	1995	1997	1998	1999	2000	
2. FISHERY MANAGEMENT						
Establishment of a Fisheries and Limnological Research Center	24,300,000	4,125,000	4,125,000	4,125,000	4,125,000	For further studies by LLDA-LMD
Establishment of Fish Sanctuary						Included in the Research Agenda
Research on the Propagation of Indigenous Species						Included in the Research Agenda
Resource Assessment of Aquatic Fishes						
3. AQUACULTURE DEVELOPMENT						Technology already available for 3 projects
Freshwater Pearl Culture	500,000	264,000				
Freshwater Aquarium Fish Production	1,000,000	340,000	350,000			
Polyculture of Macrobrachium sp. and Tilapia sp.	870,000	870,000				
4. POST HARVEST TECHNOLOGIES DEVELOPMENT						
Survey to Determine Market Needs of the Fishery Sector	20,000					
Rehabilitation of Selected Existing Fishing Ports	5,700,000					
Seminar on the Proper Handling and Processing of Fish	1,300,000	3,000,000	1,300,000	1,400,000		For coordination with DPWH, LGUs and PPA To be Institutionalized
Improvement of Fish Transport Systems						DPWH function, for coordination
5. INSTITUTION BUILDING AND SUPPORT SERVICES						
Fisherfolk Cooperative Formation						Included in the Community Development Program
Credit and Funding Facilities						Included in the Institutional Development Program
Marketing Assistance						Included in the Lake Environmental Education & Communication Support Program
TOTAL	38,890,000	15,766,000	5,775,000	5,525,000	4,125,000	
4. AGRICULTURAL DEVELOPMENT PROGRAM						
1. AGRI-SPATIAL DEVELOPMENT						Cost of Land use assessment is included w/ Regional Land use Planning under Watershed Mgt.
1. AGRI-SPATIAL DEVELOPMENT	15,038,000	5,378,000	5,052,000			
2. AGRI-RESOURCE MANAGEMENT						
2. AGRI-RESOURCE MANAGEMENT	9,945,000	3,481,000	2,154,000	2,155,000	2,155,000	
3. AGRI-ECOSYSTEM PROTECTION AND WASTE MANAGEMENT						
3. AGRI-ECOSYSTEM PROTECTION AND WASTE MANAGEMENT	9,430,000	1,812,000	1,812,000	1,812,000	1,812,000	
4. ALTERNATIVE LIVESTOCK AND POULTRY DEVELOPMENT						
4. ALTERNATIVE LIVESTOCK AND POULTRY DEVELOPMENT	11,750,000	6,560,000	1,790,000	1,790,000	1,790,000	Agri support will be coordinated with DA & other concerned agencies providing these services.
5. AGRICULTURAL SUPPORT PROGRAM						
6. RESEARCH AND TECHNOLOGY DEVELOPMENT						Cost of Agri-research, IEC, CD and Institutional arrangement are packaged with respective general programs for these activities.
7. INFORMATION, EXTENSION AND COMMUNITY DEVELOPMENT						
8. INSTITUTIONAL ARRANGEMENT						
TOTAL	46,153,000	6,780,000	10,748,000	5,697,000	5,697,000	

LAGUNA LAKE DEVELOPMENT AUTHORITY
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Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST	ESTIMATED COST					REMARKS
		1996	1997	1998	1999	2000	
5. COTTAGE INDUSTRIES DEVELOPMENT PROGRAM							
1. LDB LIVELIHOOD TRAINING PROGRAM	2,131,500	951,500	300,000	295,000	297,500	297,500	For coordination with DTI, NGOs & LGUs
2. TRADE HOUSE ARTS AND CRAFTS CENTER	6,850,000	1,500,000	2,500,000	950,000	950,000	950,000	For coordination with DTI, LGUs & Industry Group
TOTAL	8,981,500	2,451,500	2,800,000	1,245,000	1,247,500	1,247,500	
6. INSTITUTIONAL DEVELOPMENT PROGRAM							
1. Restructure the Decision-making Process, Ensure Public Participation & Strengthen the Coordinative Powers of LLDA	376,000	376,000					For consultation with all stakeholders
2. Proposal to Reorganize the Laguna Lake Development Authority	284,000	284,000					For coordination with CSC & DBU
3. Strengthening the Financial Resources & Fiscal Capability of the Laguna Lake Development Authority	326,000	326,000					For study of LLDA - Board of Directors
4. Human Resources Development Project	1,422,000	1,422,000					For coordination with CSC, DAP, etc
TOTAL	2,408,000	2,408,000					
7. LAKE ENVIRONMENTAL EDUCATION AND COMMUNICATION SUPPORT PROGRAM							
A. Personnel Services	4,862,975	972,595	972,595	972,595	972,595	972,595	
B. Capital Outlay							
1. Communication Equipment	679,000	679,000					
2. Service Vehicle	500,000	500,000					
3. IEC Facilities/ Infrastructure Dev't.							
o Equipment Acquisition (refer to communication equipment)							Procurement for approval of DBU
o Establishment of Audio-Visual Room with necessary equipment and furnitures	250,000	250,000					
o Establishment of Library, Creating House including the procurement of books and other furnitures	3,000,000		3,000,000				
o Establishment of a Mini-museum for Freshwater Fish and Aquatic Plant Species	1,000,000			1,000,000			
o Establishment of a Regional Training Center	1,000,000				1,000,000		

LAGUNA LAKE DEVELOPMENT AUTHORITY
 MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST	ESTIMATED COST					BEYOND	REMARKS
		1996	1997	1998	1999	2000		
4. Facilities								
Media Production Room & cubicle	5,000	5,000						
Video Editing Studio	5,000	5,000						
C. Maintenance and Operating Expenses								
a. Supplies/Miscellaneous	5,720,000	1,144,000	1,144,000	1,144,000	1,144,000	1,144,000		
b. Training/Capability building	500,000	100,000	100,000	100,000	100,000	100,000		
c. PO/NGO/Networking & Linkages	50,000	10,000	10,000	10,000	10,000	10,000		
d. Environmental Consciousness Promotion Project	1,375,000	275,000	275,000	275,000	275,000	275,000		
o Environmental Concerts	250,000	50,000	50,000	50,000	50,000	50,000		
o Environmental concerts and cultural preservation								
- Rock with Nature Concert								Per sponsorship by the private sector
o Environmental Rallies and Monorcade	30,000	10,000	10,000	10,000	10,000	10,000		
o Environmental Education Integration Project	1,000,000	200,000	200,000	200,000	200,000	200,000		
e. IEC Materials Production Project								
Print Production								
o Primer on Laguna de Bay	250,000	250,000						
o Lukas-Kayang Pag-Unlad Comics	175,000	35,000	35,000	35,000	35,000	35,000		
o Publication of a Quarterly LLDA Newsletter	500,000	100,000	100,000	100,000	100,000	100,000		
o Community Posters on Saving Laguna Lake	300,000	100,000	100,000	100,000	100,000	100,000		
o Other Campaign Materials	200,000	40,000	40,000	40,000	40,000	40,000		
f. Audio-Visual Production								
o Mobile Exhibit on Laguna de Bay Ecosystem	200,000	100,000	100,000	100,000	100,000	100,000		
o Public Affairs Radio Program	360,000	120,000	120,000	120,000	120,000	120,000		
o Documentary Film on Laguna de Bay Region	400,000	200,000	200,000	200,000	200,000	200,000		
o Press Conferences/Media Briefings	250,000	50,000	50,000	50,000	50,000	50,000		
o Flipcharts, Slides, and Film Showing	100,000	20,000	20,000	20,000	20,000	20,000		
o T.v. Radio Plugs	180,000	36,000	36,000	36,000	36,000	36,000		
D. Contingency Fund	300,000	200,000						
TOTAL	23,341,975	5,201,595	3,812,595	6,262,595	5,032,595	3,032,595		
	23,342,000							

LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 6.1 ESTIMATED COST SCHEDULE

PROGRAMS/PROJECTS	ESTIMATED COST	ESTIMATED COST					REMARKS
		1994	1997	1998	1999	2000	
8. COMMUNITY DEVELOPMENT PROGRAM							
1. Community Development & Institution Building	2,450,000	490,000	490,000	490,000	490,000	490,000	
a. Formation of Organizations, Associations & Cooperatives							
b. Formation of Alliances/Federation	800,000	160,000	160,000	160,000	160,000	160,000	
c. Skills Training/Capability Building							
a. Leadership and Values Orientation	5,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	
b. Organizational Development & Implementation	5,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	
c. Technological Skills Training for Livelihood Development							
o Fishery	-	-	-	-	-	-	Cost of Fishery, Agriculture, Upstream Dealers, Urban Poor are packages with respective general programs for these activities
o Freshwater Pearl Culture							
o Freshwater Aquarium Fish Production							
o Polyculture of Macrobrachium & Tilapia							
o Fish Handling & Processing							
o Agriculture							
o Goat Raising for Dairy and Meat							
o Deer Farming							
o Sheep Raising							
o Quail Production							
o Other Livestock & Poultry Production							
o Upland Dwellers							
o Industrial Tree Farming							
o Agro-Facility							
o Reforestation & Fruit Tree Farming							
o Urban Poor							
o Fruit & Meat Processing							
o Stuffed Toys and Decor making							
o Hollowblock Manufacturing							
3. Mobilization Program							
a. Banay Lawa	1,250,000	250,000	250,000	250,000	250,000	250,000	
b. Banay Kapaliguan	1,250,000	250,000	250,000	250,000	250,000	250,000	
TOTAL	15,750,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	
9. RESEARCH AGENDA							
	25,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	
GRAND TOTAL	403,879,500	208,245,095	70,804,595	42,305,595	31,487,095	28,671,095	

**LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION**

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME					REMARKS
		1996	1997	1998	1999	2000 BEYOND	
1. ENVIRONMENTAL MANAGEMENT PROGRAM							
1. WATER QUALITY MONITORING PROGRAMS							
1.1 Laguna de Bay Sampling and Monitoring Program	LLDA						Regular activity. Annual operating cost.
1.2 Laguna de Bay Primary Productivity Studies	LLDA						Regular activity. Annual operating cost.
1.3 Tributary Rivers Water Quality Monitoring Program	LLDA						Regular activity. Annual operating cost.
1.4 Fish Diseases Monitoring Program	LLDA						Regular activity. Annual operating cost.
1.5 Other Lakes Sampling and Monitoring Program	LLDA						Regular activity. Annual operating cost.
1.6 LLDA Laboratory Upgrading Project	LLDA	■	■				
2. POLLUTION CONTROL PROGRAM							
2.1 Industrial Waste Management Program							
2.1.1 Waste Minimization Program	LLDA, DENR	■	■				Initial, to be Institutionalized
2.1.2 Upgrading of Self-Monitoring System for Industries Project	LLDA, DENR	■	■				24 weeks. Initial, to be Institutionalized
2.1.3 Pilot Common Wastewater Treatment Facility Project	LLDA, DENR	■	■				Cost exclude design and construction
2.1.4 Air Quality Management Project	LLDA, DENR	■	■				Initial, to be Institutionalized.
2.1.5 Study for the Introduction of Economics Incentives and Disincentives to Promote Water Pollution Prevention and Abatement in the Region	LLDA, DENR	■	■				
2.1.6 Pollution Control and Rehabilitation of Laguna de Bay Through Biotechnology and Ecotechnology	LLDA, UPLB					■	Joint project of UPLB, LLDA and Tsukuba University To be implemented by the year 2001.
2.1.7 Wastewater Treatment Plant Operators Training Program	LLDA, DENR	■	■				6 weeks. Initial, to be Institutionalized
2.1.8 Industrial Pollution Source Database Project	LLDA, DENR	■	■				
2.2 Agricultural Waste Management Program							See Agricultural Dev't. Program
2.3 Domestic Waste Management Program							See Interceptor Project
2.4 Solid Waste Management (SWM) Programs							
2.4.1 Solid Waste Management Improvement Project (FS)	LLDA, DENR, LGUs	■	■				Cost do not include R.A.D. design, construction & dev't.
2.4.2 Hospital Waste Management Project	DOH, LLDA, LGUs, DENR	■	■				Eight months
2.4.3 Proposed Closure of Open Disposal Sites and Rehabilitation of Abandoned Sites	DENR, LLDA, DOST	■	■				PHIP2.5 million for the first year PHIP1.5 million for the first year
2.5 Toxic and Hazardous Waste (THW) Management Program							To be integrated with on-going DENR project

**LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION**

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME				REMARKS
		1996	1997	1998	1999	
3. RE-ASSESSMENT OF MAJOR RECOMMENDATIONS ON ENVIRONMENTAL MANAGEMENT						
3.1 Technical Surveys						
3.1.1 Bathymetric Survey	LLDA, NAMRIA					
3.1.2 Topographic Survey of Lakeshores	LLDA					
3.1.3 Hydrological Re-assessment	NIRC, DPWH, NWRB					
3.1.4 Extension of Telemetric Network	DPWH, NWRB					
3.2 Infrastructure Projects						
3.2.1 Re-assessment of Interceptor Study	MWSS, LLDA					
3.2.2 Re-assessment of Petroleum Pipeline Project	LLDA, NPC, PPC					
3.2.3 Re-assessment of Parasitic Spillway	DPWH, LLDA					
4. WATER RESOURCES MANAGEMENT PROGRAM						
4.1 Framework for the Formulation of a Water Resource Use Policy	MWSS, NWRB, LLDA					
4.2 Study on the Laguna de Bay as Domestic Raw Water Supply Source	MWSS, LWUA					
4.3 Groundwater Management Project	LLDA, NWRB					2 916 million for the 1st year/ 2.0 million for the last year
2. WATERSHED MANAGEMENT PROGRAM						
1. ESTABLISHMENT OF WATERSHED MANAGEMENT COUNCIL						
1.1 LLDA Reorganization	LLDA					To be integrated w/ the LLDA Institutional Dev't.
1.2 Terms of Reference						
1.3 Memorandum of Agreement						
1.4 Policy/Plan of Operations						
1.5 Program Coordination						
1.6 Local Planning Teams						
1.7 Trainings						
1.8 Appraisal						
1.9 Management Info-System						
1.10 Monitoring/Evaluation						
2. WATERSHED RESOURCES INFORMATION SYSTEM						
2.1 Project Management						
2.2 Data Inventory/Assessment of Spatial Data & Information Holdings of Different Agencies and Users	DENR, NAMRIA					Initial year will focus on LLDA's on-going San Cristobal-Diermo River Rehabilitation Project
2.3 Data Base Management/Creation of Database Design/Program/GIS & Digitization						
2.4 Field Work/Areal Photography, Ground Truthing/Validation/Socio-economic Survey						
2.5 Training						
2.6 Cartography/Mapping						

**LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION**

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME					REMARKS
		1996	1997	1998	1999	2000	
3. PILOT UPLAND MANAGEMENT PROJECT (MARIKINA PAGSANJAN SUB-WATERSHED): MANAGING THE LAKE FROM THE UPLAND	LLDA, DENR						
3.1 Marikina Sub-Watershed Pilot Project							
a. Coupled Agroecosystems and Forest							Complementary projects to DENR Watershed Rehabilitation Program in Region IV
b. Managed Forest Occupancy							
c. Erosion Control Measures							
d. Erosion/Sedimentation/Pollution Studies							
e. Ecotourism							
f. Mapping of Ground Water Resources							Linkage w/ LLDA-NWRB Proposed Water Management Project
3.2 Pagsanjan Sub-Watershed Pilot Project							
a. Review/Inventory of Land Titles in Forest & Shoreland							
b. Policy Study on Tenure							
c. Appraisal of LLDA Paete Reforestation Project							
d. ITP Feasibility Study							
4. DEVELOPMENT OF A POLICY FRAMEWORK FOR WATERSHED RESOURCES PROTECTION	DENR, LLDA						Integrated within each component/activity of the Program; for integration in Agency Protection Budget
4.1 Community Mobilization/Organization							
4.2 Protection of Vegetative Cover							
4.3 Protection of Water Bodies/Tributaries							
4.4 Protection of Industrial Concerns							
4.5 Protection of Bio-diversity							
5. REGIONAL LAND USE PLANNING	LLDA, HLURB						To be integrated with Provincial/Municipal Land-Use Planning
5.1 Data Collection							
5.2 Data Analysis							
5.3 Scenario Building							
5.4 Consultation							
5.5 Report Preparation							
5.6 Multisectoral Review							
5.7 Final Report							
6. LAGUNA DE BAY SHORELANDS MANAGEMENT PROJECT	LLDA						Budget allocation in LLDA annual appropriation
6.1 Draft Policy Review							
6.2 Resource Inventory/Review of 1986 LLDA Shoreland							
6.3 Policy Review on NIPAS							
6.4 Community Mobilization							
6.5 Management Agreements							
6.6 Legislative Executive Action							
6.7 Shorelands Protection							
7. SUPPORT COMPONENT	LLDA						Integrated in all component activities of the program
7.1 Policy Reorientation/Strengthening							
7.2 Institutional Manpower/Development/Training Education							
7.3 Research Support and Technological Options							

LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME				REMARKS
		1996	1997	1998	1999-2000	
3. FISHERIES DEVELOPMENT PROGRAM						
1. FISHERY REGULATION						
Rejuvenation of the Fishery Industry						
- Rejuvenation of the Fishery Zoning and Management Plan	LLDA, LGUs					On regular LLDA budget appropriations.
- Action Plan for the Demolition of Illegal Fishpens	LLDA					Pipeline: LLDA corporate fund
Community Mobilization Project for Law Enforcement on Illegal Fishing (Bantay Lupa Project)	LLDA, BFAR, LGUs					Continuing activity of LLDA, linked with Community Development Program
2. FISHERY MANAGEMENT						
Establishment of a Fisheries and Limnological Research Center	LLDA, DOST, UPLB, BFAR, LGL					For further studies by LLDA-LND
Establishment of Additional Fish Sanctuaries						Included in the Research Agenda
Research on the Propagation of Inshore Fish Species						Included in the Research Agenda
Resource Assessment of Aquatic Fishes						Technology already available for J projects
3. AQUACULTURE DEVELOPMENT						
Freshwater Pearl Culture	LLDA					
Freshwater Aquaculture Fish Production	LLDA					
Polyculture of Macrobrachium sp. and Tilapia sp.	LLDA					
4. POST-HARVEST TECHNOLOGIES DEVELOPMENT						
Survey to Determine Market Needs of the Fishery Sector	LLDA, LGU					
Rehabilitation of Selected Existing Fishing Piers	LLDA, DPWH, LGU, PPA					For coordination with DPWH, LGUs and PPA
Seminar on the Proper Handling and Processing of Fish	LLDA, LGU, DOST					To be institutionalized
Improvement of Fish Transport Systems	DPWH					DPWH function for coordination
5. INSTITUTION BUILDING AND SUPPORT SERVICES						
Fisheries Cooperative Formation	LLDA, CDA, LGU					Included in the Community Development Program
Credit and Financing Facilities	LLDA, LB					Included in the Institutional Development Program
Marketing Assistance	LLDA, BAS, LGU					Included in the Lake Environmental Education & Communication Support Program
4. AGRICULTURAL DEVELOPMENT PROGRAM						
1. AGRISPATIAL DEVELOPMENT						
LAND USE ASSESSMENT						
IDENTIFICATION & MAINTENANCE OF AGRIPROTECTED AREAS						
1. Primary Agri-area (low land)	LLDA, NAMRIA, DENR, LGU, DA, DAR					Included as a component of Regional Land Use Planning
2. Secondary Agri-area (lower upland)						
3. Agro-environment protective area						
a. Agro-watershed protective area						
b. Lakeshore protective area						
DELINEATION & MONITORING OF URBAN AND INDUSTRIAL ZONE						
1. Short-term agri-utilization						
2. Environmental Planning, Impact Assessment & Monitoring						
2. AGRI-RESOURCE MANAGEMENT						
1. Crop Diversification	LGU, DAR, NGO, DENR					
2. Integrated Farming	DA, DOST, NGO					
3. Soil and Water Conservation Measure						
4. Hygiene Farming						

LAGUNA LAKE DEVELOPMENT PRIORITY
 MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME					REMARKS
		1996	1997	1998	1999	2000	
2. AGRI-RESOURCE MANAGEMENT	LGU, DAR, NGO, DENR, DA, DOST, NGO						
PILOT IMPLEMENTATION: Development, Documentation & Technology Package							
1. Papanan Subwatershed Area							
2. Marikina subwatershed							
3. Napalan Interim Organic Agriculture							
PROJECT EXPANSION: Documentation & packaging of technologies for development planning at APAs							
3. AGRI-ECOSYSTEM PROTECTION AND WASTE MANAGEMENT	LLOA, DENR, DA, LGU						
PROJECT DEVELOPMENT STUDY							
CONTROL POINTS ESTABLISHMENT							
Assessment of Pollution Profile							
1. Agricultural Pollution							
2. Livestock waste							
3. Poultry waste-Duck and Chicken							
4. Other types of agriculture							
FORMULATION OF MANAGEMENT & CONTROL SYSTEMS							
IMPLEMENTATION: ENFORCEMENT OF WASTE MANAGEMENT & CONTROL MEASURES							
4. ALTERNATIVE LIVESTOCK AND POULTRY DEVELOPMENT	DA, BAI, POC, LLOA, DENR, LGU						
1. Goat (for meat and dairy)							
2. Deer raising							
3. Sheep raising							
4. Quail production							
RESEARCH & DEMONSTRATION FARM							
SMALL ANIMAL DISPENSAL PROGRAM							
ASSISTED SMALL-SCALE LIVESTOCK & POULTRY							
5. AGRICULTURAL SUPPORT PROGRAM	DA, LLOA						
AGRICULTURE MODERNIZATION	DRWH, NIA						
AGRICULTURAL INPUT ASSISTANCE	LAND BANK						
CAPITAL CREDIT GUARANTEE	LGU						
INFRASTRUCTURE SUPPORT							
MARKETING SUPPORT							
6. RESEARCH AND TECHNOLOGY DEVELOPMENT	LLOA, DA, DAR, DOST						
AGRI CROP & LIVESTOCK PRODUCTION DEVELOPMENT	ERDB, OTHER RESEARCH INSTITUTIONS, NGO						
AGRI-ENVIRONMENTAL RESEARCH	LGU						
AGRI-BASED LIVELIHOOD & SUPPORT							
POLICY RESEARCH							
7. INFORMATION, EXTENSION AND COMMUNITY DEVELOPMENT	LLOA, DA, LGU, PD						
INFORMATION & EXTENSION NEEDS ASSESSMENT							
COMMUNITY DEVELOPMENT & MOBILIZATION							
INSTITUTIONAL BUILD-UP							
8. INSTITUTIONAL ARRANGEMENT	LLOA						
INSTITUTIONAL ROLE OF LLOA							
ORGANIZATIONAL & HUMAN RESOURCES							
INSTITUTIONAL LINKAGE							
							Included in the Institutional Development Program

Agri-support will be coordinated with DA & other concerned agencies providing these services.

Included in Research Agenda for the Master Plan

Included in Lake Erosion, Education & Communication Support and Community Development Program

Included in the Institutional Development Program

**LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION**

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME				REMARKS
		1996	1997	1998	1999-2000	
5. COTTAGE INDUSTRIES DEVELOPMENT PROGRAM						
1. LDB LIVELIHOOD TRAINING PROGRAM	LLDA, DTI, LGU, NGO					For coordination with DTI, NGOs and LGUs
Preparation of Feasibility Study						
Preparation of Survey Design						
Inventory of Manpower Resources & Industries						
Data Banking of Manpower Profile						
Integration of Training Programs						
Coordination with concerned agencies						
Manpower Training						
On-the Job Training						
Monitoring & Evaluation						
2. TRADE HOUSE ARTS AND CRAFTS CENTER						
Preparation of Feasibility Study	LLDA, DTI, LGUs, NGO					For coordination with DTI, LGUs and Industry Group
Site Identification/Developments						
Information Campaign & Distribution of Project Concept to Prospective Producers						
Product Selection						
Construction of Building						
Setting-up of Display Center						
Operationalization						
6. INSTITUTIONAL DEVELOPMENT PROGRAM						
1. RESTRUCTURE THE DECISION-MAKING PROCESS, ENSURE PUBLIC PARTICIPATION & STRENGTHEN THE COORDINATIVE POWERS OF LLDA	LLDA					For consultation with all stakeholders
2. PROPOSAL TO REORGANIZE THE LAGUNA LAKE DEVELOPMENT AUTHORITY	LLDA					For coordination with CSC and DBM
3. A PROPOSAL TO STRENGTHEN THE FINANCIAL RESOURCES AND FISCAL CAPABILITY OF THE LAGUNA LAKE DEVELOPMENT AUTHORITY	LLDA					For study of LLDA-Board of Directors
4. HUMAN RESOURCES DEVELOPMENT PROJECT	LLDA					For coordination with CSC, DAP, etc.
7. LAKE ENVIRONMENTAL EDUCATION AND COMMUNICATION SUPPORT PROGRAM						
1. LLDA IEC ORGANIZATIONAL DEVELOPMENT PROJECT						
a. Formulation of LLDA IEC Unit						
Mobilization	LLDA, LGU, PIA					
Training and Capability Building	LLDA					
PD/NGO/GO Networking and Linkages	LLDA, DENR					
	LLDA, PIA					

**LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION**

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE


PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME				REMARKS
		1996	1997	1998	1999 - 2000	
1. LLDA IEC ORGANIZATIONAL DEVELOPMENT PROJECT						
b. IEC Facilities/Infrastructure Development						
Equipment Acquisition	LLDA					Procurement, for approval of DBM
Establishment of Audio-Visual Room	LLDA					
Establishment of Library/Reading House	LLDA					
Establishment of a Mini-Museum for Freshwater Fish and Aquatic Plant Species	LLDA					
Establishment of a Regional Training Center	LLDA					
2. ENVIRONMENTAL CONSCIOUSNESS PROMOTION PROJECT						
Institutionalization of "Laguna de Bay Month"						
Environmental concerts	LLDA, DECS, PIA					
Environmental concerts and cultural presentations - Rock with Nature Concert	LLDA, LGU, NGO					
Environmental rallies and motorcade	LLDA, LGU, NGO					
Environmental Education Curriculum Integration	LLDA, DECS, NGO, LGU					
3. IEC MATERIALS PRODUCTION PROJECT						
a. Print Production						
Primer on Laguna de Bay	LLDA					
Lilas-Kayang Pag-unlad Comics	LLDA					
Publication of a LLDA Newsletter	LLDA					
Community Posters on Saving Laguna Lake	LLDA					
Other Campaign Materials						
b. Audio-Visual Production						
Mobile Exhibit on Laguna de Bay Region Ecosystem	LLDA, LGU, NGO					
Public Affairs Radio Program	LLDA, PIA					
Documentary Film on Laguna de Bay Region	LLDA, PIA					
Press Conferences/Media Briefings	LLDA, PIA					
Flipcharts, Slides and Film Showing	LLDA, PIA					
TV/Radio Plugs	LLDA, PIA					
8. COMMUNITY DEVELOPMENT PROGRAM						
1. COMMUNITY ORGANIZING AND INSTITUTION BUILDING						
a. Formation of Organizations, Associations & Cooperatives	LLDA, NGO, CDA, PO					
b. Formation of Alliances/Federations						
2. SKILLS TRAINING/CAPABILITY BUILDING						
a. Leadership and Values Orientation	LLDA					
b. Organizational Development & Implementation	LLDA, NGO					
c. Technological Skills Training for Livelihood Development	LLDA, NEDA, UP, Private Sector					
o Fishery						
Freshwater Pearl Culture	LLDA, BFAR, PCAMRD					Cost of trainings are packaged in respective general programs for these activities.
Freshwater Aquarium Fish Production	LLDA, BFAR, PCAMRD					
Polyculture of Macrobrachium & Tilapia	LLDA, BFAR, PCAMRD					
Fish Handling & Processing	LLDA, DOST, LGU					


LAGUNA LAKE DEVELOPMENT AUTHORITY
MASTER PLAN FOR THE LAGUNA DE BAY REGION

Table 7.1. PROPOSED IMPLEMENTATION SCHEDULE

PROGRAMS/PROJECTS	IMPLEMENTING AGENCY	TIME FRAME				REMARKS
		1996	1997	1998	1999	
c. Technological Skills Training for Livelihood Development						
o Agriculture						
Goat Raising for Dairy and Meat	LLDA, DA, UPLB.					
Deer Farming	TLRC					
Sheep Raising						
Quail Production						
Other Livestock & Poultry Production						
o Upland Dwellers						
Industrial Tree Farming	DENR, DA, UPLB-CF					
Agro-Forestry						
Reforestation & Fruit Tree Farming						
o Urban Poor						
Fruit & Meat Processing						
Stuffed Toys and Decor making						
Hollowblock Manufacturing	MIMDA, DTI, TLRC, DSWD					
3. MOBILIZATION PROGRAM						
a. Banay Iawa	LLDA, DENR, DA, BFAR, PO					
b. Banay Kapalitiran	NGO, PO, LGU, DND					

Legend:

 currently implemented by LLDA

 activities before and beyond Master Plan implementation

 Master Plan Program Activities

FIGURES

LIST OF FIGURES

FIGURE No.

- | | |
|-----|---|
| 2.1 | Laguna de Bay Location Map |
| 3.1 | LLDA Main Project Locations |
| 3.2 | Existing Organizational Structure |
| 3.3 | Institutional Relationships of LLDA with Other Government Agencies |
| 3.4 | Overlapping Responsibilities of Major Agencies in the Laguna de Bay Basin |
| 4.1 | Sampling Stations (LLDA) in the Laguna de Bay Basin |
| 4.2 | Pollution Sources in Laguna de Bay |
| 4.3 | Areas for Possible High THS |
| 4.4 | Major Barging Route for Petroleum Products |
| 4.5 | Present Land Use of Laguna de Bay Watershed Region |
| 5.1 | Laguna de Bay Region Proposed Major Development Zones |
| 5.2 | Laguna de Bay Region Industrial Zone |
| 5.3 | Laguna de Bay Region Watershed Protection Zone |
| 5.4 | Lake Resources Management Zone |
| 5.5 | The Shoreland Area |
| 5.6 | CALABARZON Tourism Circuit |
| 5.7 | Agricultural Sub-regions |

LAGUNA DE BAY BASIN

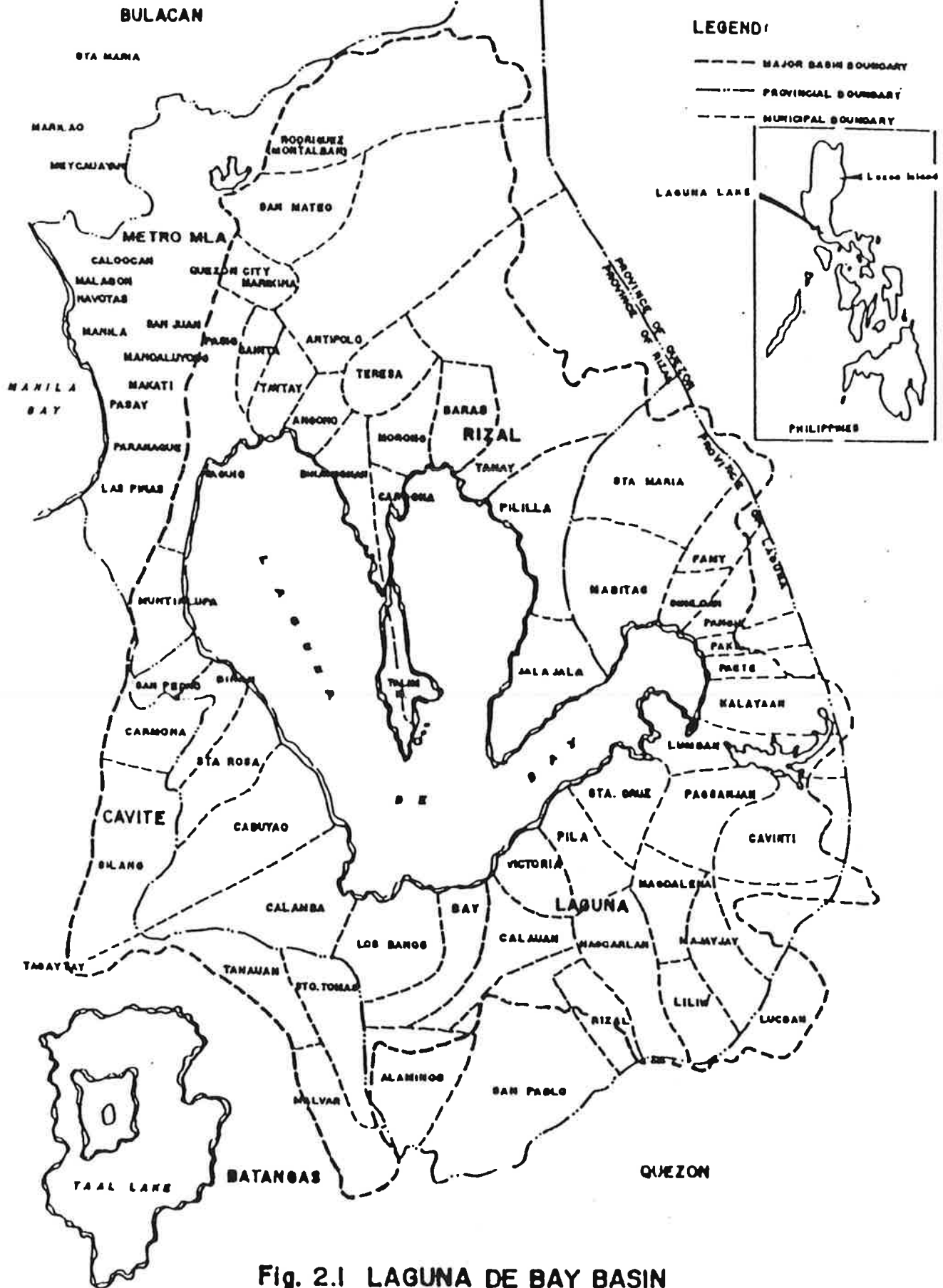


Fig. 2.1 LAGUNA DE BAY BASIN (LOCATION MAP)

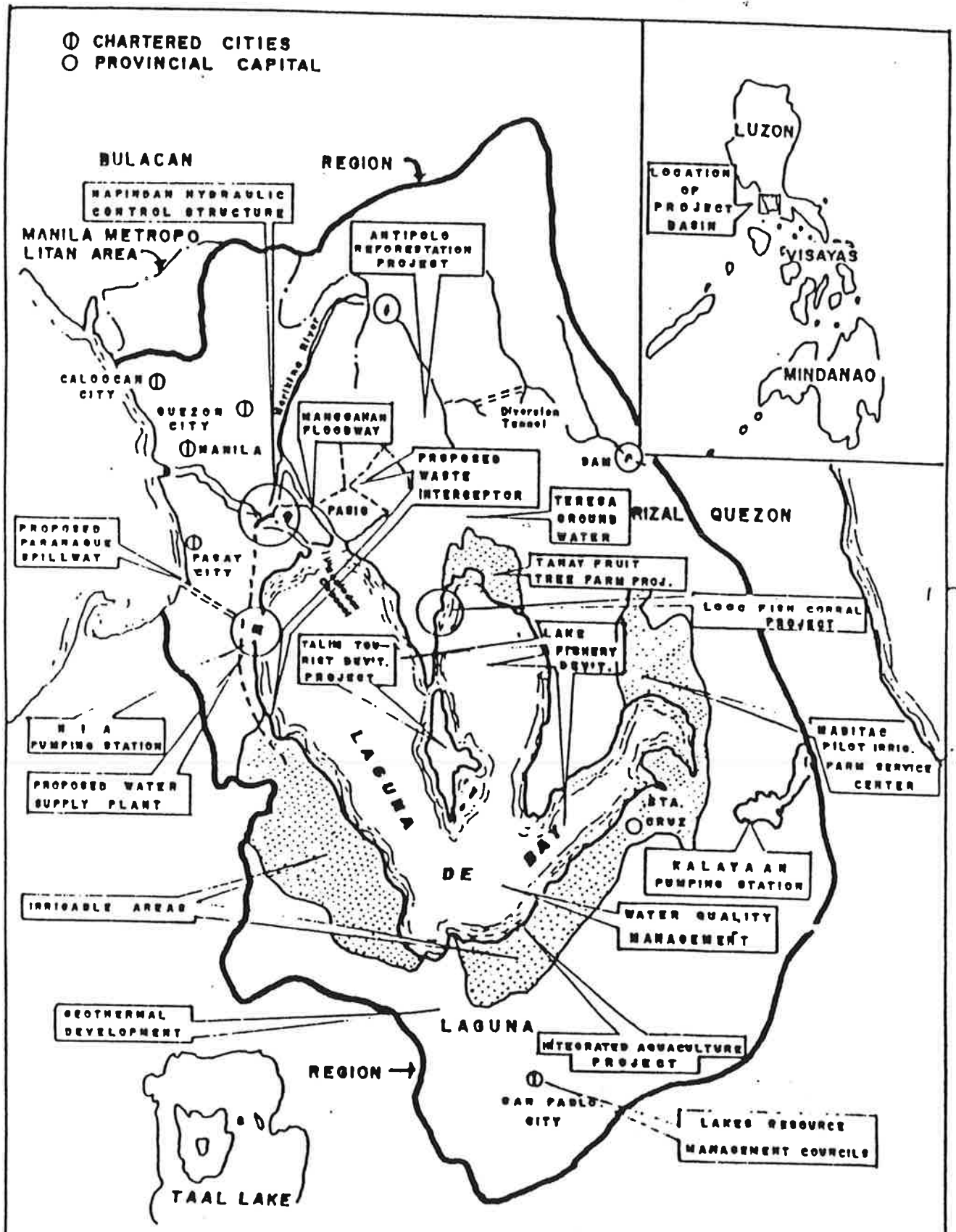


Fig. 3.1 LAGUNA DE BAY REGION Main Project Location

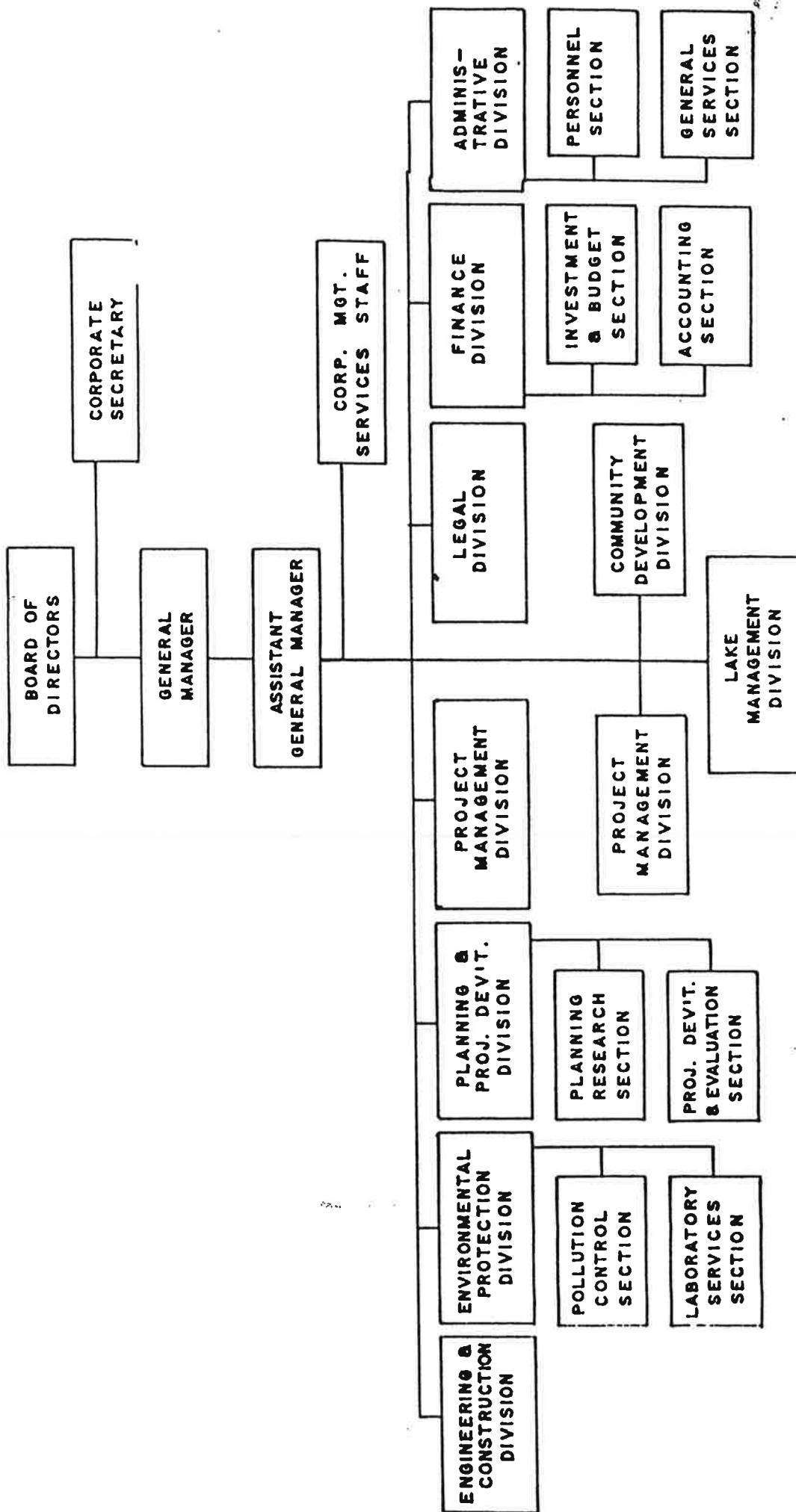
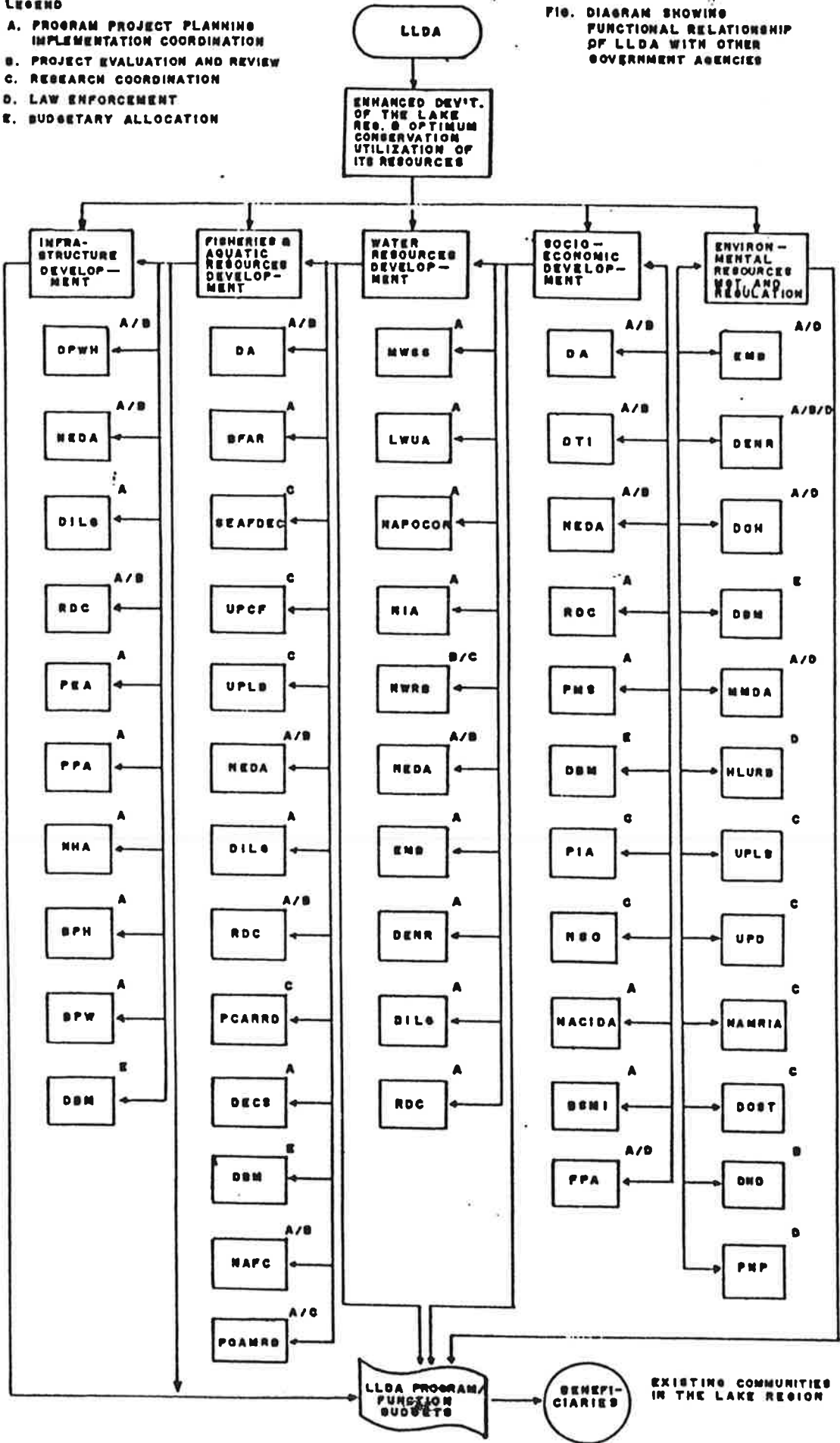


FIG. 3.2 LAGUNA LAKE DEVELOPMENT AUTHORITY EXISTING ORGANIZATIONAL STRUCTURE

LEGEND

- A. PROGRAM PROJECT PLANNING
IMPLEMENTATION COORDINATION
- B. PROJECT EVALUATION AND REVIEW
- C. RESEARCH COORDINATION
- D. LAW ENFORCEMENT
- E. BUDGETARY ALLOCATION

**FIG. DIAGRAM SHOWING
FUNCTIONAL RELATIONSHIP
OF LLDA WITH OTHER
GOVERNMENT AGENCIES**



**FIG. 3.3 INSTITUTIONAL RELATIONSHIPS OF LLDA
(Modified from URSI, 1989)**

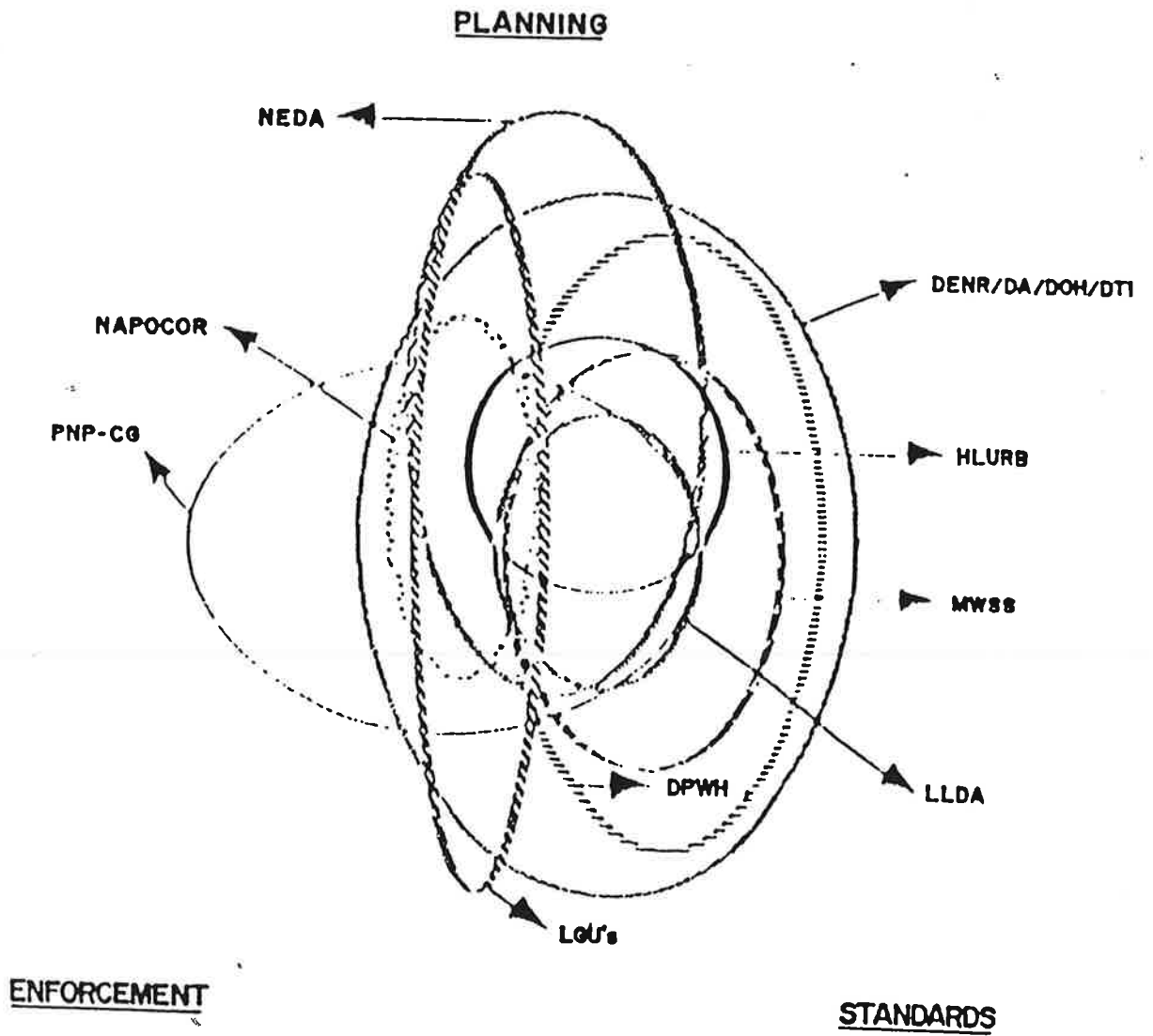


Fig. 3.4 OVERLAPPING RESPONSIBILITIES IN THE LAGUNA LAKE REGION

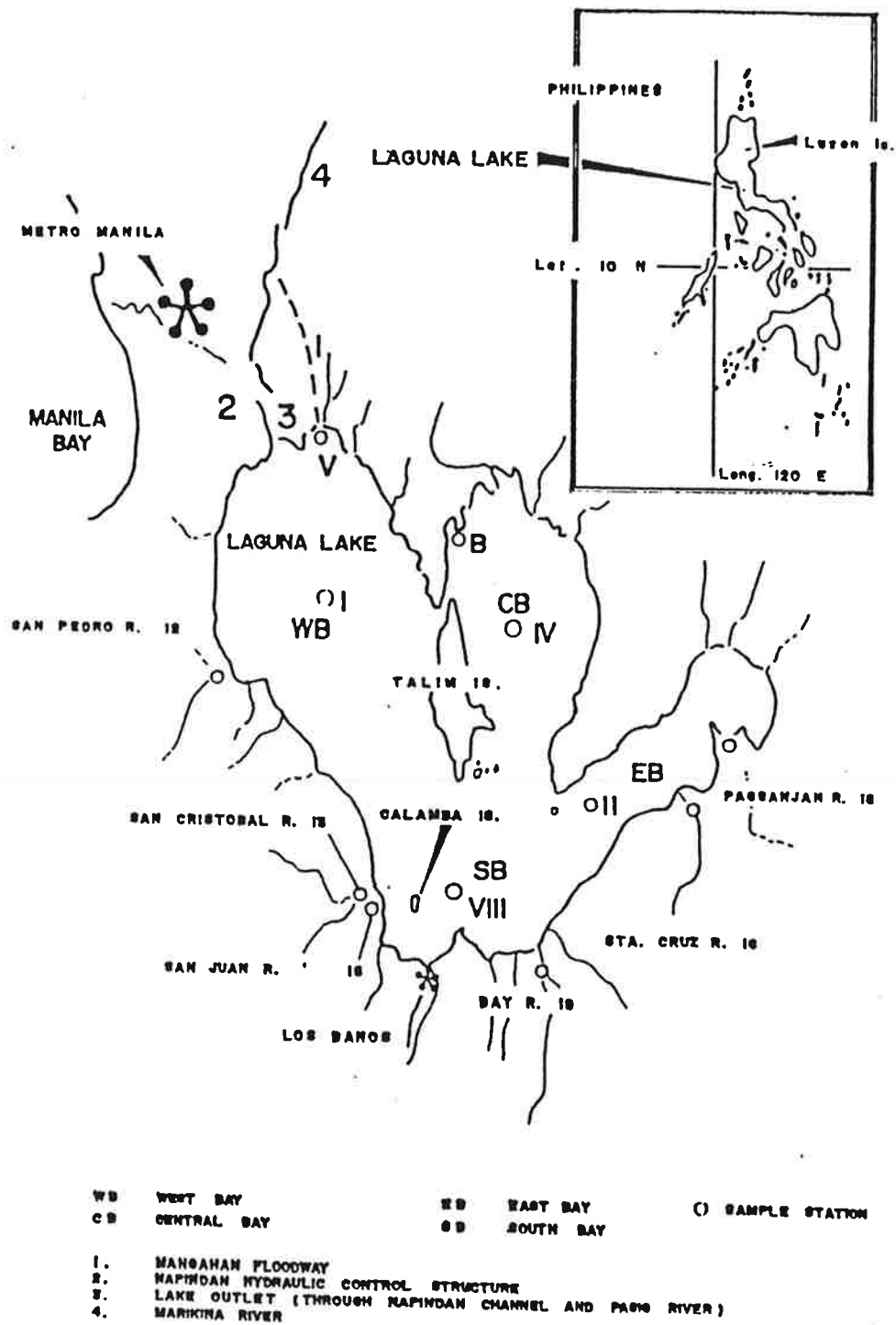


Fig. 4.1 SAMPLING STATIONS (LLDA) IN LAGUNA LAKE BASIN
(6 TRIBUTARIES & 5 LAKE SITES)

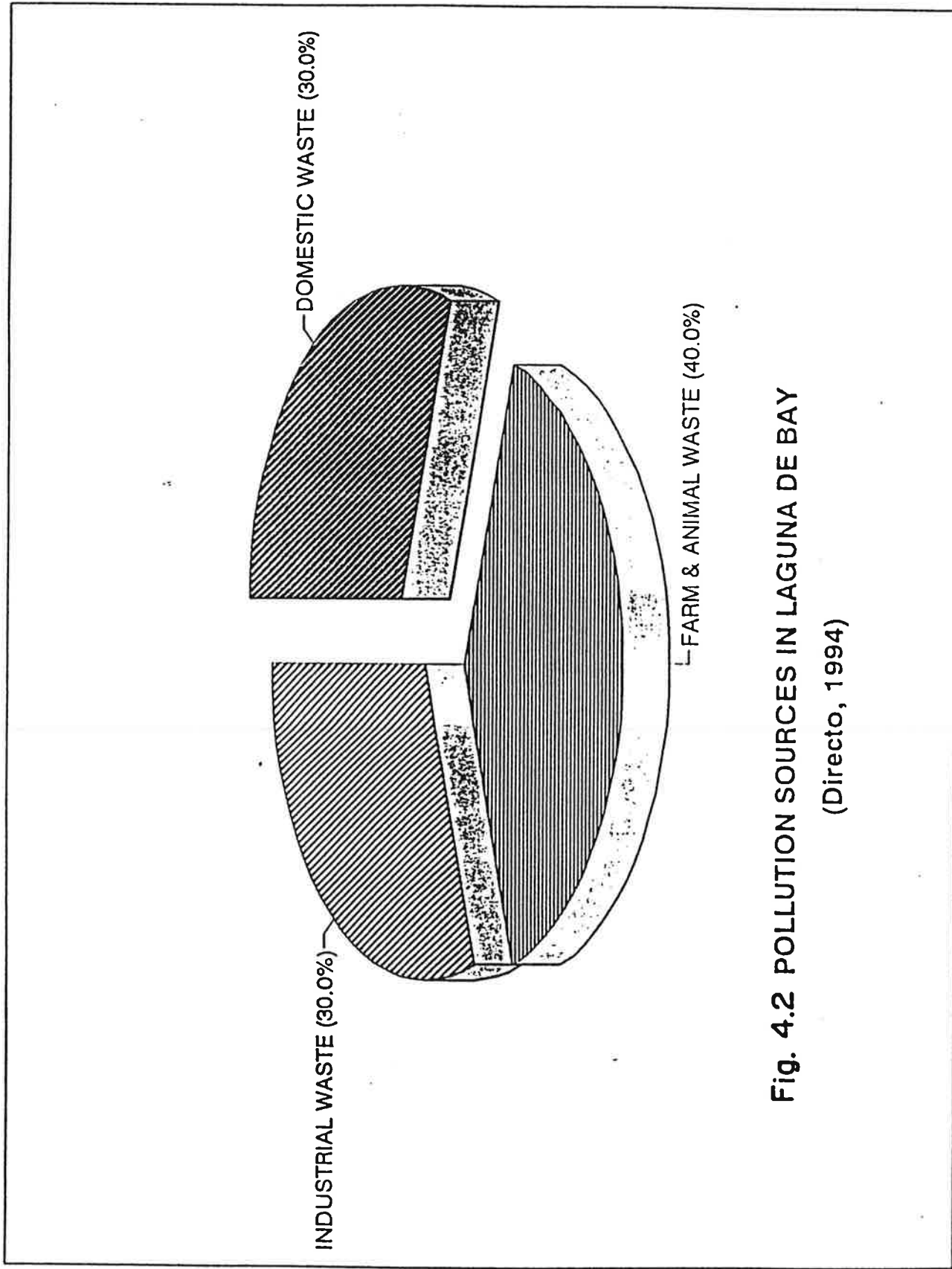


Fig. 4.2 POLLUTION SOURCES IN LAGUNA DE BAY

(Directo, 1994)



Fig. 4.3 AREAS FOR POSSIBLE HIGH THS (URSI, 1989)

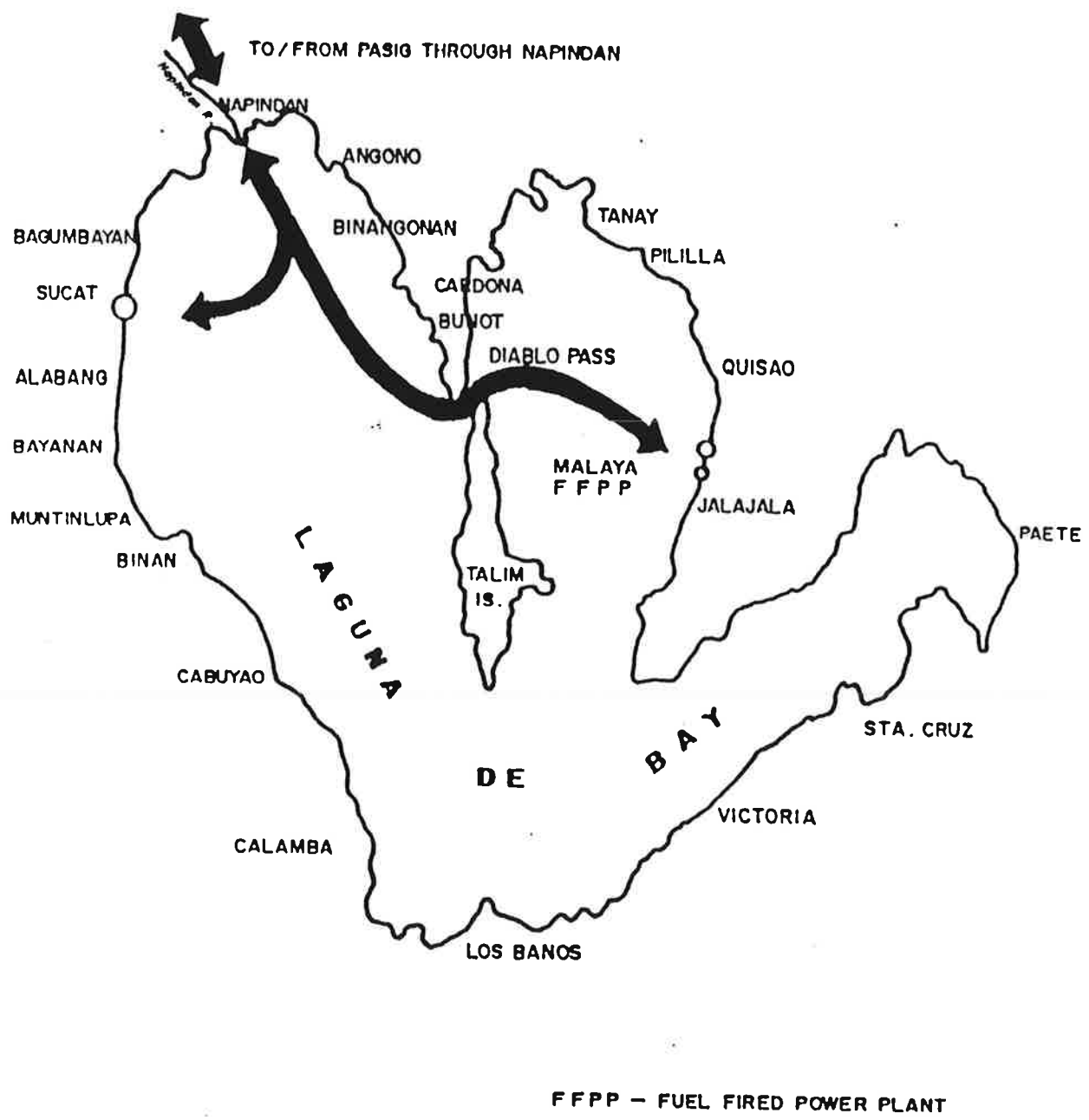


Fig. 4.4 BARGING ROUTES FOR PETROLEUM PRODUCTS (SOGREAH, 1991)

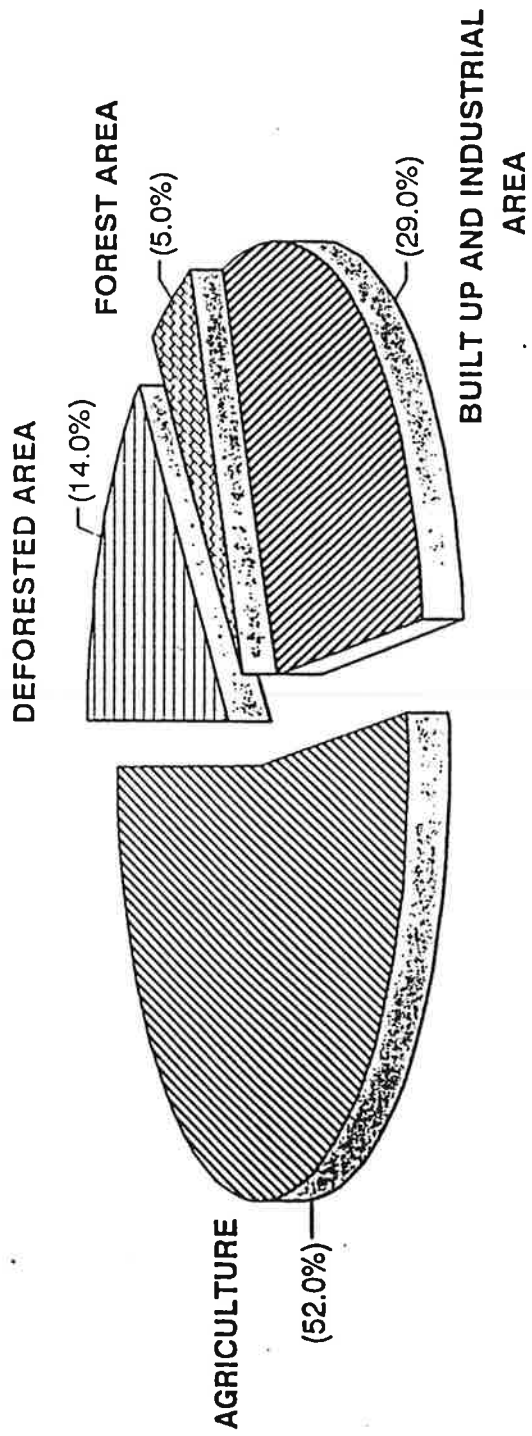


Fig. 4.5 LAND USE OF LAGUNA DE BAY WATERSHED REGION

(LLDA 1992)

LAGUNA DE BAY BASIN

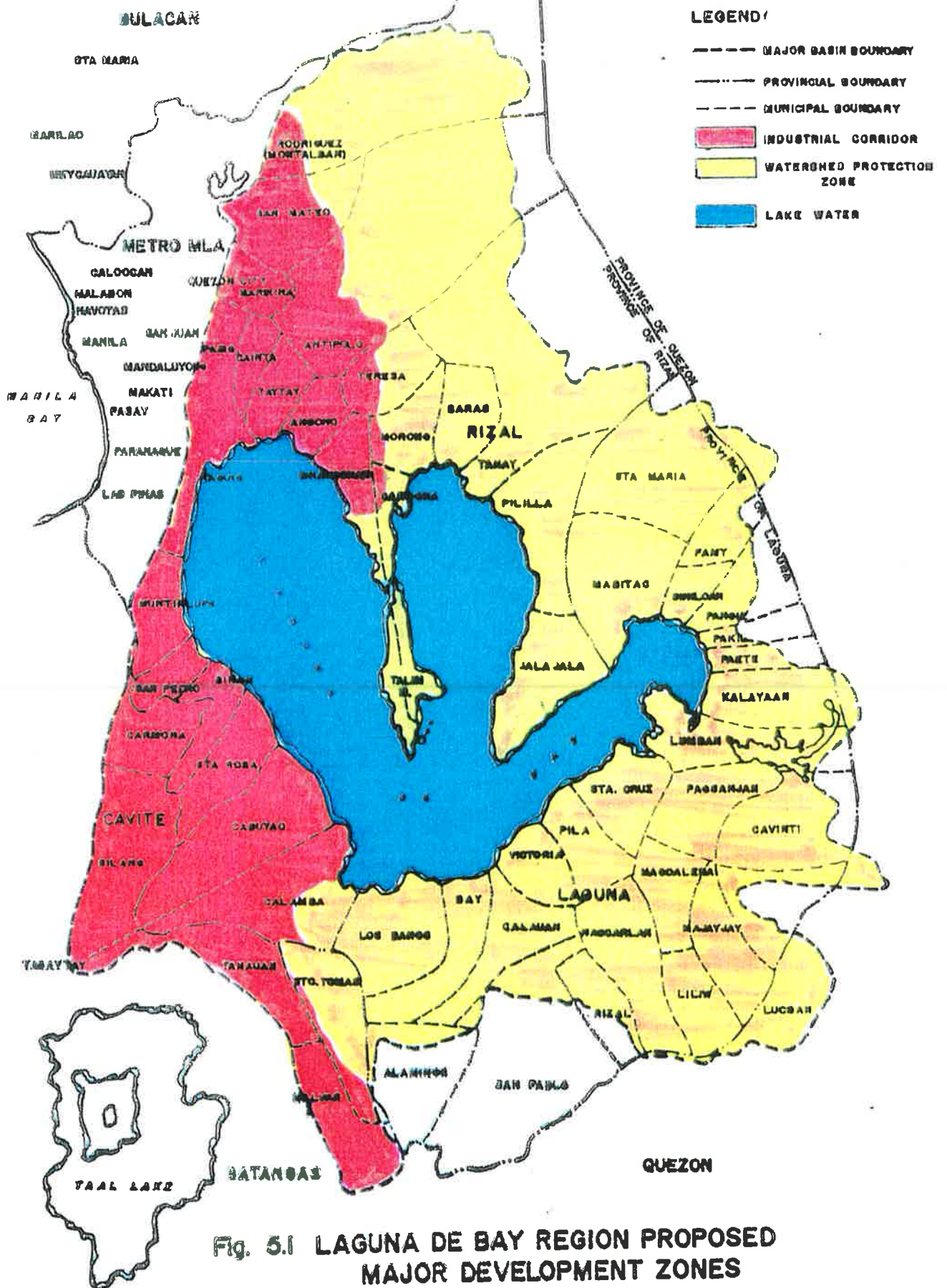


Fig. 5.1 LAGUNA DE BAY REGION PROPOSED MAJOR DEVELOPMENT ZONES

LAGUNA DE BAY BASIN

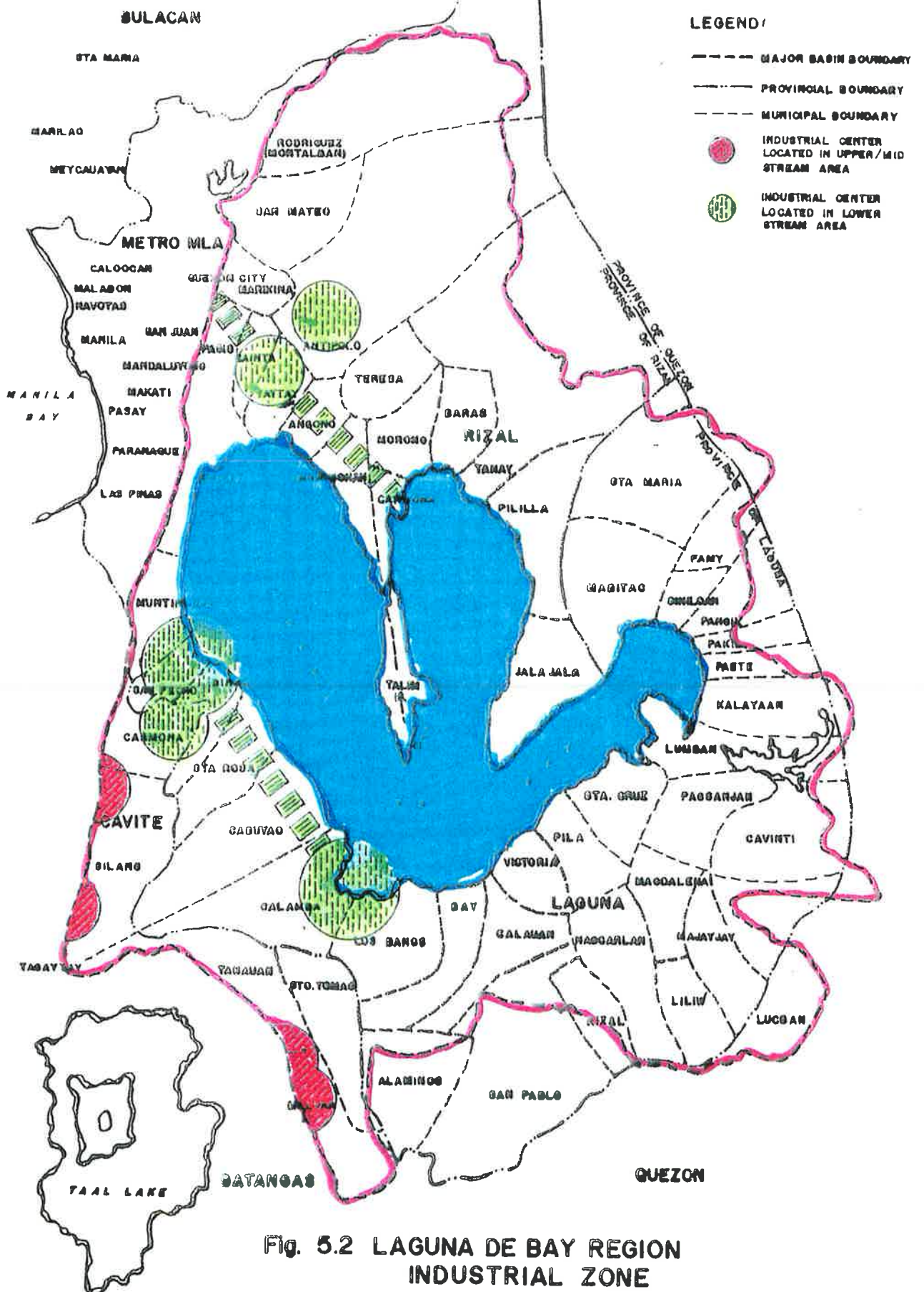


Fig. 5.2 LAGUNA DE BAY REGION INDUSTRIAL ZONE

LAGUNA DE BAY BASIN

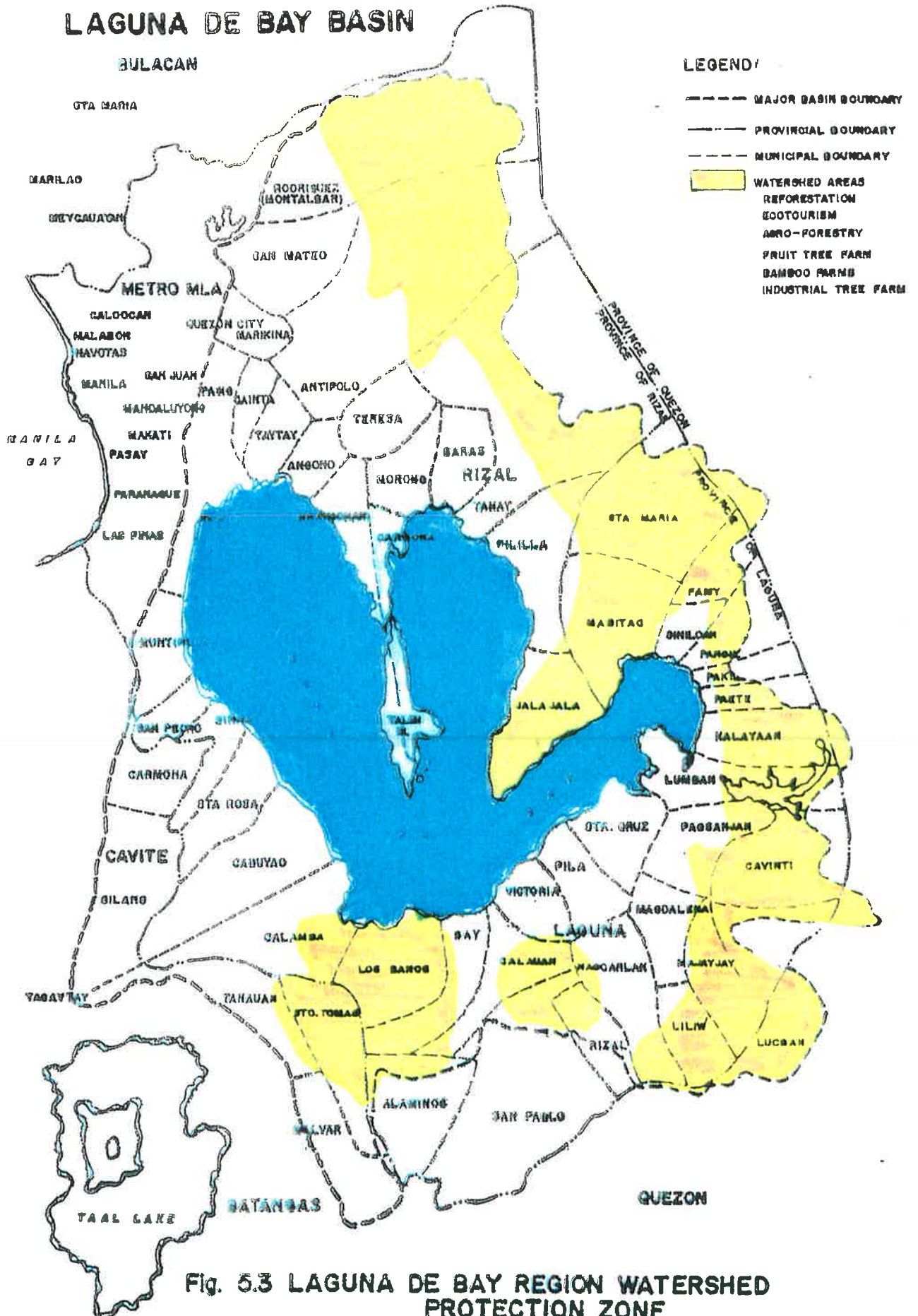


Fig. 5.3 LAGUNA DE BAY REGION WATERSHED PROTECTION ZONE

LAGUNA DE BAY BASIN

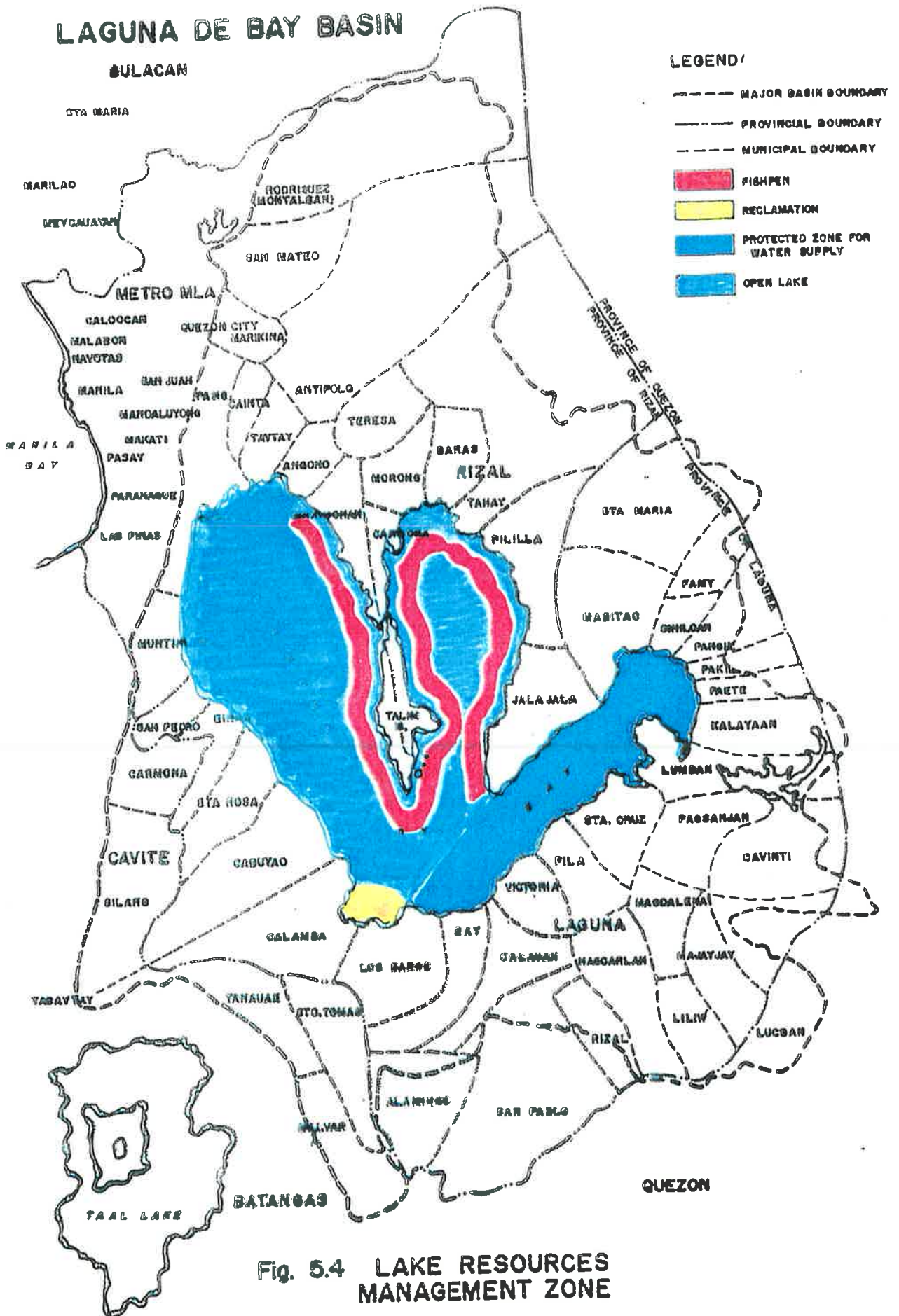


Fig. 5.4 LAKE RESOURCES MANAGEMENT ZONE

LAGUNA DE BAY BASIN

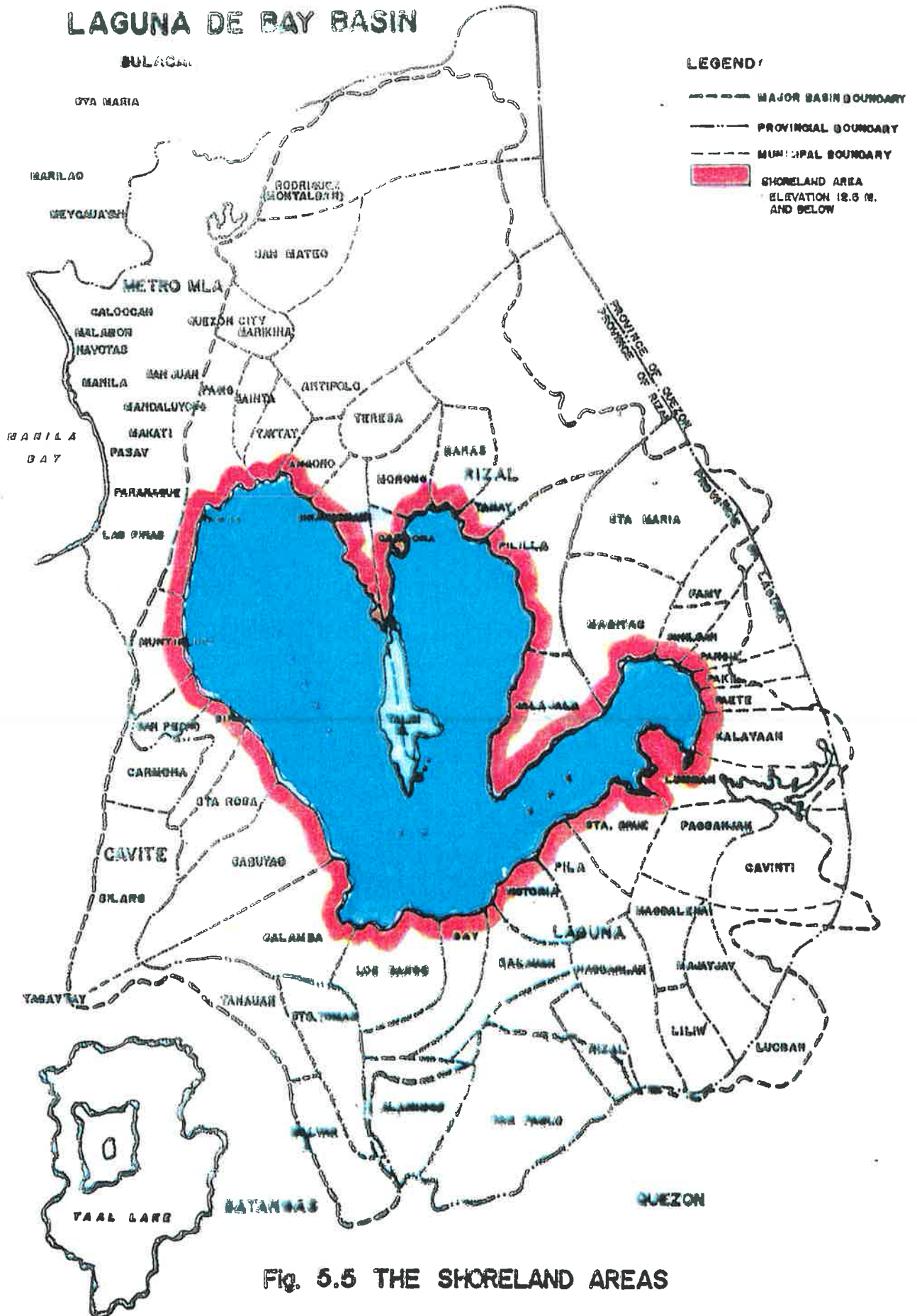


Fig. 5.5 THE SHORELAND AREAS

LAGUNA DE BAY BASIN

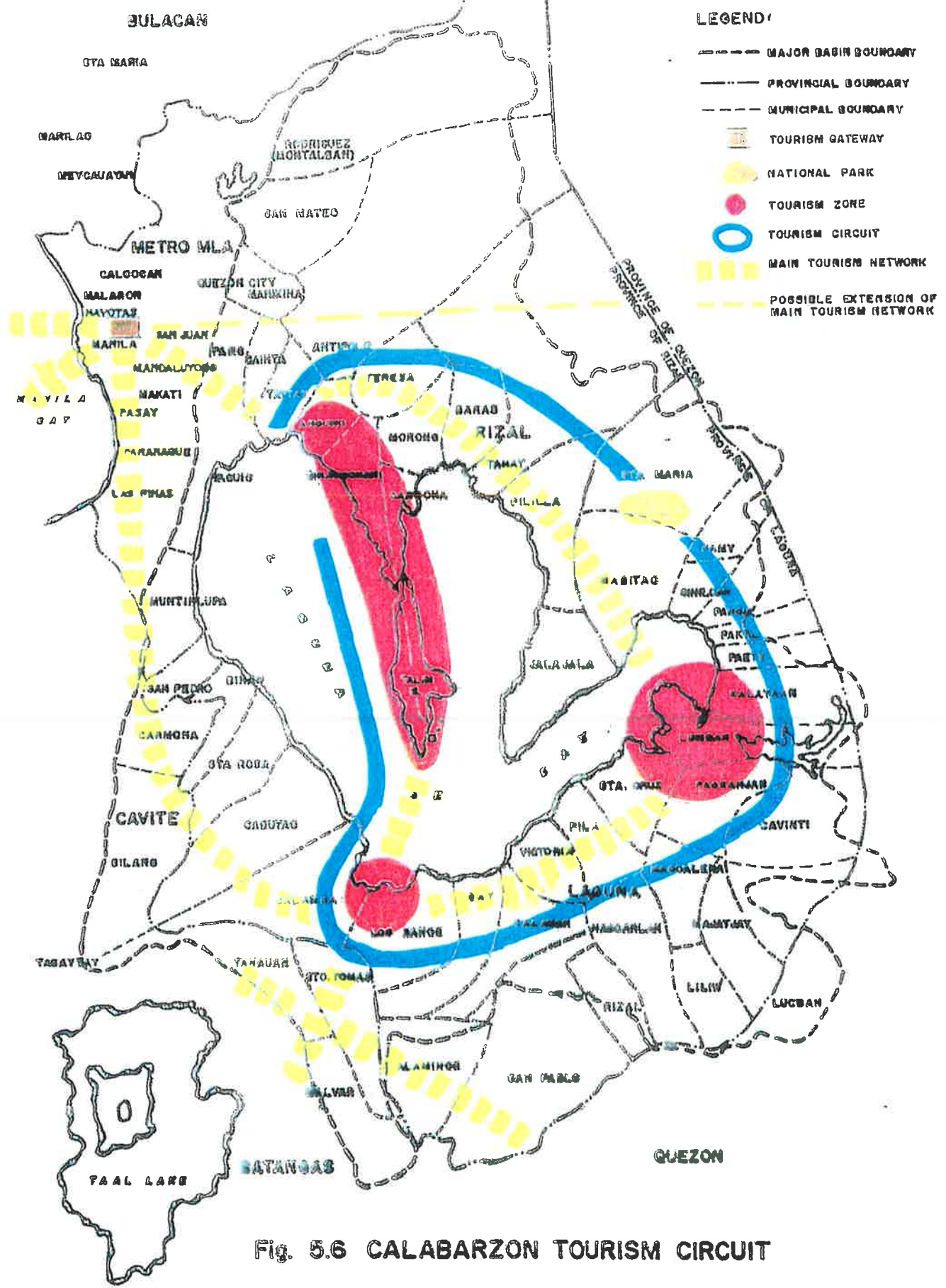


Fig. 5.6 CALABARZON TOURISM CIRCUIT

LAGUNA DE BAY BASIN

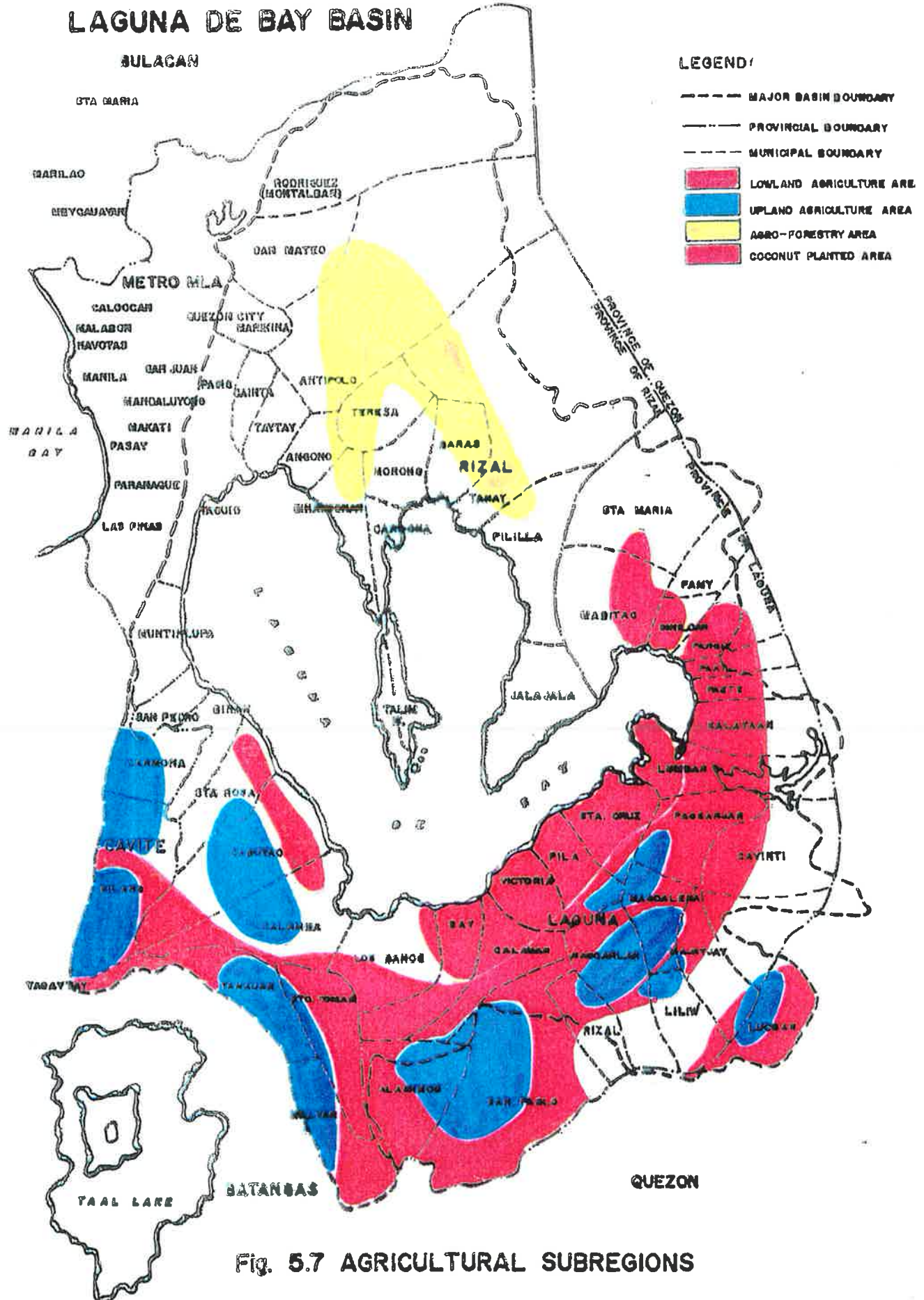


Fig. 5.7 AGRICULTURAL SUBREGIONS

ACRONYMS

ACRONYMS

ADB	- Asian Development Bank
AGMARIS	- Agricultural Marketing Information System
AKLAS	- Alyansa ng Kapisanan Alay sa Sambayanan
APA	- Agriculture Protected Area
BAS	- Bureau of Agricultural Statistics
BDTP	- Bureau of Domestic Trade Promotion
BETP	- Bureau of Export Trade Promotion
BFAR	- Bureau of Fisheries and Aquatic Resources
BSMBD	- Bureau of Small and Medium Business Development
BSWM	- Bureau of Soils and Water Management
CAC	- Calauan Aquaculture Center
CALABARZON	- Cavite, Laguna, Batangas, Rizal & Quezon
CALARIZ	- Cavite, Laguna, Rizal Fisherfolks Federation
CBBE	- Countryside and Barangay Business Enterprise
CDA	- Cooperative Development Authority
CDD	- Community Development Division
CITC	- Cottage Industry Technology Center
CITEM	- Center for International Trade Expositions and Mission
CTF	- Common Treatment Facilities
COs	- Community Organizers and/or Organizations
DA	- Department of Agriculture
DAP	- Development Academy of the Philippines

DAR	- Department of Agrarian Reform
DBM	- Department of Budget and Management
DECS	- Department of Education Culture and Sports
DENR	- Department of Environment and Natural Resources
DILG	- Department of Interior and Local Government
DND	- Department of National Defense
DOH	- Department of Health
DOST	- Department of Science and Technology
DPWH	- Department of Public Works and Highways
DSWD	- Department of Social Welfare and Development
DTI	- Department of Trade and Industry
EMB	- Environmental Management Bureau
FAEB	- Fishermens' Association in East Bay
FARMC	- Fishery Aquatic Resource Management Council
FLIC	- Footwear and Leathergoods Industry Center
FPA	- Fertilizer and Pesticide Authority
FPRDI	- Forest Products Research and Development Institute
GFSME	- Guarantee Fund for Small and Medium Enterprise
GOs	- Government Organizations
GPEP	- Grains Production Enhancement Program
HLURB	- Housing and Land Use Regulatory Board
IEC	- Information, Education and Communication
IFCA	- Information for Competitive Advantage
IFMA	- Information for Mission Accomplishment

ISF	- Integrated Social Forestry
JICA	- Japan International Cooperation Agency
KAMPI	- Kapatiran ng Malayang Maliliit na Mangingisda ng Pilipinas, Inc.
KASAMA	- Kalipunan ng Samahan ng mga Mamamayan
KCCA	- Key Commercial Crops Area
KCCDP	- Key Commercial Crops Development Program
KLDA	- Key Livestock Development Area
KPA	- Key Production Area
LB	- Land Bank
LESMP	- Lake Environmental Social Mobilization Project
LGUs	- Local Government Units
LLDA	- Laguna Lake Development Authority
LMD	- Lake Management Division
LPDP	- Livestock and Poultry Development Program
LWUA	- Local Waterworks and Utilities Administration
MAFCs	- Municipal Agriculture & Food Councils
MEIP	- Metropolitan Environmental Improvement Programme
MIRDC	- Metals Industry Research and Development Center
MMA	- Metro Manila Area
MMDA	- Metropolitan Manila Development Authority
MO	- Memorandum Order
MRP	- Moral Recovery Program
MTADP	- Medium-Term Agricultural Development Plan

PD	- Presidential Decree
PDC	- Productivity and Development Center
PDDCP	- Product Development and Design Center of the Philippines
PEA	- Public Estates Authority
PHRDC	- Philippine Human Resources Development Center
PIA	- Philippine Information Agency
PICOP	- Paper Industries Corporation of the Philippines
PITC	- Philippine International Trading Company
PIU	- Public Information Unit
PMO	- Watershed Management Program Office
PMS	- Presidential Management Staff
PNP	- Philippine National Office
PO	- People's Organization
PO	- Permit to Operate
PPA	- Philippine Ports Authority
PPC	- Philippine Petroleum Corporation
PSSD	- Philippine Strategy for Sustainable Development
PTRS	- Philippine Textile Research Institute
RA	- Republic Act
RDC	- Regional Development Council
RLUP	- Regional Land Use Planning Project
RMC	- Resource Management Council
SEAFDEC	- Southeast Asian Fisheries Development Center
SELF	- Small Enterprise Loan Fund

SHORELANDS	- Shorelands Management Project
SRA	- Social reform Agenda
SWC	- Soil and Water Conservation
SOGREAH	- Socie'te' Grenobloise d'Etudes et d' Applications Hydrauliques
SUPPORT	- Support Component
TESDA	- Technical Education Skills Development Authority
TFIF	- Task Force on Illegal Fishpen
THS	- Toxic and Hazardous Substances
THW	- Toxic and Hazardous Wastes
TITDI	- The Industrial Technology Development Institute
TLRC	- Technology Livelihood Resource Center
TST-SCF	- Tulong sa Tao Sub-Contracting Financing Program
TST-SELA	- Tulong sa Tao-Self Employment Assistance Program
UN	- United Nations
UNDP	- United Nations Development Program
UP-ISSI	- University of the Philippines-Institute of Small Scale Industries
UPLAND	- Pilot Upland Management Project (Marikina and Pagsanjan Sub Watershed): Managing the Lake from the Upland
UPLB	- University of the Philippines Los Banos
UPLB-CF	- University of the Philippines-College of Forestry
UPLB-IESAM	- University of the Philippines-Institute of Environmental Science and Management
URSI	- URS International Trans-Asia Inc.

WATPRO	- Watershed Resource Protection
WMC	- Watershed Management Council
WRIS	- Watershed Resource Information System
ZOMAP	- Lake Fishery Zoning and Management Plan

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