STATE OF THE NATION

RESEARCH REPORTS

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Baseline Assessments

The State of the Philippine Environment

UNIVERSITY OF THE PHILIPPINES
CENTER FOR INTEGRATIVE AND DEVELOPMENT STUDIES
AND THE UP PRESS

Baseline Assessments

The State of the Philippine Environment

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FOREWORD

Environmental issues continue to occupy a central place in our national discourse. The impending water crisis is but one of the most recent manifestations of the profound effects of environmental abuse for which solutions must be collectively sought and found.

But solutions to the environmental crisis, which has now taken global proportions, are far from simple. Among other things, finding solutions requires that we accurately grasp the problem through adequate knowledge of the state of our environment and resources development.

For this reason, UP-CIDS is publishing the *State of the Philippine Environment*. This report was done by a multidisciplinary team of experts from UP Los Baños and UP Diliman under the leadership of Dr. Percy Sajise. The team was convened in 1989 as part of the UP Assessments of the State of the Nation Project. Although the data is quite dated, the report continues to be relevant precisely because it provides a baseline assessment of our environmental state against which future developments may be viewed.

Appropriately, the study uses an ecosystem approach so that we can fully apprehend the relationships among the different influences on our environment and resource use. Apart from the assessments, it also gives some policy recommendations.

The UP-CIDS wishes to acknowledge Ms. Sheila Coronel, Ms. Bella Lucas and Prof. Patricia Arinto for their editorial assistance; Michael Arciga for painstakingly drawing the figures on the computer, encoding the numerous tables and layouting the text; and Erlinda Cometa, for encoding some of the papers.

As in all our publications, the views presented in this report are those of the authors whose academic freedom is upheld by the University.

Maria Cynthia Rose Banzon Bautista
Executive Director
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INTRODUCTION

The bleak environmental scenario which 20 years ago was only being drawn up, is now becoming a reality. In recent years, the country has witnessed the convergence of two major phenomena which threaten the well-being of the present and future generations. On one hand, there is the continued deforestation of watersheds and the pollution of water, land and air. At the same time, there is rapid population growth. The consequences of these are exemplified by the devastation wrought by big floods in Eastern Visayas and Bicol; the prolonged flooding of the Laguna Lake shoreline; the drying up of rivers, streams and lakes; the disappearance of animal and plant species; and the decline in the productivity of forest lands, croplands, lakes and marine ecosystems. These are the stark realities facing the nation today.

This study aims to undertake a general assessment of the state of the environment and resources development in the Philippines for planning and policy formulation purposes. To fully understand the interrelationships between the different factors affecting the environment and resources utilization, the analysis was done by ecosystems. Six primary interconnected and interrelated ecosystems in the country mere examined: forest, marginal land, cropland, urban, freshwater, and marine and coastal. This report draws a general picture of the state of these life support systems and analyzes the causes and effects of natural resources utilization and development in the country. The impact of population pressure on the utilization, development and carrying capacity of various environmental systems is highlighted. Management strategies as well as policy and research recommendations for a sustainable (national environmental and resource) development are likewise presented.

CHAPTER 1
CONCEPTUAL FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

*DEFINITION AND CONCEPTUAL FRAMEWORK**

Sustainable Development **can be defined as:**

a dynamic process in which the development and utilization of *resources*, orientation of *technological* development, *institutional* change and direction of *investments* are in harmony and enhance both current and future potentials to meet human *needs* and *aspirations*.

This definition was modified from the 1987 Bruntland Report by the addition of the word "dynamic" and the use of the word "utilization" instead of exploitation. This definition includes the development of both human resources as well as natural resources development. Its main focus is the primary goal of development which is the satisfaction of the needs and aspirations of humankind.

Figure 1.1 shows the interrelationship between the four components of sustainable development as defined, namely: *resources, technologies, institutions,* and *investments*. These components exist in a very dynamic relationship with one another. This means that an alteration in one component initiates changes in the other three components. Furthermore, these four components are in harmony with one another and enhance both the present and future satisfaction of human needs and aspirations.

Sustainable development can also be represented by the framework shown in Figure 1.2. Because the concept of sustainable development is a dynamic and integrated one, we are interested in the mechanisms that will allow human society to cope with changes—for example, in population or technology.

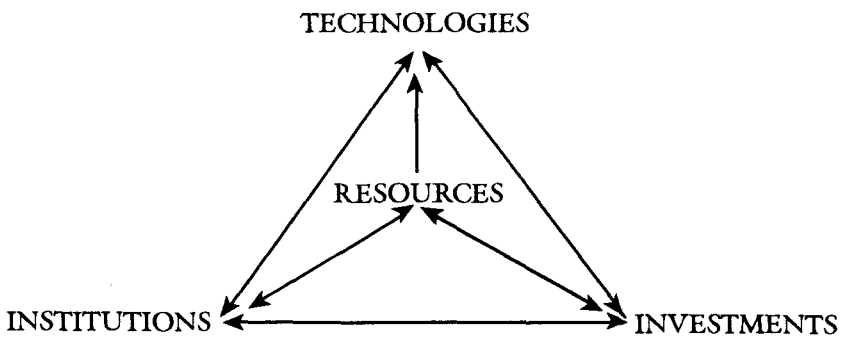
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*This conceptual framework for sustainable development was formulated by the participants and members of the different sub-themes of Theme I (Population, Resources, Environment and Sustainable Development) of the UP State of the Nation Assessment Project during the seminar-workshop held on August 10, 1990 at the University of the Philippines at Los Baños, College, Laguna.

FIGURE 1.1

CONCEPT OF SUSTAINABLE DEVELOPMENT (WCED, 1987)

Sustainable development is a dynamic process in which the development and utilization of **resources,** orientation of **technological** development, **institutional** change and direction of **investments** are all in harmony and enhance both current and future potentials to meet human needs and aspirations.



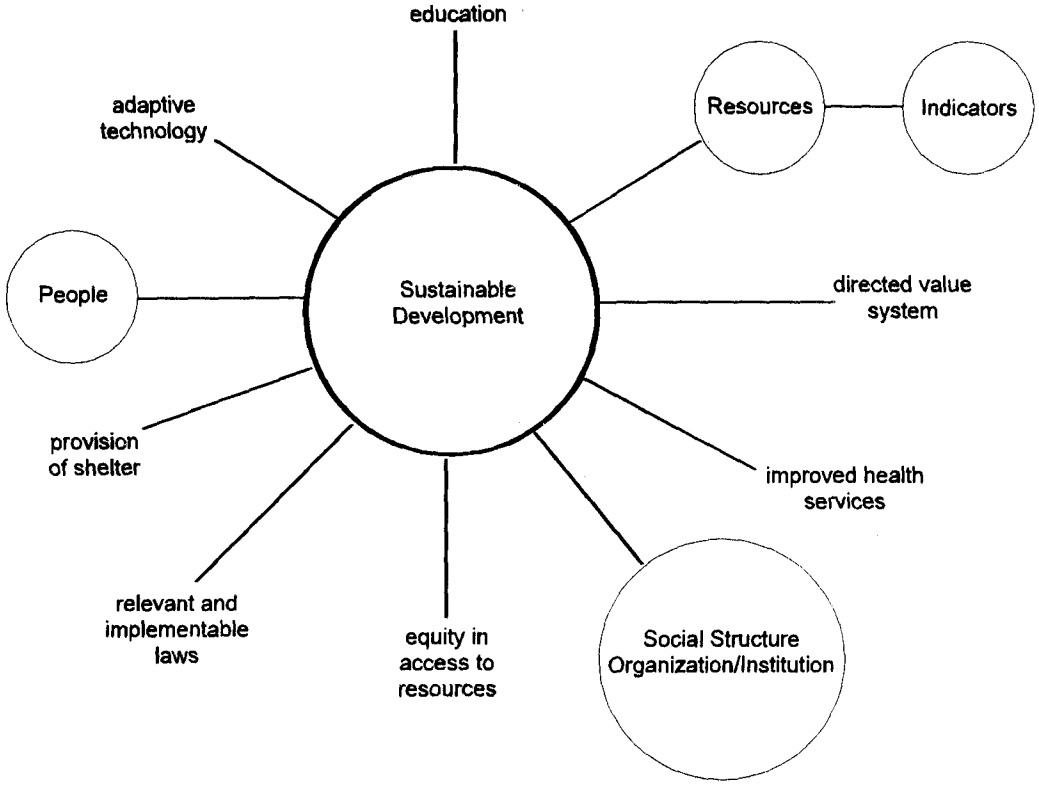


FIGURE 1.2
CONCEPTUAL FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

OPERATIONALIZATION OF SUSTAINABLE DEVELOPMENT

Two relevant issues emerge with the operationalization of sustainable development. The first concerns the time frame involved between present and future satisfaction of needs and aspirations. What is the optimal time pathway of production and consumption which will ensure both present and future sustainability of a nonrenewable resource? How long should a resource be allowed to last for its utilization to be considered sustainable? Although time frame may vary with the situation, it is recognized that the time frame for sustainable development should be long-term, at least one generation or 60 years.

The second relevant question concerns the hierarchical structure for achieving sustainable development. What is the relevant level for attaining sustainable development? Project level? Provincial? Regional? National? This is a difficult question because what may be viewed as sustainable at the project level, such as ***kaingin*** farming, may be viewed as unsustainable at watershed level under conditions of low population density.

In the Philippine context, sustainable development cannot be achieved without addressing the needs of the 50 percent of our population living below the poverty line. Many among the poor can meet their present needs only through the use of harmful technologies such as dynamite or cyanide fishing, charcoal making, which are destructive but necessary in the context of their needs satisfaction.

SUSTAINABLE DEVELOPMENT AND THE ENVIRONMENT

There are therefore three major elements or needs for achieving sustainable development:

1. A definition of the minimum quality of life or standard of living for the people.

2. An assessment of the limits of the carrying capacity of the ecosystem and resource base and a set of indicators which will tell us whether the limits have already been exceeded.

3. The introduction of technologies which can enhance the transformation of goods and services into more useful but environmentally benign forms.

While the country has always shown its willingness and readiness to adopt imported technologies, there is no provision for assessing these technologies. Government tends to promote or sponsor technologies like golden *kuhol* culture and monoculture without first determining their potential risk to the environment and the people.

There are three priorities for operationalizing sustainable development, taking into account its dynamic and integrated nature:

1. The adoption of nondestructive technologies as well as provision for technology assessment;

2. The formulation of a rational population policy which can be related to fertility control; and

3. Environmental education.

Strategies for Operationalization*

1. Induce growth which will address the poverty of the 50 percent of our people in urban and rural areas who live below poverty line.

2. Integrate environmental considerations into the decision-making process.

3. Implement proper pricing and distribution of costs and benefits from natural resources.

4. Reform property rights to cover both equitable access to resources as well as recognition of the property rights of cultural communities.

5. Establish an integrated protected areas system geared toward resources conservation.

6. Rehabilitate degraded ecosystems from the deforested upland areas downstream to the lakes and waterways which suffer from pollution and sedimentation loads.

*Modified from the Philippine Strategy for Sustainable Development (PSSD) of the Department of Environment and Natural Resources.

7. Strengthen residuals and all point-sources of pollution management.

8. Strengthen population concerns and social welfare in development planning.

9. Promote environmental education at all levels.

10. Strengthen citizen participation and constituency building.

Priority Agenda for Research

1. Identify and evaluate different indicators of sustainable development.

2. Identifiy self-reliance strategies in the pursuit of development.

Role of the University of the Philippines System

1. Provide technical assistance in policy formulation.

2. Serve as linkage between decision makers and planners.

3. Develop environmentally sound technologies.

4. Monitor and evaluate development programs and projects.

5. Provide training programs for policy makers and planners, middle-level decision makers and managers, and grassroots workers.

6. Integrate environmental education in the University curricula.

SUSTAINABLE DEVELOPMENT IN THE AGRICULTURAL AND RURAL SECTOR

The conceptual framework evolved for achieving sustainable development in the agricultural and rural sector is shown in Figure 1.3. There are six basic elements of sustainable development identified within this framework. These elements can be translated into five agricultural strategies for achieving sustainable development, as follows:

1. Agricultural Production

   a. organic vs. inorganic fertilization
   b. biological control techniques/integrated pest management vs. chemical pesticides
   c. appropriate and indigenous technologies and resources
   d. crop and product diversification
   e. production of import substitutes
   f. more active land distribution
   g. promotion of cooperative movements
   h. people empowerment toward greater participation in decision making
   i. agro and social forestry

2. Market

   development of small-scale agribusiness industries; concern for food security vs. export orientation

3. Infrastructure

   increased financial support for infrastructural development

4. Education

   a. extension delivery system
   b. communication and information dissemination
   c. value formation from primary to college level
   d. vigorous family planning education
   e. regulation of spatial mobility—from upland to lowland and urban growth centers
   f. consumer education

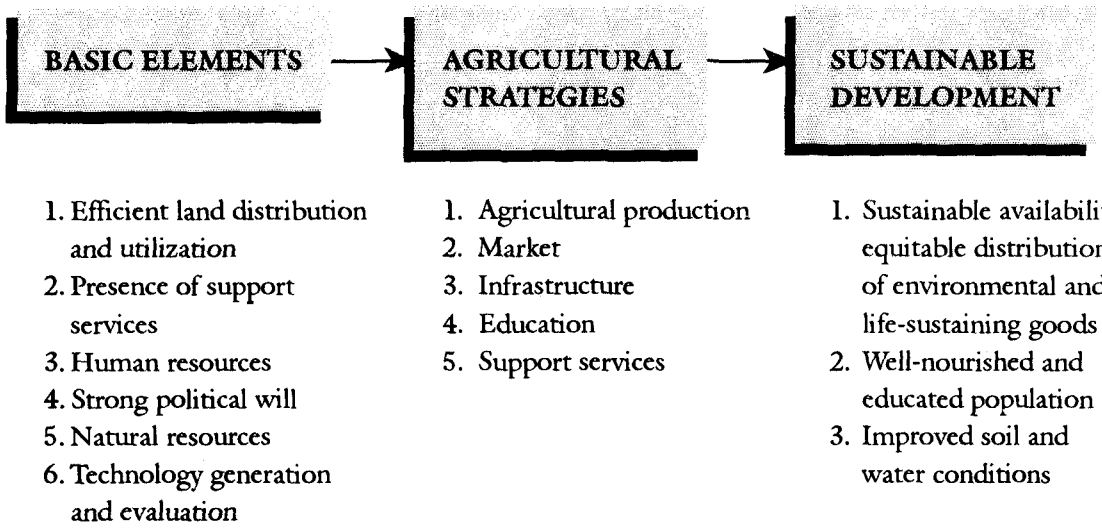


FIGURE 1.3
CONCEPTUAL FRAMEWORK FOR SUSTAINABLE DEVELOPMENT IN THE AGRICULTURAL AND RURAL SECTORS

5. Support Services

Sustainable agricultural and rural development is indicated by the following:

a. Sustained availability and equitable distribution of environment and life-sustaining goods

b. Well-nourished and educated population

c. Improved soil and water conditions

Policy Agenda for the Agricultural and Rural Sector

1. Advocate policy which is biased for resource poor farmers

2. Streamline the bureaucracy

3. Provide equitable access to resources

4. Patent locally developed technologies

5. Adopt nonpollutive agricultural practices

6. Discourage "cheaper to import" policy

Action Agenda

1. Develop and test Integrated Pest Management (IPM) package for various crops

2. Promote agro-based rural industries

3. Adopt organic agriculture

4. Introduce appropriate and indigenous technology and farming system

5. Promote agroforestry

6. Promote sustainable agricultural practices and human health

7. Establish integrated community-based development programs

CHAPTER 2
THE PHILIPPINE FOREST ECOSYSTEM

Percy E. Sajise and Nenita E. Tapay

INTRODUCTION

This report attempts to synthesize available information on the present state of the Philippine forest ecosystem and forest resource management in order to arrive at a rational assessment of the causes and impact of forest degradation in the country. It aims to provide a comprehensive report on environment and resource management in the country as it pertains to the forestry sector. The issues besetting forest resources management are raised here and management strategies and policy recommendations are highlighted to come up with a framework for sustainable national forest resource utilization and development.

The initial section of this report gives a general description and a historical account of forest resource utilization in the country and an assessment of the present status of the resource base. The next section presents and evaluates the processes that lead to forest depletion as well as the environmental and social costs involved. The final section presents the hypothesis of the study, the priority problems to be addressed, and the recommended courses of action.

1. Approach and Scope

This report is largely a product of bibliographic search. The data and information used here came from academic and expert analyses and studies on natural forest ecology and forestry management. In addition, newspaper and magazine articles and other popular publications provided a measure of the public pulse and reactions to complex forestry problems. Consultation meetings of the core group involved in this study were also held. A seminar workshop was held on 10 August 1990 on Theme I. Population, Resources, and the Environment of the UP State of the Nation Assessment Project, to which this study belongs, to serve as a forum for interaction among the team members and other interested parties. The comments and outputs from these sessions have been considered in the writing of this document.

There are two ways of defining a forest: (a) the **jurisdictional category** and (b) **the biological category.** The former definition concerns a purely, jurisdictional grouping, especially with regard to agency jurisdiction. Under this classification, "forest lands" with a slope greater than 18 degrees are public domain and fall under the jurisdiction of the Department of Environment and Natural Resources (DENR). According to the 1988 Philippine Forestry Statistics estimate, 15 million hectares of the country's 30 million hectares of land are classified as forest land under this jurisdictional categorization. In the ecological sense, however, forest areas are those covered with woody species greater than 10 centimeters in diameter. These two definitions of forest land are incompatible as there are jurisdictional forest lands with no forest vegetation. The latest estimate (DENR,1988) of the country's total classified forest lands shows that only 6.8 million hectares are covered with forests of different types and conditions. Of these, the old growth dipterocarp forests comprise only 0.98 million hectares while some 3.4 million hectares belong to the residual or second-growth forests (Philippine Forestry Statistics, 1988).

The present study is primarily concerned with the assessment of Philippine forests in their biological or ecological meaning.

2. Analytical Framework of the Study

The ecosystem approach is used in the study in looking at the forest as a whole complex system of closely interlinked biophysical, social, and economic components. Figure 2.1 shows the analytical framework that explains the causes and impact of the present condition of Philippine forests.

Natural physical phenomena such as climate and the naturally changing biophysical environment interact with the forest ecosystem to result in particular ecosystem properties—*i.e.* sustainability, equitability, diversity, stability. Without the interference of human beings, such a relationship is expected to continue to exist in harmonious balance. However, people have been tinkering with nature, giving rise to disastrous and often irreversible results. Uncharacteristic climatic aberrations such as long droughts which hamper the natural succession process and seedling establishment are among the natural causes of forest degradation which can be triggered by human activity.

Figure 2.1 shows that the interacting factors of population and weak enforcement of forest/grassland protection laws are two major causes of the

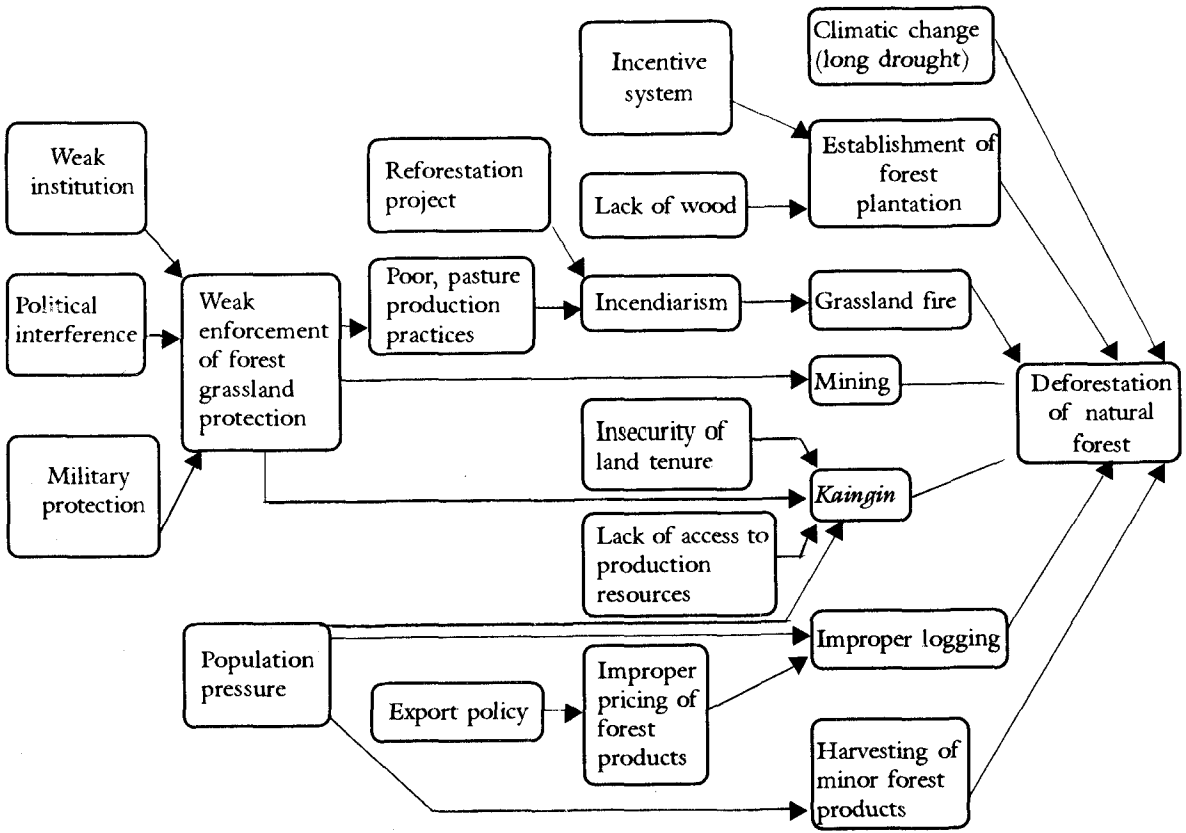


FIGURE 2.1. PROBLEM ANALYSIS IN FORESTRY: CAUSES AND IMPACTS

swift and large-scale destruction of our forests. Population pressure is the single most important factor. The increasing demands for food, settlement, agriculture, raw materials, and livelihood opportunities intensify the exploitation of forest resources. The insecure land tenurial status and inaccessibility of resources to upland migrant farmers also make the problem of upland habitation and shifting cultivation difficult to solve or even manage.

The weak enforcement of laws that protect the forest/grassland resource can be traced to weak institutional infrastructure, political interference, and military protection of big-time forest violators. The existence on the one hand of an improperly organized forestry bureaucracy and on the other hand of an inadequate policy environment and incentive system, cripple forest management efforts. Weakly enforced forestry laws and regulations allow for the continued existence and proliferation of unregulated ***kaingin*** activities on the fragile upland, improper mining, intentional burning of reforestation sites, and other forest degrading activities. The interplay among these factors contribute to the rapid disappearance of the Philippine natural forest.

Improper export and pricing policies of forest products coupled with inefficient and harmful logging and extraction technologies for both major and minor forest products further ensure the destruction of our forests, as Figure 2.1 shows. To sustain forestry needs, natural forest stands are increasingly being replaced by artificial forest plantation systems. Such systems, however, lack the resilience and other physical attributes of the natural forest ecosystem and are thus a very poor alternative.

Deforestation and other human activities impair the natural forest ecosystem. This is manifested in changes in the ecosystem's structural and functional attributes and in the human/social system with which the forest is inextricably linked. An analysis of the impact of forest denudation should consider both the primary (those which occur on-site or in the uplands) and secondary impacts (those which happen off-site or downstream in the lowlands). Figure 2.1 identifies the major impacts of forest destruction as: displacement of cultural communities, hydraulic impairment, erosion/siltation, low income and poverty, and malnutrition.

HISTORICAL BACKGROUND OF FOREST UTILIZATION IN THE PHILIPPINES

The history of forest exploitation in the Philippines parallels that of the growth of population and industry. It also reflects the government's policy orientation and conscious efforts toward forest conservation and management.

Forest utilization in the country began long before Ferdinand Magellan landed on Philippine shores. The country's population then was very small and our ancestors had a harmonious relationship with the forest resource. With the coming of the Spaniards, forest conversion accelerated as Philippine logs were used to build ships for the Galleon Trade.

In 1575, forests covered around 27.5 million hectares or almost 92 percent of the total land area of the Philippines. The total population that year was only 0.75 million. These figures show that in that year, the per capita forest was about 36.7 hectares and the per capita land area was 40 hectares. By 1800 when the population jumped to 1.8 million, forest cover shrank by 1.4 to 26.1 million hectares. This meant an estimated annual deforestation rate of only 4,444 hectares.

There is a paucity of records on the cutting of timber before the 1900s. But estimates have placed the amount of timber cut in 1800 at 5,000 cubic meters. The value reportedly increased to 75,000 cubic meters around 1876.

The Spanish government started the practice of forestry in the country in June 1863 when it organized the Forest Service which was patterned after that of Spain's (Sulit, 1958). The forest laws and regulations enacted during the Spanish period were appropriate but were not properly implemented. From 1800 to 1900 the estimated average annual reduction in forest cover went up to 51,000 hectares. The reduction was brought about by the increased demand for land for agriculture and for settlement. The areas converted to agriculture were mostly lowland areas suitable for cultivation.

When the Americans colonized the Philippines at the end of the nineteenth century, the islands of Mindanao, Luzon, Samar, and Palawan were still covered with virgin dipterocarp forest (Porter and Ganapin, 1988). During the early American colonial period, the lumber needed for reconstruction purposes had to be imported from the United States (US). Logging operations were delayed by the Spooner Amendment which prohibited any form of

disposition of public and timber lands and restricted the number and allowable cut of timber licenses which were granted for only one year. Later, however with the expansion of local lumber companies and logging activities, more sawmills were established. By 1917, lumber exports [12,186,186 board feet] exceeded imports [4,646,088 board feet] (Sulit, 1958). Furthermore, American logging firms, equipped with more advanced logging and sawmill machinery, went into partnerships with Philippine businessmen and set up logging companies in the country. Many of the local loggers were members of the Filipino elite and were elected to the legislature. This frustrated regulation efforts by the Bureau of Forest Development (Tucker, 1987 cited by Porter and Ganapin, 1988). Logging throughout the American period was wanton, done without regard for future regeneration.

From 1901 to 1902 the reported volume of timber cut was 140,412 cubic meters. By 1918, there were already 16 sawmills in operation, producing about 167,000 cubic meters annually. By 1924, the number of sawmills had increased to 37, and annual production rose to 396,000 cubic meters. Before the Second World War, there were 163 sawmills throughout the country (Sulit, 1958).

The Philippines started exporting lumber to China in 1910, and by 1918 exports had risen to 16,500 cubic meters. By 1924, the export of lumber had reached the 120,000-cubic-meter mark. At that time, log production was recorded at 868,432 cubic meters.

The rate of conversion of forests to other land uses began to accelerate in 1935 under the Commonwealth Government when an estimated 100,000 hectares of forests were cut. The Japanese took over the management and control of the Forest Service during the Second World War. But despite their frantic efforts to exploit the country's forest resources, the Japanese were unable to get much wood because of the guerilla activities and poor transportation and communication facilities (Sulit, 1958). However, the food shortage created during the war prompted the issuance of Executive Order No. 40 dated May 14, 1942 which allowed people to plant all available idle public and private lands, regardless of whether they were within a public forest. Although the Bureau of Forest Development (BFD) tried to minimize forest destruction, the people who retreated to the mountains resorted to rampant shifting cultivation to feed themselves, thereby further aggravating the situation (Sulit, 1958).

The period from 1947 marked the mechanization of the logging industry and the near-elimination of the animal method of logging (Sulit, 1958). This resulted in a very big increase in timber production and export of logs. Forest destruction reached its peak in 1969 and 1970 with the conversion of about 300,000 hectares a year. This period saw the blossoming of the Philippine logging industry as local loggers rushed to reap profits from the expanding Japanese demand for wood (Boado, 1985 cited by Porter and Ganapin, 1988). Beginning with only a few timber concessionaires, logging soon became one of the major industries of the country. The 1960s was a decade of massive log exports which increased from three million cubic meters or 45.9 percent of total production to 8.6 cubic meters or 78.3 percent of total production by the end of that decade (NEPC, 1983). [See Table 2.1 Philippine log production and export.] The denudation of luxuriant virgin forests accelerated during this period.

In 1955, the government introduced the policy of selective logging and sustained yield. But since the specific provisions of the regulations were based in only one area, loggers were allowed to cut faster than the forests could be renewed (Porter and Ganapin, 1988). Moreover, most companies had no incentive to use the sustained yield method since they would have to wait at least 25 years for the next cut. Thus, as competition for timber concessions increased, most logging companies just cut and got out, maximizing their revenues on the first cut and ignoring the second cut (Woell, 1983 cited by Porter and Ganapin, 1988).

In 1981, all timber concessionaires were required to carry out reforestation within their sites (Porter and Ganapin, 1988). The loggers were required to either apply for a lease for industrial tree plantations on the denuded lands within their area or submit a seven-year plan for reforestation. However, this did not succeed as only one-third of the concessionaires applied for a tree plantation lease, citing financial constraints as the reason (Freese and O'brien, 1983 cited by Porter and Ganapin, 1988).

Logging also paved the way for a second wave of exploitation by the expanding lowland population. The construction of roads to speed up logging operations opened up the heretofore inaccessible forests to human occupancy. As the population increased while the lowland land base remained fixed and employment opportunities shrank, migration into the uplands increased through the years.

Table 2.1
Philippine log production and export:
FY 1960-CY 1981 (in cubic meters)

	Year	Production	Exported	% of Production
FY	1960-61	6,596,458	3,028,020	45.9
	1961-62	6,771,781	3,749,087	55.4
	1962-63	7,668,078	4,593,485	69.9
	1963-64	6,536,115	4,542,505	69.5
	1964-65	6,175,142	3,486,646	56.5
	1965-66	8,047,148	5,534,375	68.8
	1966-67	7,843,283	5,648,531	84.8
	1967-68	11,113,650	7,510,956	67.6
	1968-69	11,583,713	8,649,021	71.3
	1969-70	11,004,564	8,616,078	78.3
	1970-71	10,679,519	8,443,256	79.1
	1971-72	8,416,099	7,018,218	83.4
	1972-73	10,445,620	6,949,312	66.5
	1973-74	10,189,898	5,434,217	53.3
	1974-75	7,331,898	4,579,225	62.5
	1975-76	8,440,691	3,050,262	36.1
CY	1976	8,645,835	2,331,297	26.9
	1977	7,873,490	2,046,735	25.9
	1978	7,168,549	2,210,463	30.8
	1979	6,577,864	1,248,153	19.0
	1980	6,400,000	714,885	11.0
	1981	5,399,523	706,399	13.0
	1982	4,589,000		
	1983	4,468,000		
	1984	3,872,000		
	1985	3,568,000		
	1986	3,434,000		
	1987	4,147,000		
	1988	3,809,000		

Source: National Environmental Protection Council, 1983.

Log exports which peaked at an average of 8.6 million cubic meters from 1968 to 1971, fell considerably in later years. Once the country's primary dominant export, annual exports of logs declined since 1980 to less than one million cubic meters (*Philippine Yearbook*, 1989). Log production steadily declined, attaining its lowest level of 3.43 million cubic meters by 1986. Since then, production levels have not exceeded those attained in the seventies and early eighties. This reduction in production and export was the result of the log export ban and the decrease in the number of timber licenses being issued. Because of these developments, forest conversion began to slow down beginning 1980. In 1990, the expected rate of forest destruction fell to about 88,000 hectares. By the end of 1990, it was estimated that the forest cover of the country had gone down to only 6.1 million hectares. The population by that year was 61.9 million, so that the per capita forest was only about 0.099 hectare.

It can be observed from the above that deforestation is caused by a combination of demographic pressure, logging, and agricultural developments. The historical trend in the relationship between forest land use, population, and agricultural land use from 1948 to 1988 is shown in Figure 2.2. Agriculture became the most dominant land use in the Philippines in the early 1980s. However, the highest annual deforestation rate coincided with the logging boom. But even during this boom period, the total amount of area deforested was much higher than the area actually logged during any given year. In 1968-1969, when the reported log production was highest at 11.58 million cubic meters, the area logged was about 128,708 hectares while an estimated 300,000 hectares of forest were destroyed. This is because forest land is being used for road, cable, and tractor ways and for log storage. An estimated average of 30 percent, often from 40 to 70 percent of the forest land, had been cleared in the course of the logging (Sy and Lasmarias, 1983).

Rapid deforestation also came about when the availability of land per capita continued to decline with the increase in population. By 1960, the land per capita was 1.11 hectares. By 1970, it was 0.82 hectare, and by 1980, it had dropped to 0.62 hectare. With this scarcity in land, the incursion into forests became inevitable. To complicate matters, upland migrants practiced *kaingin* or slash-and-burn cultivation. This is alarming because the scarcity of land does not allow long fallow periods. Sure enough, in 1990 the land per capita was estimated to be less than 0.50 hectare.

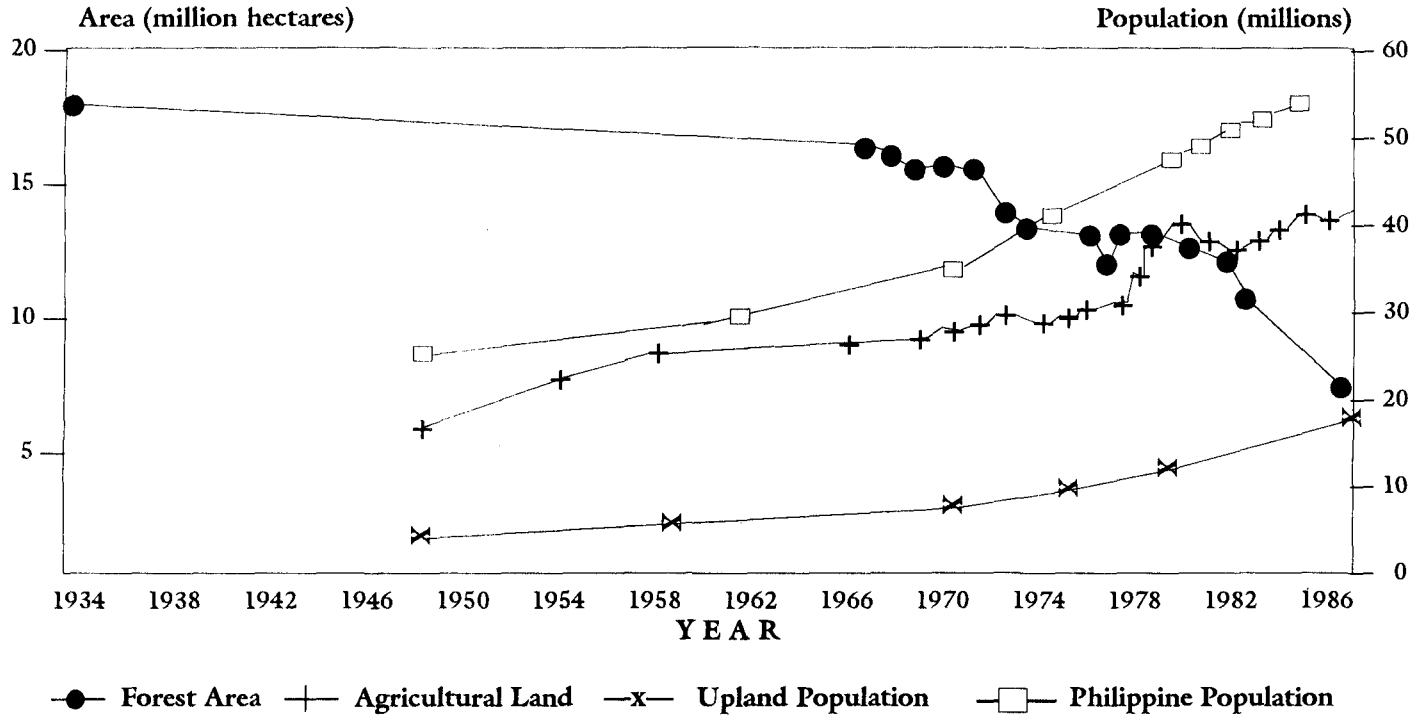


FIGURE 2.2 FOREST AND AGRICULTURAL LAND USE VS. POPULATION GROWTH

The loss of forest cover in the Philippines is also a consequence of government policies and incentives. The Homestead Act, for example, contributed immensely to forest depletion. Since the early 1900s, the policy enabled the provision of land to landless and impoverished families. From 1903 to the late 1960s the government tried to broaden the agricultural base of the economy by opening up virgin forests and encouraging people to settle there. When the program started there was enough land to distribute: the per capita land was still four hectares. However, with rapid population especially after the Second World War, the Homestead Act began to have a deleterious effect on the forest cover. The conversion of forest lands to other land uses, primarily agriculture, reached 200,000 hectares a year.

The policy of giving "land to the landless" which was promulgated in the 1950s contributed greatly to the large-scale conversion of forest lands to agricultural use. Philippine presidents found it more politically expedient to cut down forests than to alter the existing ownership of agricultural land.

Forest destruction was also largely a consequence of the government's policy since the early postwar years to intensively utilize forest resources to raise export revenues for the financing of domestic capital formation. This continued into the the sixties and seventies when increasing log exports were reported. As Porter and Ganapin (1988) observed:

> *The dynamics of the Philippines' external economic relations since the mid-1960s have also added pressure on the natural resource base by forcing economic policy to emphasize short-term and medium-term export earnings. The requirement inherent in the export-oriented development strategy to increase exports was a major source of pressure to exploit natural resources more intensively. As the Japanese market opened up, logging became a central element in Philippine economic strategy. In 1969, forest products (primarily logs) made up the largest single category of Philippine exports, representing 33 percent of the total export area of forest land leased [to] logging concessions from 4.48 million hectares to 10.6 million hectares. A gradual reduction in log exports was ordered by the Bureau of Forestry in 1967, only to be suspended two years later to alleviate [the] balance-of-payments problem.*

> *As Marcos's debt grew, the pressures to use forest resources for export earnings multiplied. By 1976, the World Bank expected earnings from [the] exports of logs and wood products to grow by 20 percent annually and to reach $1.4 billion by 1985. Only a slowdown in the Japanese market's growth appears to have prevented a much higher level of log exports in the late 1970s and early 1980s. In fact, log export earnings declined from their 1973 high of $304 million to only $60 million in 1983. That year, the Minister of Natural Resources said that a log export ban was desirable but could not yet be implemented because of the need for foreign exchange.*

These and other factors that have contributed to the massive depletion of our forest reserves are discussed in more detail in the subsequent sections of this paper.

PRESENT CONDITION OF PHILIPPINE NATURAL FORESTS

The Philippine dipterocarp forests are evergreen closed canopy forests which generally are of the perhumid tropical zone. These forests are a highly diverse, multistorey, productive and stable system, the woody flora of which is dominated by the family *Dipterocarpaceae*. Philippine forests support one of the world's richest plant and animal life, which has continued to be the nation's life blood, supplying its ecological and economic requirements. The forests have also supported and nurtured innumerable generations of tribal Filipinos whose lives depend on the forest's well-being.

The country, however, is now in danger of losing this vital natural resource. Forest destruction in the Philippines has been swift and massive. A 1988 Swedish study showed that the country's forest cover is very low (only 23.92 percent) compared to an ideal cover of 54 percent based on slope consideration [see Table 2.2 Land use/land cover classification of the Philippines]. This means a reduction of 52 percent forest cover from a 75 percent value during the 1950s. Table 2.2 shows that intensive and extensive cultivation areas cover a very high value of 71.78 percent, implying that agricultural land uses steadily replace forest land use. Dipterocarp forests cover only 21.94 percent of the total land area. Only one-third of these forests or 8.06 percent of the total land area are still in virgin state. This means that we now have only a thin reserve of dipterocarp species which are important both as an ecological resource and as a source of high-quality wood. The

lowest forest cover is in Region 7 (3%), followed by Region 5 and Region 6 (7%), Region 1 (14%), Region 3 (16%), and Region 4 (19%), except Palawan [see Table 2.3 Forest cover by Philippine region]. Only Palawan has a relatively adequate forest cover of 54 percent. In 1968, the country's forests covered 54 percent of the total land area (Ibon Facts and Figures, 1985).

Table 2.4 shows the preponderance of nonforest over forest land uses in all the 12 regions in the country. By far, the fastest deforestation rates can be found in Regions 5, 6, 7, and 9. These regions have depleted their forest cover to low levels as shown by the low percentage of their total forest areas. The competition between forest and agricultural land use is evident in Table 2.4 because the same regions mentioned have higher percentages of cultivated areas.

The pattern of forest destruction from 1968 to 1982 is shown in Table 2.5 (EMB, 1985). These figures indicate that we have been depleting our forests for the past 18 years at a very rapid annual rate of about 190,000 hectares. Estimates taken from LANDSAT [earth resources technology satellite], aerial photography data and SPOT [*Satellite pour Observation de la Terre*] imagery, and aerial photography interpretation by the National Mapping and Resource Information Authority (NAMRIA) show a lower annual rate of deforestation of 119,000 hectares of logged-over forest in the last few years (DENR, 1989). The second national forest inventory pegged present rates of deforestation at about 130,000 hectares annually (DENR, 1989).

Recent estimates based on LANDSAT photographs show that adequately stocked forest land covers 3.8 million hectares and open forest lands, 5.3 million hectares (RAAP, 1987 cited by Quisumbing, 1987). Estimates in 1985 showed that "adequately stocked" forests totalled 7.6 million hectares while degraded forests totalled 3.8 million hectares (Boado, 1985 cited by Porter and Ganapin, 1988). The Second National Forest Inventory revealed an average annual rate of conversion from 1969 to 1988 for old growth forest of 192,000 hectares. The estimate is that 1.2 million hectares of virgin commercial forest were cleared from 1971 to 1980 (Porter and Ganapin, 1988). In 1988, the total volume of standing timber in commercial forest stood at 744,073 million cubic meters covering a total area of 4.64 million hectares (Philippine Forestry Statistics, 1988).

Table 2.2
Land use/land cover classification of the Philippines

Land Use/Land Cover		Area (thousand hectares)	% of Total
A.	Forest	7,226	23.92
	Pine	81	0.27
	Mossy	246	0.81
	Dipterocarp	6,629	21.94
	Closed	2,435	8.06
	Open	4,194	13.88
	Mangrove	149	0.49
	Others	—	—
B.	Extensive Cultivation	11,958	39.58
	Open in Forest	30	0.09
	Grassland	1,813	6.00
	Mixed*	10,114	33.49
C.	Intensive Cultivation	9,729	32.20
	Plantation	5,336	17.67
	Coconut	1,133	3.75
	Others	91	0.30
	Coconut and Cropland	3,748	12.40
	Others and Cropland	365	1.20
	Cropland	4,392	14.54
D.	Fishponds	205	0.67
	Fishponds from Mangrove	195	0.64
	Other Fishponds	10	0.03
E.	Nonvegetable Areas	101.4	0.34
	Eroded Areas	0.7	0.002
	Quarries	8	0.02
	Riverbeds	81	0.27
	Other Barren Lands	10	0.03
F.	Others	439	1.45
	Built-up Areas	131	0.43
	Marshy Areas	103	0.34
	Lakes	205	0.68
G.	Unclassified	546	1.80
	Total	30,205	99.96

Source of Data: Swedish Space Corporation, Mapping of the Natural Conditions of the Philippines, Solna, Sweden, 1988.

* mixed grass, brush, plantation and other crops

Table 2.3
Forest cover by Philippine region

Region	Land Area (hectares)	Forest Cover (%)	Total Productive* Dipterocarp Forest (hectares)
1	2,156,845	14	337,300
2	3,640,300	42	862,400
3	1,823,082	16	178,600
4	4,756,016	19 **	675,200
Palawan		54	
5	1,763,249	7	58,500
6	2,022,311	7	56,400
7	1,495,142	3	12,100
8	2,143,169	26	351,000
9	1,868,514	20	187,800
10	2,832,774	37	703,400
11	3,169,275	31	720,000
12	2,329,323	34	257,200
Philippines	30,000,000	100	4,399,900

Source of Data: Swedish Space Corporation, Mapping of the Natural Conditions of the Philippines, Solna, Sweden, 1988.

*Consolidated Spot (1988) and Philippine-German Forest Inventory (1988)
**data exclude Palawan

Table 2.4
Deforestation rate, forest and cultivated land by region in the Philippines, 1988

Region	Deforestation Rate (%)	Total Land (in thousand hectares)	Total Forest (in thousand hectares)		Total Cultivated (in thousand hectares)	
1	0.82	157	289	(13.4%)	810	(37.55%)
2	0.63	640	1470	(40.38%)	928	(25.49%)
3	2.3	1823	294	(16.13%)	815	(44.70%)
4	2.3	4840	1334	(27.56%)	1692	(34.96%)
5	5.2	1763	118	(6.7%)	1000	(56.72%)
6	I3.9	2022	140	(7.0%)	974	(48.17%)
7	4.6	1495	45	(3.0%)	685	(45.82%)
8	3.4	2142	559	(26.097%)	782	(36.508%)
9	4.2	1868	318	(17.02%)	729	(39.02%)
10	—	2833	1040	(36.71%)	862	(30.427%)
11	—	3169	975	(30.76%)	1108	(34.96%)
12	3.2	2329	523	(22.45%)	932	(40.017%)

Source: Swedish Space Corporation, 1988.

Table 2.5
Forest cover in the country from 1968 to 1982
(in million hectares)

Year	Actual Forest Area*
1968	16.08
1969	16.09
1970	15.90
1971	15.88
1972	15.67
1973	13.89
1974	13.69
1975	13.48
1976	13.27
1977	12.07
1978	12.86
1979	12.66
1980	12.46
1981	12.25
1982	11.25

Source: Environmental Management Bureau (EMB) 1984-1985.

*includes forest areas within public forest and alienable lands

In the early 1900s, there were approximately 10 million hectares of virgin and five million hectares of second-growth forests in the country. The latest inventory, however, shows that from the 4.7 million hectares of virgin dipterocarp forest in 1969, less than one million hectares of old growth forest are left today. Moreover, we now have more residual forest at three million hectares than virgin forest, a complete reversal of the situation early this century. Furthermore, only 388,000 (39 percent) of 988,000 hectares of virgin forests are not included in the timber license agreement (TLA). The remaining virgin forests are now in remote locations, on steep slopes and at high elevation.

On the positive side, since 1987 the country has been maintaining 59 national parks located in 441,331 hectares of forest lands [see Table 2.6]. In addition, seven forest lands covering a total area of 939,886 hectares have been designated as game refuge and bird sanctuaries and 747,984 hectares of forest lands are presently maintained as watershed reservations. However, only seven of these parks meet international standards due to squatting, illegal logging, ***kaingin***, and subdivisions. In 1975, there were 23 national parks meeting international standards.

According to the World Ecological Areas Programme survey (***Balai: Asian Journal***, September 1981 cited by Porter and Ganapin, 1988), if forest destruction continues unabated Philippine forests would have a life span of at most ten years. The survey classified the forest situation in the Philippines as critical, *i.e.,* lowland forests are mostly gone, hill forests are under attack or dwindling, and biological maintenance is breaking down. Furthermore, it is expected that in the first quarter of the next century, the natural forest will yield very little timber. The logging industry will have to establish and maintain tree plantations (Revilla, 1980 cited by Porter and Ganapin).

More alarming is the fact that of the estimated 11 million hectares of critically denuded forest land today, at least two million hectares are in critical watershed areas like the Agno River, Pampanga River, Cagayan River, Magat Watershed and Pantabangan Watershed (Sajise, *et al.,* 1988).

The forest condition would not be as hopeless today if reforestation had kept pace with denudation. However, over a period of 13 years from 1976 to 1988, the reforestation record averaged only 54,553 hectares per year (Philippine Forestry Statistics, 1988). There is therefore a gap between reforestation and deforestation of about 135,000 hectares per year. At the present rate of reforestation, it would require 177 years to reestablish the ideal 54 percent forest cover.

Table 2.6
Number and area of national parks, watershed reservations and game refuge and bird sanctuaries by region, 1987 (area in hectares)

Region	National Parks		Watershed		Game Refuge and Bird Sanctuaries	
	Number	Area	Number	Area	Number	Area
Philippines	59	441,330.85	57	747,984	7	939,886
Metro Manila Area (National Capital Region)	1	58.85	—	—	—	—
1 Ilocos	8	30,117	12	216,894	—	—
2 Cagayan Valley	3	2,349	3	16,372	1	6,003
3 Central Luzon	8	34,199	6	190,851	—	—
4 Southern Tagalog	8	167,964	16	35,256	4	903,403
5 Bicol	6	24,811	5	28,357	—	—
6 Western Visayas	2	23,505	—	—	—	—
7 Central Visayas	4	21,670	1	19,410	1	480
8 Eastern Visayas	5	4,060	2	10,224	—	—
9 Western Mindanao	3	3,323	3	11,281	—	—
10 Northern Mindanao	2	53,319	4	113,970	—	—
11 Southern Mindanao	2	53,673	4	103,475	—	—
12 Central Mindanao	7	22,282	1	1,894	1	30,000

Source: Forest Management Bureau: Protected Areas and Wildlife Division.

The major forestry problems besetting the country today are briefly presented below. These will be elaborated on in the succeeding sections of the report.

1. improper land uses/land degrading cropping systems
2. widespread degradation/depletion of the forest resources
3. weak forest administration
4. dismal performance in forest protection/reforestation/renewal
5. lack of active support for forest development and conservation by the people
6. inefficient and destructive forest utilization and a forest-based industry now in distress
7. overemphasis on short-term objectives
8. peace and order problem in the uplands
9. predominance of poverty in the countryside
10. evident inability of the socioeconomic system to meet the basic needs of the people
11. continuous incursion of agriculture into forest lands and forest reserves
12. rapid depletion of forest cover in the face of severe population pressure and the export of logs and timber (to earn foreign exchange)
13. administrative inadequacy of forest agencies and the inability to resist economic and political pressures to exploit forest resources
14. weaknesses of development planning in relation to ecological management and forest conservation and development

ENVIRONMENTAL PROBLEM ANALYSIS

Like other major resource management problems, forestry issues are inextricably bound to and ultimately rooted in population and poverty problems. Forest destruction is largely a result of the cumulative effects of small-scale extractive activities of the 18 million impoverished and expanding population in the uplands. The following section describes how the degradation and depletion of the forest resource in the Philippines is closely linked to the interwoven problems of unequal access to resources, population growth, poverty, military intervention, political interference, and inadequate policy and incentive systems. These factors create incentives for ***kaingin***-making, improper mining procedures, overharvesting of forest products, forest/grassland fires and illegal logging which are the identified major causes of the destruction of natural forests in the country.

1. Forest Fires

Forest fires refer to any incendiary occurrence in the forest which often results in extensive destruction of forest areas. The burning of forests may be accidental or intentional in origin. Lightning, carelessness during picnics, logging, *etc.* and uncontrolled firing during ***kaingin***-making cause accidental burning while vindictive urges and other socioeconomic and psychological motives stimulate the occurrence of intentional forest fires.

Whether natural or intentional, fires destroy vast tracts of forest land. They were responsible for the bulk of forest destruction in 1981 and 1982 [see Table 2.7]. As shown in Table 2.7, fires accounted for 49.55 percent of the total forest destroyed during the period while only 21.7 percent was destroyed by ***kaingin***, 27.28 percent by logging, and 1.46 percent by pests and diseases. The regions with the greatest forest damage by fire were Regions 1, 3, 5, and 6. Benguet fires are more particularly alarming due to the burning of thousands of seedlings, saplings, and mature trees, human deaths and other negative effects on the forest ecosystem (NEPC, 1983). In 1983, a total of 121,326 hectares of forests were reportedly destroyed by forest fires (EMB, 1984).

There have been fires deliberately staged by lessees so they could apply for a lease agreement to rebuild the destroyed area (Umali, 1988). As shown in Table 2.8, fires destroyed large amounts of vegetation within reforestation sites. Department of Environment and Natural Resources

Table 2.7
Forest destruction due to *kaingin*, forest fire, logging and pest and diseases in 1981 and 1982

Region	Percent of the Total Forest Destroyed Due to			
	Kaingin	Forest Fire	Logging	Pest & Diseases
Philippines	21.70	49.55	27.28	1.46
1	0.47	97.57	1.95	—
2	28.84	30.77	36.86	3.47
3	8.54	77.53	2.02	11.92
4	49.95	26.46	23.73	—
5	26.59	52.83	20.57	—
6	12.49	78.40	9.11	—
7	54.30	27.94	17.42	—
8	1.46	28.09	70.45	—
9	23.70	0.11	76.19	—
10	49.38	16.04	34.58	—
11	16.33	5.33	78.34	—
12	9.67	17.22	73.11	—

Source of data: Bureau of Forest Development.
Note: Data are averages of 1981 and 1982 figures.

Table 2.8
Record of fires within reforestation projects
in the Philippines, 1960-1968

Year	Area Burnt (hectares)
1960-1961	177
1961-1962	1,135
1962-1963	1,723
1963-1964	1,100
1964-1965	689
1965-1966	2,363
1966-1967	1,560
1967-1968	1,191
Total	**9,938**

Source: Food and Agricultural Division of the United Nations Development Program (UNDP) based on the work of T.J. Wormland, 1970.

(DENR) reports indicate that since summer of 1990, about 900 hectares of reforestation projects supported by substantial foreign and local funds in Ilocos and 800 hectares in the Cordillera region were razed by fires (Calicia, 1990).

In Central Luzon, it was reported that "fires of highly suspicious origin" destroyed some 100 hectares of reforested land in two towns. The two fires destroyed some 500,000 pesos worth of reforestation projects, including seedlings, thus setting back reforestation efforts in the region (*Philippine Star*, 18 April 1990).

The current inability of authorities to prevent the occurrence or to arrest the spread of forest fires is lamentable. According to an April 6, 1977 editorial published by the *Daily Express*: "Fire fighting in the forest is hindered by the lack of forest guards. It is said that there is only one forest guard for every 10,000 hectares of forest, where the ideal ratio should be one guard for every 3,000 hectares." The present ratio of one permanent guard per 3,500 to 4,500 hectares is an improvement but it still means tremendous responsibilities for forest guards (BFD Annual Report, 1981). The DENR has issued a number of directives to prevent destructive fires, as follows: suspension of payments for services rendered by erring contractors until they have reforested burned areas, the blacklisting of contractors of burned reforested areas, and the blacklisting of contractors of reforestation projects who failed to protect their areas from fires. While these measures can minimize forest fires, having more men and equipment to protect forests and prevent fires would be able to save thousands of hectares of our forests.

2. *Kaingin* Practices

Kaingin-making or slash-and-burn agriculture is a farming technique that uses fire to burn cut vegetation. It involves the rotation of fields rather than crops. This is an extensive and subsistence-dominated farming technique which uses minimal labor and cash and is therefore widely used to farm the uplands.

The bulk of forest destruction is blamed on this cropping practice. However, not all shifting cultivations are environmentally damaging. Some systems are in harmonious balance with the environment by virtue of size, crops, management, and other traditional cultural systems and are therefore self-perpetuating and stable (Sajise, 1975). A well-known example of this is the Hanunuo shifting cultivation (Conklin, 1957).

It is widely recognized, however, that ***kaingin*** farming is one of the primary factors that have contributed to the escalation of forest destruction in the Philippines. The Bureau of Forest Development (BFD) reported in 1979 that the agricultural practice destroyed 32,916.8 hectares, representing 52.9 percent of the total destroyed forest during that period (29.2 percent was attributed to forest fires, 12.9 percent to illegal logging, and five percent to other causes). For the period 1980-1984, the Environmental Management Bureau reported that 18,792 hectares were lost due to ***kaingin***.

It is believed that ***kaingin*** is responsible for the destruction of 25 percent of our forests (Librero, 1977). However, Domingo Abadilla, former Haribon president, believes that the ***kaingineros*** and settlers from the lowlands are responsible for 75 percent of total forest destruction while only 25 percent are perpetuated by loggers (as reported in *Philippine Star*, 15 July 1988). This conforms to the notion that "where the loggers [leave] off, the shifting cultivators usually take over" or "the forest that the loggers cripple, the ***kaingineros*** will kill." The current estimate is that about 3.5 million hectares of logged-over areas are continuously being converted to swidden farms by upland migrants.

The ***kaingineros*** are not shifting cultivators by choice. Most of them are landless farmers or agricultural laborers who have been driven into the forests because they cannot gain access to land and other employment opportunities in the lowlands. As a consequence, the country's upland population has escalated enormously because of increasing upland migration and natural population growth.

There are about 17 to 18 million people living in the uplands, of whom six to eight million are located within forest zones. These people derive their livelihood from shifting cultivation (Umali, 1988). These migrants are mostly ignorant of the ecological constraints of upland agriculture. As a study by the Silliman University concludes: "The inefficient agricultural practices of migrants and the ecological disturbances they create are explained by the fact that most of them do not have any tradition of farming" (Marchand, 1987). Worse, because they belong to the poorest of the poor Filipinos (their average annual per capita income in 1985 was 2,168 pesos, way below the official poverty line), they cannot sacrifice present income for farming technologies with long-term payoffs.

Even the traditional ***kaingin*** practiced by cultural communities has been affected by changes brought about by increasing upland population and

logging activities in their ancestral land. Displacement from ancestral lands due to encroachment by lowlanders and logging concessions have contributed to the shortening of fallow periods which allow the land to recover. This has also resulted in the disappearance of traditional customs which protect the forest cycle. Moreover, tribal people are forced or deceived into selling their lands to lowlanders whose pattern of exploitation wreak much havoc on the forest ecosystem.

Thus, it is not surprising that many environmentalists do not put the real blame on ***kaingineros***, arguing that it is precisely because of big loggers that most farmers can enter the forests in the first place. The farmers themselves blame widespread destruction on big logging companies because of their practice of clear-cutting the hill slopes (Marchand, 1987).

3. Land Tenure

A basic issue that further complicates the ***kaingin*** problem is land tenure, which allows individuals and groups to gain access to the productive opportunities of the land. This problem is intimately linked to the productivity of the land. Because most upland areas are an open-access resource, the lack of a titling mechanism discourages land improvement or nutrient maintenance. Thus, cultivation sites are impermanent because of the rapid exhaustion of soil fertility. Also, land tenure is a major determinant of whether upland farmers will adopt appropriate farming systems. Farmers will not plant crops with long life cycles if they are not assured that the land will still be theirs when the farm becomes productive.

There are two basic doctrines that provide the legal framework for the land tenure system in the uplands (Cornista *et al.*, 1986). The first is the **regalian doctrine** which assumes that all lands are owned by the crown/state unless otherwise declared alienable and disposable. Lands belonging to this type are commonly known as public domain/land which are either classified or unclassified. The second is the doctrine of **private ownership** whereby public lands that have been classified by the state as alienable and disposable are subjected to private ownership. All unclassified public lands (those with a slope of 18 percent or over) are referred to as public forest under the Revised Forestry Code of the Philippines.

It is believed that the conflict between the legal conception and the actual realities of the upland tenure system is a major source of tenurial

problems (tenurial conflicts, displacement, and tenurial insecurity) in the uplands (Cornista *et al.*, 1986). For instance, while public lands are legally owned by the government, upland settlers in general perceive themselves as the actual owners. The study by L.B. Cornista *et al.* recommends that since there are a substantial number of uplanders in what is legally defined as public lands, the 18 percent slope requirement should be seriously reviewed so as to solve a multitude of tenurial problems.

The *kaingineros* were first viewed by the government as illegal settlers on public lands. As such, they were dealt with harshly and prosecuted for violating clear-cut laws on court litigation but the incarceration of those caught failed to stem the tide of upland migration.

Finally understanding the plight of the *kaingineros*, the Bureau of Forest Development (BFD) began to address the problem of land tenure in 1971 through the issuance of Forestry Administrative Order No. 62 known as the "*Kaingin* Management and Land Settlement Regulations." This gave one-year forest occupancy permits to upland settlers. The length of tenure agreement was modified to a renewable two-year permit to *kaingineros* who entered the forest lands before May 19, 1975. In 1979, the government launched the Communal Tree Farming (CTF) program which gave farmers 25-year CTF leases renewable for another 25 years. Another program launched was the Family Approach to Reforestation Program which involved the payment of forest settlers/participants for taking care of three- to five-hectare forest plantations. The land would subsequently be turned over to the BFD after two years of survival of at least 80 percent of the seedlings. And then there was the Integrated Social Forestry (ISF) Program which signalled the adoption of social forestry as a guiding principle for forest management and development in the country. Through the program, long-term stewardship contracts (CSC) lasting 25 years and renewable for another 25 years were granted to forest occupants. By late 1987, the ISF had issued some 64,000 individual and seven collective CSCs covering 189,000 families and 460,000 hectares (on average, an individual CSC covers 2.6 hectares).

There have been problems, however, with the granting of lease agreements. Short-term leases encourage concessionnaires to maximize present gain and thus exploit the forest without concern for future sustainability. But even the long-term leasehold agreements are not spared some problems. They are only a temporary cure to the problems caused by the insecure land tenure of the present generation of occupants. Once the agreements mature, the

problems could reappear, perpetuating the cycle of tenurial conflicts in the uplands. Moreover, because the stewardship contract is short of the farmers' goal of owning the land and being able to give the land to their children as inheritance, most of them are not satisfied with the program. This again has some effect on the farmers' relationship with the land they till. The imminent maturity of the agreement entices farmers to increase the area for short-lived cash crops, using erosion-inducing farming practices to gain as much profit from the land in the least possible time. Some prefer a tax declaration to the CSC because with the former, they can mortgage or even sell the land. Moreover, lacking a title for their cultivated lands, the farmers have scant access to any form of credit to finance improvements.

4. Logging

Commercial Logging

Commercial logging *per se* is not considered a form of forest destruction by the government. In fact, commercial logging may be done in scientific and ecologically sound ways. There are, however, some facets in the Philippines' political, socioeconomic, and technological life that make logging a primary agent of forest destruction and a perpetuator of social inequity.

The most dramatic illustration of the inequities in the logging business is the fact that the remaining timber forests were controlled by only 103 logging concessions with annual allowable cuts of 6.98 million cubic meters. Together, these concessionaires controlled 4,886.877 hectares of our forests. Haribon, one of the most active environmental organizations in the country, estimated that these concessionaires have realized about $52 billion in profits in the last 16 years (*Philippine News and Features*, 11 March 1989). In 1988, 15 logging companies landed among the Top 1000 Companies in the country, earning gross revenues ranging from 23 to 389 million pesos [see Table 2.9].

Timber concessions are major culprits of forest denudation in the country. Once richly forested areas like Regions 5, 6, and 7 now have very thin forest cover (seven percent for Regions 5 and 6 and only three percent for Region 7). According to the Department of Environment and Natural Resources (DENR) and the Environmental Management Bureau (EMB), the forest covers in concession areas are below the standard of 54 percent.

Table 2.9
Logging companies in the top 1000 corporations in the Philippines, 1988

Logging Companies	Gross Revenues (in thousand pesos)	Rank
Zamboanga Wood Products, Inc.	389,728	213
M & S Co. Inc.	176,944	431
Industries Development Corp.	121,804	583
Landasan Timber Corp.	115,991	606
Anakan Lumber Co.	97,716	698
Consolidated Logging & Timber Mills Co.	92,940	717
Aras-asan Timber Co., Inc.	74,662	849
Pava Logging Co., Inc.	51,796	1113
Provident Tree Farms, Inc.	49,865	1114
Timber Industries of the Phils, Inc.	47,159	1183
West Basilan Timber, Inc.	39,539	1353
Liberty Forest, Inc.	34,597	1488
Butuan Logs, Inc.	33,776	1513
MF Timber Industries, Inc.	32,975	1536
Verdant Agro-Forest Development Corp.	23,070	1941

Source: Philippines' Best 1000 Corporations 1989, *Mahal Kong Pilipinas* Foundation, Inc.

Table 2.10 shows the types of existing timber licenses in the country. Majority of the licenses are timber license agreements (TLAs). In 1987, there were 137 TLA holders in the country covering a total area of 5.4 million hectares with an allowable cut of 8.20 million cubic meters. TLA operators are mainly in Southern Mindanao (Region 9), Cagayan Valley (Region 2), and Northern Mindanao (Region 10). These regions have relatively more forests (31 percent, 42 percent, and 39 percent, respectively) than the rest of the country. Without any restrictive and regulatory actions, these regions are expected to further lose their forest cover and suffer the same fate as former concession areas. This is expected because the prevailing mechanized logging employed in concession areas inflict heavy damage on the residuals. Furthermore, when shifting cultivators, charcoal-makers, carabao-loggers and other upland settlers enter the logged-over areas, they complete the destruction of the residuals.

The total recorded log production by region for 1988 is given in Table 2.11. Regions 2, 10, and 11 were responsible for 71 percent of total log production during that year. Considering that about 80.2 percent of recorded log production comes from natural forests, log production from dipterocarp stands was estimated to be some 3.1 million cubic meters in 1988 (Forestry Master Plan, 1989). It is also shown in Table 2.11 that 80.2 percent of total log production were produced by TLAs.

Logs and lumber produced in the country in 1987 were exported mainly to Japan (33%), the United Kingdom (25%), and the United States (8.6%) (TWNF, 14 April 1989) which altogether constituted 64 percent of the amount earned for that year (*Philippine Yearbook*, 1989). In the period 1972 to 1988, total export earnings from logs reached $2.65 billion (53 billion pesos) per year, the profits of which accrued to only about 150 logging companies (Cruz and Cruz, 1988).

The figures estimated for forest destruction caused by logging, however, are very low. For instance, for the period 1980-1984, a total of 19,879 hectares of forest were reportedly cleared by logging (EMB, 1985). This is an underestimation and somewhat misleading. Incorporated in this estimate were only the areas destroyed due to the construction of logging roads, damaged residuals, and other logging wastes. Timber utilization in the country is only 55 percent. Between 30 and 50 percent is lost in the processing, and total end recovery ranges from 1/5 to 1/3 only. The World Bank study in 1989 traced the problem to the financial incentives created by

Table 2.10
Number and types of timber licenses by region, 1987

Region		Total	TLA	MTL	SoTL	PTL	PLTL	CRTL	OTL	STL
	Philippines	154	137	2	4	2	3	2	1	3
1	Ilocos	5	2	1	—	1	—	—	—	1
2	Cagayan Valley	34	32	—	—	1	—	—	—	1
3	Central Luzon	1	—	—	—	—	—	—	1	—
4	Southern Tagalog	11	10	—	—	—	1	—	—	—
5	Bicol	1	1	—	—	—	—	—	—	—
6	Western Visayas	—	—	—	—	—	—	—	—	—
7	Central Visayas	—	—	—	—	—	—	—	—	—
8	Eastern Visayas	7	7	—	—	—	—	—	—	—
9	Western Mindanao	18	17	—	—	—	—	—	—	1
10	Northern Mindanao	29	22	—	4	—	2	1	—	—
11	Southern Mindanao	36	34	1	—	—	—	1	—	—
12	Central Mindanao	12	12	—	—	—	—	—	—	—

Source: Forest Management Bureau.

Legend: TLA - Timber License Agreement
MTL - Miner's Timber License
SoTL - Softwood Timber License
PTL - Provisional Timber License
PLTL - Private Land Timber License
CRTL - Civil Reservation Timber License
OTL - Ordinary Timber License
STL - Special Timber License

Table 2.11
Total recorded log production in relation to TLAs
by region, 1988

Region	Log Production m^3	Proportion of Total (%)	TLAs m^3
1	28,076	0.7	24,173
2	706,736	18.6	695,584
3	3,692	0.1	3,692
4	278,016	7.3	261,516
5	9,014	0.2	184
6	0	0	0
7	0	0	0
8	275,527	7.2	275,527
9	260,231	6.8	145,011
10	735,975	19.3	575,015
11	1,259,567	33.1	824,128
12	252,362	6.6	251,729

TLAs – timber license agreements
m^3 – cubic meters

the charging system which gives high profit margins on logs due to low stumpage fees, and the regulations which require concessionaires to maintain sawmills. Partly to blame also is the kind of sawmill equipment in the country: few Philippine mills are equipped to make use of chips or sawdust (ffARM Study, World Bank Document, 1989).

Furthermore, the low estimates of forest destruction by logging assume that the loggers generally strictly follow the selective logging system and confine themselves to their allowed areas of operation. But this may not be so. Logging, moreover, indirectly leads to permanent loss of forest. Whenever loggers build roads and settlements, other people follow. Widening clearings and shifting cultivation sites are formed around new roads in logging concession areas.

Licensing and Forest Charges System — The low value imposed on the cutting of timber resources encourages inefficiency both in the logging and wood processing operations. Cruz and de los Angeles have calculated that the cutting charge of 30 pesos per cubic meter gives loggers a profit of around 160 percent and not 30 percent, as it should be. Because the charges are equivalent only to one to three percent of the market value of the logs, even the inefficient operations can make profits. Thus, loggers do not have an incentive to improve the efficiency of their operation. For instance, it has been estimated that only about 20 to 30 percent of the timber resource drain is transformed into primary wood products while the bigger part of the drain is wasted in the logging and processing operations. Thus, it is not surprising that the Forestry, Fisheries and Agricultural Resource Management (ffARM) study in 1989 claimed that the failure of the government to collect significant rent from loggers largely explains the rapid depletion of timber resources during the last 20 years. Realized rents, according to the study, also fall below potential rents because most timber is not directly exported.

Moreover, forest charges are based on the volume rather than the value of production; hence, this decrease in real value over time may be due to inflation. Because charges are fixed regardless of timber quality, there is no premium on quality and efficiency. Forest charges also do not reflect the decrease in product value due to high production costs. More important, the collection of potential charges is very low. Prior to the 1970s, revenues were probably only in the vicinity of five percent of potential rents. At their peak value in 1979, the collection of forest taxes amounted to only 440 million pesos out of a potential 2.8 to 3.6 billion pesos (ffARM Study, World Bank

Document, 1989). If the government collected only half the potential rents, it could already finance a major reforestation program, according to the World Bank study.

The licensing system has also delegated forest management responsibilities to the licensees who often fail to manage the forests because this would entail additional costs on their part. In addition, the 50-year limit of the licensing system discourages investments by licensees in forest crops which mature after 50 years.

The government has attempted to correct the inefficiencies in the licensing and charges system initially by raising stumpage fees for existing licenses to 250 pesos per cubic meter. It also imposed on licensees a deposit of 10,000 pesos per hectare for the required reforestation work and a provisional forest management fee of 250 pesos per cubic meter on expiring timber license agreements. In addition, the government stopped licensing any new concessions and reduced the number of existing concessions. It initiated stumpage bidding as a means of capturing full economic rents for timber resources. The imposition of these additional charges on existing concessions can increase total revenues from logging to up to 50 percent or more of economic rent. Under this scheme, loggers must show proof that reforestation activities have been completed in their concession areas.

Illegal Logging

Illegal logging is also a persistent problem in Philippine forestry. There are basically two broad types of illegal production from the forests: overcutting by legally authorized corporations and poaching. Illegal logging was identified as the cause of an increasing proportion of forest destruction during the late 1970s and 1980s (Porter and Ganapin, 1988). It was estimated in late 1988 that illegal logging accounted for 34 percent of the total log production in one province and that this figure can be assumed to be representative of the national average (DENR Master Forestry Plan, 1989).

Illegally-cut logs were exported mainly to Japan and Taiwan through smuggling or underreporting. The export of illegally cut logs to Korea and Japan was about 40 percent of the total production in 1979-1980. The value of illegal log shipments to Korea, Japan, and Taiwan during the 1978-1982 period has been estimated at 24.4 billion pesos, or $60 million per year (Ganapin, 1986 cited by Porter and Ganapin, 1988).

An average of 40 percent of the logs exported to Japan are believed to have been smuggled (*Philippine Daily Inquirer*, 16 November 1990). The discrepancies between Philippine figures for log exports and Japanese figures for imports show that by 1980, most Philippine log shipments were illegal [see Table 2.12]. This is also borne out by official figures for legal felling in 1982 which indicated a total of only about two to 2.7 million cubic meters cut while sawmills processed over five million cubic meters of wood. This means that an estimated 2.3 to three million cubic meters of wood cut must have been unreported (Cruz and Cruz, 1988).

Log smuggling to other countries has cost the Philippines over two billion dollars in revenues since 1965 according to Haribon chairman, Maximo Kalaw (*Philippine Daily Inquirer*, 16 November 1990).

5. Harvesting of Minor Forest Products

The degradation of second-growth forests is partly associated with firewood gathering and charcoal-making. Most rural households are dependent on these traditional fuel sources for their cooking and energy needs.

According to the 1989 ffARM study, fuelwood may account for 70 percent of all wood used, and about one-third of all commercial and noncommercial energy consumed (or roughly equivalent to total oil consumption). The large contribution of fuelwood to energy needs is promoted in part by its low cost relative to most other energy sources. The total consumption of fuelwood in 1985 was estimated to have been 28.5 million cubic meters, of which 82 percent was for household use (ffARM Study, World Bank Document, 1989). It was also estimated that the annual growth in demand is likely to be two to three percent so that an additional 12 million cubic meters per annum may be required by the year 2000. It is expected that future shortages of fuelwood will occur. In the face of the dwindling natural forests, this can pose a serious problem.

Export of minor forest products (resins, gums, seed oils, essential oils, wild food plants, and natural dyes) have contributed to the country's foreign earnings. In 1987, export earnings from almaciga, elemi, bamboo, and unsplit rattan totalled $735 thousand (*Philippine Yearbook*, 1989). The production of these forest products, however, shows a generally declining trend [see Table 2.13] probably because of overexploitation and declining forest cover.

Table 2.12
Discrepancies in log export reports, 1978-1981
(in cubic meters)

Year	Japan	Philippines	Difference
1978	1,559,000	1,322,650	236,350
1979	1,264,000	776,927	487,073
1980	1,073,000	441,926	631,074
1981	1,418,000	365,441	1,052,559

Source: National Environmental Protection Council, *The Philippine Environment*, 1982.

Table 2.13
Production of selected minor forest products, 1982-1987 (in thousands)

Product	Unit of Measure	1982	1983	1984	1985	1986	1987
Almaciga resin	kilo	1,407	462	191	380	368	4
Anahaw leaves	piece	22	96	6	31	—	2
Bamboo and boho	piece	647	410	309	644	428	402
Buri	kilo	97	57	155	48	33	5
Hingiw	kilo	3	10	9	10	3	8
Honey	kilo	94	1	—	1	1	a
Nipa shingles	kilo	4,126	3,166	1,757	2,675	3,989[b]	3,579[b]
Nito	kilo	17	8	12	23	—	—
Orchid/fern	piece	a	1	a	1	a	1
Split rattan	kilo	195	73	2,770	72	249	98
Salago bark	kilo	258	83	144	47	156	2
Tan bark	kilo	83	52	98	53	1,020	35
Elemi	kilo	4	5	6	—	—	—

Source: Forest Management Bureau.

[a] less than a thousand
[b] by piece

6. Mining

Mining activities seriously disturb the existing balance in the environment. The very nature of mining operations entails extensive use of land, air, and water. Mineral resources development activities such as open pit mining, quarrying and ground preparation inevitably result in large-scale disruptions of environmental processes by altering land forms and physiography, disrupting the hydrologic regime, discharging wastes into rivers, polluting water bodies with toxic wastes, and destroying prime agricultural lands.

The Philippine National Oil Company's (PNOC's) plan to build three geothermal power plants inside a 106,000 square-meter park within Mount Apo is an example of how forests are destroyed by mining operations. The PNOC is building an 8.5-kilometer access road that cuts across what used to be virgin forest. The park is home to a number of wildlife species such as the famous Philippine Eagle which face displacement from their habitat because of the project (*Philippine Daily Inquirer*, 4 September 1989).

In Sorsogon, PNOC is facing opposition to a geothermal power plant it is constructing at the foot of Mount Bulusan. Since January 1989, PNOC began clearing hundreds of hectares of forests within Mount Bulusan (*Manila Bulletin*, 18 October 1989).

7. Population Pressure

Rapid population growth and the resulting pressure on land provide the driving forces for high rates of deforestation. Deprived of economic opportunities in the lowlands, displaced populations have always tended to migrate either to forested uplands or to urban centers. In 1988 the upland population was estimated to be already 17.8 million or about one-third of the total Philippine population [see Table 2.14]. There are about 3.18 million upland households, with an average family size of 5.6 members. Migrants with little knowledge and experience in upland farming constitute 60 percent (10.7 million) of the total upland population while traditional tribal groups comprise the remaining 40 percent (7.1 million) [see Table 2.15].

The growth of the upland population has been very rapid. From an average of 39 persons per square kilometer in 1948, population density in the uplands jumped by 305 percent to 119 persons per square kilometer in 1988.

Table 2.14
Upland population statistics
by region (in thousands), 1948-1988

Region	1948	1960	1970	1975	1980	1988*
1	756	973	1,205	1,317	1,446	1,678
2	402	592	832	917	1,129	1,437
3	285	409	633	742	844	1,036
4	422	666	958	1,129	1,299	1,660
5	496	741	916	988	1,059	1,185
6	861	1,069	1,179	1,362	1,478	1,682
7	1,035	1,217	1,462	1,640	1,840	2,212
8	567	659	794	863	945	1,091
9	199	275	422	461	570	800
10	384	554	875	1,047	1,254	1,675
11	309	689	1,225	1,504	1,834	2,519
12	152	348	607	678	743	860
Total	5,868	8,192	11,108	12,702	14,441	17,835
Population growth (%) average annual rate over previous period		2.98	3.03	2.73	2.59	2.67
Population density/ persons per square kilometer	39	55	74	85	96	119

Source: Ma. Concepcion Cruz and Imelda Zosa-Feranil, Policy Implications of Population Pressure in the Philippine Uplands, 1988. (unpublished)

*Estimated population based on projections from 1975 to 1980 level

Table 2.15
Population of uplanders by constituent-group

Major Constituent-Groups	Population Estimate (1988)
Upland migrants	10.7 million
Muslims (Western Mindanao/ Maguindanao, Zamboanga, Cotabato, Sulu, Basilan, and Tawi-Tawi)	2.4 million
Lumadnons (Eastern and Southeast Mindanao/ Bukidnon, Agusan del Norte and Surigao del Norte)	1.1 million
Igorots (Cordillera Region/ Mountain Province, Benguet, Abra, Kalinga)	1.2 million
Mangyans (Mindoro) Negritos (Region II/Zambales and Quezon); Negritos/Atis (Panay Island); other indigenous Filipino cultural communities	2.4 million
TOTAL	17.8 million

Sources of basic data: Ma. Concepcion Cruz and Imelda Zosa-Feranil, Policy Implications of Population Pressure in the Philippine Uplands 1988; R.B. Rodil, The Minoritization of the Indigenous Communities of Mindanao and the Sulu Archipelago, 1986; and Bureau of Forest Development, 1985.

Although the growth rate gradually declined after 1970, the total population size has risen steadily. In 1980, the fastest growth in upland population was exhibited in Region 9 (4.34), Region 11 (4.05), Region 10 (3.68), Region 4 (3.11) and Region 2 (3.06) [see Table 2.16]. The present annual growth rate of the upland population is about 2.6 percent. If this rate continues, the upland population will double in 27 years.

In Table 2.17 higher densities of population are shown to correspond to regions with high deforestation rates (Regions 5, 7, 4) while regions with lower population density rates (Regions 1, 2, 4) have lower deforestation rates. Generally, this pattern also holds true in the forest zone area. This supports the conclusion that the level of population in the upland and forest areas directly affects the deforestation rate.

The attraction of upland and forest areas to lowland migration is shown in Table 2.18. Those areas of the uplands with the most migrants to forest lands are also the remaining areas with large forests (Regions 2, 4, 10, 11, and 12). Those areas with large out-migration, on the other hand, have already lost a considerable portion of their forest cover (Regions 1, 3, 5, 6, and 7).

The SPOT Satellite study in 1987 reported an estimate of 8.4 million upland farm population (1.5 million households) occupying a total of 3.9 million hectares of cultivation sites or 2.6 hectares per household [see Table 2.19]. Table 2.20 shows the correlation analysis between deforestation rate, total forest area (1980-1987), total cultivated areas and upland population density (1948-1988) as well as forest population zone density for 1980. The result of this analysis and Figure 2.2 provide the basis for the conclusion that deforestation is largely caused by agricultural use as a result of population pressure.

Tables 2.21 and 2.22 show just how alarming is the threat posed by increasing population on remaining forest resources. In Table 2.21, the dependency ratio indicates the proportion of the total population that needs to be supported. This ratio may be used as an indicator of population pressure. The greater the dependency burden of an area, the higher the need to exploit resources in order to provide for the consumption requirements of the population. Based on a reliable estimate, 43 percent of the upland population are 0-14 years old, while 54 percent are of working age, 15-64 years old. (Cruz and Zosa-Feranil, 1988). Three regions have high dependency ratios

Table 2.16
Annual growth rates of the Philippine upland population

Region	1948-1960	1960-1970	1970-1975	1975-1980
Philippines	2.98	3.03	2.73	2.59
1. Ilocos	2.24	2.11	1.8	1.88
2. Cagayan	3.46	3.39	3.14	3.06
3. Central Luzon	3.23	4.37	3.24	2.60
4. Southern Tagalog	4.09	3.63	3.36	3.11
5. Bicol	3.58	2.10	1.52	1.41
6. Western Visayas	1.92	0.96	2.95	1.63
7. Central Visayas	1.43	1.81	2.33	2.33
8. Eastern Visayas	1.34	1.84	1.69	1.82
9. Western Mindanao	2.88	4.29	1.77	4.34
10. Northern Mindanao	3.27	4.58	3.66	3.68
11. Southern Mindanao	7.31	5.80	4.20	4.05
12. Central Mindanao	7.53	5.60	2.26	1.84

Source: Values were derived by the CPDS-PIDS Project Team from the National Census and Statistics Office, 1980.

Table 2.17
Upland population density data

Region	Total Upland Area (square kilometers)	Forest Zone Land Area (square kilometers)	1948	1960	1970	1975	1980	1988*	Growth from 1948 to 1988	Forest Zone Population Density (1980)
1	15,122	13,586	50	64	80	87	96	111	61	92
2	23,437	21,088	17	25	36	41	48	61	44	48
3	6,119	4,125	47	67	103	121	138	169	123	147
4	23,062	15,062	18	29	42	49	56	72	54	65
5	7,188	6,024	69	103	127	137	147	165	96	151
6	10,080	8,499	85	106	117	135	147	167	81	135
7	7,892	6,124	131	154	185	208	233	280	149	204
8	8,538	7,763	66	77	93	101	111	128	61	97
9	5,520	4,178	36	50	76	84	103	145	109	73
10	11,762	9,354	33	47	74	89	107	142	110	110
11	21,282	16,318	15	32	58	71	86	118	104	76
12	9,698	7,308	16	36	63	70	77	89	73	80

Source: Ma. Concepcion Cruz and Imelda Zosa-Feranil, Policy Implications of Population Pressure in the Philippine Uplands, 1988.

* Population projections from 1975 to 1980.

Table 2.18
Migration to upland areas, 1975-1980

Region	Intraregional	Interregional		
	Migrants to Upland Areas from Other Provinces of the Same Region	In-migrants to Upland Areas from Other Regions	Total Out-Migrants Lost to Upland Areas in Other Regions	Regional Upland Net Migration
1	11,657	17,279	18,017	-738
2	8,680	17,670	8,912	8,758
3	5,855	17,792	15,775	2,017
4	11,361	40,216	12,101	28,115
5	5,684	11,094	13,487	-2,393
6	6,644	9,951	23,934	-13,983
7	4,959	20,332	39,950	-19,618
8	2,860	10,056	18,985	-8,929
9	2,881	8,354	14,668	-6,314
10	21,781	48,228	23,088	25,140
11	23,653	47,120	21,863	25,257
12	5,247	26,195	16,147	10,048

Source: Ma. Concepcion Cruz and Imelda Zosa-Feranil, Policy Implications of Population Pressure in the Philippine Uplands, 1988.

Table 2.19
SPOT estimate of Philippine upland farm population, 1987

Region	Upland Cultivated Area (thousand hectares)[a]	Estimated Farm Population (thousand)[b]
1	407	877
2	436	940
3	202	435
4	544	1,172
5	173	372
6	333	717
7	308	664
8	339	731
9	177	382
10	345	742
11	419	902
12	244	525
NATIONAL TOTAL	3,927	8,459

[a] Includes cultivated areas in forests and grasslands, and in areas of mixed cultivation/brushland/grassland

[b] 2.6 hectares per farm and 5.6 persons per farm

SPOT - *Satellite pour Observation de la Terre*

Table 2.20
Correlation analysis between factors affecting deforestation rate in the Philippines

	Deforestation Rate	Total Forest Area 1980	Total Cultivated Area 1987	Upland Population Density	Forest Zone Population Density 1980
Deforestation Rate	1				
Total Forest Area 1980 (% of Total Land)	-0.66546	1			
Total Cultivated Area (% of Total Land) 1987	0.77404	-0.87334	1		
Upland Population Density (1948-1988)	0.61891	-0.71800	0.61086	1	
Forest Zone Population Density (1980)	0.60393	-0.83295	0.77457	0.81266	1

Critical Value (1-tail, .05) = +/- 0.55240
Critical Value (2-tail, .05) = +/- 0.62972

Relationships:

1. Total forest area is smaller with larger deforestation rate and vice versa.
2. Total cultivated area is larger with larger deforestation rate.
3. Deforestation rate is positively correlated with upland population density under the 1-tail, .05 test but not significantly correlated under the 2-tail, .05 test.
4. Deforestation rate is positively correlated with the forest zone population density under the 1- tail, .05 test but not significantly correlated under the 2-tail, .05 test.
5. Total forest area is strongly negatively correlated with the forest population density.

Table 2.21
Dependency ratios and forest cover relationship in the different regions of the country (in square kilometers)

Dependency Level 1980	1975 Density Level	1975 Total Forest Land	1975 A & D	1984 Density Level	1984 Total Forest Land	1984 A & D
High Dependency (190 or more)						
Bicol	137	5,561 (32)	12,071 (68)	147	5,550 (31)	12,100 (69)
Eastern Visayas	101	11,929 (56)	9,502 (56)	111	10,600 (50)	10,800 (50)
Central Mindanao	70	18,310 (63)	10,696 (37)	77	14,000 (60)	9,400 (40)
Western Visayas	135	7,032 (35)	12,190 (65)	147	6,500 (32)	12,700 (68)
Moderate Dependency (185 - 189)						
Southern Tagalog	49	28,890 (61)	18,623 (39)	56	27,900 (59)	19,600 (41)
Southern Mindanao	70	16,356 (60)	10,970 (40)	86	20,100 (64)	11,500 (36)
Cagayan	41	26,253 (72)	10,150 (28)	48	26,200 (72)	10,300 (28)
Western Mindanao	83	10,108 (54)	8,578 (46)	103	9,900 (53)	8,700 (47)
Low Dependency (< 185)						
Ilocos	87	12,507 (57)	9,620 (43)	96	12,400 (58)	9,100 (42)
Central Visayas	208	6,903 (46)	8,049 (54)	233	6,700 (45)	8,200 (55)
Central Luzon	121	8,102 (44)	10,175 (56)	138	8,100 (44)	10,300 (56)
Northern Mindanao	89	18,344 (65)	9,983 (35)	107	18,100 (64)	10,300 (36)

Source: Values were derived by the CPDS-PIDS Project Team from the National Census and Statistics Office 1980 and Bureau of Forest Development Statistics 1975.

Note: All numbers in parentheses are percentages.
A & D - alienable and disposable land

Table 2.22
Population and area of municipalities in upland and timber concession areas*

REGION	Total Number of Municipalities Classified as Upland	Number of Municipalities in the Forest Zone	Number of Municipalities with Timber Concessions	Forest Zone Land Area (square kilometers)	Total Population in the Forest Zone (1980)	Population in Municipalities with Timber Concessions	Forest Zone Population Density	Growth Rate in Municipalities with Timber Concessions		
								1948-60	1960-70	1970-80
1	115	86	6	13,586	1,246,010	87,935	92	1.69	2.37	1.45
2	67	54	19	21,088	1,017,045	436,509	48	3.17	2.49	3.75
3	34	17	—	4,125	605,566	—	147	—	—	—
4	72	49	9	15,062	984,980	190,483	65	9.28	5.76	4.19
5	50	36	1	6,024	907,267	32,659	151	0.10	1.44	0.41
6	61	39	—	8,499	1,145,538	—	135	—	—	—
7	72	53	—	6,124	1,252,435	—	204	—	—	—
8	53	43	5	7,763	754,742	72,399	97	1.83	3.35	2.04
9	28	14	10	4,178	305,680	630,847	73	2.04	4.62	4.25
10	55	38	16	9,354	1,033,005	396,972	110	5.05	1.65	3.32
11	68	40	36	16,318	1,235,242	1,887,978	76	5.61	7.10	4.15
12	34	21	12	7,308	588,226	522,706	80	7.20	2.79	2.08
Philippines	709	490	114	119,429	11,075,736	4,258,483	93	4.58	4.72	3.49

Source: Ma. Concepcion Cruz and Imelda Zosa-Feranil, Policy Implications of Population Pressure in the Philippine Uplands, 1988.

* The area classified as upland comprises about 16.8 million hectares or 56 percent of national territory. This includes both alienable and disposable land (A & D) and officially held forest land.

and density levels—Bicol, Eastern Visayas, and Western Visayas. Forest lands in Bicol and Western Visayas are relatively small compared to total forest land in the country. With limited forest resources and relatively dense settlements, population pressure has reached critical levels in these regions. On the other hand, the Central Visayas has low dependency ratios but comparatively high density levels. The forest land in this area is also limited. In contrast, Cagayan Valley which has a low population density level and moderate dependency has a large area of forest land.

Population tends to build up around timber concessions. In 1980, the estimate of total population in municipalities with timber concessions was 4.3 million. Today it is 5.6 million [see Table 2.22]. Population growth rates near logging concessions is about 3.5 percent.

Tonie Balangue (1985) estimates that upland population will be 18.82 million in 1990 and will reach 37.84 million by 2015 [see Table 2.23]. The areas with the highest upland populations will be Regions 2, 1, and 7.

If trends in the upland population growth rate continue, more forest lands will be converted to agriculture use to meet food needs. The estimate is that the rate of forest conversion from 1988 to 2025 will be 1.56 percent per year which is significantly faster than the rate of conversion from logging operations of 1.2 percent per year for 1960-1980 (Hernandez, 1989). Given a population growth rate of 2.6 percent, it is projected that by year 2025, 5.24 million hectares more of forest lands will be cleared to accomodate the increasing population (Cruz and Zosa-Feranil, 1988).

Based on the total area of grasslands and intensive and extensive agricultural lands, the population density in the uplands is 174.7 persons per square kilometer. In contrast, the sustainable population density in a shifting cultivation system is estimated to be 25 persons per square kilometer. This may mean that the carrying capacity of the uplands has already been reached; hence, the poverty and environmental degradation in these areas.

Balangue's study (1989) on alternative land use scenarios from 1990 to 2015 clearly shows that population pressure will be a major determinant of land use in the future. He predicted that given the current population growth trend, it would be very difficult for the country to feed its growing population starting 1995. Moreover, if the situation is not remedied, a serious land use conflict between agriculture and forestry will probably arise, resulting in the further deterioration of the environment and living condition of the people.

Table 2.23
Projected upland population distribution by region, 1990-2015

Region	Year 1990 (millions)	2015 (millions)
1	2.63	5.32
2	1.13	2.29
3	1.34	2.68
4	1.77	3.55
5	2.13	4.08
6	2.27	4.58
7	2.76	5.55
8	1.02	2.11
9	1.33	2.66
10	2.16	4.34
11	3.97	7.98
12	1.39	2.80
TOTAL	18.82	37.84

Source: Tonie Balangue, Alternative Land-Use Allocation Scenarios for the Philippines (1990-2015), 1989.

8. Weak Enforcement of Forest Protection

It has been recognized that the major causes of ineffective forest protection in the Philippines are weak institutional infrastructure, persistent political interference, and military protection of violators of forest laws.

a. Weak Institutional Infrastructure

Many of the problems in the forestry sector are institutional, according to Manuel Bonita (1981). These institutional weaknesses may be attributed to an inefficient organizational structure and ineffective policies and programs.

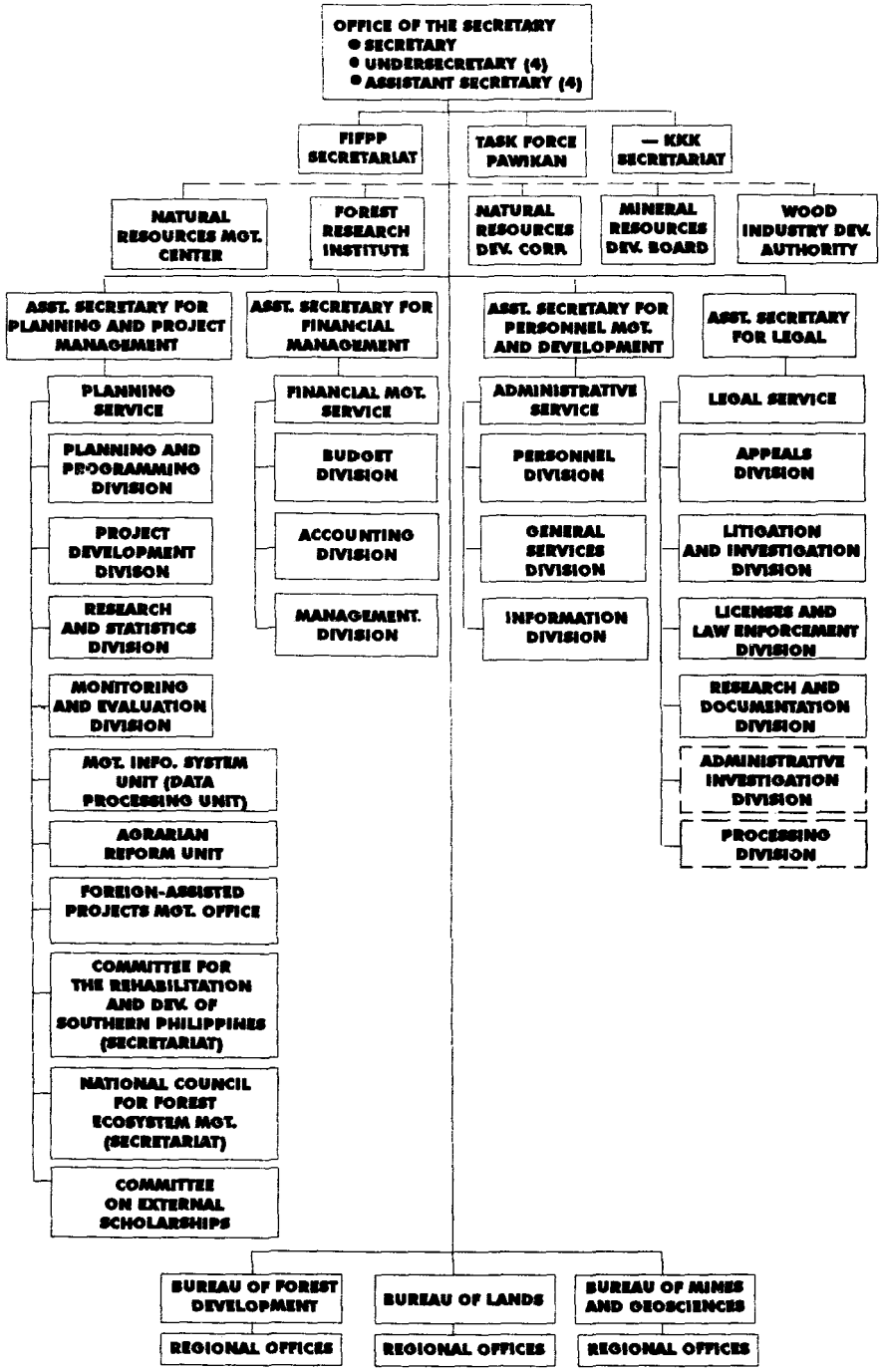
Historically, the management of the forestry resources sector has been the responsibility of one bureau, the Bureau of Forest Development (BFD). In the 1980s, the BFD had overall responsibility for the development, management, and regulation of the country's forest resources [see Figure 2.3 Organizational Chart of the Ministry of Natural Resources]. It was BFD's primary responsibility to keep the forestry sector a healthy and viable component of the national economy in the face of pressures from groups with vested interest and resource limitations.

But the BFD was not able to check massive forest destruction. A World Bank Report attributed this failure to the bureau's organizational problems. It pointed out that although the BFD appeared to be adequately structured and staffed to undertake the task of developing and managing forest resources, it was in fact weak. The top management in the BFD apparently was not fully committed to enforcing regulations. Its efforts at reforestation have been inadequate in both qualitative and quantitative terms.

Bonita (1981) enumerates the specific organizational and management weaknesses of BFD in the 80s, as follows:

1) vague definition of performance targets
2) no clear delineation of responsibility
3) centralized authority and poorly shaped decisions
4) improperly distributed technical staff, overstaffed central office, understaffed regions
5) lack of a clear-cut policy of whether the divisions are doing staff or line functions
6) too much bureaucracy and red tape

Figure 2.3 Organizational Chart of the Ministry of Natural Resources



FIFPP - Forest Industries Food Production Program
KKK - Kilusang Kabuhayan at Kaunlaran

7) too many staff support for the director in addition to the numerous divisions
8) poor management information systems
9) lack of coordination between national and regional staff
10) poor relation and interactions with other public agencies and the public sector
11) poorly developed plans
12) lack of funds, equipment, infrastructure, and capable personnel
13) unreliable information or statistics for planning and decision making
14) misuse of funds
15) urbanized foresters

The recognition of these problems showed the need for effective institutional reforms, including a general reorganization. The general reorganization signaled a new era in forestry characterized by mission orientation and seriousness of purpose, by developmental concerns rather than regulatory ones.

After the EDSA Revolution of 1986, the Ministry of Natural Resources (MNR), of which BFD was one of the bureaus, was reorganized. The MNR was renamed the Department of Energy, Environment and Natural Resources (DEENR). Executive Order No. 192 issued on June 10, 1987 provided for the reorganization of the DEENR, and its renaming to the Department of Environment and Natural Resources (DENR).

Present Organizational Structure of DENR

The Department of Environment and Natural Resources (DENR) aims to consolidate management in a single agency. Until 1987, there were at least 24 agencies dealing fully or partially with environmental management and administration. The other agencies are the Department of Agriculture (DA) and the Department of Agrarian Reform (DAR) which is responsible for upland and coastal area management.

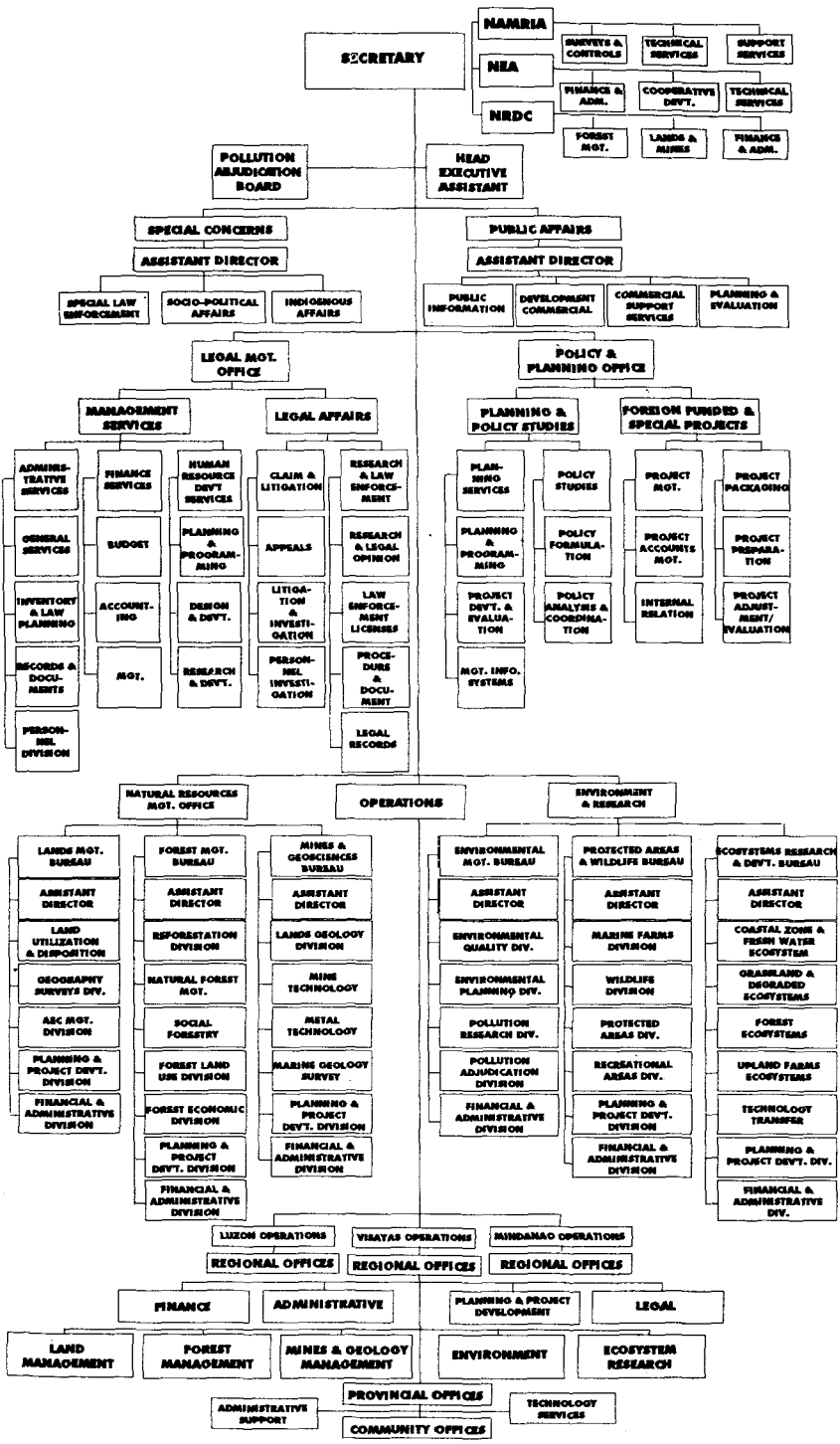
The establishment of DENR represents a major effort to create a natural resource and environmental lead agency. The DENR is responsible for the conservation, management, development, and use of forest and grazing lands, mineral resources, and other lands in the public domain. The DENR's principal responsibility is public forest lands, defined in Presidential Decree

(PD) No. 705 to include lands with a slope of 18 percent or greater and mangrove forests of 20 hectares or more. The line functions of the DENR are being decentralized and will be exercised through the Regional Environment and Natural Resources Offices located in regional capitals and headed by Regional Executive Directors (REDs). The REDs report to assistant secretaries for field operations in Luzon, the Visayas and Mindanao. The assistant secretaries in turn, report to the Undersecretary for Field Operations in Quezon City. The DENR Secretary is assisted by four undersecretaries for policy and planning, legal services, natural resources management and environment, and research [see Figure 2.4].

The DENR has six staff bureaus: three for natural resources and three for environment. They are: (a) the Forest Management Bureau (FMB) comprising the former Bureau of Forest Development (BFD) and Wood Industry Development Authority (WIDA), with responsibility for forest land use, forest management, reforestation and social forestry; (b) the Land Management Bureau with responsibility for the survey, classification, and disposition of public lands; (c) the Mines and Geosciences Bureau (MGB) with responsibility for terrestrial and marine geological surveys, mines and metal technology; (d) the Environmental Management Bureau, comprising the former National Environmental Protection Council (NEPC), the National Pollution Control Commission (NPCC) and the Environmental Center of the Philippines; (e) the Ecosystem Research and Development Bureau (ERDB) which absorbed the former Forest Research Institute and the National Mangrove Committee and contains specialized units for coastal zones, grasslands, and degraded ecosystems, forests, upland farms, and technology transfer; and (f) the Protected Areas and Wildlife Bureau (PAWB) which is responsible for all national parks and wildlife sanctuaries, including those presently belonging to other departments and bureaus. Through decentralization, former line agencies such as the BFD, which wielded considerable power over staff and budgetary resources prior to 1987, have been restructured as staff bureaus and their line functions are now assigned to regional operational staff. Through consolidation, other organizations that formerly functioned as centers or commissions, such as the NPCC and the NEPC, have been made integral parts of DENR.

In addition, several agencies or corporations are attached to the DENR and report directly to the Secretary. These are the Pollution Adjudication Board (PAB), the National Mapping and Resources Information Authority

Figure 2.4 Organizational Structure of the Department of Environment and Natural Resources



(NAMRIA), the Natural Resources Development Corporation, and the National Electrification Agency (NEA).

Organizational Weaknesses

With the reorganization, DENR has to deal with complex reorganization issues which can lead to organizational ineffectiveness. It has to deal with the consolidation of all major natural resource and environmental functions within a single agency; decentralization of staff from Quezon City to the regions and provinces; more active consultation with the public about policies, programs and projects; and transformation of its image from that of a corrupt regulator to an enlightened developer (Philippine ffARM Study, World Bank Document, 1989).

The immediate organizational task is for DENR to shrink from approximately 25,000 staff (with 35 percent at the center and 65 percent in the field), to an initial target of approximately 23,000 staff with 15 percent at the center and 85 percent in the field (*i.e.,* the staff will shrink by 2,000 and 4,600 personnel will be moved from central staff functions to field operations). The intention is to reduce the size of the Central Office even further to under five percent of the total staff allotment.

The 1989 World Bank Document on Philippine Forestry, Fisheries and Agricultural Resource Management (ffARM) Study cited the following as the more significant organizational issues relating to natural and resources management: limited mandate, reorganization, resource limitation, budget allocation, corruption in the line agencies charged with managing natural resources, and ineffectiveness of local government and user groups that need to be empowered.

Limited mandate. The issue of limited mandate has two major aspects: changing roles, and overlapping responsibilities. With respect to **changing roles**, the predecessor of DENR (MNR), from the time of its separation from the Ministry of Agriculture later called the Department of Agriculture (DA) in the mid-1970s, consistently viewed all aspects of management of public forest lands as its exclusive responsibility. As a result, an enormous amount of energy was expended in resisting the efforts of other agencies to enter its enormous "territory." At the same time, the ministry tried to provide a range of services to upland people that foresters and engineers are ill-equipped

to do. The **overlapping responsibilities** refer mainly to the DA's lack of involvement in the uplands where one-third of the population live. The DA's concern for upland development has been limited to a few special projects on sites under the 18 percent slope criterion by authority vested in DENR. The DA has never chosen to invest heavily in understanding upland agricultural technologies, and upland farmers are left without access to a research and extension system.

Reorganization. Reorganization efforts have involved significant measures of both decentralization and demolition. More resources and decision making power have been put into the hands of the regional, provincial, and district managers. In the case of the DENR, DA, and DAR (Department of Agrarian Reform), only the initial stages of reorganization appear to be planned. There is a need to identify the functions of these agencies.

Coordinated action among agencies over occupied public lands and lands for settlement is important to avoid duplication and conflict. It is apparent that senior administrators of government agencies are willing to cooperate but the administrative mechanism to facilitate this still needs to be worked out.

Resource limitation. Resource limitation as an organizational weakness of national agencies concerned with environmental problems takes several forms, covering both personnel and financial aspects. Within the DENR there is an acute scarcity of staff who can deal effectively with people in public forests and the problems they pose in their search for more secure tenure and more productive production systems to generate livelihood. The Integrated Social Forestry (ISF) programs contain a small nucleus of such individuals, but they tend to be junior staff in need of training, experience and effective leadership. The line agencies are affected by financial resource limitations in several ways: they lack vehicles and/or fuel and communications facilities, and they need daily and travel allowances. In the DENR, overcentralized decision-making and poor financial backing for field operations have resulted in a staff that is not oriented nor favorably disposed to field work. The lack of operational vehicles and fuel and maintenance systems means that professional staff have little mobility and become dependent on concessionaires to take them to the field. The lack of effective communications systems means that the staff are often isolated in the field and have no means of seeking advice or support. Poor mobility and poor communications become overwhelming factors in areas where personal safety may be put at risk or security is believed

to be weak. The lack of operating funds for travel allowances kills the incentive to leave the office and travel to the hills regardless of the security situation or the availability of transport.

Budget allocation. The budget allocation for the Department/ Ministry of Natural Resources, the forerunners of the DENR, has declined steadily in recent years [see Table 2.24]. This decline is comparable to that experienced by all the "agricultural" agencies in the Philippines and is the result of the severe financial crises that occurred in 1983. Between 1981 and 1986, the DENR's budget declined in real terms by 4.4 percent per annum. The appropriation for 1987, representing an increase of 8.4 percent, restored the budget to its 1983 level but was still short of the peak levels achieved between 1979 and 1982. It appears that while DENR has expanded responsibilities, its budget is below the peaks achieved six to nine years before. It therefore hopes to use its funds more effectively through decentralized operations (ffARM Study, World Bank Document, 1989).

Corruption. Corruption is a problem that besets almost all government agencies. The DENR, including the BFD and the Bureau of Fisheries and Aquatic Resources (BFAR), is not exempted from public perception of favoritism and dishonesty in the disposition of public resources. This perception covers both the explicit use of public resources as rewards and the abuse of the regulatory power of officials. The reliance on rules and administrative discretion, rather than on a proper pricing system for access rights to valuable resources, creates opportunities for financial abuse at almost every step in the resource management process—from inventory to extraction, transport, processing, and export. The sums involved can be significantly higher than government salaries and allowances. Public perception of the BFD was of consistently high levels of secrecy and impropriety. It has been pointed out that the potential rewards for corrupt behavior are still very high and staffing and procedures in field operations have undergone few changes. Unless the system for allocation, management, and regulation of resource use is first changed to reduce the scope of administrative discretion and increase mandatory resource-use fees to levels commensurate with economic rents, current programs of decentralization within these bureaus may simply decentralize the locus of corruption.

Local government ineffectiveness. The ineffectiveness of local government in responding to environmental problems is attributed to limited local government resources for personnel and finances. The ineffectiveness of user groups, meanwhile, is attributed to the absence of awareness.

Table 2.24
Agriculture sector expenditures by department/agency and by type
(million pesos, constant 1972 prices), ffARM Study, 1989

	Actual Obligations					Allotments	Appropriations	Growth Rates (% p.a.)	
	1981	1982	1983	1984	1985	1986	1987	1981-86	1986/87
Current Operating Expenditures	595	581	498	325	359	454	559	-4.4	10.9
Dept. of Agrarian Reform	52	50	48	33	34	40	46	-4.4	7.7
Dept. of Agriculture & Food	204	191	171	124	151	197	258	-0.6	14.5
Dept. of Natural Resources	128	138	114	79	74	98	115	-4.4	8.4
National Irrigation Administration	67	74	66	44	47	57	66	-2.7	8.1
Department of Public Works and Highways (rural roads)	46	54	39	24	20	32	47	-6.2	22.2
Others*	97	74	61	21	33	32	26	-17.1	-8.1
Capital Outlays	1,042	923	827	483	388	395	679	-14.9	31.0
Dept. of Agrarian Reform	15	15	28	6	17	10	11	-6.4	5.7
Dept. of Agriculture & Food	51	33	78	87	62	52	96	0.4	36.2
Dept. of Natural Resources	9	1	8	2	3	6	6	-5.1	-2.6
National Irrigation Administration	705	594	476	242	193	229	301	-17.1	14.8
Department of Public Works and Highways (rural roads)	125	147	106	57	55	59	88	-11.8	22.0
Others	137	132	132	89	58	39	176	-18.8	111.9
GRAND TOTAL	1,637	1,504	1,325	808	747	850	1,238	-10.3	20.7
Capital outlays/grand total	0.64	0.61	0.62	0.60	0.52	0.46	0.55		

Source: Department of Budget and Management and Staff estimates.

*Including Corporate Equity Investment Fund and subsidy to government corporations and government-supported entities such as the Philippine Coconut Authority, Philippine Veterans Assistance, Philippine Virginia Tobacco Authority, etc.

From the preceding discussion it can be inferred that effective organizational mechanisms are necessary for DENR to attain a high performance level in protecting the country's resource and environment. At the same time, there is a need for appropriate policies and programs.

Weak Policies and Programs

Forestry policy is defined as a course or plan of action that society prescribes to influence decisions related to the production, protection, conservation, utilization and rehabilitation of forest resources. The formal forestry policies are embodied in forestry laws, rules/regulations, systems/ procedures, and program/project plans in forest development and conservation (Revilla, 1986).

The Philippine's basic forestry policy is given in Section 1824 of the Revised Administrative Code of 1917 (Act 2711), which states: "The public forests of the Philippines shall be held and administered for the protection of the public interest, the utility and safety of the forest, and the perpetuation in productive condition of wise use."

Celso R. Roque (undated) has pointed out that to ensure implementation, national environment policy would have to be formulated at the highest level of government. Such a policy would have to bind the entire government machinery. In the Philippines, environmental policy is formally embodied in Presidential Decree No. 1151. The National Environmental Council was established in 1977, with the President of the Philippines as chairperson.

Roque contends that a large gap in the enforcement and implementation of environmental policies exists. The major reason is that the formulation of high-level environmental policies has resulted in agencies with a broad mandate but diminished authority. Moreover, the agencies have insufficient clout to influence the course of actual decision making. They are underfunded and inadequately staffed and have little influence in formulating important development projects.

Adolfo V. Revilla Jr. (1986) lists the broad policies that have evolved from the basic policy, as follows:

1. forest management for sustained yield
2. multiple use of forest land management

3. state ownership and inalienability of forest lands
4. land classification and forest land subclassification
5. forest utilization by the private sector, forest products disposal through licensing and forest charges system
6. rationalization of the wood-based industries
7. selective logging system
8. government reforestation
9. proliferation of agencies with forestry functions
10. log export ban or log export quota
11. integrated social forestry
12. industrial tree plantations
13. food production by forest concessionaires or licensees
14. other decrees, directives, letters of instruction, administrative orders, special orders, circulars, and memoranda.

Revilla's evaluation of the state of forestry policies in the Philippines attributes the present weaknesses of the country's forestry policies to the following:

1. Overregulation, which refers to the vicious cycle of administration by regulation. When a provision of a regulation is violated, another regulation is handed down to curb further violation of the said provision, instead of strengthening the implementation system. Thus, wood industry sector, for example, has articulated out the impossibility for forestry licensees to comply with existing forestry laws, rules and regulations. There are indications that existing policies have resulted in anomalies, malpractices, and violations, such as rampant timber poaching, the gathering of illegal forest products, and log smuggling. These problems may be traced to the difficulty and expenses involved in obtaining permits. They are also due to log export quotas and the high taxes on log exports.

2. Inadequacy of certain forestry policies and their implementation systems or programs. In the case of tree planting and social forestry programs, participants are turned off when they discover that their pulpwood/fuelwood/pole harvests are confiscated by the same authorities who had encouraged them to join the program.

3. Forestry policies that are sound in principle but very ineffective for program and project implementation.

4. Unsound forestry policies that assume ideal situations and adequate implementation capabilities but are not effective in the real situation.

Adolfo V. Revilla Jr. and Manuel Bonita (1978) indicated that Philippine policies, programs, and practices have been ineffective in carrying out the task for which they were developed. The classic example is the forest licensing system that was conceived to allow government control over the exploitation process. Instead, the system has resulted in the delegation of forest management responsibilities to the licensees.

Revilla (1986) notes that on the basis of past Philippine experience, the mere adoption of new policies, strategies, and programs or the creation of new agencies or the revamp of existing ones is not enough to attain the desired objectives of forest development, utilization, and conservation unless certain minimum necessary conditions are satisfied. Effective forest protection policies and programs require a reorientation of the DENR mandate and mission for it to be consistent with the constitutional provisions on natural resources disposition. Such reorientation is consistent with government programs, which recognized DENR as the primary government agency responsible for the sustainable development of the country's natural resources and ecosystems.

The DENR has adopted the mission "to promote the well-being of the Filipino people through sustainable development of forest resources; optimal utilization of lands and minerals; social equity and efficiency in resource use; and effective environmental management" (DENR Document). To implement this mandate, it has embraced the following policy interests:

1. ***Sustainable development of forest resources.*** This policy focuses on the development of forest resources, emphasizing maintenance with sustained use. The sustainability of resource development is focused on two approaches: the prevention of irreversible depletion and harmful effects from exploitative use of resources, and resource use and allocation that would provide for the needs of the present generation without sacrificing the ability of future generations to provide for their own needs. The programs and projects in sustainable development of forest resources are: (a) the national reforestation program; (b) establishment of an integrated protected area system; (c) forest resources inventory; (d) rainfed resources development programs; and (e) watershed rehabilitation and management.

2. ***Optimal utilization of lands and minerals.*** This policy seeks to achieve the most favorable use of nonrenewable resources such as land and minerals. The strategy is to accelerate land survey and titling as well as evaluation and classification of lands to determine their best uses and to generate more geological information or data for mineral resources. The programs and projects are: (a) land classification and evaluation; (b) cadastral survey; (c) final lot survey; (d) Palawan Integrated Agricultural Development Project (PIADP); (e) research development on mineral resource utilization; and (f) stone industry resource survey.

3. ***Social equity and efficiency in resource use.*** This policy thrust incorporates the social, economic, and political dimensions of resource use into the department's overall scheme of resource and environmental management. It is intended to correct the imbalance in resource allocation and to allow the people to be a part of the decision making process. The programs are: (a) integrated social forestry; (b) community-based reforestation; (c) community-based forest management lease; (d) *Handog Titulo* Program; (e) promotion and operationalization of small-scale mining; (f) agrarian reform in public land under the Comprehensive Agrarian Reform Program (CARP); and (g) wood industry rationalization.

4. ***Environmental management.*** Environmental management underpins all DENR efforts. This policy thrust is geared toward protecting and preserving remaining resources as well as preventing further environmental degradation caused by various forms of industrial pollution and misuse of natural resources. The programs are: (a) the Philippine Strategy for Sustainable Development (PSSD); (b) strengthening the Environmental Impact Assessment (EIA) System; (c) establishment of a new regulatory regime for pollution control; (d) rivers revival program; and (e) ecosystems research.

5. ***Other major programs or projects.*** The three other major programs are the natural resources management and development project, remote sensing and mapping, and inventory of forest occupants.

These policies and programs are more focused and are parallel to the organizational structure of DENR. The respective line and staff responsibilities of different bureaus and agencies are specified. The accountability and

responsibility of agencies and bureaus to implement policies and programs are clearly defined. Staff bureaus whose main responsibility are to advice and recommend policies are also clearly delineated.

Action-Oriented Policy Measures

DENR has resorted to more active and forceful measures to implement policies and programs to attain its goal (ffARM Study, World Bank Document, 1989). The recent measures are:

1. Cancellation of 22 logging concessions (1986-1987) and suspension of 39 others for noncompliance with logging regulations; closure of 40 sawmills for processing illegally cut logs.

2. Issuance of Executive Order No. 277 (July 1987) making illegal logging and gathering of forest produce (including purchases and possession without proper documents) a criminal offense chargeable under the Penal Code; and authorizing confiscation of forest products, equipment, and conveyance used in the commission of the offense.

3. Pilot of competitive bidding for stumpage determination under Timber Production Sharing Agreements for timber resource exploitation (mandated by the 1987 Constitution).

4. Census of forest occupants.

5. Initiation of a task force, in cooperation with Haribon Foundation, to develop an integrated protected areas system.

6. Imposition of a 10,000-peso deposit per logged hectare reforestation on existing timber license agreements and a 250 peso provisional forest management fee per cubic meter on expiring timber license agreements.

7. Signing of a memorandum of agreement among the DA, DENR, and DAR delineating the functions of each agency in implementing CARP and providing for coordination of delivery of support services under the program.

Because of the strict DENR enforcement of these policies, illegal logging in Central Luzon (Region 3) declined during the first quarter of 1990 with the government's successive confiscation of illegally cut logs worth millions of pesos. Region 3 officials made 75 seizures of illegally cut logs, including flitches and lumber, and filed criminal charges against illegal loggers. They also seized machineries, tools, vehicles, animals, and other implements used in the illegal cutting and transporting of forest products (*Philippine Star*, 1990).

The strict DENR measures to curb illegal logging and the implementation of policies to protect the deteriorating environment are "mutually compatible" with environmental protection and economic growth. Environment Secretary Fulgencio Factoran, Jr. subscribes to the idea of sustainable development where government-proposed projects seek to "achieve economic growth with adequate protection of the country's biological resources and its diversity, vital ecosystem functions, and overall environmental quality." He further elucidated that "growth objectives should be compatible not only to the needs of society but also to the natural dynamics and carrying capacities of the ecosystem" (*Veritas*, 1990). In short, the main concept of Philippine Sustainable Development is the effective management of natural resources and conservation of the environment for the benefit and use of future generations.

b. Political Interference

Political interference in the logging industry has been well documented by G. Porter and D.J. Ganapin Jr. (1988). Before martial law, logging was linked with political favoritism and corruption, with timber licenses being granted for short terms, varying from one to 10 years (Boado, 1985; cited by Porter and Ganapin, 1988). Companies had to have an influential politician, usually a member of Congress, on their board of directors to ensure that their licenses were renewed. By the late 1960s, politicians were pressuring logging firms to make them major stockholders in exchange for timber concessions. Often, cronies and other officials of Ferdinand Marcos got their own timber licenses and then rented out their concessions to legitimate logging companies in return for a share of the profits (Dugan, 1987; cited by Porter and Ganapin, 1988). These practices put more pressure on companies to maximize immediate profit, even if they had previously been more circumspect in their logging operations.

Marcos cronies were able to consolidate control over forestry resources. Many of the original concessionaires lost their licenses and the concessions were gobbled up by Marcos associates (Dugan, 1987; cited by Porter and Ganapin, 1988). Some favored logging firms owned by Marcos's friends were allowed to cut timber in areas legally held by other concessionaires, using as a pretext the clearing of forests for resettlement projects sponsored by the Ministry of Agrarian Reform (Guevarra, 1986; cited by Porter and Ganapin, 1988).

In addition, favored officials and cronies defied a constitutional provision banning anyone from controlling more than 100,000 hectares of land. The law stipulated the average size of a concession to be 30,000 hectares in 1977 and 36,000 hectares in 1982, but logging companies controlled by Defense Minister Juan Ponce Enrile obtained four or five leases, each with 80,000 to 90,000 hectares (Poole and Vanzi, 1984; cited by Porter and Ganapin, 1988). One Marcos crony got nearly 200,000 hectares in timber concessions in three provinces in Northern Luzon that included the tribal lands of the Tingguians (Aguilar, Jr., 1982 cited by Porter and Ganapin, 1988).

Also during the Marcos era, most mayors of towns with exploitable forests had financial interests in the concessions in their areas through pay-offs or royalties (Griffin, 1987; cited by Porter and Ganapin, 1988). They profited from allowing illegal loggers to operate and concessionaires to ignore the legal requirements for sustained yield logging. A confidential report of the Natural Resources Management Center cited the protection and even ownership of logging companies by military officials and politicians as an obstacle to strict implementation of rules on forestry management (*Malaya*, 1985; cited by Porter and Ganapin, 1988).

The collusion of BFD personnel and municipal and military officials facilitated the proliferation of illegal logging. The BFD, dubbed the "Bureau of Forest Destruction" by its critics, has long been regarded as the most corrupt of Philippine government agencies because of its readiness to protect loggers for a price (Griffin, 1987; cited by Porter and Ganapin). "For the past many years," observed the assistant director of the bureau in 1982, "government foresters have time and again been accused of catering mostly to the whims and fancies of moneyed politicians and cunning timber and other forest product exploiters" (Alvarez, 1982; cited by Porter and Ganapin, 1988).

Political indifference is also a problem. According to Art Borjal (1990), many government agencies are indifferent to the task of protecting our natural resources. Few seem to care that the country could turn into an arid desert by the year 2000. Indeed, no government official has come close to admitting that the water problem is due to the destruction of the watersheds and forests and the lack of preparation on the part of the agencies involved in water management (Borjal, 1990).

There is also an alleged anomally committed in the 480 million peso foreign-assisted reforestation program. It has been reported that some DENR projects are actually non-existent because some DENR officials have cornered the contracts and awarded reforestation contracts to fictitious persons. The very people tasked with implementing the program are the ones accused of pocketing the money for the project (Petilla, 1989).

c. Military Protection

Illegal logging was made possible during the Marcos era through the collusion and protection of military officers. The Philippine military protected loggers in return for payoffs. Some officers had part ownership in concessions themselves and were believed to have participated in illegal logging and log smuggling (Bonita, 1981; Dugan, 1987; cited by Porter and Ganapin, 1988).

The logging families who built great fortunes from the forest are generally indifferent to the consequences of their operations. They simply do not care. They have private armies to protect them from the mob. Some are in the corridors of power. They are untouchable (Borjal, 1990).

In spite of the imposition of the log ban in Samar on February 10, 1989, extensive logging operations continued in the province. This was made possible by the help of private armies and enterprising soldiers. Forest guards reported that "logs are being cut during the period of the ban and are shipped out of the island at the rate of 40,000 board feet a week." The forest guards are helpless against private armies and enterprising soldiers who escort truckloads of logs, making a mockery of the DENR log ban (Petilla, 1989).

ENVIRONMENTAL IMPACTS

Forest destruction sets into motion a series of catastrophes that includes soil erosion and sedimentation, loss of biodiversity, hydrologic impairment, displacement of cultural communities, low income and poverty, as well as malnutrition in the uplands.

1. Erosion and Sedimentation

Deforestation-induced erosion has been estimated by the Department of Environment and Natural Resources (DENR) at 100,000 hectares at one meter depth or about one billion cubic meters of materials every year. This has caused massive and irreparable loss of fertile top soil, deterioration of productive arable lands, and low crop yield. Soil erosion has also contributed to the increased occurrence of floods, and the siltation and sedimentation of rivers, lakes, and waterways. Ultimately, these problems lead to a shortened lifespan of hydroelectric dams and irrigation canals, water shortage, and destruction of standing crops in the lowlands.

At present, more than half the total area of 22 provinces has been eroded. The percentages of land area subject to erosion are: 80 to 85 percent in Batangas and Cebu, 75 to 80 percent in Marinduque, 60 to 70 percent in Ilocos Sur and La Union, and 50 to 60 percent in Capiz. Massive soil erosion due to logging results from the logging techniques employed and the amount of earth removed to gain access to forest areas. The practice of swiddening in steep slopes has also resulted in a large amount of soil loss.

The pollution of drinking water from the Angat, Apo and Bicti rivers and the La Mesa Dam due to massive erosion of the watersheds has been reported. The water supply in these areas has been described as "generally turbid and contains large amounts of suspended solids" (*Manila Chronicle*, 14 November 1988).

Rapid soil erosion has also caused the siltation of the Ambuklao and Binga dams in the Mountain Province. The siltation in both dams was measured in 2.7 million cubic meters a year as early as 1970. Rapid soil erosion particularly in Mount Pulag was determined in several investigations. The accumulation of silt in both dams has now reached a level which renders ordinary dredging measures by the National Power Corporation (NPC) ineffective (*Philippine Daily Inquirer*, 3 October 1989). Also, the siltation in both dams is cutting their lifespan in half (Porter and Ganapin, 1988).

Siltation problems occur in other major rivers and dams in the country as a consequence of the destruction of watersheds. A well-known example is the Agno River where heavy siltation caused some areas of the river to become higher than the surrounding fields. A survey of this river basin in the mid-1970s revealed that 58,415 hectares within five different watersheds had become severely eroded, with the top soil completely lost and 50 percent of the subsoil eroded (Duldulao, 1978). An estimated 65 percent of the total silt load of the Agno River has been attributed to logging and deforestation. One consequence of this is lost rice production (due to hampered irrigation) estimated at 98 million pesos in 1980 and projected to reach 105 million pesos by 1985 (ffARM Study, World Bank Document, 1989).

The erosion in about 817,000 hectares of the Pampanga River Basin has also resulted in the siltation of the Pampanga River to a level higher than the surrounding fields. By the mid-1970s, the Pantabangan Dam was reportedly being silted at a rate of about one million cubic meters of soil annually, with negative implications for its lifespan. The Banga Irrigation System in South Cotabato is able to service only half of its designated service areas during the dry season because of the clogging of diversion dams and canals due to sediments (Duldulao, 1978). Similarly, the Magat reservoir which in the early 1970s had been given a lifetime of about 100 years now has a probable lifespan of 25 years due to watershed degradation. The damage is attributed to some 6,000 shifting cultivator families farming on three percent of the area and to cattle ranches that have encroached on 33,000 hectares of the watershed.

2. Loss of Biodiversity

The progressive decline of Philippine wildlife has largely been the result of deforestation. People's continued encroachment on the forests destroy and alter the natural habitat of wildlife, hastening their decline or even extinction. Of the 1,657 known wildlife species, 46 are possibly threatened, based on the 1988 IUCN [International Union for the Conservation of Nature and Natural Resources] Red List of Threatened Animals. Presently, 18 species are already in the endangered list, including the Philippine eagle, tamaraw, Philippine tarsier, dugong, Philippine crocodile, monitor lizard and the famous monkey-eating eagle; 25 others are classified as threatened. Forest plant species are also on the endangered species list, including seven ornamental species. The gigantic molave trees (*Vitex parviflora*) used for railroad ties, and as construction material for churches, convents and large houses during the

Spanish period are now practically extinct (*Philippine Daily Express*, 23 January 1981). Other endangered plant species today are ***kalantas*** (*Toona calantas*) used for cigar boxes; ***gubas*** (*Endospermum peltatum* and *Rauwolfia amsoniaefolia*) used for matchsticks; ***batikuling*** (*Paralstonia clusiacea*), ***batsan*** (*Litsea microphylla*) and ***sanglo*** (*Pistaca chinensis*) which are used for carving and other wood handicrafts (*ibid.*).

3. Hydrologic Impairment

The loss of forest cover has also resulted in changes in the hydrological regime in the country. Salt water intrusion, droughts and floods disrupting the social and economic life of the people have become more frequent.

a. Salt Water Intrusion

Salt water intrusion is characterized by the movement of saline water into fresh aquifer or surface water. The general mechanisms responsible for such an intrusion are the reversal or the reduction of natural barriers that prevent the movement of saltwater and the lowering of groundwater level due to reduced infiltration of water in denuded areas.

Unofficial reports from the Metropolitan Waterworks and Sewerage System (MWSS) and National Water Resources Council (NWRC) reveal that the total area affected by saltwater intrusion (excluding Metro Manila) has reached 480,802 hectares. The most heavily affected provinces are Cagayan, Bulacan and Cebu. In Metro Manila, the affected areas may be categorized according to source of contamination, namely: (1) seawater intrusion—10,244 hectares; (2) seawater intrusion and connate water—513 hectares; and (3) connate water—8,674 hectares. The affected areas total 19,611 hectares. Most of the affected areas are urban and rural settlements.

A study by the National Environmental Protection Council (NEPC) on groundwater salinity intrusion classified coastal areas according to levels of intrusion. Areas identified with significant intrusion in the groundwater resources are Metro Manila, Cebu City, Mandaue City, Lapu-Lapu City and Cavite. "Significant" intrusion is indicated in water resources that have chloride contents exceeding 250 mg/1, total dissolved solids exceeding 600 mg/l, or electrical conductivity exceeding one millimho/cm. Areas with little or no intrusion in the groundwater resources, but which already show indications that improper development of groundwater may lead to intrusion are the

following: lower Bulacan, lower Pampanga, northwest Pangasinan, Cagayan, Lingayen, San Carlos, coastal La Union, Ilocos Sur, Ilocos Norte, Butuan City, Dapitan City, and Aparri in Cagayan.

Saltwater intrusion leads to poor water quality, corrosion of wells, salinization of agricultural land due to inundation (which subsequently reduce agricultural yield), reduced revenues in some industries due to additional cost of water supply, revenue loss in public water utilities due to replacement costs for wells which become too saline to use, and additional cost for the acquisition of water from piped supply.

b. Droughts

The study done in the mid-1970s for the United States Agency for International Development found that deforestation had reduced rainfall in northwestern Luzon (Hickey and Flammang, 1977). Deforestation also induces droughts by lowering the amount of water retained in forest soil. The little water left is quickly depleted during the dry season.

Severe droughts hit the country in 1982-1983. The areas that suffered were Regions 1, 2, 3, 4, 5, 10 and 11 (NEPC, 1985). About 987,380 hectares of agricultural areas were hit; losses in production amounted to 763.1 million pesos; and 22,765 families were affected. The regions affected by this calamity have been assessed to have dwindling forest cover, especially Regions 1, 2, 3, 4 and 5.

In the early part of 1990, drought again destroyed half-a-billion pesos worth of rice crops in four provinces in Central Luzon (*Philippine Daily Inquirer*, 15 March 1990). Severely affected were vast tracts of ricelands in 21 towns of Bulacan, six in Pampanga, three in Tarlac and one in Nueva Ecija. The hardest hit was Bulacan, where some 376 million pesos worth of crops were destroyed. Some 196 million pesos worth of rice crops were also destroyed in Pampanga, 15 million pesos in Nueva Ecija, and 2.4 million pesos in Tarlac. The water level of the dam ebbed too low which resulted in inadequate irrigation. The dam now irrigates only 7,384 hectares of rice land in Bulacan, very much lower than its normal capacity of about 16,000 hectares. Similarly, a study on Palawan indicated that due to the hydrological effects of forest denudation, about half the projected total irrigated area of 36,000 hectares would no longer be feasibly irrigated (Finney and Western, 1986 cited by Porter and Ganapin, 1988).

c. Floods

Most Philippine floods are linked to forest denudation. For instance, a 1982 study traced the increased frequency of floods from Northern Luzon to Southern Samar to watershed degradation (FAO, 1982). Flooding catastrophes which washed out entire villages in the Cagayan Valley into the rivers had never been seen there before the days of logging (Fay, 1987 cited in Porter and Ganapin, 1988). The Mindanao area has also been hard hit by flooding caused by deforestation. In 1981, 283 died, 14,000 were injured and tens of thousands were left homeless by a flood that hit northern Mindanao (*Asia Magazine*, 20 May 1984 cited in Porter and Ganapin, 1988). In Davao del Norte Province, two or three days of continuous rain always causes severe flooding (*Wall Street Journal*, 27 April 1982 cited in Porter and Ganapin, 1988). In the very denuded Negros island, destructive floods brought down large logs from the mountains and eroded thousands of hectares of productive farm land (*The Manila Times*, 30 May 1987).

4. Displacement of Cultural Communities

There are about 7.1 million tribal Filipinos in the uplands (Cruz and Zosa-Feranil, 1988). Unlike upland migrants, indigenous Filipino cultural communities have lived in the mountains for hundreds of years. This long occupancy has endowed them with a profound knowledge of upland environs. They are heir to agricultural traditions handed down by their ancestors. Hence, their farming practices are generally protective of the forest resource.

But the tribal Filipinos are being displaced from their ancestral lands. Migration to the uplands has deprived tribal Filipinos of their land, largely because of the failure of society to recognize property rights associated with ancestral lands. In 1982, director Mangubat of the PANAMIN [Presidential Assistant on National Minorities] revealed that his agency had filed 3,000 tribal land cases. Some 50 percent of these cases were terminated, and of these, only 20 percent were in favor of the minorities. The minorities usually lost their cases because their opponents had Torrens titles which are the legally recognized proof of land ownership.

Other factors leading to the displacement of cultural minorities are documented in a study for the DENR by Luis M. Hernandez and associates

(undated) on policy analysis for recognizing vested rights on public lands. These factors include:

a. Putting up of national parks

The National Park of Mount Kanlaon is one example of a case where indigenous inhabitants already adequately settled are declared squatters upon the designation of the area as a national park.

b. Logging concessions

In Palawan, logging—a booming industry because of still extensive tropical rainforests—is displacing the Batacs. These tribal Filipinos live by gathering resin from *almaciga* trees. They are being driven into extinction as the giant hardwood (supposedly a protected tree) is continuously hauled out of Palawan's forests. In Abra, 18 municipalities were included in Cellophil Corporation's 197,000-hectare forest concession. This concession adversely affected the Tinguians and indigenous communities in Kalinga, Apayao, Ilocos Sur and the Mountain Province. Worse, most displacement cases due to forest concessions remain undocumented due to the inadequacy of BFD resources.

c. Illegal logging

In Southern Mindoro illegal logging denuded ancestral lands. In the same area, a project of the then Ministry (now Department) of Agrarian Reform was opposed by residents who claim that their ancestral lands had been encroached on.

d. Agribusiness

One case involved are the Manobos of San Fernando, Bukidnon who allowed cattle ranches to be built on ancestral lands. The cattle ranchers later sold the land to a sugarcane company, thus depriving the Manobos of their ancestral land.

e. Hydroelectric development projects

The construction of the Ambuklao and Binga dams in 1956 and 1960, respectively, displaced some 300 Ibaloi families. Some Ibalois were relocated

to Palawan where they contracted malaria. They found the land there unfit for cultivation, so most of them returned to Benguet. The proposed construction of four dams in the Chico River Valley threatened ancestral lands of over 100,000 upland citizens. On the other hand, the Magat Dam displaced 304 Ifugao families.

As a response to this dilemma, the government has enacted laws to protect ancestral domains. The laws creating the autonomous regions of Muslim Mindanao and the Cordillera have provisions for the protection of ancestral domains and ancestral lands of indigenous cultural communities. These rights are also spelled out in the 1987 Constitution and Republic Act No. 6657. The Constitution mandates that the right of cultural communities to their ancestral domain shall be recognized and honored. Meanwhile, the displacement of both tribal people and rural poor from their homes and farming grounds has enticed many people to become communist insurgents in their struggle against unpopular logging concessionaires and illegal logging in their areas. An extensive documentation of this is found in the case study by G. Porter and D.J. Ganapin Jr. (1988). There are 36 logging operations in Luzon and 49 in Mindanao that affect the tribal Filipinos in those areas.

5. Low Income and Poverty in the Uplands

The poor socioeconomic condition of upland dwellers is evident in their annual incomes which range from 10,000 to 15,000 pesos, compared to 34,933 pesos in the entire country in 1988 (at 1985 prices). This is way below the poverty line, which is placed at 36,000 pesos a year. As the Department of Agriculture reported in 1989:

> *Poverty is rife in the rural areas. Over 40 percent of rural families live on incomes below the poverty line in contrast to only 20 percent of urban families. What is even more disturbing is how far and fast rural incomes have fallen behind. The average rural family income is now only 40 percent of the urban income level, compared to 60 percent in 1970 and 75 percent in 1975. Four-fifths of the households in the bottom 30 percent of the income scale are in the rural areas.*

Upland poverty is evident in poor housing conditions (houses are usually made of bamboo and other light materials and *nipa*), lack of toilet facilities, children unable to go to school beyond the primary level, and low

level of nutrient intake. Upland dwellers are deprived of health and social services and information sources are very limited (usually only the radio is available). Many of the upland poor also have to cope with a deteriorating peace and order.

A study of three upland communities reveals that 68.1 percent of children who are of school age are out of school. Aside from their parents' inability to send them to school, children are out of school because of the demand for farm labor, particularly during the peak periods of cleaning, planting, harvesting and weeding.

Three factors explain why the income of the upland farmers is low: (a) low farm productivity and limited products gathered from the forest; (b) high cost of inputs; and (c) low prices of farm products. Because farmers cannot afford the high cost of inputs, their productivity is low. This is compounded by the farmers' inability to apply appropriate agricultural technology. Moreover, the absence of farm-to-market roads does not allow them to get higher prices for their produce. Prices are usually set by unscrupulous traders who pay very low costs.

6. Malnutrition in the Uplands

The incidence of child malnutrition in the uplands is alarming. In Palawan, the rate of second and third degree malnutrition ranges from 40.7 to 46.9 percent. It is probable that equally high malnutrition rates prevail in other upland areas.

There is also a high rate of infant mortality due to improper health practices and inadequate knowledge of proper infant care. Poor nutrition, overfatigue, and lack of proper clothing in cold upland communities likewise weaken the resistance to disease of both children and adults.

RECOMMENDATIONS

From the foregoing assessment of the Philippine forest ecosystem, the following have been identified as relevant questions for further research and study. Appropriate courses of action are also outlined..

1. Priority Problems

Priority should be given to the following research questions in order to come up with a workable strategy for sustainable forest management:

a. What strategy should we use to protect the remaining original dipterocarp forest?

b. How do we generate basic information which will be incorporated into the utilization of logged over areas fast enough to safeguard remaining forests?

c. How do we bring together successful lessons to establish a community-based participatory forest development cum conservation effort?

d. How do we begin to tie up forest development and protection to lowland, coastal and town development integrated planning?

2. Courses of Action

a. Legislate an Integrated Protected Areas Network and provide the necessary institutional support system for preserving the remaining dipterocarp forest.

b. Integrate all lessons into all phases of Forestry Development Programs for running successful programs in the following areas:

1) Integrated Social Forestry;

2) Community Forestry;

3) Mangrove Rehabilitation; and

4) Reforestation.

c. Analyze forestry policy formulation and implementation, including appropriate management units and institutional arrangements at grassroots levels.

d. Provide adequate forestry research development for priority areas related to logged over forestry utilization, forest ecology and conservation.

e. Strengthen regional strategies for environment and natural resources management and training for DENR and local governments.

f. Establish a DENR, nongovernment organization and academe network for forest management and conservation at all levels.

3. Specific Recommendations

a. Equity

1) Stop the implementation of Presidential Decree (PD) No. 1515, PD 2282 and PD 1998 and other decrees resulting in arbitrary allocation of resources, confusion over jurisdiction, and inconsistency in the enforcement of regulations, pending a review of their impact on equity.

2) Give local communities priority access to and control over the use of resources they need, with the pertinent rights and responsibilities over these, and without prejudice to national welfare issues.

3) Return to rightful claimants the use of land and natural resources seized without due process through government instrumentalities, or provide just compensation to claimants adversely affected.

4) Ensure equal opportunities and access to natural resources by establishing community resource reserves, such as communal forests, for priority use of the rural poor.

b. Resource Management

1) Develop a reforestation program approach where areas are identified for the specific purpose of either environmental rehabilitation or community-based livelihood.

2) Draft a reforestation strategy based on a cost-benefit analysis which by implication should encompass the livelihood activities of the population with self-perceived claims on the land.

3) Develop a national data base on species and habitat distribution to intensify research on the ecologies of species, taxonomic studies, and the construction of a national depository for scientific collections.

4) Preserve the remaining dipterocarp forests by developing a strategy of selective logging combined with regeneration using the original species.

5) Protect for future generations representative selections of the critically-limited remaining areas of relatively undergraded habitats for flora and fauna native to tropical forests, mangrove swamps, and coral reefs.

6) Alter development patterns to make them more compatible with the preservation of the extremely valuable biological diversity of the planet.

7) Review the criteria and conditions under which the present national parks and 16 marine reserves were established and determine the realistic number and size that are environmentally viable and which can be administratively managed or maintained effectively. Priority should be given to unique ecological units.

c. National Cultural Community Interests

1) Empower a specialized body to determine through due process the actual extent of ancestral lands for tribal communities and broaden the current modes of land tenure to include eventual tribal ownership of ancestral lands without prejudice to other justly-held rights.

2) Reconcile customary and civil laws to be affected by new and current legal provisions.

d. Upland Migrants' Interests

1) Examine the tenurial options available to migrant upland communities. An alternative to the tenurial options under the Integrated Social Forestry (ISF) is one which is based on common property rights and collective (community) management of the land resource. There ought to be specific restrictions on the sale of land titles to guard against speculation.

2) Develop and effectively implement social forestry/community extension programs that provide basic necessities and more opportunities for upland communities and guarantee equal access to development services.

3) While continued upland migration should be minimized, develop more nonland-based enterprises or livelihood opportunities for lowland and upland communities to help relieve pressure on the limited and fragile uplands.

e. Industrial Forestry

1) Pursue vigorous timber production through the perpetuation of the natural dipterocarp forests in productive capacity and the development of forest plantations in suitable areas.

2) Monitor and check annual timber drain so that the liquidation period of the old growth forests may be extended.

3) Improve and effectively protect residual forests.

4) Develop and implement the processing machineries phase out/ acquisition/retooling program because processing plants are currently operating below their capacities and the anticipated processing of small-diameter logs would require the retooling or acquisition of suitable machineries.

5) Utilize lesser-used species to delay the depletion of our forests.

6) Intensify research on the production and utilization of forest plantation species because in a few years the old growth forest will become less available and there will be greater reliance on forest plantation species.

f. Community Participation

1) Recognize and encourage the establishment of an independent multisectoral and grassroots-based People's Council on Natural Resources to serve as a network of nongovernment organizations (NGOs), private volunteer organizations (PVOs), research institutions, government agencies and concerned individuals for effective and participatory planning, approving, reviewing, implementing, monitoring and evaluating natural resources programs. Basic to the success of this is the encouragement and support of the formation of independent and active community organizations in the uplands.

2) Strengthen community participation by granting secure tenurial status to individuals or groups with proven capacity to manage resources on a sustainable basis. Grant police authority to organized communities especially in areas where transgression of regulations obtain.

3) Encourage participation by NGOs in planning and implementing development programs. Maintain periodic dialogues with NGO representatives on all matters pertaining to resource management.

g. Organizational Strengthening

1) Provide flexibility for locally-based offices of the Department of Environment and Natural Resources to develop site-specific programs with adequate resources, highly simplified procedures and active participation of local communities and local governments.

2) Develop strong linkage and coordinative mechanism with other concerned government agencies, especially local communities, and local governments, since the needs of upland development are beyond the capability or jurisdiction of DENR.

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CHAPTER 3
THE PHILIPPINE MARGINAL LANDS ECOSYSTEM

Enrique P. Pacardo

INTRODUCTION

The Philippines' rapidly increasing population continues to exert stress on the country's settlements, food resources and raw materials. Population pressures have also intensified the exploitation of forests, croplands, and coastal and fishery resources.

While these resources are renewable, the lopsided relationship between exploitation and natural regeneration, particularly under conditions of inadequate resource management, can result in environmental problems and catastrophes. Recent problems like droughts, floods, soil erosion, and the sedimentation of dams and reservoirs attest to this. These disasters demonstrate how nature responds to human excesses. Another glaring proof of nature's wrath is the fact that 41 percent of the country's total land area is now considered marginal, *i.e.*, unproductive, highly eroded, barren.

Philippine marginal lands constitute a very important ecosystem type both in terms of their total area and varied ecological and economic importance. For instance, the success of reforestation efforts hinges on the type, diversity, and regeneration of species within marginal habitats. Moreover, grasslands, one of the marginal land types, constitute a rich and diversified network of food chains and offer cheap forage for livestock. But they are also excellent fuel for forest fires. In view of these, it is important that the causes and effects of the degradation of marginal lands be studied.

Compared to other Philippine ecosystem types, marginal lands have not been the subject of much study. Thus, a bibliographic search did not yield enough information with which to draw a general picture of the present situation of the country's marginal lands. More meaningful analysis would have been possible if there were available statistics on the use, trends and spatial distribution of marginal lands on a regional or provincial basis.

1. Definition of Terms

Following the definition by the Department of Environment and Natural Resources (DENR), "marginal lands are areas once covered with tropical moist forest, converted to plantation forests, fire-climax *Imperata* grassland, and reproduction brushlands." These areas have the general characteristics of low productivity, inability to support extensive lowland-type agriculture and a high in-migration rate. There are different categories of grasslands, defined by the DENR thus:

> *Open lands are denuded forest lands, croplands, and grazing lands that have been abandoned, including areas of exposed soil resulting from landslides or erosion.*
>
> *Grasslands refer to lands with natural grass cover, devoid of trees or with very few isolated trees.*
>
> *Rangelands refer to large tracts of land naturally vegetated with native grasses, herbs or shrubs of valuable forage.*
>
> *Grazing lands are lands primarily used for the production of forage plants, naturally or artificially.*
>
> *Pasture lands are small lands usually fenced mainly for raising forage plants for domestic livestock.*

2. Analytical Framework of the Study

The main issues pertaining to marginal lands are concerned with population pressure, environmental degradation, rapid deforestation, lack of upland tenurial security, poverty and inequitable access to resources, and inadequate soil and resource management. The interrelationship among these factors is graphically shown in Figure 3.1.

The figure emphasizes the importance of population pressure as a factor greatly affecting the quality of the environment. In rural areas, lowlanders either migrate to industrial and urban centers, or uphill to the remaining forests.

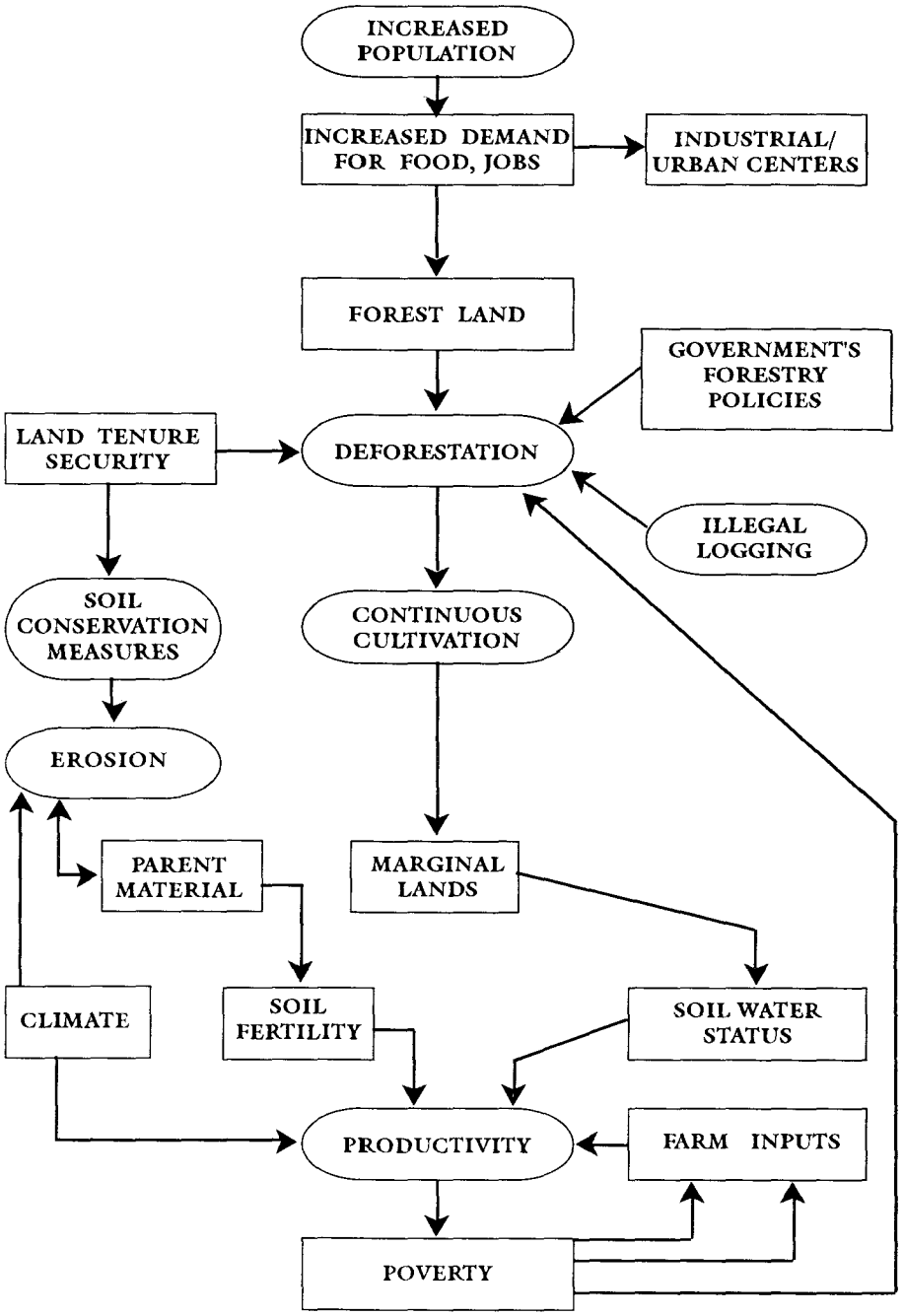


Figure 3.1. Analytical Framework for Marginal Lands

Cities can absorb only a finite number of landless and jobless people. Thus, great waves of in-migration occur in the forested uplands. Upland habitation coupled with the need to supply growing requirements for fuel, food, and raw materials intensify the conversion of forests. Inappropriate government forestry and land use policies and illegal logging abet deforestation.

In agriculture, two strategies are being employed to the detriment of marginal lands: extensification as well as intensification. The expansion of cultivation into marginal areas invariably leads to rapid loss of fertile top soil. On the other hand, intensification involving the use of agricultural chemicals and other inputs brings ecological and health problems and further degrades the land base.

Moreover, the lack of tenurial security creates powerful disincentives among upland farmers to invest in soil conservation measures. This leads to the perpetuation of the marginal condition of the land. Thus, a cyclic pattern of further marginalization of the habitat and upland impoverishment ensues, as poor farmers do not have the capability to buy farm inputs necessary to maintain or enhance productivity.

PRESENT ENVIRONMENTAL SITUATION

1. Extent

The marginal lands in the country today are composed mostly of converted forests, grasslands, brushlands and barren areas. They comprise 41 percent of the total land area in the country, according to the latest estimate of the Department of Environment and Natural Resources (DENR).

Based on 1988 satellite photos, Philippine marginal lands (in million hectares) are distributed as follows:

cultivated mixed brushlands	- 10.1143 Mha
grasslands	- 1.8129 Mha
cultivated/open areas	- 0.3040 Mha
eroded areas	- 0.0007 Mha
barren areas	- 0.0103 Mha
Total	11.9686 Mha

Marginal lands are concentrated in the degraded uplands (with slopes greater than 18 percent) of the country. Upland areas cover an estimated 17.6 million hectares or nearly two out of every three hectares of our total land area. Once covered with lush tropical forest vegetation, these are now subject to extensive cultivation of upland inhabitants.

Extensive grasslands have been opened up in the country as a result of anthropogenic disturbances. Notable among these is shifting cultivation. Native Philippine grasslands belong to four community types: *Imperata cylindrica* (cogon), *Themeda triandria* (bagokbok), *Capillipedium parviflorum* (Misamis grass), *Chrysopogon aciculatus* (amorseku). These have been described by Percy E. Sajise (1977) as marginal in productivity, undulating in topography, prone to soil erosion, and remote.

Major range areas in the country are found in the hilly mountains of Northern Luzon, particularly in Nueva Ecija, Nueva Viscaya, Isabela, Cagayan, Ilocos Norte, Abra, and Pangasinan; in Mindoro and Palawan; Masbate, Panay, and Negros in the Visayas; and Bukidnon, Zamboanga, and Cotabato in Mindanao (Umali and Pameron, 1977).

2. Population

The population presently occupying marginal lands throughout the country was estimated at 7.5 million in 1988, about 50 percent of whom are national minorities (DENR, 1988).

3. Environmental Problems and Issues

The present environmental concerns and issues with respect to marginal lands are as follows:

a. Soil Erosion

Soil erosion involves the process of detachment, transportation, and deposition of soil materials by wind or water, away from the original site. Most of the erosion problems in the country are induced by human activities such as shifting cultivation, logging, mining, overgrazing, and burning of grasslands. The loss of soil materials due to erosion was estimated by the Department of Environment and Natural Resources (DENR) to be about a billion cubic meters a year or about 200,000 hectares of land at one meter deep.

Presently, more than half of the land areas of at least 22 provinces are known to be eroded [see Table 3.1]. Thirty-six of 81 provinces are considered severely eroded. About nine million hectares of alienable lands in the country are eroded in varying degrees and approximately one million hectares of agricultural lands have an eight- to 15-degree slope, making them susceptible to severe soil erosion during the rainy season. This means that about 75 percent of our total alienable and disposable lands are vulnerable to erosion.

Even more vulnerable to the problem are the uplands of which about 11 percent are in the Central Visayas and about 69 percent in Southwestern Mindanao (Librero, 1977). Extensive cultivation, logging and other extractive activities in these areas make them susceptible to varying degrees of soil erosion. It has been estimated that the average annual erosion rate in Philippine uplands varies from 20 to 40 tons per hectare to as much as 200 tons per hectare in degraded grasslands (Revilla, 1985 cited in Cruz, 1989). The soil erosion rate in disturbed and overgrazed open grasslands has been reported to reach as high as 300 to 400 tons per hectare per year. This translates into a loss of some two billion pesos annually, computed in terms of the cost of lost nutrients and the damage done by the sedimentation and siltation of dams, irrigation canals and coastal fishing grounds.

Climate, soil topography and improper land use are the major factors affecting soil erosion in the country. The effect of vegetation and cover on the degree of soil erosion has been shown in many studies. For instance, a study of soil erosion rates in Bicol showed that 22.9 tons per hectare per year were lost from bare plots and those with a 27 percent slope (Bocato, 1981) [see Table 3.2]. In Benguet, 62.3 tons per hectare per year were lost in 29 percent slope areas. In Negros, the annual losses amounted to 218.5 tons per hectare in 21 percent slope areas (Sajise, 1982).

Shifting cultivation and indiscriminate logging are the major causes of soil erosion, according to Amado Maglinao, director of the Farm Resources and Systems Research Division of the Philippine Council for Agriculture and Resources Research and Development or PCARRD (*Kapaligiran*, 1985). Also contributing to serious erosion problems are massive government infrastructure projects like road construction, hydroelectric power plants, and tourist resorts (*Kapaligiran*, 1985). These projects alter the natural terrain, scrape off vast amounts of fertile top soil and remove large tracts of protective vegetation cover.

Table 3.1
Provinces with more than half of their areas eroded

Provinces	Eroded Area (% of total area of the province)
Ilocos Sur	60 — 70
La Union	60 — 70
Batangas	80 — 85
Marinduque	75 — 80
Capiz	50 — 60
Aklan	50
Antique	50
Iloilo	50
Cebu	80 — 85
Negros Occidental	50
Negros Oriental	50
Misamis Oriental	50
Bukidnon	50
Davao del Norte	50
Davao del Sur	50
Davao Oriental	50
Zamboanga del Norte	50
Zamboanga del Sur	50
Lanao del Norte	50
Lanao del Sur	50
North Cotabato	50
South Cotabato	50

Table 3.2
Amount of soil loss in different vegetal cover

Vegetal Cover	Total Rainfall in Erosion Plots (liter)	Amount of Runoff (liter)	% Runoff of Total Rainfall	Amount of Sediment (gallons per liter)	Amount of Soil Loss (kilograms per hectare)
Paragrass	1710	70.40[d]*	4.56	0.56	65.71[d]
Guinea grass	1710	113.05[c]	6.61	1.61	303.35[c]
Corn	1710	620.40[c]	36.30	14.29	14,784.91[ab]
Centrosema	1710	120.40[c]	7.04	2.07	415.38[c]
Paragrass+ Centrosema	1710 1710	64.40[d] 190.48[c]	3.77	0.86	92.31[d]
Stylo	1710	368.95[bc]	11.13	0.47	149.15[d]
Corn+ stylo	1710	46.00[d]	21.58	8.92	5,485.06[b]
Sweet potato	1710	57.95[d]	2.69	1.93	147.97[d]
Natural vegetation	1710	767.10[a]	3.38	0.73	72.33[d]
Bare Plot	1710		44.86	17.89	22,872.37[a]

Source: F.M. Bocato, 1981.

* Means with the same letter are not significantly different at £ = 0.01 (DMRT).

The damage wrought by these activities is made more alarming by the fact that the Philippine climate makes the soil very vulnerable to erosion. Studies by the Bureau of Soils have estimated the natural density of a raindrop to be about five millimeters, while the nation's soils are able to absorb only one millimeter. The remainder, according to Lucas (*ibid.*), turns into runoff which causes erosion. The Bureau of Soils estimated that the average amount of rainfall every six months totals 2,000 millimeters. This is the reason why all provinces suffer from moderate to severe erosion which is aggravated by hilly topography.

Soil erosion has many negative effects. It lowers crop productivity, silts dams and rivers, reduces the capacity of water conveyance structures, destroys wildlife habitats, degrades water quality, and destroys crops. Four major river basins — the Magat, Bicol, Agno, and Pampanga river basins— are in danger of drying up due to massive sedimentation. Erosion is also blamed for reducing the lifespan of Magat Dam from 100 to only 25 years. The watershed near the dam is severely eroded, with grasslands covering 38 percent of the area.

Sheet erosion is estimated to average 122 tons per hectare in much of the open grasslands (10 tons on 3-8 percent slopes, 33 tons on 8-15 percent slopes, 56 tons on 15-25 percent slopes, and 240 tons on 40 plus percent slopes). Where overgrazing is heavy, the average is 250 tons per hectare, and on farmed hillslopes, 100 tons per hectare. The major source of damage in the watershed is attributed to ranching activities on leased or illegally occupied pastures. The degraded grasslands—whether grazed, farmed or ungrazed— are estimated to contribute 93 percent of all eroded materials washed downhill.

b. Low Productivity

The general lack of vegetation cover and the great vulnerability to soil erosion due to steep slopes and particular soil characteristics have rendered upland soil unstable and unproductive. These areas are generally acidic and low in organic matter and macro elements [see Table 3.3].

The relatively low productivity of marginal lands is shown by the fact that rice yield in these lands is only one ton (20 cavans) per hectare on the average (Sajise *et al.*, 1990). Furthermore, the productivity of upland rice was found to decline to one-third of its original value in only three years due to soil erosion and dominance of cogon (Sajise and Magcale, 1983).

Table 3.3
Some chemical properties of grasslands soils

Soil (by depth, cm)	pH	Available p (ppm)	CEC (me/100 gm)	Ca	Mg (me/100 gm)	K	Organic Matter %
Alaminos clay (Pangasinan)							
0 - 20	5.25	0.8	14.92	5.43	2.51	0.18	1.98
20 - 51	5.25	0.9	15.84	6.04	2.71	0.11	1.13
51 - 81	5.15	0.9	18.24	7.6	3.88	0.08	0.85
81 - 112	5.25	0.7	17.84	7.85	3.88	0.06	0.72
112 - 154	5.15	0.4	19.80	8.06	3.88	0.04	0.63
Annam clay (Nueva Ecija)							
0 - 15	5.85	3.8	19.28	9.26	6.01	0.26	2.23
15 - 30	5.85	2.5	19.20	9.87	6.01	0.21	2.37
30 - 60	6.35	2.1	23.54	13.70	8.92	0.16	1.31
60 - 90	5.95	1.2	32.84	28.37	12.80	0.17	0.49
Bolaoen clay (Zambales)							
0 - 12	5.35	1.7	17.80	4.83	3.10	0.39	3.17
12 - 43	5.15	26.23	5.23	5.23	2.71	0.18	1.61
43 - 60	5.15	0.7	21.78	6.04	2.32	0.13	1.25
60 - 82	5.35	0.5	16.77	5.64	3.49	0.09	0.82
82 - 100	5.35	0.3	24.32	6.85	6.59	0.09	0.36
Faraon clay (Quezon)							
0 - 12	5.60	22.6	65.20	43.92	12.80	1.06	5.87
12 - 33	5.80	6.5	65.20	44.73	12.02	0.54	3.57
33 - 59	6.35	4.5	64.04	45.94	9.70	0.30	0.77
59 - 89	6.55	3.8	65.04	47.55	9.12	0.34	0.91
Luisiana clay (Ilocos Norte)							
0 - 12	5.50	1.0	26.39	4.03	9.31	0.44	5.42
12 - 20	5.40	0.5	25.92	4.03	8.53	0.35	4.17
20 - 38	5.55	0.5	31.00	4.43	10.08	0.35	3.46
38 - 46	5.65	0.7	30.84	5.27	11.64	0.34	3.32
Luisiana clay (Nueva Ecija)							
0 - 10	5.35	1.3	24.12	9.87	5.81	0.11	2.75
10 - 20	5.50	1.8	26.32	11.68	7.17	0.29	3.27
20 - 30	5.15	0.9	29.88	13.49	7.95	0.10	2.22
30 - 60	5.55	0.4	31.44	14.30	10.28	0.08	1.51
Adtuyon (Bukidnon)							
0 - 15	5.1	4.2	19.12	3.0	3.66	0.41	5.36
15 - 30	5.1	0.7	19.44	1.8	2.50	0.29	4.18
30 - 45	5.1	1.4	16.2	2.0	1.16	0.62	2.54
45 - 60	5.1	1.05	17.48	1.8	1.73	0.62	1.79

Source: Tilo *et al.* cited by Sajise, 1983.

cm = centimeters
pH = symbol used in expressing acidity and alkalinity
p = phosphorous
ppm = parts per million
Ca = calcium
Mg = magnesium
gm = gram
K = potassium

Loss of soil fertility in the uplands is brought about by two processes. The first is the loss of nutrient-rich topsoil due to erosion. The second is the carrying away of nutrients by the runoff water or the leaching of these nutrients down the soil profile, below the reach of crop roots.

The low productivity of marginal upland areas can also be traced to impaired hydrologic characteristics: excess water during the wet season and low or no water during the dry season (Sajise, 1983). This is because the cogonal vegetation in these areas exhibit poor water-holding capacity. Excess water is lost as runoff which can easily collect to create a destructive flood during the rainy season. But in the dry months, there is no water because of poor storage and rapid evaporation.

The uplands are known to be fragile and generally unsuitable for cultivation. But the encroachment of urban and industrial growth on the remaining better-quality lowlands means that the uplands will be increasingly used for agricultural purposes. As early as 1980, 13.8 percent of all farm land was already encroaching into permanent meadows, pastures and land covered with forest growth [Table 3.4].

c. Acid and Saline Soils

Areas with acid and saline soils are another emerging problem. These kinds of soil are enemies of agriculture. Many acid soils are particularly susceptible to the dispersion of clays because of the characteristic low electrolyte levels in the soil solution. Compared to soils with higher base status, acid ones are more vulnerable to a variety of physical changes such as erosion (Holzhey and Kimble, 1990). In addition, agricultural productivity could be hampered by the high exchangeable aluminum content, toxic levels of iron, and less amount of calcium and magnesium and of most essential nutrients in acid soils.

In 1989, the National Economic and Development Authority (NEDA) reported that acid soils with pH *levels of less than* 5.0 characterize about 56 percent of the total land area of the country (Recale *et al.*, 1990). In some provinces, acid soils cover 20 percent to 50 percent of total hectarage. But despite their productivity, acid soils are continuously being cultivated due to the limited area available for farming.

Table 3.4
Area of farms by land use in the Philippines, 1971 and 1980

Land Use	1971 Area (hectares)	1971 Percent	1980 Area (hectares)	1980 Percent
Total	8,493,735	100.00	9,034,354	100.00
Arable land under temporary crops	3,891,982	45.82	4,487,679	49.56
Planted to permanent crops	2,532,166	29.80	3,313,054	36.67
Under permanent meadows and pastures	690,988	8.14	610,125	6.75
Lying idle	752,272	8.86	—	—
Covered with forest growth	433,707	5.11	623,496	7.02
All other lands	192,620	2.27		

Source: NSO Census of Agriculture 1971 and 1980.

Soil acidity occurs naturally through the centuries as hydrogen ions carried by downward percolating waters slowly replace the calcium and magnesium ions in the soil. But human activities such as the excessive use of acid-forming chemical fertilizers and mining activities can also increase the soil's acid content. In Loo Valley in Benguet, for instance, the use of inorganic fertilizers, particularly of the acid-forming kind, resulted in increased soil acidity (Alcantara, undated). There, the Bureau of Soils reported a pH value ranging from 3.7 to 6.4. Similarly, the University of the Philippines at Los Baños-Institute of Environmental Science and Management (UPLB-IESAM) reported an average pH value in the valley of 4.4.

In contrast, salt-affected soils occur extensively in natural conditions, although improper irrigation can also increase the soil's salt content. In areas where there is a high groundwater table, restricted drainage may contribute to the salinization of soil (Bower and Milton, 1957). Abnormally high salt concentration in soil retards plant growth by restricting the rate at which the crops can absorb water. For example, the severe intrusion of salt water in deep wells in the central and coastal areas of Bulacan has resulted in economic losses placed at 25.6 million pesos in only three years (*Manila Chronicle*, 28 September 1988).

d. Other Soil Pollution Problems

The major culprits behind soil pollution are improper pesticide and inorganic fertilizer use, excessive deposition of solid materials such as mine tailings and other solid wastes, and intrusion of salt water into farm land. Moreover, the intensified use of inorganic fertilizer in farming leads to the deterioration of soil structure, making it prone to erosion. In addition, pesticides, herbicides, and similar chemicals pose serious ecological problems because of their high degree of chemical stability and the persistence of their residues in the soil.

Since 1960, the deposition of mine tailings in the Agno River in Central Luzon has been occurring at the rate of one centimeter per day (PCARRD, 1980). This has resulted in the reduction of irrigated farms, clogged irrigation canals, and crop yield lowered by 50 percent in heavily silted areas and 20 percent on the average.

e. Loss of Biodiversity

The indiscriminate clearing of forest vegetation threatens the remaining biodiversity of the country. At present, the forest cover of the Philippines is only 23.92 percent. From 1968 to 1982, forests were being cut at the rate of 190,000 hectares per year (EMB, 1985). The present annual rate of denudation of 119,000 hectares (DENR, 1989) or about 14 hectares per hour is attributed mainly to three factors: illegal logging, forest fires and slash-and-burn agriculture.

Deforestation also means the destruction of the habitat of countless species. Tan *et al.* (1987) documented five immediately endangered tree species, including the Philippine Teak (*Tectona Philippinensis*), vulnerable or potentially threatened species, and 34 rare species.

Aside from deforestation, the simplification of biological communities is abetted by the extensive use of artificially created varieties, monocultures and uniform strains. While these activities may help raise food production, they also increase the risk of pest infestation and disease outbreaks. More alarming, the extinction of many of the wild strains from which crops are developed diminishes the potential to improve the resistance to diseases and pests of the new varieties. In forestry, the increasing emphasis on tree plantation types of activities, usually involving few, exotic, fast-growing species, increases the risk that reforestation and tree farm-based development will fail. An example is the psyllid infestation on *Leucaena spp.*

f. Uncontrolled Fires

Upland farmers have traditionally burned grasslands in order to manage the pasture areas for grass regrowth, to control pests and disease, and to facilitate the clearing of *kaingin* sites. The improper use of fire, however, leads to soil degradation and the perpetuation of marginal conditions. Burning patches of forest exposes the soil to erosion, volatilizes nitrogen during combustion and reduces plant litter for soil organisms. Slash-and-burn farming also has a damaging effect on the subsequent reforestation of logged-over or *kaingin* sites and is often the source of forest fires.

Fire occurs regularly in grass-covered areas in the uplands, thu continually threatening reforestation efforts. Most fires take place during th dry season when water is scarce (Sajise, 1983). At times, fires rage for weeks during the dry months. For instance, an uncontrolled fire in 1988 destroyed a vast area from the Dalton Pass in Nueva Vizcaya and throughout the circuitous mountain highway to Santiago, Isabela — a distance of more than 100 kilometers (*Philippine Daily Inquirer*, 8 April 1988).

In 1978, 21,094.32 hectares of forest plantations were razed by 1,225 fires (NEPC, 1980). That year, 2,148,377 saplings valued at 6.7 million pesos were destroyed. Similarly, records show that in 1981 and 1982, forest fires were responsible for an average of 49.6 percent of total forest loss. Shifting cultivation and logging accounted for only 21.7 percent and 27.28 percent, respectively (NEPC, 1983).

Repeated burnings scorch and kill seedlings and abort the regrowth of trees. Fires expose the soil, resulting in the exhaustion of seed supplies and a decline in fertility. These ultimately lead to the establishment of grass-dominated vegetation with which reforestation species can hardly compete.

The Department of Environment and Natural Resources (DENR) lacks the staff and equipment with which to cope with the problem. As the *Philippine Daily Inquirer* (8 April 1988) reports: "The standard equipment of an FMB forest protection officer consists of an antiquated ordinary water-sprayer, fire rake, and fire swatter from tree branches. And because of lack of transportation, they have to hike at times for several days to reach a fire area. Their common defense is to establish a fireline or isolate an undamaged area."

Moreover, there is at present insufficient knowledge on the natural system's capabilities and limitations with respect to fire (DENR, 1988).

g. Poverty and Low Access to Production Resources

The poverty of those who live in the uplands and other marginal areas is evident in the fact that the majority of them have an annual income of only 800 to 3,000 pesos (*Philippine Panorama*, 1 January 1990). Most do not have access to basic services like health, education and livelihood. Consequently, they appear to be the least educated, lowest paid, least healthy and most neglected in agricultural development (Alcantara, 1985). R.Y. David (1987) observes that with very poor harvests from marginal land, the nutritional status of upland farmers is worse than that of lowlanders.

One study of marginal farmers in Southern Leyte and Eastern Samar found out that more than half did not use fertilizers (63 percent and 94 percent, respectively) and pesticides (65 percent and 92 percent, respectively) because they did not have enough money to buy these inputs (Tabada and Dabuet, 1985). Those who could afford them used the chemicals only in their lowland rice fields. The study also showed that the main source of upland farm labor is family members. Most respondents (45 percent and 52 percent, respectively) did not use hired labor due to lack of money.

P.E. Sajise (1982) summed up the sociocultural constraints in upland areas as:

1) lack of production inputs;
2) lack of effective marketing system;
3) weak or insufficient institutional linkages, especially with regard to social services; and
4) insecure land tenure system.

The lack of infrastructural and institutional support in remote marginal areas hinders access to social services, financial and marketing facilities, and various technical assistance programs offered by both government and nongovernment organizations (NGOs).

In addition, the worsening peace-and-order situation in the uplands is a deterrent to productivity. The upland farmers are often caught in the war between government forces and insurgents. Moreover, given their poor socio-economic condition, they are vulnerable to recruitment by insurgents.

FACTORS AFFECTING THE DEGRADATION OF MARGINAL LANDS

There are certain conditions that reinforce and perpetuate existing problems in the marginal lands. These are:

1. Rapid Population Increase

In May 1990, the National Statistics Office estimated the Philippine population at 60.5 million. The population growth rate is 2.3 percent per year. By the year 2000, the population is expected to swell to 71 million, and to reach 97 million by 2030 (Herrin, 1988). Before the country attains zero population growth by 2075, the number of Filipinos would have reached 125 million.

The manner by which population growth can be controlled has divided Church and State. While this issue is very difficult to resolve, the urgency of an effective population control program remains crystal clear. Environmental degradation and poverty are linked to the sheer numbers of people who have to be supported by increasingly scarce resources. The statistical analysis and graphs demonstrating this linkage are shown in the forest assessment by Sajise *et al.* (1990). Although the current population growth rate is now perhaps in the "transition stage towards slow growth levels," the deceleration is seen as too slow. Economic growth cannot yet keep pace with population growth. (*Philippine Daily Inquirer*, 21 August 1990). The population is already large, so that yearly increments to the total, even at a declining rate, are still considerable. It is therefore expected that greater population pressure on land will result in the conversion of more forests to agriculture and other uses. At present, the per capita land availability in the Philippines is only 0.55 hectare, the lowest in Southeast Asia with the exception of Singapore.

The great pressure on land and resources is best illustrated by the fact that about one-third (17.8 million) of the total Philippine population lives in the uplands. The upland population grows at 2.54 percent, faster than the national average. By the year 2000, the upland population is projected to increase to anywhere from 24 to 26 million (Cruz, 1989). This means that an additional five to six million people in hilly areas will be opening up more lands for cultivation. On the assumption that each upland family cultivates about two hectares, Cruz (1989) calculated that another eight million hectares of forest lands will be converted to agriculture to be able to feed the growing upland population. This means that about four-fifths of the present forest land under tree cover is going to be cleared. Cruz's projection does not even include forest loss due to logging, urban encroachment and other activities, which may damage much more forests than agricultural expansion.

More alarming is the fact that 8.8 million of the total upland population actually live within the interior forest zone (Cruz, 1989). Around five million of them (or 59 percent of the total forest zone population) belong to the tribal shifting cultivation communities.

Without a tradition of upland farming and with little knowledge of the ecological constraints of the hill slopes, upland migrants (who represent 50 to 60 percent of the 17.8 million upland population) practice the only farming method they know: shifting cultivation. Unlike the agricultural

practices of tribal communities, shifting cultivation by migrants often leads to soil erosion and land degradation. Erosion, in turn, leads to declining yield, abandonment of fields, and the conversion of new forest areas for cultivation. This is how forests are transformed into cogonal lands. Lacking the necessary inputs to intensify and practice sedentary farming, this practice of extensification in the fragile uplands is expected to continue unless adequate measures are put in place.

In the meantime, upland migration continues unabated. The present rate of upland population growth has actually been decreasing, from about 3.0 percent in the 1950s and 1970s [see Table 3.5] to about 2.5 percent. But the fall in in-migration seems to occur only in municipalities with already high densities of about 150 to 250 persons per kilometer. In other areas, poor lowlanders are driven up to the hills by lack of employment and livelihood opportunities, the spiraling cost of living, stiff competition for access to lowland resources, social injustice and other factors.

At present, millions of rural inhabitants do not have the opportunity to eke out a living on a piece of land, while a few rich people own vast tracts of arable, often underutilized, lands. In 1987, 154 concessionaires had the right to exploit more than a third of the country's prime forest resources (National Statistics Office, 1989). On the other hand, 17.8 million "poorest of the poor" Filipinos languish in the degraded forest areas and marginal lands. The Department of Environment and National Resources (DENR, 1988) admits that despite current efforts to more equitably allocate forest resources, the structure of forest land disposition still favors timber concessionaires. In 1988, the timber license agreements (TLAs) covered about 23 percent of total forest lands while only three percent were allocated to some 152,528 beneficiaries of various Integrated Social Forestry (ISF) programs. A welcome development is DENR's plan to reduce the number of TLA holders from 65 to about 50 and eventually phase out the scheme with the full implementation of the Forest Land Management Agreement (FLMA).

The sad fate of tribal inhabitants of the forest, especially in the light of the increasing encroachment of spill-over lowland population into their ancestral lands, is another big social issue that needs to be addressed.

Table 3.5
Indicators of demographic change in the Philippine uplands 1948-1988

Indicators	1948	1960	1970	1975	1980	1988
Population size (thousands)	5 868	8,190	11,109	12,703	14,440	17,835
Population growth rate per year (%)		2.98	3.03	2.73	2.59	2.76
Population density (persons per square kilometer)	39	55	74	85	96	119

Source: Cruz, M.C. 1989.

2. Insecurity of Land Tenure

Experience has shown that the uplands cannot be rehabilitated unless the tenurial security of their inhabitants is addressed. As long as their tenure over the land is not assured, settlers will continue to indiscriminately exploit upland resources without concern for sustainability. Under such a setup, upland farmers will not be responsive to adopting government-initiated soil conservation programs.

In 1987, the Department of Agrarian Reform (DAR) reported that only 1.5 million Filipino farmers own the land they till. Two million others are share and leasehold tenants, and 1.5 million work on public land and have no land titles. Since 1987, however, thousands of land emancipation patents have already been distributed under the Comprehensive Agrarian Reform Program (CARP), the core program of the Aquino administration. But land tenure and other problems arising from inequitable land distribution may not be resolved for a very long time to come. One very problematic issue that has been the source of dispute between the DAR and the DENR is that of farmers occupying public land in areas with more than an 18 percent slope.

The prevailing land use policy classifies as alienable and disposable all land with an 18-degree slope and below. Over 14 million hectares or 47 percent of the country's total land area belong to this category. The rest (53 percent) are classified as forest lands (Philippine Statistical Yearbook, 1987). This categorization, however, does not take into consideration the fact that land forms in the country are mostly hilly and mountainous: about 59 percent of the country's total land area has slopes greater than 18 degrees. Problems arise because in areas considered as uplands, about 5.6 million hectares or 39.7 percent are classified as alienable and disposable, based solely on the 18-degree slope criterion. On the other hand, some lands which are categorized as alienable and disposable are not actually so. Factors such as land quality, climatic conditions, market accessibility, and the presence of a watershed are ignored in the prevailing land use classification scheme.

Land conflicts also arise because of the current government policy of vesting private rights based on the Regalian doctrine. This doctrine espouses the principle that all natural wealth (except for alienable and disposable lands) belong to the State. This has been the cornerstone of Philippine land use laws since the Spanish colonial era. There are two natural consequences of the adherence to the doctrine:

a. Native titles and customary laws are not accepted or recognized by the state; and

b. The displacement of both cultural minorities and long-settled upland migrants occurs very frequently due to land grabbing and encroachment by various development and industrial projects.

There are other laws which have abetted the usurpation of tribal land rights. Presidential Decree (PD) No. 410, also known as the Ancestral Land Decree, required that tribal lands be registered within a specific period of time, after which all unregistered lands will be declared public domain. PD 705 or the Revised Forestry Code does not recognize the rights of those who live on ancestral lands if they do not have titles and of those who engage in *kaingin* or other upland farming methods without a government license. These laws are entirely alien to tribal Filipinos whose systems of ownership are rooted in custom and tradition.

Over the years, the evolution of social forestry has resulted in the recognition of tenurial security of upland farmers by guaranteeing them a plot of land over a set period of time. But this still falls short of actual ownership and does not guarantee that families can acquire permanent rights over the land they till. Moreover, the lands available under the Integrated Social Forestry (ISF) program are usually marginally productive lands not covered by various concessions, permits, and leases. As such, the land usually cannot support an acceptable level of development for the beneficiaries. Likewise, the various land stewardship contracts such as the Communal Stewardship Contract (CSC) awarded to cultural communities show an apparent reluctance on the part of government to officially recognize ancestral land rights. This ambiguity is rooted in Article XII Section 5 in the 1987 Constitution which provides that:

> *The State, subject to the provisions of this Constitution and national development policies and programs, shall protect the rights of indigenous and rural communities to their ancestral lands...*

Government policy has undermined the efforts of indigenous peoples to protect their land from incursions. In many cases, tribal groups are displaced in the name of national interest. In reality, transnational corporations and agribusiness companies benefit from government laws and from infrastructure

such as dams and export processing zones which are built on tribal land. The following are just some documented examples of injustices committed against tribal Filipinos because of the government's failure to protect their land rights (*Kapaligiran*, 1984).

a. The Chico River dam proposed for the Cordillera region would have affected 100,000 Igorots and 341,000 hectares of ancestral lands.

b. In Pampanga, the ancestral lands of the Negritos were occupied for decades by the United States (US) military bases. As a result, the Negritos have been deprived of livelihood and a few have been forced to work as servants inside the bases.

c. In Tanay, Rizal, the proposed Kaliwa-Kanan Dam Project will affect 11,000 Dumagats, Remontados and settlers.

d. In Mindanao, dam projects like the Pulangi River Dam, Lake Sebu Dam and others located in different areas have submerged thousands of hectares of fertile lands.

The lack of a single agency solely entrusted with land classification further aggravates land problems. In addition to the Housing and Land Use Regulatory Board, several government agencies can place certain portions of land under their jurisdiction and management through presidential or legislative action. Equally to be blamed is the slow process of classification of public lands which often results in forests being used for nonforestry purposes before they are classified as forest land. Table 3.6 presents the pace of land classification in the country from 1955 to 1988. The process of classifying lands tends to be very slow because it involves not only physical but also ecological, economic, sociocultural and legal considerations.

Lastly, while the government is in the process of evolving various tenurial forms for the uplands, there is insufficient time and research data to support and identify the appropriate tenurial forms and rehabilitation strategy (Sajise and Ganapin, 1990).

Table 3.6
Classified and unclassified land area, 1955 to 1988
(in hectares)

Year	Classified Area				Unclassified Area	
	Alienable and Disposable		Forest Land			
	Area	Percent	Area	Percent	Area	Percent
Fiscal Year						
1955	10,470,634	34.90	4,079,231	13.59	15,450,135	51.51
1960	11,833,353	39.61	6,300,979	21.00	11,815,168	39.39
1965	12,365,431	41.21	7,270,082	25.75	9,906,482	33.04
1970	12,572,433	41.90	8,542,527	28.47	8,885,040	29.63
1971	12,651,472	42.17	8,794,789	29.35	8,553,739	28.52
1972	12,747,516	42.49	8,851,076	29.50	8,401,218	28.00
1973	12,807,993	42.69	8,936,532	29.79	8,256,638	27.52
1974	12,917,083	43.06	9,050,804	30.17	8,018,775	26.77
1975	12,971,282	43.23	9,114,118	30.38	7,893,371	26.38
Calendar Year						
1976	12,975,861	43.25	9,129,961	30.43	7,894,178	26.31
1977	12,991,758	43.30	9,134,168	30.45	7,874,074	26.25
1978	13,069,840	43.57	9,147,714	30.49	7,782,446	25.94
1979	13,093,263	43.64	9,328,559	31.10	7,578,178	25.26
1980	13,269,340	44.23	9,705,170	32.35	7,025,490	23.42
1981	13,327,630	44.43	10,825,731	36.08	5,846,639	19.49
1982	13,359,243	44.53	10,914,433	36.38	5,726,324	19.09
1983	14,515,393	48.23	10,472,269	34.91	5,060,139	6.87
1984	14,515,393	48.38	13,657,272	45.52	1,827,335	6.09
1985	14,659,760	48.87	14,020,446	46.73	1,319,794	4.40
1986	13,852,398	46.17	14,961,027	49.87	1,186,575	3.90
1987	14,108,087	47.03	15,010,616	50.04	881,297	2.94
1988	14,117,753	47.06	15,001,090	50.00	881,157	2.94

Source: National Mapping and Resource Information Authority, Department of Environment and Natural Resources.

Note: Based on total land area of 30 million hectares.

4. Slow Rate of Reforestation

The launching of the Program on Forest Ecosystem Management (PROFEM) in 1976 marked a watershed in reforestation efforts. From 1976 to 1988, an average of 54,553 hectares were reforested every year, compared to only 20,000 hectares in the pre-PROFEM period. Despite this improvement, there remains a big gap between deforestation and reforestation of about 135,000 hectares annually, based on official Department of Environment and Natural Resources (DENR) figures. This disparity is illustrated in Table 3.7. The area reforested annually by the government and private sectors from 1960 to 1987 is shown in Table 3.8 which shows that the private sector's contribution to reforestation has been quite substantial.

Current reforestation efforts are slowed down by several problems. The most pressing is the continued high rate of forest denudation, especially when compared to the high cost of reforestation. The Forest Management Bureau (FMB) is now targeting an annual reforestation rate of 100,000 hectares in critically denuded watersheds. About 50,000 hectares of these are supposed to be financed by private entities. Without the private sector contribution, the government allocation for reforestation can cover only 20,000 hectares, way below the levels of the late 1970s. At an estimated cost of about 21,500 pesos to replant one hectare, the government would need to raise 2.15 billion pesos to cover the target area of 100,000 hectares. This amount is nearly 10 percent of the 1990 national budget.

Other factors hampering reforestation include the slow growth and low survival rate (50 percent) of tree seedlings and the lack of skilled manpower, effective technology and information on species adaptability. These problems are compounded by intense population pressure on existing natural forests, the complex nature of forest protection, and general public apathy toward forest conservation and renewal (BFD Annual Report, 1981).

Another problem which has persistently sabotaged reforestation work is late budgetary releases, resulting in the failure to plant during the normal planting season. The current DENR practice of allowing funds to be carried over from one year to the next has diminished this problem somewhat. But the potential for graft and corruption and other irregularities remains. In 1990, the House committee on environment and natural resources charged that the "DENR has been parceling out reforestation contracts to persons who eventually turned out to be fictitious or dummies of certain persons" (*Philippine Daily Inquirer*, 9 February 1990).

Table 3.7
Forest utilization and forest plantation areas, 1976-1988 (1988 Philippine Forestry Statistics)

Year	ITP/TF/AFF	TLA (hectares)
1976		800,500
1977	2,000	827,900
1978	11,000	706,000
1979	39,000	677,600
1980	98,000	650,000
1981	140,000	653,900
1982	232,000	670,900
1983	305,000	539,200
1984	386,000	587,800
1985	407,000	609,300
1986	432,000	567,500
1987	428,000	434,000
1988	464,000	365,000

ITP — Industrial Tree Plantations
TF — Tree Farm
AFF — Agro-Forestry Farm
TLA — Timber License Agreement

Table 3.8
Area reforested annually by government and private sectors, 1960-1987 (hectares)

Year	Total	Government Sector			Private Sector		
		Total	DENR	Other Gov't. Agencies	Total	Timber	Others
Fiscal Year							
1960-61	11,543	11,543	11,543	—	—	—	—
1961-62	7,474	7,474	7,474	—	—	—	—
1962-63	11,543	11,543	11,543	—	—	—	—
1963-64	16,822	16,822	16,822	—	—	—	—
1964-65	11,709	11,709	11,709	—	—	—	—
1965-66	7,396	7,396	7,396	—	—	—	—
1966-67	5,327	5,327	5,327	—	—	—	—
1967-68	6,869	6,869	6,869	—	—	—	—
1968-69	7,511	7,511	7,511	—	—	—	—
1969-70	6,458	6,458	6,458	—	—	—	—
1971-72	4,831	4,831	4,831	—	—	—	—
1973-74	4,994	4,994	4,994	—	—	—	—
1974-75	15,280	15,280	15,280	—	—	—	—
Calendar Year							
1976	31,733	23,228	20,977	2,251	8,505	8,275	230
1977	53,263	33,365	23,677	9,688	19,898	17,276	2,622
1978	78,425	44,686	34,343	10,343	33,739	22,006	11,733
1979	79,397	51,858	35,305	16,553	27,539	20,132	7,407
1980	60,516	39,881	32,956	6,925	20,635	15,579	5,056
1981	64,541	33,296	30,707	2,589	31,245	20,096	11,149
1982	63,262	35,201	31,202	3,999	28,061	21,588	6,473
1983	78,538	42,239	27,155	15,084	36,299	31,703	4,596
1984	38,935	16,088	15,520	568	22,847	14,186	8,661
1985	24,231	12,684	12,201	483	11,547	8,148	3,399
1986	32,998	24,426	22,495	1,931	8,572	6,572	2,000
1987	39,811	28,843	27,558	1,285	10,968	7,956	3,012

Source: Forest Management Bureau.

Effective reforestation can be achieved only if marketing and utilization schemes are incorporated in the overall project strategy. This is particularly critical in areas where there are no established markets for agro-forestry products.

While reforestation is important, the rehabilitation of denuded marginal lands also depends on how well these areas are protected from fire and illegal settling on steep slopes. Up to now, the DENR's forest protection and law enforcement efforts remain hampered by the lack of human resources. In 1985, there were only 4,000 forest guards all over the country. They were assisted by 6,168 *barangay* captains and officials, 42 concession guards and 187 other individuals. To turn these deputized *barangay* officials and individuals into effective forest protectors requires intensive training, forest education and commitment. It also entails added costs for the under-financed DENR. Problems also arise when deputized groups succumb to the temptations of graft and corruption in the discharge of their duty.

NEEDS AND RECOMMENDATIONS

The following are some research needs and policy recommendations on the sustainable management of marginal lands. Many of these were identified under the Philippine National Conservation Strategy in 1983, but are still relevant today.

1. Reexamine policies regarding land tenure of upland communities within public lands.

   * Provide mechanisms which involve local people in land and resource use planning and in the allocation of benefits and/or institute a system of compensation for displaced traditional resource users.

2. Expand the development of plantations to provide an alternative source of forest products and reduce the rate of conversion of the tropical forest.

   * Increase the emphasis of research on the natural, ecological processes of regeneration of marginal areas; the development of silvicultural techniques for indigenous species, mixed agro-silvi pastoral systems and improved pasture grasses; technologies for range management;

and traditional land use practices of indigenous Filipinos for the incorporation of ecologically sound practices into modern management.

* Require stricter compliance with conservation requirements in the management of agro-forestry plantations, pasture lands, and other land use practices under government permits and leases.

* Provide economic incentives for incorporating ecologically sound land use management practices and establish stable markets for agro-forestry products.

* Expand the agrarian reform program and increase livelihood opportunities in the lowlands, thereby reducing the incentive to migrate to marginal lands.

* Revise the criteria for selecting lands for social forestry to include consideration of both land capability and the needs of the local communities. Identify lands suitable for social forestry under new terms and evaluate the performance of current permit holders. On a case-to-case basis, either recommend the immediate termination of the agreement or disallow renewal at the end of the current permit period.

3. Introduce land use management which provides the variety of habitats necessary for the maintenance of species diversity.

4. Develop professional, technically trained and socially sensitive personnel; draft effective policy and national law; and introduce ecologically sound land use management practices to the residents of marginal lands.

Other relevant strategies are the following:

1. *Adopt a well-financed program to promote proper management of "problem soils."* These soils can be grouped into two categories: (a) those which are difficult to manage like soils polluted with mine tailings, coarse-textured soils, saline/sodic soils, swampland soils and acid sulfate soils; and (b) those which are quite manageable given the necessary input requirements, like those which are found on steeply

sloping lands (greater than 30 percent in slope), heavy cracking clays, and soils with severe fertility limitations. The first type of soil covers some one million hectares, while the manageable "problem soils" comprise a total of about 21 hectares.

A more vigorous national action program that will reclaim "problem soils" can be established by the government. Research on appropriate management schemes and agro-technology for these types of soil is necessary.

2. *Conversion of reclaimable open grasslands into productive agro-forestry farms.* This will help remedy the scarcity of lands for cultivation and the need for food and raw materials for the growing population. Possible sites for reclamation are those with an 18 to 30 percent slope condition. Those with a 30 to 50 percent slope should be left forested or converted into agroforestry while those with higher slopes should be fully protected.

3. *Preserve and protect the remaining old growth dipterocarp forests.* Old growth dipterocarp forest areas should be identified and selected for preservation in order to secure genetic diversity and natural regeneration. A total log ban in these selected areas and their proclamation as preserved/protected sites should be promulgated by the legislative branch. The public, nongovernment organizations, cause-oriented groups and local communities should be mobilized to support the Department of Environment and Natural Resources in its campaign to protect old growth dipterocarp forests.

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CHAPTER 4
THE PHILIPPINE CROPLANDS ECOSYSTEM

Nicomedes D. Briones

INTRODUCTION

The country's croplands are under great environmental stress. Prime or productive agricultural lowlands and alluvial plains are rapidly shrinking from about eight million hectares to less than five million. Soil erosion is severe in 36 of 71 provinces. Urban encroachment into productive farm lands has reduced the country's agricultural production capacity and the decreasing man-land ratio has led the landless to cultivate ecologically unstable croplands.

Under the Medium-Term Development Plan (1987-1992) of the National Economic and Development Authority (NEDA), the government is adopting the following strategies for cropland conservation: (1) promotion of the efficient use of agricultural land in order to meet the food requirements of a growing population; and (2) intensification of land classification to promote optimal use of land and to prevent and/or discourage conversion of agricultural lands to nonagricultural uses.

The Department of Agriculture is pursuing policy reforms outlined in its Medium-Term Development Plan (1990-1995). These include the formulation of a land use policy which will preserve the best agricultural lands for agricultural use, ensure the sustainability of the agricultural resource base, and adhere to the spirit of the Comprehensive Agrarian Reform Law.

This paper analyzes the state of the cropland environment in relation to other ecosystems. Policy recommendations are also suggested to maintain the integrity of the croplands.

EXTENT

About one-third or 9.9 million hectares of the country's total land area of 30 million hectares is classified as croplands. The classes of lands

under this category based on the SPOT [*Satellite pour Observation de la Terre*] (1987) are the following in million hectares (mha):

coconut plantations	-	1.1326
other plantations	-	0.0908
arable land, cereals, sugar	-	4.3923
crops mixed with coconuts	-	3.7478
crops mixed with other plantations	-	0.3652
fishponds from mangroves	-	0.1952
other fishponds	-	0.0101
TOTAL	-	**9.9340**

By region, the largest percentage of farm areas can be found in Region 4 (22.98%), Region 11 (11.67%), Region 5 (10.72%), and Region 10 (9.9%) [see Table 4.1]. There are temporary crops in a large percentage of arable lands in Regions 6, 12, 3, 2 and 4. Permanent crops are found mostly in Regions 10, 11, 9 and 12.

The cropping utilization of agricultural lands in 1983 is shown in Table 4.2. Land planted to corn (3.16 mha) and rice (3.12 mha) occupied the largest hectarage of land planted to annual crops. High-yielding varieties of rice were planted in about 82 percent of all rice farms and 21 percent of total croplands. Coconut, on the other hand, was the most dominant perennial crop, occupying 26 percent of total cropland area. Pasture areas comprised 5.78 percent.

ENVIRONMENTAL ISSUES

While one-third of the country's total land area is farmed, only a little over one-fifth or 5.8 million hectares is actually suitable for planting. (Porter and Ganapin, 1988). Furthermore, only 2.5 million hectares are capable of intensive agriculture or can be cropped more than once a year (NEPC, 1985).

Aggravating this situation is the rising demand for food production to sustain a growing population. At the same time, the sustainability of croplands is being threatened by the degradation of soil quality due to excessive use of agricultural chemical inputs, land pollution, unsustainable farming in the fragile uplands and climatic changes. The loss of genetic diversity due to

Table 4.1
Area of farms by land use, by region, 1980 (in hectares)

Region	Total Farm Area	Arable Under Temporary Crops	Land Lying Idle	Land Under Permanent Crops	Land Under Permanent Meadows and Pasture	Land Covered With Forest Growth	All Other Lands
Phil	9,725,150	4,365,183	838,551	3,488,978	530,035	336,476	165,918
NCR	9,389	4,997	2,649	1,099	98	113	405
1	430,875	308,571	17,097	21,960	50,430	18,863	13,948
2	639,030	415,720	54,431	38,007	95,614	18,111	17,146
3	501,924	444,471	16,524	13,769	17,076	3,259	6,823
4	1,261,904	400,253	84,881	591,600	105,871	63,448	15,852
5	1,042,461	274,224	57,551	597,153	68,131	27,961	17,437
6	766,496	502,274	51,026	127,980	38,435	25,183	21,597
7	584,188	321,302	53,459	165,386	20,328	8,460	15,253
8	746,417	224,230	34,448	444,507	13,394	22,445	7,454
9	802,643	264,832	102,988	380,043	24,845	22,422	7,513
10	965,841	368,185	139,899	354,459	33,942	50,281	19,075
11	1,134,608	365,970	129,313	541,708	40,358	46,587	1,067
12	839,302	470,155	94,244	211,307	21,512	29,342	12,742

Source: National Statistical Coordination Board. 1989 National Statistics.

Table 4.2
Cropping utilization of agricultural lands in the Philippines, 1983

Crop/Land Use	Cropped Area (in thousand hectares)	Percent of total
1. Seasonal Food, Feed and Other Crops		
Rice HYV-Irrigated	1,523.0	12.43
Rice HYV-Rainfed	1,040.5	8.49
Rice LV-Rainfed	266.4	2.17
Rice Upland	157.1	1.28
Rice LV-Irrigated	134.1	1.09
Corn	3,157.5	24.78
Root Crops	432.7	3.53
Vegetable Crops	49.2	0.40
Peanut	48.7	0.40
Beans and Peas	45.8	0.37
Irish Potato	4.3	0.04
Other Food Crops	80.6	0.66
Onion	6.8	0.06
Ginger	5.2	0.04
Native Tobacco	29.1	0.24
Virginia Tobacco	25.3	0.21
Castor Oil	0.7	0.01
2. Seasonal Fiber Crops		
Cotton	9.2	0.08
Ramie	0.6	0.01
3. Annuals and Perennials		
Sugarcane	423.8	3.46
Coconut	3,209.5	26.20
Fruits and Nuts	483.5	3.95
Abaca	169.2	1.38
Coffee	137.7	1.12
Rubber	58.7	0.48
Citrus	26.0	0.21
Cacao	11.0	0.09
Maguey	3.3	0.03
Kapok	0.8	0.01
4. Pasture	708.2	5.78
Total Cropped Area	12,248.5	100.00

Source: Fernandez, N.C. and R.B. Badayos, 1986.

the excessive use of artificially created varieties also affects sustainability. On the other hand, small farmers worry about land ownership and inequitable access to land resources. The present land use system, however, cannot control the encroachment into prime agricultural land of urban, commercial, and industrial projects.

1. Continued Degradation of the Production Base

a. Soil Erosion

Geographical and climatic conditions make the Philippines prone to soil erosion. More than half (59 percent) of the country's total land area is hilly and mountainous and therefore susceptible to erosion. Erosion also results from improper land use, poor soil and harmful farm practices.

In its 1984 surveys, the Bureau of Soils identified 8.25 million hectares (or 75 percent) of the country's alienable and disposable (A & D) lands as severely eroded. Of the 5.78 million hectares suitable for crop production, 45 percent belong to Erosion Class A (0-5% slope); 31 percent to Class B (6-10% slope); one percent to Class C (11-15% slope); and 23 percent to Class D (16-22% slope). This means that all of these land types are prone to erosion in varying degrees.

Loss of fertile topsoil results in the deterioration of crop productivity. Rice yield in eroded, marginal habitats is estimated at only one ton per hectare. Soil erosion also effects productivity by clogging up and shortening the lifespan of irrigation canals. Four major river basins in Luzon—the Magat, Bicol, Agno, and Pampanga river systems—which are important to lowland irrigation and hydroelectric power generation are in danger of drying up due to soil erosion. The irrigation system which taps the Agno owes 65 percent of its total sediment load to erosion during the rainy season (NEPC, 1977). The estimated cumulative losses in the Upper Agno River basin is shown in Table 4.3.

b. Land Pollution from Agricultural Activities

In the past years, agricultural activities have been characterized by intensive farm production using fertilizers and pesticides. These production inputs mean increased crop production and protection, but they also have disadvantages. Overuse of pesticides and fertilizers decreases the soil's humus content, adversely affecting its infiltration and water-holding capacities. In

Table 4.3
Cumulative losses from erosion in the Upper Agno River Basin

Year	Foregone Rice Production	Foregone Power Production	Increased Amortization	Total
1955	0.00	0.00	0.00	0.00
1960	4.08	1.56	0.59	6.23
1965	15.84	5.88	1.36	29.08
1970	35.40	13.00	2.12	50.52
1975	62.78	22.89	2.89	88.56
1980	97.96	35.58	3.65	137.19
1985	104.96	51.04	4.42	196.42

Source: National Environmental Protection Center, 1977.

Table 4.4
Volume of fertilizer consumption by type of product, Philippines, 1971-1984 (thousand tons)

Year	Ammosol/Can Urea	Amchlor	NP&P	NPK	Potash	Total	Total in Nutrient N	P205	K20
1970	121.6	116.1	83.1	84.2	49.0	454.0	100.3	31.2	41.9
1971	159.0	130.0	73.9	82.5	46.0	491.4	120.8	31.4	40.2
1972	132.7	134.6	89.2	88.6	47.4	492.5	132.8	35.0	48.2
1973	153.0	210.0	129.4	116.3	68.2	676.9	151.9	51.0	55.6
1974	212.2	200.5	130.7	126.9	68.0	738.3	177.5	47.7	60.0
1975	143.8	167.5	105.5	102.1	58.7	577.8	132.8	38.6	49.7
1976	174.8	185.4	116.0	108.0	59.7	643.9	152.4	38.3	55.1
1977	229.3	177.7	106.1	124.1	48.4	686.6	174.2	40.4	45 9
1978	287.1	171.2	125.3	147.2	60.8	791.6	205.4	49.8	56.6
1979	320.0	175.4	124.2	163.7	63.7	785.4	209.9	51.2	60.6
1980	329.2	143.6	131.8	158.2	56.8	819.6	224.8	53.4	55.8
1981	307.3	126.5	124.2	163.7	63.7	785.4	209.9	51.2	60.6
1982	342.2	140.3	143.1	161.1	58.8	845.9	232.8	56.1	57.4
1983	371.5	137.7	145.2	149.6	73.4	878.3	244.1	54.7	64.5
1984	256.3	118.6	119.2	134.3	34.0	665.2	180.6	45.4	38.6

Source: Fertilizer and Pesticides Authority.

turn, the loss of these two vital soil characteristics loosens the soil and makes it erosion-prone. Fertilizer and pesticide use also causes other ecological and health problems which are discussed below.

Fertilizer

After high-yielding varieties (HYVs) of rice were introduced in the late 1960s, fertilizer consumption in the country rose from 200,000 metric tons in 1960 to 878,000 tons annually beginning 1983. The government encouraged higher consumption by subsidizing fertilizer and pesticide purchases through the Masagana 99 Program which began in 1975.

Table 4.4 shows the volume of fertilizer consumption by type of product from 1971 to 1984. The most popular nutrient based on Table 4.5 is nitrogen, which is used mainly in *palay* and sugarcane production. Nitrogen use was highest in the sugarcane-producing Western Visayas region (Region 6) and the rice-producing regions of Central Luzon, Ilocos and Southern Tagalog. Figure 4.1 shows that fertilizer consumption declined in 1983 and increased sharply beginning 1986.

Because local manufacturers could not satisfy local demand, fertilizers were imported. In 1983, the country's fertilizer imports totalled 613,380.25 metric tons. This increased by 30.4 percent to 881,545.33 metric tons in 1984.

Fertilizers are important to enhance productivity. A.C. Rola (1988), for instance, has estimated that 25 percent of total production gains in the country have been due to fertilizers. R.W. Herdt and C. Capule's (1983) study has shown that fertilizer use increases yields of modern rice varieties by about 31 percent. Because of fertilizer use, rice yields on irrigated lowland farms rose from an average of two metric tons per hectare in 1970 to three metric tons in 1983 (Porter and Ganapin, 1988).

In 1976, the Philippines was self-sufficient in rice for the first time, after major increases in fertilizer and chemical use as well as improved irrigation facilities during Phases 5 and 6 of the Masagana program. By 1977, the Philippines started exporting rice (Bernardo, 1985). Three complementary factors—adoption of modern varieties, increased fertilizer use and expansion of irrigated areas—were estimated to have contributed to about one-third of the total growth in rice yields (Herdt and Capule, 1983). The contribution of these factors to increased rice production is shown in Table 4.6.

Table 4.5
Estimated consumption of fertilizer by crop and by region, 1983
(unit: nutrient ton)

	Total	Iloc.	Cag.V.	C.Luz.	S.Tag.	Bicol	W.Vis.	C.Vis.	E.Vis.	W.Min.	N.Min.	S.Min.	C.Min.
Palay													
N	128571	19016	11094	27759	15344	9548	20745	1885	2114	2064	4452	8750	5800
P205	34294	6191	3345	5023	2633	1933	8298	857	384	304	1002	2975	1289
K20	22077	2340	2321	2950	2233	1039	1844	343	192	971	2115	2975	2148
Corn													
N	18548	1579	236	101	2878	54	2278	6041	482	0	0	0	4899
P205	3482	0	0	0	0	54	456	1510	10	0	0	0	1452
K20	17918	0	0	0	0	54	152	1510	10	0	0	0	1089
Sugarcane													
N	60023	121	682	4301	7759	200	42407	1007	869	0	1332	244	315
P205	12077	0	0	0	127	61	10480	159	745	0	266	104	135
K20	17918	0	0	0	0	84	17285	159	124	0	266	0	0
Vegetables													
N	6624	2759	75	1419	1183	58	53	539	11	13	347	156	11
P205	1632	720	58	404	23	72	00	23	14	16	90	72	14
K20	1275	690	13	415	20	0	0	20	0	0	87	24	0
Others													
N	30262	940	227	53	40	0	6457	590	2	15058	2645	4143	71
P205	3315	257	15	12	12	0	0	1398	0	1613	3	0	5
K20	20417	487	0	21	23	0	6319	558	0	8985	240	1500	0
Consumption Total													
N	244028	24415	12314	33633	27210	9926	72000	10722	3478	17135	8776	13293	11096
P205	54800	7168	3418	5499	2795	2120	19300	3947	1153	1993	1361	3151	2895
K20	64502	3529	2334	3386	2276	1777	25600	2590	326	9956	2708	4499	3273

Source: A.C. Rola, 1990.
N - Nitrogen

Figure 4.1
Fertilizer Consumption
(plant nutrients and fertilizer products)

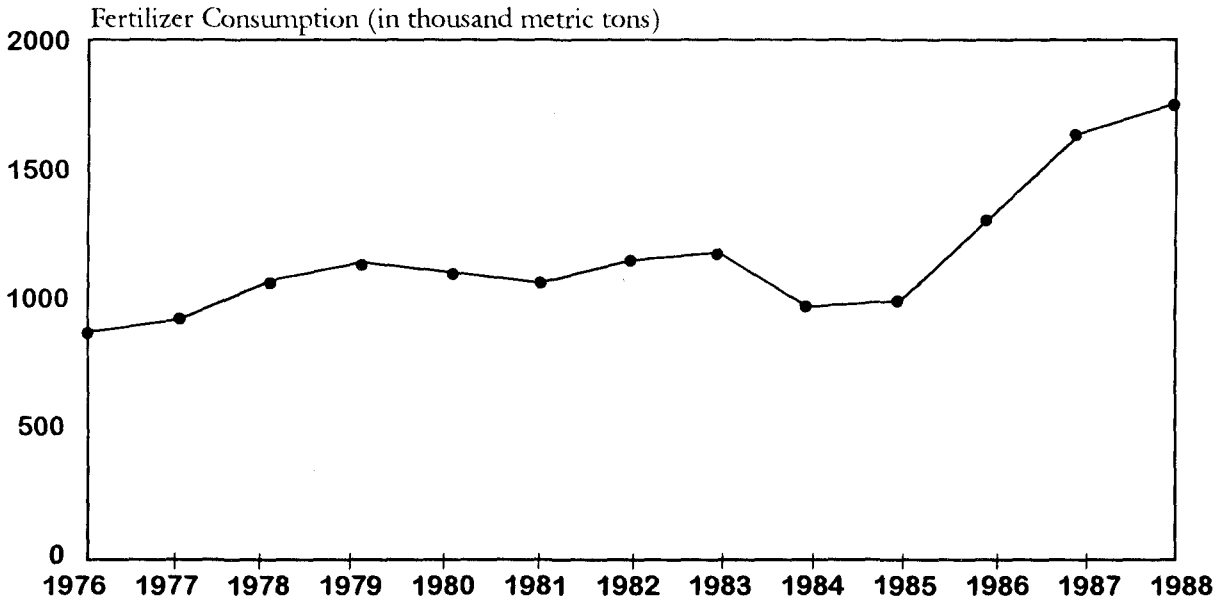


Table 4.6
Contribution of area and yield increasing factors to rice production growth in the Philippines (percent)

	Philippines	
	1955-65 *	1965-80 **
Area	68	19
Yield	32	81
Modern Varieties		26
Fertilizer		31
Irrigation		24

* Source of basic data: World Rice Statistics, IRRI, 1982.

** R.W. Herdt and C. Capule. Adoption, Spread, and Production-Impact of Modern Rice Varieties in Asia. IRRI, 1983, p.21.

Table 4.7
Efficiency of production

(1) Year	(2) Area of Palay and Corn ('000 ha)	(3) Average Mean Yield of Palay and Corn (MT/ha)	(4) Fertilizer Consumption ('000 MT)	(5) (2) / (4) (ha/MT)	(6) (5) x (3)
1976	6,836.3	1.29	890.7	7.68	9.90
1977	6,868.1	1.34	946.2	7.26	9.73
1978	6,731.0	1.43	1,103.4	6.10	8.72
1979	6,795.8	1.51	1,191.0	5.71	8.62
1980	6,670.0	1.60	1,152.4	5.79	9.26
1981	6,714.0	1.67	1,107.0	6.07	10.13
1982	6,734.0	1.74	1,192.3	5.65	9.83
1983	6,186.0	1.68	1,241.7	4.98	8.37
1984	6,389.0	1.73	982.0	6.51	11.25
1985	6,817.0	1.86	993.4	6.86	12.76
1986	7,059.0	1.89	1,316.2	5.36	10.14
1987	6,938.0	1.85	1,667.7	4.16	7.70
1988	7,138.0	1.88	1,745.2	4.09	7.69

ha - hectares
MT - metric tons
(5) - area planted to corn and rice per metric ton of fertilizer used
(6) - tons of produce (palay and corn) per ton of fertilizer

Trend: decreasing - which means that a ton of fertilizer then could produce more crops than today.
Implication: To produce the same yield, more fertilizer should be used.

But there are other views. One commentator said that "the apparent stability of rice yields through the 1950s and 1960s masked the fact that yields in areas that were not benefiting from irrigation and fertilizer were declining and that from newly opened rice lands were consistently less than those in established rice growing areas. Fertilizer consumption quadrupled and irrigated land tripled between 1950 and 1969, while average rice yield stagnated." This observation is supported by Table 4.7 and Figure 4.2 which reveal that the increase in fertilizer consumption since 1986 was accompanied by a sharp decline in the efficiency of *palay* and corn production.

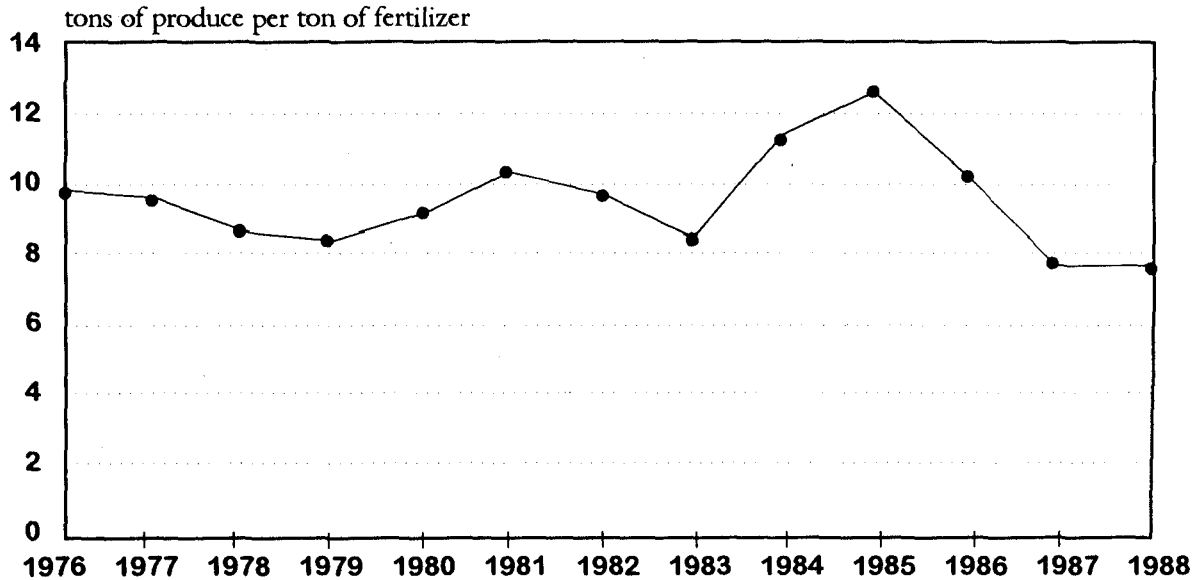
In contrast, the period from 1983 to 1985 when fertilizer consumption declined was the period of highest production efficiency in *palay* and corn. This is also reflected in the volume of rice exports which drastically declined through the years. Rice exports amounted to 230,624.95 MT in 1980, down to 83,300 MT in 1981, to 147.2 MT in 1982, to 39,758.76 in 1983, and to 737.60 MT in 1984. In 1985 and 1986, the country no longer exported rice. In 1987, 111,000 MT of rice were sent to Indonesia as loan repayment. Since 1988, rice exports have stopped. Instead, the country is now importing rice.

There are also ecological problems concomitant with chemical fertilizer use. Excessive use has been known to cause the acidification of soil. In Loo Valley in Benguet, for example, the excessive use of chemical fertilizers in vegetable gardens resulted in the lowering of soil pH to an average of 4.4. Acidic soils are vulnerable to erosion because of the characteristic low electrolyte levels in the soil solution. Acidity also depletes soil fertility through the development of toxic levels of iron and by lowering the amount of most essential nutrients in the soil. In addition, soil microbiota which are partly responsible for nutrient release are adversely affected (Medina, 1990).

The use of chemical fertilizers also poses some health problems. Contamination of drinking water with nitrate concentrations greater than 45 parts per million (ppm) can cause metheglobinemia disease, which affects livestock and human infants (Rola, 1990). Another health hazard results when nitrates in food or the digestive system combine with protein to form nitrosoamines which are carcinogenic.

Nitrogen and phosphorus nutrients from fertilizers are washed down by runoff water into freshwater bodies, creating eutrophication problems. One glaring example is the much eutrophied Laguna Lake. Of the 3,600 MT of nitrogen, the major determinant of the recurrent algal blooms, that enter the lake, 77.2 percent is agricultural in origin (LLDA, 1978).

Figure 4.2
Efficiency of Production
(palay and corn)



Note: Palay and corn data were averaged.

Pesticide

The emergence of the pesticide industry in the country in the late 1940s coincided with the introduction of DDT; 2, 4-D; Endrin; and Malathion (Elazequi, 1989). With the launching of the "Green Revolution" in 1965, the government embarked on a program of crop protection based on chemicals. At that time, the Bureau of Plant Industry treated free of charge half of the total irrigated rice land. Subsequent government programs like the *Masagana 99, Masaganang Maisan,* and *Gulayan sa Kalusugan* and the expansion of plantation areas also encouraged pesticide use. This trend is shown in Figure 4.3 which reveals that pesticides were widely used in the 1970s. Similarly, Table 4.8 shows that insecticide importation grew by 93 percent from 1977 to 1987. Farmers gained confidence in chemical control due to its immediate and dramatic effects (Alcantara, 1988). In rice production, insecticide and fungicide use grew by 15 percent and 2,210 percent, respectively, from 1981 to 1987 [see Table 4.9]. On the other hand, the use of pesticide in vegetables showed a declining trend from 1981 to 1987.

Pesticide use is said to be responsible for increasing marketable surplus as it minimizes crop losses due to pests. Yield losses have been noted to range from 0.5 to 1.7 tons per hectare if no pesticides are used (Herdt *et al.*, 1984). Nevertheless, pesticides have negative effects on the health of farmers. Statistics from rural health clinics show rising numbers of pesticide poisoning cases (Rola, 1989). M.E. Loevinsohn's study in 1987 showed that widespread use of pesticides by Central Luzon farmers was followed by a 27 percent increase in deaths from causes other than physical injury. The study also found out that mortality patterns for rural males peaked in August, the month of greatest insecticide use in the wet season. After double cropping became widespread in the region, two mortality peaks were observed: February, the month of pesticide application during the dry season, and August.

A yearly average of 503 cases of pesticide poisoning, 15 percent of which result in deaths, was reported from 1980 to 1988. Some reports claim that a number of workers in banana plantations of Mindanao have become sterile after constant handling of a toxic pesticide.

These reports probably understate the reality in the field. The figures reported were only of those who were treated in hospitals and health centers, which are often inaccessible to most poor farmers in remote areas. In addition, pesticide poisoning may be misdiagnosed as symptoms of other diseases. For

Table 4.8
Growth rate of total pesticide importation

	In Percent			
	1977-80	1980-85	1985-86	1986-87
A. Volume (MT/kl)				
Insecticides	33.26	2.22	41.91	93.25
Herbicides	121.05	26.78	49.84	142.50
Fungicides	106.98	140.24	28.19	537.40
Others*	178.47	113.89	67.89	900.00
Total	89.62	54.61	45.09	325.39
B. Value [CIF ($000)]				
Insecticides	76.55	0.19	91.63	237.69
Herbicides	140.45	17.60	77.76	252.19
Fungicides	149.68	28.13	33.14	325.94
Others*	137.03	126.15	70.42	1,700.00
Total	117.77	17.61	70.12	335.71

Source: A.C. Rola, 1990.

* Include miticides/acaricides, molluscides, nematicides, rodenticides, fumigants, etc.

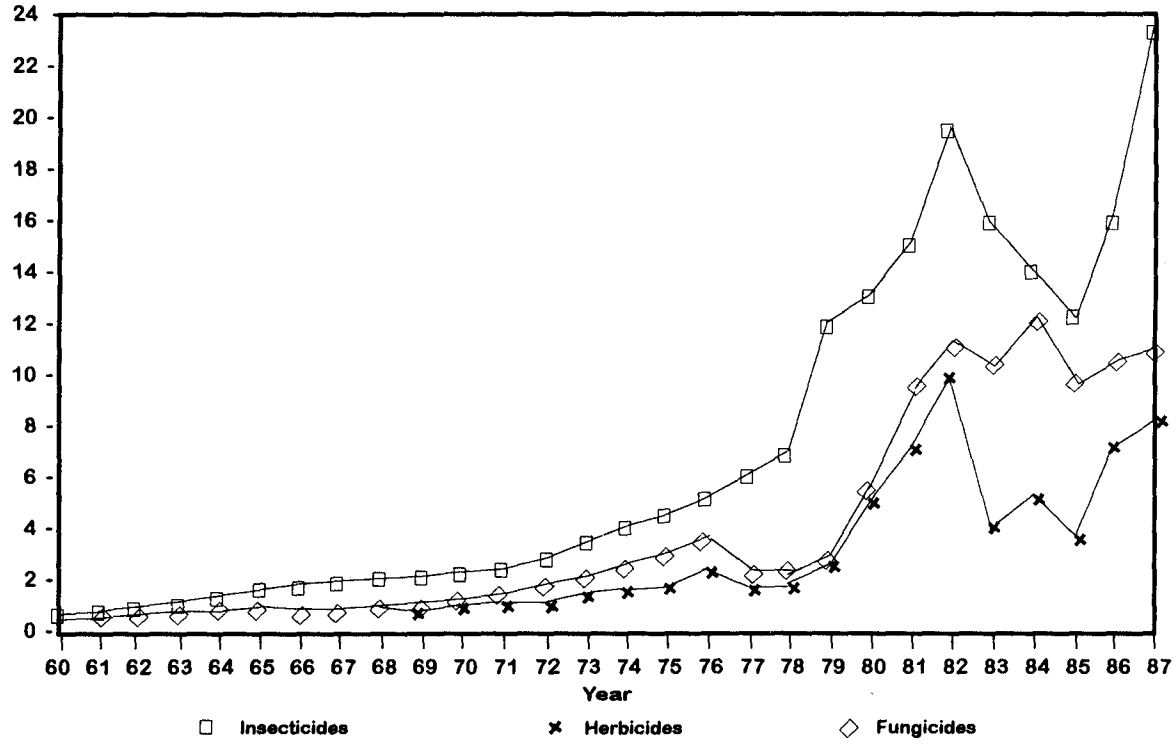
Table 4.9
Estimated pesticide use in selected crops, 1981 and 1987

Crop	Percent of Total Sales							
	Insecticides		Herbicides		Fungicides		Others	
	1981	1987	1981	1987	1981	1987	1981	1987
Rice	47.0	54.0	82.0	—	3.8	84.0	—	—
Corn	2.0	4.2	2.0	—	2.0	—	—	—
Banana	—	0.1	21.0	5.9	60.0	72.0	—	73.6
Pineapple	*	1.2	*	7.3	*	9.0	—	26.4
Vegetables	39.0	19.0	5.0	0.1	38.0	14.7	—	—
Others	5.0	18.5	18.0	4.7	—	0.5	16.0	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: APIP

* No data available
** Nematicides only

Figure 4.3
Pesticide Importation
1960-1987



example, organochlorine insecticides such as endrin can cause chronic convulsions which may be mistaken for epilepsy, brain tumor, and strokes. Poisoning by organophosphates such as parathon may be misdiagnosed as cardiovascular and respiratory diseases.

The widely used insecticides in the country in the 1970s were carbofuran, endrin, parathon and monocrotophos, which are all classified by the World Health Organization as extremely or highly hazardous (Macracken and Conway, 1987).

Several pesticides consist of toxic compounds that can persist in the environment for long periods of time. Long-term chemical contamination of the environment occurs when persistent pesticide residues scatter, remaining suspended in the air or settling on the soil and water where they may endanger non-target organisms. These residues can continue to act either through direct contact or by being collected in harmful quantities through biological accumulation and magnification.

Continued reliance on chemical pesticides may also cause pest build-up. One documented case is that of the diamond back moth (*Plutella xylostella*, L.) which exhibits multiple resistance to malathion, methyl parathon, DDT, diazinon, meviaphos and carbaryl, and is developing resistance to newly introduced insectides (Barroga and Rejesus, 1981 cited in Alcantara, 1988).

The findings of A.C. Rola (1989) indicate that farmers continued to use pesticides despite the hazards because they did not know enough about other pest control methods that would give them the same level of production and profit. Worse, several studies have pointed out that current pesticide utilization by farmers is not efficient. For instance, Medina (1983) found that reduced spraying does not significantly lower yields. Similarly, only 50 percent of 105 farmers surveyed in 1980-1983 showed a significant difference in yields between completely protected and untreated fields. This is probably because of the use of resistant varieties and presence of natural enemies (Rola, 1989), thus revealing possible inefficiency in the present level of pesticide use.

Pesticide hazards are compounded by the widespread ignorance of the hazards involved, poor labeling, inadequate supervision, and lack and difficulty of wearing protective clothing due to the prevailing hot climate.

Fertilizer and Pesticide Policies and Programs

Fertilizer policies are ultimately aimed at providing low-cost fertilizer so that farmers can increase food production. Balisacan (1988), cited by Rola (1989), showed that indeed, farm prices, farm incomes and fertilizer prices are responsive to fertilizer policy changes. But he also noted that historically, government policies have sometimes had dual, oftentimes conflicting, objectives: providing low-priced fertilizer to farmers and giving adequate incentives to local fertilizer manufacturers. This contradiction, he concluded, resulted in falling net incomes of sugar and cotton farmers whose incomes have declined by an average of 10 percent from 1980 to 1987.

In 1988, several programs were instituted by the Fertilizer and Pesticide Authority (FPA), the government agency responsible for the regulation of these two industries. These were aimed at creating an atmosphere which would enable private entities to provide fertilizers and pesticides at prices approximating world market levels. These programs included the following: (Villareal, 1988)

1) Import liberalization;
2) Provision of tax and duty incentives;
3) Quality control standards;
4) Information assistance program; and
5) Improved efficiency of fertilizer use.

The main activities of the FPA with respect to the pesticide industry are: (Magallona, 1980)

1) Registration of pesticide active ingredients and formulated products, label requirements and restrictions on use of highly toxic products;

2) Licensing of all pesticide handlers and pest control operators; and

3) Agro-medical training programs.

Because of the hazards associated with pesticide use, any pest control strategy should consider not only economic returns but also the possible damage to health and the environment. Rola's recommendations (1989), summarized below, should be looked into:

1) More research on alternatives to inorganic fertilizer;
2) Correct timing of fertilizer application;
3) Aggressive regulatory policy which has legal clout;
4) Phasing out of highly toxic pesticides and looking into Category I pesticides (with oral LD50 values of less than 20 mg/kg body weight);
5) Independent studies by the government to countercheck the data submitted by private pesticide companies and an improvement of the existing practice of allowing companies to generate their own safety data on the pesticides they produce;
6) Stepped-up training of extension agents and farmers regarding judicious and efficient use of pesticides as well as fertilizers;
7) Crop insurance for farmers in place of more pesticides; and
8) More research on crop protection, particularly pesticide use.

A welcome development is the Integrated Pest Management Program which has been institutionalized as the national crop protection policy. This policy is expected to result in declining pesticide use. There is also a Senate bill that will empower the FPA to monitor the impact of pesticides on public health and the environment. Although the FPA's regulatory policies are ideal on paper, field experiences indicate a discrepancy between policy statements and implementation (Rola, 1989).

c. Land Pollution from Mining Activities

The mining industry continues to be a main source of land pollution. Ranging from sand-like mine tailings to larger coarse rocks, mine wastes may affect land both physically and chemically. Physical pollution occurs when landscapes are destroyed through excavation, erosion and dusting. When residues from mine washings accumulate in river bodies as silt, agricultural lands are endangered. One example is the way mine tailings flowing into irrigation canals have damaged fields in the watersheds of the Agno, Bued and Amburayan rivers in northern Luzon. The National Irrigation Administration spends 57 million pesos every year to maintain irrigation systems affected by tailings. Aside from reducing the area of irrigated farms and clogging irrigation canals, deposited mine tailings reduce crop yield by 50 percent in heavily silted areas and 20 percent in those with average siltation (PCARRD, 1980).

A recent survey of the Department of Agriculture found that sedimentation of rice farms and rivers in northern Luzon resulted in yearly

losses of 208 million pesos in *palay* production. The same study revealed that 60 percent of irrigation canals in the region have been rendered useless by heavy siltation from mine tailings and soil erosion (*The Manila Chronicle*, 12 October 1988). Mining firms in the Benguet area alone are believed to have discharged some 117 million metric tons of tailings into the lowlands.

In the town of Natividad in Pangasinan's Caraballo mountain range, siltation damaged 265.5 hectares of agricultural land, yielding a loss of 2.27 million pesos (*Philippine Daily Inquirer*, 15 October 1990). Much of Caraballo's slopes, which span both Nueva Ecija and Nueva Vizcaya, have been extensively denuded by the flue-curing of Virginia tobacco after World War II and by slash-and-burn farmers and cogon-gatherers. Use of the grassy lower slopes for cattle pasture prevented the growth of new trees.

Mine tailings may also carry other pollutants such as excessive salts used in mineral extraction, cyanides, acids, alkalis and heavy metals such as silver, copper, aluminum, lead, zinc, nickel, chromium, iron, calcium and arsenic.

Region 7 has the largest mine tailings output. Most of this comes from the Atlas Consolidated Mining and Development Corporation in Cebu, which discharges 109,670 DMT daily into the sea. The company which dumps the biggest amount of tailings inland is the Philex Mining Corporation in Benguet Province. Other major contributors to the mine tailings pollution problems are Central Luzon's Benguet Corporation (Dizon Copper Operations), the North Davao Mining and Development Corporations and the Atlas Consolidated Corporation in Aroroy, Masbate.

In Sorsogon, there is strong opposition to a geothermal plant being built by the Philippine National Oil Company (PNOC) at the foot of Mount Bulusan. Organized groups active in the campaign against the project said that Irosin, Sorsogon stands to lose some $59 million in agricultural products from the toxic fallout from the operation of the geothermal plant. Oppositors say that rice fields would be badly affected if the watershed at Mount Bulusan dries up as a result of the geothermal plant's operations (*Manila Bulletin*, 18 October 1989).

d. Pollution from Industries

Pollution of croplands also come from industries. In Apalit, Pampanga, the Central Fermentation Industrial Corporation (CFIC), one of the largest

alcohol fermentation firms in the country, has been blamed for the pollution of land, air and fishponds. Farmer Augusto Marcelino said that his rice harvest is down to 21 cavans per hectare compared to the almost 100 cavans he harvested before the pollution. Farmers now have to wait for the rainy season to start planting because the river water is so polluted, it can no longer be used for irrigation (*The Manila Chronicle*, 30 May 1988).

2. The Land Constraint

The scarcity of land is indicated by the prevailing land-man ratio. In 1982, Alcasid estimated that the land-man ratio was 0.82 hectares per person and would decrease to 0.36 hectare per year per person by the year 2000. The present ratio is 0.54 hectare per person, the lowest in Southeast Asia except Singapore (Sajise, 1987). In terms of arable area, however, the ratio will decrease from 0.48 hectare per person to 0.21 hectare per person by the year 2000 (Rapera and Revilla, 1986). Some experts say that the country had already reached its land frontier for agriculture in the beginning of the 1970s (Encarnacion *et al.*, 1976; ILO 1974 cited in Agenda for Action for the Philippine Rural Sector, 1986).

a. Urban and Industrial Encroachment

As rural lands become urbanized, the need for prime agricultural land competes with the requirements of urban growth. This was most obvious in Metro Manila where a 35.29 percent decrease in rice lands occurred from 1972 to 1976 as a result of residential, commercial, and industrial pressures (Pascual and Silonga, 1978).

Infrastructure projects also contribute to the diminution of available agricultural lands. For example, hydroelectric dams flood thousands of hectares in impounded areas which silt up in time and become less useful (Stein, 1973). Controversial examples are the Chico and Magat dams in Luzon.

b. Rapid Population Growth: Implications for Agriculture and Forestry

Based on the 1988 SPOT survey, the country has only 23.9 percent forest cover while extensive (39.6 percent) and intensive (32.2 percent) cultivation is done on 71.8 percent of the total land area. As much as 30,000 hectares of extensively cultivated land are now found within forest lands, while 1.8 million hectares are cultivated in former grasslands. In 1983, the

Forest Management Bureau (FMB) estimated that the proportion of cultivated lands in the forest zone was only 23 percent (Cruz, 1989).

At the same time, population has grown 1.5 times in 30 years, from 19 million in 1948 to over 48 million in 1980 (Cruz, 1989). In May 1990, the National Census and Statistics Office (NCSO) counted 61.5 million Filipinos. By the year 2000, the country's population is projected to grow to 71 million (Herrin, 1988). By the time we attain a zero growth rate in year 2075, the number of Filipinos would have reached 125 million (Vu and Elwan, 1982 cited in Cruz, 1989). The Philippine population is presently growing at a lower rate of 2.3 percent, but the base is already large, so that the increment at this rate is a significant addition.

G. Porter and D. Ganapin Jr. (1988) observe that: "Until 1960, the high population growth rates did not reduce the total ratio of cultivated land to population because new land was being brought into cultivation even faster than population was growing. From the late 1940s to the late 1950s, while population was growing at an average annual rate of 3.1 percent, cultivated land was increasing at an average annual rate of 3.8 percent. During the 1960s, however, the average annual increase in cultivated land of only 1.4 percent fell far behind annual rates of population increases, which continued to average over three percent.

If the present trends in population growth (currently 2.6 percent in the uplands, 3.5 percent in logging concessions and 2.3 percent national average) continue, more forest lands will be converted to agriculture to meet food needs. The estimate is that the rate of forest conversion from 1988 up to year 2025 will be 1.56 percent per year which is significantly faster than the rate of conversion from logging operations of 1.2 percent yearly from 1960 to 1980 (Hernandez, 1989). At a population growth rate of 2.6 percent, it is projected that by the year 2025, 5.24 million hectares more of forest lands would be cleared (Cruz and Zosa-Feranil, 1988).

Fernandez and Badayos (1986) analyzed the trend in areas planted to various crops from 1979 to 1983. Their findings indicated a decline of about 95,250 hectares per year [see Table 4.10]. With 1979 as the base year, the percent decrease in total area for all crops in 1983 amounted to approximately 4.0 percent, or about 500,000 hectares. The same study also revealed that from 1979 to 1983, farm land increased only for areas planted to irrigated high-yielding rice varieties, coconut, fruits and nuts, coffee and rubber.

Table 4.10
Cropped area, Philippines 1979-1983

Year	Area (in thousand hectares)	% Change
1979	12,041.0	100.00
1980	12,133.4	100.77
1981	11,961.8	99.34
1982	12,182.3	101.17
1983	11,540.3	95.84
Trendline Slope — 95.25 (hectares per year)		

Source: N.C. Fernandez and R.B. Badayos, 1986.

Table 4.11
Status of land in the Philippines, 1970-1984 (in million hectares)

	1970		1977		1980		1982		1984	
	Hectares	% to Total	Hectares	% to Total	Hectares	% to Total	Hectares	% to Total	Hectares	% to Total
Total Philippines	30.00	100.00	30.00	100.00	30.00	100.00	30.00	100.00	30.00	100.00
1. Forest	15.90	53.00	13.10	43.67	12.50	41.67	12.00	40.00	11.50	38.33
Productive	14.10	47.00	11.30	37.67	10.70	35.67	9.70	32.33	9.30	31.00
Unproductive	1.80	6.00	1.80	6.00	1.80	6.00	2.20	7.33	2.30	7.67
2. Non-Forest	14.10	47.00	16.90	56.33	17.50	58.33	18.00	60.00	18.40	61.33
Open Land	2.60	8.67	1.00	3.33	0.80	2.67	1.00	3.33	1.80	2.67
Managed Pastures	0.80	2.67	1.00	3.33	1.00	3.33	0.60	2.00	0.70	2.33
Wash and Small Water	0.20	0.67	0.10	0.33	0.10	0.33	0.10	0.33	0.10	0.33
Plantation			6.80	22.67	7.20	24.00	247.30	24.33	7.50	25.00
Cultivated Cropland	9.80*	32.67*	7.20	24.00	7.60	25.33	8.00	26.67	8.20	27.33
Urban & Other	0.60	2.00	0.80	2.67	0.80	2.67	1.10	3.67	1.10	3.67

Source: Bureau of Forest Development.

*The figure combines plantation and cultivated croplands.

The expansion of agricultural land between 1971 and 1980 was made possible through a decrease in the hectarage utilized for other purposes (Agenda for Action for the Philippine Rural Sector, 1986). Table 4.11 reveals that the area of productive forest and open lands declined as a result of the expansion of plantation and croplands and urban areas. This relationship between agricultural and forest land uses is also shown in Table 4.12.

Using sensitivity analysis, Tonie Balangue presented several scenarios showing the effect of population on land use. Several alternative population growth rates were assumed in the analysis. Table 4.13 shows that at the current growth rate of 2.4 percent, the Philippines will no longer be able to meet the requirements for land-based goods and services of its incoming population beyond 1995. With a one percent population growth rate, a conflict would arise between agriculture and forestry beyond the year 2000 [see Table 4.14].

Table 4.15 indicates that with a 0.5 percent growth rate, there would still be conflict in the year 2000. At a 0.5 percent growth rate and increasing yields of 15 tons per hectare for rice and three tons per hectare for corn within the 25-year period, the total land area would be fully allocated by the year 2005 [see Table 4.16]. If some of the coconut lands are converted to fruit tree plantations, the allocation can be extended up to 2007 [see Table 4.17].

M.C.J. Cruz and I. Zosa-Feranil (1988) also made a projection on what would happen if the remaining forest lands are distributed. At a rate of one hectare per household (the current Integrated Social Forestry Program distributes 2.5 hectares per family), Table 4.18 shows that only 3.08 million hectares of forest would remain by the year 2000. By 2025, this area will further diminish to 1.7 million hectares.

The pressure on land may be eased if employment rates increase. Philippine unemployment, however, only rises every year [see Table 4.19]. Unemployment levels are the same in rural and urban areas, implying that everywhere, job opportunities cannot increase with the rise in working-age population [see Table 4.20]. The labor force is projected to increase at 3.2 to 3.6 percent by 1991. This means a net addition of 800,000 job-seekers by 1991, and nearly 900,000 by 1992 (NEDA, 1986). The shift to plantation crop production from small-scale farm production is expected to make things worse. Mechanization of cultivation in large-scale plantations is capital-intensive but does not mean more jobs. The current estimate is that only one worker is needed for every two to five hectares of plantation.

Table 4.12
Agricultural and forest land uses, 1968-1988

Year	Forest Area (million hectares)	Agricultural Land (million hectares)
1968	16.08	8.7021
1969	16.09	8.9193
1970	15.90	8.9464
1971	15.88	9.0968
1972	15.67	9.3818
1973	13.89	9.2129
1974	13.69	10.1170
1975	13.48	10.7596
1976	13.27	11.5038
1977	12.07	11.8428
1978	12.86	11.7493
1979	12.66	11.9687
1980	12.46	12.7640
1981	12.25	12.8170
1982	11.25	13.0900
1983	10.51	12.5860
1984	9.84	12.5380
1985	9.15	12.9860
1986	8.49	13.2640
1987	7.77	13.1030
1988	7.11	13.3880

Sources of Data:

1. **1968-1982 Forest Data**: EMB, The Philippine Environment.
2. **1988 Forest Data**: SPOT Satellite Data.
3. **1949, 1955, 1958, 1964, and 1969-79 agricultural land data:** 1981 Philippine Statistical Yearbook.
4. **1980-88 agricultural land data:** 1989 Philippine Statistical Yearbook.
5. **1960, 1970, 1975, 1980, 1988 upland population data:** Cruz, Ma. Chona.
6. **1981-1986 Philippine population data:** 1986 Economic and Social Indicators.
7. All other data are estimated from graphs.

Table 4.13
Land use allocation scenario based on 2.4 percent population growth rate, 1990-2015

Land Use	1990	1995	2000	2005	2010	2015
			(in thousand hectares)			
Agriculture	12800.33	14895.21	17398.37	20707.83	25183.00	31343.51
Settlements*	1280.82	1281.10	1281.41	1281.77	1282.17	1282.62
Agroforestry	3000.00	3420.00	3930.00	4510.00	5200.00	6010.00
Prod'n Forest	3701.89	4270.83	4616.02	5038.48	5585.41	6258.01
Protective Forest	2817.00	2817.00	2817.00	2817.00	2817.00	2817.00
Roads	239.03	259.04	280.44	308.46	346.15	415.46
Other Land Uses	1239.00	1239.00	1239.00	1239.00	1239.00	1239.00
TOTAL	25078.08	28182.18	31562.23	35902.53	41652.73	49347.58

Source: T. Balangue, 1989.

* Based on seven percent rate of increase of area for settlement using 719.7 thousand hectares (1980).

Table 4.14
Land use allocation scenario based on 1.0 percent population growth rate, 1990-2015

Land Use	1990	1995	2000	2005	2010	2015
			(in thousand hectares)			
Agriculture	11126.67	13056.26	15146.50	18008.94	21983.69	27584.77
Settlements*	1280.82	1281.10	1281.41	1281.77	1282.17	1282.62
Agroforestry	3000.00	3420.00	3930.00	4510.00	5200.00	6010.00
Prod'n Forest	3701.89	4270.83	4616.02	5038.48	5585.41	6258.01
Protective Forest	2817.00	2817.00	2817.00	2817.00	2817.00	2817.00
Roads	226.49	245.25	263.55	288.21	322.16	369.26
Other Land Uses	1239.00	1239.00	1239.00	1239.00	1239.00	1239.00
TOTAL	23391.86	26329.44	29293.47	33183.40	38429.43	45560.65

Source: T. Balangue, 1989.

* Based on seven percent rate of increase of area for settlement using 719.7 thousand hectares (1980).

Table 4.15
Land use allocation scenario based on 0.05 percent population growth rate, 1990-2015

Land Use	1990	1995	2000	2005	2010	2015
			(in thousand hectares)			
Agriculture	11126.67	12926.26	14876.50	17588.94	21403.69	26834.77
Settlements*	1280.82	1281.10	1281.41	1281.77	1282.17	1282.62
Agroforestry	3000.00	3420.00	3930.00	4510.00	5200.00	6010.00
Prod'n Forest	3701.89	4270.83	4616.02	5038.48	5585.41	6258.01
Protective Forest	2817.00	2817.00	2817.00	2817.00	2817.00	2817.00
Roads	226.49	244.28	261.52	285.06	317.81	363.63
Other Land Uses	1239.00	1239.00	1239.00	1239.00	1239.00	1239.00
TOTAL	23391.86	26198.46	29021.45	32760.25	37845.08	44805.63

Source: T. Balangue, 1989.

* Based on seven percent rate of increase of area for settlement using 719.7 thousand hectares (1980).

Table 4.16
Land use allocation scenario based on 0.05 percent population growth rate with increasing productivity per hectare, 1990-2015

Land Use	1990	1995	2000	2005	2010	2015
			(in thousand hectares)			
Agriculture	12006.67	12336.26	13296.50	15338.94	18973.69	24284.77
Settlements*	50.00	50.00	50.00	60.00	60.00	60.00
Agroforestry	3000.00	3420.00	3930.00	4510.00	5200.00	6010.00
Prod'n Forest	3701.89	4270.83	4616.02	5038.48	5585.41	6258.01
Protective Forest	2817.00	2817.00	2817.00	2817.00	2817.00	2817.00
Roads	122.31	129.05	138.84	158.23	189.59	234.47
Other Land Uses	1239.00	1239.00	1239.00	1239.00	1239.00	1239.00
TOTAL	22936.87	24262.14	26087.36	29161.65	34064.69	40903.25

Source: T. Balangue, 1989.

* Based on seven percent rate of increase of area for settlement using 719.7 thousand hectares (1980).

Table 4.17
Land use allocation scenario based on 0.05 percent population growth rate with increasing productivity per hectare, and conversion of some coconut areas into fruit tree plantations, 1990-2015

Land Use	1990	1995	2000	2005	2010	2015
			(in thousand hectares)			
Agriculture	12006.67	12336.26	12928.62	14803.85	18271.39	23415.25
Settlements*	50.00	50.00	50.00	60.00	60.00	60.00
Agroforestry	3000.00	3420.00	3930.00	4510.00	5200.00	6010.00
Prod'n Forest	3701.89	4270.83	4616.02	5038.48	5585.41	6258.01
Protective Forest	2817.00	2817.00	2817.00	2817.00	2817.00	2817.00
Roads	122.31	129.05	136.08	154.22	184.33	227.95
Other Land Uses	1239.00	1239.00	1239.00	1239.00	1239.00	1239.00
TOTAL	22936.87	24262.14	25716.72	28622.55	33357.13	40027.21

Source: T. Balangue, 1989.

* Based on seven percent rate of increase of area for settlement using 719.7 thousand hectares (1980).

Table 4.18
Projected area of forestlands remaining after distribution to upland residents, 1988-2025

Region	Forestland Remaining After Land Distribution (in million hectares)		
	1988	2000	2025
Philippines	**4.496**	**3.080**	**1.704**
1 Ilocos	1.199	1.095	0.808
2 Cagayan	2.076	1.939	1.474
3 Central Luzon	0.419	0.334	0.069
4 Southern Tagalog	1.996	1.837	1.287
5 Bicol	0.561	0.439	0.289
6 Western Visayas	0.694	0.601	0.357
7 Central Visayas	0.376	0.213	(0.276)
8 Eastern Visayas	0.650	0.584	0.404
9 Western Mindanao	0.403	0.295	(0.164)
10 Northern Mindanao	0.864	0.673	(0.050)
11 Southern Mindanao	1.644	1.342	(0.060)
12 Eastern Mindanao	0.810	0.752	0.613

Source: M.C.J. Cruz, 1989.

Note: Based on one hectare per household; 5.6 persons per household.

Table 4.19
Household population 15 years and over by employment status, third quarters 1980-1988

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Projected Household Population (15 years and over)									
Number (in '000)	28,967	29,847	30,748	31,676	32,682	33,646	33,838	34,840	35,865
Percent in the Labor Force	59.8	61.7	60.1	64.1	64.2	63.4	63.8	65.7	65.4
Percent of Labor Force:									
Employment Rate	95.0	94.7	94.0	94.6	93.8	92.9	88.9	90.9	91.7
Unemployment Rate	5.0	5.3	6.0	5.4	6.2	7.1	11.1	9.1	8.3
Underemployment Rate	34.5	36.3	34.2	35.9	35.7	33.7	36.0	30.5	29.4
Percent of Employed:									
Agriculture	51.4	51.1	51.3	51.4	49.5	48.4	49.9	47.8	46.1
Non-Agriculture	48.6	48.9	48.7	48.6	50.5	51.6	50.1	52.2	53.9

Source: National Statistical Coordination Board, 1989 National Statistics.

Notes: 1. Figures were based on the October round of the ISM survey results.
2. The working age population (15 years and over) in 1986 and 1987 were based on the new population projections.
3. The underemployment rate is the ratio in percent of the number of employed persons working less than 40 hours a week over the total employed.

Table 4.20
Labor force participation rate, employment status, urban and rural: 1975 to 1988
(number of persons in the labor force in thousands)

Year/Area	Labor Force Participation Rate (%)	Labor Force by Employment Status		
		Total Labor Force	Employed (%)	Unemployed (%)
Philippines				
1975	51.0	15,161	95.8	4.2
1976	60.5	15,017	94.8	5.2
1977	58.2	15,002	95.5	4.5
1978	62.5	16,792	95.9	4.1
1979	61.4	16,945	96.0	4.0
1980	59.8	17,308	95.0	5.0
1981	61.7	18,423	94.7	5.3
1982	60.1	18,474	94.0	6.0
1983	64.1	20,310	94.6	5.4
1984	64.2	20,969	93.8	6.2
1985	63.4	21,318	92.9	7.1
1986	63.8	22,067	93.3	6.7
1987	66.0	22,984	90.5	9.4
1988	65.4	23,451	91.7	8.3
Urban				
1975	47.4	4,822	92.2	7.8
1976	58.1	4,972	91.5	8.5
1977	55.5	4,954	92.8	7.2
1978	57.5	5,403	94.0	6.0
1979	—	—	—	—
1980	54.8	5,252	91.8	8.2
1981	56.4	5,575	91.7	8.3
1982	56.2	5,722	90.2	9.8
1983	57.8	6,067	90.7	9.3
1984	59.9	7,766	89.3	10.7
1985	59.4	7,892	88.2	11.8

Table 4.20 (continued)

Year/Area	Labor Force Participation Rate (%)	Labor Force by Employment Status		
		Total Labor Force	Employed (%)	Unemployed (%)
Urban (continued)				
1986	59.6	8,037	88.5	11.5
1987	62.5	8,668	86.2	13.8
1988	61.9	8,821	87.7	12.3
Rural				
1975	52.8	10,339	97.4	2.6
1976	61.7	10,049	96.4	3.5
1977	59.6	14,049	69.3	2.2
1978	65.1	11,390	96.8	3.2
1979	—	—	—	—
1980	62.2	12,056	96.3	3.7
1981	64.4	12,847	96.0	4.0
1982	62.0	12,751	95.8	4.2
1983	67.3	14,243	90.3	3.7
1984	66.9	13,202	96.5	3.5
1985	66.0	13,426	95.6	4.4
1986	66.3	14,030	96.1	3.9
1987	68.2	14,316	93.2	6.8
1988	67.7	14,631	94.1	5.9

Source: National Statistical Coordination Board, 1989 National Statistics.

Note: All data on years 1975 to 1986 were based on the past Third Quarter Reference Period and 1987 Past Week Reference Period.

Because the nonagricultural sector can absorb only so much of the labor force, population increase must be accompanied by the expansion of agricultural areas. But the reverse is taking place. The Ministry of Human Settlements, for example, estimated that as much as one million hectares of high-quality land would be utilized for nonagricultural purposes by the year 2000 (The World Bank, 1980).

c. Settlement and Farming of Marginal Uplands

By definition, the uplands comprise: (1) marginal lands with slopes of 18 percent or greater; (2) lands within mountain zones including table lands and plateaus lying at high elevations; and (3) lands with terrain classified as hilly to mountainous.

It has been estimated that one-third (17.8 million) of the total Philippine population lived in the uplands in 1987 (Cruz, 1989). This is broken down as follows:

Urban	3.63 million
Forest lands	8.50 million
alienable and disposable (A & D) lands	5.76 million

The Department of Environment and Natural Resources (DENR), however, gives a much lower estimate of the upland population in its Inventory of Forest Occupants (IFO) project. As of March 20, 1990, the project has inventoried 7,553 of 8,473 targeted *barangays*. It has counted 477,417 households representing 2,230,339 persons. The DENR also estimates that the present population density in the uplands is 174.7 persons per square kilometer. However, the estimate for the sustainable level of population in shifting cultivation areas is only 25 persons per square kilometer.

The upland population lives mainly by shifting cultivation (Umali, 1988). Growing at an annual rate of 2.54 percent, the upland population is projected to increase to 24 to 26 million by the year 2000 (Cruz, 1989). This means that an additional five to six million people in steep slopes would be opening up more lands for cultivation.

Hill-slope farming without adequate soil conservation measures often leads to soil erosion and fertility depletion. For instance, in the Bayhay River watershed in Leyte, cultivation in hillside farms resulted in the decline in Ca (calcium), Mg (magnesium), available P (phosphorous), pH [acidity and alkalinity], and organic matter [see Table 4.21]. The same study also measured

an average of 489 tons per hectare soil loss in six months of cultivation [see Table 4.22].

The average annual erosion in Philippine uplands varies from 20 to 40 tons per hectare to as much as 200 tons per hectare in degraded grasslands. Upstream, upland farming can result in low farm productivity, loss of indigenous flora and establishment of grasslands. Downstream, it can lead to sedimentation and flooding.

In 1982, lands devoted to upland agriculture accounted for 25.9 percent of total forest lands. Upland agriculture usually takes place in altitudes of 500 to 2,000 meters above sea level and on slopes of 20 percent to 45 percent (Philippine Agenda for Rural Development, 1986).

The yield of upland rice cultivation has remained low at one metric ton per hectare since 1969 (MAF, 1985).

3. Loss of Genetic Diversity

Current agricultural policies which stress the more extensive use of monocultures and uniform strains erode the genetic potential of crops. While high-yielding varieties (HYVs) produce bigger harvests, they are also more disease-prone. Use of these varieties also exposes farmers to greater risks of pest and disease-related crop failures. Furthermore, as many wild strains become extinct, the gene pool from which improved pest and disease resistance can be developed is diminishing. Intensive and continuous planting of the same crops every year also favor the buildup of pests and diseases.

While biotechnology is a significant advancement in agriculture, there are potential environmental risks in its use. B.M. Espiritu (1990) enumerated these risks as follows:

a. emergence of new pests;
b. enhancement of the survival and persistence of existing pests when they hybridize with related transgenic crop plants;
c. harm to non-target species;
d. disruptive effects on biotic communities;
e. negative effects on ecosystem processes;
f. production of even more toxic by-products by the incomplete degradation of hazardous chemicals; and
g. squandering of valuable biological resources.

Table 4.21
Soil responses to cultivation in Bayhay River watershed, Leyte

Hillside Farms	Ca (meq per 100 g)	Mg	pH	Available P (ppm)	OM%
After Burning	16.0 (3.7)	22.6 (4.3)	6.7 (0.3)	19.2 (23.4)	6.5 (1.3)
1 Year Cultivation	14.2 (3.0)	20.7 (4.5)	6.2 (0.3)	3.2 (2.9)	5.8 (1.0)
2 Years Continuous Cultivation	11.3 (1.2)	16.6 (1.6)	5.6 (0.1)	0 (0)	3.2 (1.1)
5 Years Continuous Cultivation	5.2 (1.2)	9.9 (0.9)	5.4 (0.2)	0 (0)	3.2 (0.4)

Source: Siebert, 1987.

Ca = calcium
Mg = magnesium
P = phosphorous
pH = acidity and alkalinity
ppm = parts per million

Table 4.22
Soil erosion in hillside farms during first six months of cultivation

	Soil Loss (cm)		Sediments Loss Estimate (t/ha)
	mean	SD	
Overall Total (n=91) (mean slope = 45%)	3.3	3.1	489
Ridges (less than 30% slope) (n=18)	0.6	1.5	93
Steep Sites (greater than 30% slope) (n=51)	3.8	3.0	556
Gullies (n=22)	4.5	3.1	657

Source: Siebert, 1987.

cm = centimeters
SD = standard deviation

The use of HYVs has not improved the living conditions of small farmers. Dr. Burton Oñate, former head of the International Rice Research Institute, has noted that poor farmers become even poorer because of the high cost of farm inputs. Similarly, Dr. Teodoro Mendoza of the Department of Agronomy, University of the Philippines at Los Baños pointed out that the combined effect of rice ideotypes, namely, high photosynthetic productivities and photosynthetic partitioning in favor of grain yield, chained farmers to greater use of off-farm inputs (*PESAM Bulletin*, 1985). To increase crop yield requires four bags of fertilizer per hectare. To double the yield means a tenfold increase in fertilizer input.

4. Tenurial Issues

Insecurity of land tenure is a major constraint to more productive management of croplands. Absentee landlords often fail to implement conservation measures while the tenant farmer has little incentive to invest in the long-term sustainability of the land.

The problem of land ownership and distribution is being addressed by the government through the Comprehensive Agrarian Reform Program (CARP). From July 1987 to May 1990, the Department of Agrarian Reform (DAR) claims it has redistributed 430,000 hectares of land as part of the program (*Philippine Daily Inquirer*, 8 October 1990).

But critics say that only 6.2 percent of CARP's ten-year hectarage target has been achieved so far. Moreover, it is said that 79 percent (341,149 hectares) of the area redistributed was already covered by the Marcos-era land reform program.

Budgetary constraints also cripple CARP implementation. Half of the $10 billion needed for the program will be raised from foreign donors in the form of grants and loans. But frequent leadership turnovers at the DAR have prompted the coordinating council of the Philippine Assistance Program (PAP) to recommend the deferment of CARP's presentation to PAP donors (*Philippine Daily Inquirer*, 8 October 1990).

Irked and dissatisfied by the government's land redistribution program, many militant farmers have begun implementing their own version of agrarian reform. In Mindanao for instance, farmers have resorted to land occupation (*Philippine Daily Inquirer*, 8 October 1990). They have also

demanded from landlords, agricultural corporations and big ranchers higher prices for their produce, lower land rent, a sharing system favorable to farmers, the right to sell farm produce to other buyers, and other reforms.

The uneven distribution of land is best dramatized by the fact that as much as 30 percent of the population are landless farmers living on the marginal and highly erodible uplands. Only 20 percent of the population own 60 to 80 percent of cultivated land (as quoted in Porter and Ganapin, 1988). The scarcity of land is aggravated by transnational corporations who run vast plantations. Table 4.23 reveals that more than half of the land area planted to pineapples in Mindanao is controlled by two transnational corporations.

The tenurial insecurity of upland farmers is rooted in the government policy of setting an 18-percent slope cut off for land to be considered alienable and disposable. In 1987, alienable and disposable lands comprised 14.12 million hectares or 47.05 percent of the total land area (DENR, 1988). About 2.65 million hectares, however, remain idle for speculative purposes. On the other hand, about 29 percent of the forest lands are already titled through the Bureau of Forest Development (BFD) Stewardship contracts. Integrated Social Forestry is one of the projects of CARP under the non-land transfer programs.

5. Low Income and Poverty

Data from 1980 to 1983 reveal that some 5.3 million families, about 56 percent of the country's total, depend on agriculture (Philippine Agenda for Rural Development, 1986). The discrepancies in income between poor families in the agricultural and nonagricultural sectors in 1980 and 1982 is shown in Table 4.24. The table shows that there are more farming families in the poorest 30 percent of the population.

In the Philippines, cultivation is dominated by small-scale farmers. Table 4.25 shows that 85 percent of total farmlands in the country are less than five hectares in size while 94 percent are seven hectares or less.

Marginal upland farmers reportedly earn from 800 to 3,000 pesos a year (Arias, 1990) and are among the poorest of the poor. In 1988, their average annual family income was 34,933 pesos, which was below the poverty line of 36,000 pesos. Upland farmers cultivate less productive lands with an average yield of only about half that of lowland rainfed lands, and only a third of the yield of irrigated lowland fields.

Table 4.23
Plantation area of Dole and PPC in Mindanao, 1980 (in hectares)

	Area Leased to NDC	Area Leased from Local Farm Producers	Total Area	Percent to Total Area in Mindanao Planted to Pineapple
Dole	8,000	2,100	10,100	17
PPC	8,000	12,000	20,000	35
Total	16,000	14,100	30,100	52

Source: ARC (1984) Showcases of underdevelopment in Mindanao: Fishes, forest and fruits, pp. 178-179.

Table 4.24
Percentage of agricultural and nonagricultural low income families to total bottom 30 percent (national standard): third and fourth quarters 1980-1983

	3rd Quarter				4th Quarter				
	1980	1981	1982	1983	1980	1981	1982	1983	Average (80-83)
Agriculture	81.7	81.9	81.2	82.4	79.1	81.8	80.2	79.1	80.92
Non-agriculture	18.3	18.1	18.8	17.6	20.9	18.2	19.8	20.9	19.08
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: National Statistics Office.

Table 4.25
Number and area of farms by tenure of farm and by size of farm, Philippines, 1980

Tenure of Farm	All Farms	Under 0.50 ha.	0.50 to 0.99 ha.	1.00 to 1.99 ha.	2.00 to 2.99 ha.	3.00 to 4.99 ha.	5.00 to 7.00 ha.	7.01 to 9.99 ha.	10.00 to 24.99 ha.	25.00 ha. and over
Total Number of Farms	3,420,323	289,962	485,829	964,220	613,824	588,151	283,585	76,421	103,723	14,608
Farms Operated Under One Form of Tenure	2,967,667	256,067	412,325	823,349	532,712	514,975	255,460	66,326	93,536	12,917
Owned or Held in Owner-Like Possession	1,993,293	161,246	138,017	498,658	356,660	384,003	208,186	55,432	79,640	11,451
Rented or Leased from Others	871,536	71,058	156,201	298,339	162,750	119,690	40,384	9,891	11,998	1,225
Rented Free	65,376	14,454	14,653	19,834	8,041	5,206	2,123	414	581	70
Other Single Forms of Tenure	37,462	9,309	3,454	6,518	5,261	6,076	4,767	589	1,317	171
Farms Operated Under More Than One Form of Tenure	452,655	33,894	73,504	140,871	81,112	73,176	28,125	10,095	10,187	1,691
Owned and Rented or Leased from Others	367,304	25,028	58,505	114,662	67,108	61,108	23,375	8,194	8,082	1,242
Other Combination of the Forms of Tenure	85,351	8,866	14,999	26,209	14,004	12,068	4,750	1,901	2,105	449
Total Farm Area	97,251	689	3,002	11,899	13,323	20,667	16,121	6,309	14,063	11,178
Owned or Held in Owner-Like Possession	70,411	399	1,624	6,798	8,455	14,710	12,637	5,006	11,543	9,238
Rented or Leased from Others	24,116	249	1,254	4,726	4,516	5,453	3,016	1,172	2,186	1,544
Rented Free	1,343	33	98	280	217	259	171	60	128	97
Other Forms of Tenure	1,381	8	26	95	135	245	297	71	206	299

Source: National Statistical Coordination Board. 1989 Philippine Statistics.

ha = hectares

There are three reasons for the low income of upland farmers: low agricultural productivity, low prices received for their products and high cost of inputs. In Buguias, Benguet, for example, seeds, fertilizers and pesticides constituted 18 to 64 percent of the total cost of production of potato, carrot, and cabbage (Basug, 1972). By 1978, these constituted 43 to 84 percent of the production cost of the same crops (Lizarondo *et al.*, 1982). Foreign supplied inputs such as fertilizers and pesticides constituted 60 percent of the production cost of potatoes in Baguio City (Rasco, 1985).

6. Climatic Factors

Adverse climatic conditions have resulted in an estimated loss of 85 percent of the total annual production of rice and corn.

a. Drought

Data from the Office of Civil Defense [see Table 4.26] cite droughts in 1978, 1983 and 1987. In 1983, a severe eight-month long drought affected 0.99 million hectares of agricultural land and more than 400,000 farmers and resulted in production losses of 763.14 million pesos, mainly in the Visayas and Mindanao. The combined output of agricultural crops and livestock fell by 2.1 percent in terms of real gross value added. Among the most severely hit were 11 Mindanao provinces where 120,000 tons of rice and corn were destroyed. Altogether, the 1983 drought destroyed about 235,152 hectares of rice land. Sugar production declined by 15 percent and coconut production, by 10 percent.

In the early part of 1990, drought destroyed half a billion pesos worth of rice crops in four provinces in Central Luzon. Vast tracts of rice lands in 21 towns of Bulacan, six in Pampanga, three in Tarlac and one in Nueva Ecija were devastated by the drought. The hardest hit was Bulacan, where some 376 million pesos worth of crops were destroyed. Some 196 million pesos worth of rice crops were also destroyed in Pampanga, 15 million pesos in Nueva Ecija, and 2.4 million pesos in Tarlac.

The occurrence of these dry spells cannot be blamed solely on nature. Human activities in the uplands contribute to disturbances in hydrological regimes. There are no conclusive studies, however, which have established the extent of damage wrought by human activities. What is known is that the

Table 4.26
History of occurrence of droughts in the Philippines, 1978-1987

Year	Number of Occurrences	Agricultural Areas Affected (hectares)	Number of Farmers Affected	Number of Dependents Affected	Production Losses (million pesos)	Relief Assistance (million pesos)
1978	1	—	733	2,829	—	0.007
1983	1	987,379.82	422,765	—	763.14	100.819
1987	1	56,314.25	2,363	—	706.44	—

Source: Office of Civil Defense - Operations Center
Department of National Defense, Camp Emilio Aguinaldo, Quezon City.

Table 4.27
History of occurrence of flooding in the Philippines 1973-1989

Year	Number of Occurrences	Number of Casualties	Persons Affected	Damages (million pesos)	Relief Assistance (million pesos)
1973	2	3	35,277	3.31	—
1974	1	—	10,938	0.01	—
1975	4	—	594	0.80	—
1976	3	21	88,069	12.32	0.05
1977	6	5	10,801	16.20	—
1978	2	11	2,230	—	—
1979	3	1	113,464	5.17	—
1980	5	336	889,214	366.28	—
1981	4	242	4,354	4.21	4.18
1982	2	49	532,225	115.06	2.04
1983	6	86	38,276	12.60	0.13
1984	6	—	37,414	2.50	—
1985	—	—	97,861	—	—
1986	—	10	146,443	9.14	0.21
1987	4	6	2,009	—	—
1988	6	2	3,724	—	—
1989	—	324	540,882	—	—
TOTAL	**54**	**1096**	**2,553,775**	**547.62**	**13.96**
Average	3.17	64.47	150,222	32.21	0.82

Source: Office of Civil Defense - Operations Center
Department of National Defense, Camp Emilio Aguinaldo, Quezon City.

heat and moisture released into water vapor by the thick vegetation of forests create the dense cloud cover that produces rain. Droughts are therefore more common in areas of low forest cover.

b. Floods and Typhoons

From 1973 to 1989, a total of 54 floods were recorded, while 127 typhoons hit the country during the same time period [see Tables 4.27 and 4.28].

In November 1988, Leyte residents blamed a devastating flood on the Timber Producers Marketing Corporation (TPMC), whose logging operations stretch over an area of 26,000 hectares. It was reported that huge floating logs carried by strong currents from the logging site wrecked roads, bridges and houses and destroyed crops. Torrential waters cascading from the mountains submerged 400 hectares of rice fields for about a week and eroded large areas in Abuyog, Leyte. In addition, the Bito River Irrigation System suffered damage estimated at 600,000 pesos (Bacarela, 1989).

RECOMMENDATIONS

The following are some policy and program gaps and some recommended measures to rehabilitate the croplands ecosystem:

1. **The absence of a national agricultural land use policy which would resolve the conflict between agriculture and industry.** The Land Use Committee of the National Economic and Development Authority (NEDA) is currently confronted with the problem of conflicting land use between the agriculture sector and the industry, housing and commercial sectors. Resolving this conflict is difficult because of the absence of a policy that lays down the proper disposition of prime agricultural lands. The Philippine population is expected to double in about 25 to 30 years if the present growth rate of 2.4 percent continues. By the year 2020, the demand for land for non-agricultural uses will be about six million hectares, which is almost equal to the size of presently existing prime agricultural lowlands. This demand poses a tremendous threat to remaining agricultural lands, especially in the productive lowlands. It is therefore urgent for the government to formulate a land use policy now, before the problems become more difficult to resolve. It is also in the interests of the Department of Agriculture (DA) to take an active role in the

Table 4.28
History of occurrence of typhoons in the Philippines, 1983-1989

Year	Number of Typhoons	Number of Typhoons	Cost of Damage (billion pesos)	Cost of Relief (million pesos)	Affected Persons (in millions)
1983	14	4	0.51	2.068	0.747
1984	20	4	5.87	—	4.048
1985	17	4	2.72	3.001	1.643
1986	21	6	1.78	10.704	1.414
1987	16	6	4.03	18.600	3.882
1988	20	5	8.68	113.102	6.081
1989	19	7	5.53	15.650	2.576
Total	127	36	29.12	163.125	20.391
Average	18	85	4.16	25.303	2.913

Source: Office of Civil Defense - Operations Center
Department of National Defense, Camp Emilio Aguinaldo, Quezon City.

formulation of this policy and to help in the development of measures to implement it.

2. **The lack of appropriate measures to protect prime agricultural lands from being converted to other agricultural uses.** The encroachment of urban uses into prime agricultural lands continues because there is no national agricultural land use policy. Moreover, the DA has not been able to preserve prime agricultural lands not only because of the absence of such a policy but also because it has failed to clearly define the characteristic properties of prime lands and to provide information on their geographic location or spatial distribution. The only policy measure which currently protects the conversion of agricultural lands is a provision in the Comprehensive Agrarian Reform Law which prohibits such conversion under certain conditions. But this provision can be overruled by Municipal Land Use Plans which delineate areas for agricultural and nonagricultural use. The NEDA Land Use Committee has recently come up with a definition of prime agricultural lands. If this definition is officially accepted, the next step should be to assess the status of prime agricultural lands through mapping and delineation and to formulate measures to protect and preserve these lands.

3. **The need for a well-coordinated and well-funded national soil conservation program covering both lowlands and uplands.** Efforts to conserve soils and minimize erosion are undertaken by the DA's Bureau of Soil and Water Management (BSWM) in agricultural lands under 18 percent slope and by the Department of Environment and Natural Resources (DENR) in forest lands (i.e., above 18 percent slope). The BSWM's Soil Conservation Guided Farms project assists farmers in the preparation of soil conservation-oriented farm development plans. The project has established soil demonstration stations covering a total area of 423 hectares in 13 regions. The bureau has started to take interest in upland soil conservation and farming systems. It is sponsoring training activities and conducting planning exercises on crop development and soil conservation. These efforts, however, appear minuscule in the context of the magnitude of the country's soil erosion problems.

   Similarly, the forestation and Integrated Social Forestry (ISF) efforts of the DENR are only on a limited scale. They do not fully address the soil erosion problem in cultivated forest lands because DENR

extension workers do not know much about upland soil conservation farming systems. DA extension workers also lack knowledge and experience in agro-forestry. A national soil conservation program, which integrates and closely coordinates the efforts of these two agencies in developing soil conservation farming system technologies and undertaking soil conservation extension and technology transfer, is therefore necessary. Furthermore, conservation projects in critical upland areas require the collaboration of the government, nongovernment organizations and local communities.

4. **The need for agricultural planners to acquire skills in agro-environmental planning/program implementation and the need for DA and DENR extension workers to acquire knowledge and technology in upland soil conservation.** In order to efficiently and effectively implement a sustainable agro-environment development program, the DA should strengthen the technical capability of its planning staff in agro-environmental planning and program implementation. It must also upgrade the skills of its extension workers. In both the DA and DENR, extension workers must acquire skills in upland farming system technology and soil conservation.

5. **The need for the DA, DENR and Department of Agrarian Reform (DAR) to establish a coherent program for sustainable agro-environment development.** The Philippine Strategy for Sustainable Development (PSSD) formulated by the DENR is somewhat biased toward the natural resources sector. It has therefore overlooked some important aspects of the agro-environmental sector such as the protection and conservation of prime agricultural lands, the development and transfer of agrotechnologies for hilly and highland agro-ecosystems, the promotion of highly efficient agricultural land uses and the reclamation of problem soils. Likewise, the PSSD still has to be translated by the DA and the DENR into a viable operational plan. In particular, the existing programs and projects of the DA and the DENR should be organized coherently under the PSSD operational plan in order to avoid overlaps and redundancies or even conflicting programs and projects. An Integrated Sustainable Environment Development Program would serve as a means of complementing and reinforcing the efforts of the DA and the DENR. This kind of program should be pursued through the creation of a special inter-agency technical working committee.

6. **The need for the DAR and the DENR to provide security of tenure to upland dwellers and others occupying areas classified as forest lands.** If the government reclassified as alienable and disposable lands with 19- to 30-degree slope, it can then issue titles to deserving occupants of these areas. However, this may pose some legal questions and create jurisdictional quarrels between the DA and the DENR. Worse, such a policy would only attract more upland migration. A better solution would be to revise some of the conditions governing stewardship contracts, such as allowing them to be automatically renewable and transferable to other upland occupants. For contract holders who have satisfactorily achieved the objectives of the Integrated Social Forestry program, a longer renewable period of 50 years may be awarded.

7. **The lack of a program to monitor and control pesticide and fertilizer pollution.** Pesticide and fertilizer residues are not properly monitored by concerned agencies such as the Fertilizer and Pesticide Authority and the Environmental Management Bureau due to the lack of necessary laboratory facilities, equipment, human resources, and technical capability. Other factors that contribute to pesticide misuse are the lack of users' access to technical assistance and the lack of information provided by the sellers and distributors. Labels on pesticides are sometimes not fully understood by users. Given the government's target to meet 100 percent self-sufficiency in rice, it must correspondingly increase its extension efforts to promote the proper use and management of fertilizers and pesticides, and to develop and expand its program in organic fertilization and biological pest control.

8. **The need to vigorously pursue an integrated population and environmental resources development program.** The DENR is presently unaware of the maximum sustainable population that can be supported by available upland resources. Likewise, there is no clear-cut land use plan for the upland areas in general and the settled areas in particular. Without this information, the department cannot formulate a sound land use plan and promote a population program in the uplands. The DENR and the DA should actively participate in this population control campaign by integrating population programs in their development and extension work and by collaborating closely with other agencies administering population programs. One

promising approach is to integrate population concerns with development programs such as actively involving women in upland development; providing better education, nutrition, health services, and more diversified livelihood opportunities in the uplands; and improving security of tenure. In the meantime, the government should fully develop lowland agriculture and support agro-industrialization as a prelude to full-scale industrialization. This strategy is consistent with the agrarian reform vision of transforming tenants into productive tillers of their acquired lands, and former landowners into agro-industrial entrepreneurs. This development strategy worked for Taiwan by absorbing surplus labor and accumulating capital resources which provided the take-off point for industrialization.

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CHAPTER 5
THE PHILIPPINE URBAN ENVIRONMENT

Rosario D. Jimenez

BACKGROUND

By the year 2000, 46 percent of all Filipinos will be living in urban areas compared to only 37 percent in 1984. This increase is partly due to population growth, rural to urban migration, and the reclassification of land from rural to urban uses. As more areas become built-up, it becomes important to determine how the health, safety and well-being of urban residents are best assured. Even now, a large proportion of the population is already complaining about deteriorating living conditions. This paper attempts to describe the urban environment with emphasis on Metropolitan Manila and to identify measures which will bring about the sustained development of urban areas. The analytical framework for this study is shown in Figure 5.1.

PRESENT SITUATION

1. Urban Population Growth Trends

It appears that on a national scale, urban growth has been mainly due to the natural increase of the city and town-based population. From 1960 to 1970, 50 percent of urban growth was attributed to natural increase and only 17.6 percent was due to net rural to urban migration. In Metro Manila, however, urban growth as a result of net migration has been larger than that due to natural increase. In fact, the National Capital Region (NCR) had the highest population growth rate of any region in the Philippines from 1970 to 1980. For this period, about 41 percent, a little less than half of the region's total growth is attributed to net migration. Through the years, a steady stream of migrants has caused the city's population to grow to eight million people occupying a total land area of 636 square kilometers. In 1980, Metro Manila's population was 9,314 persons per square kilometer. It has about four times more the combined total population of the next four largest cities — Davao, Cebu, Zamboanga and Bacolod. In 1980, Metro Manila's population already

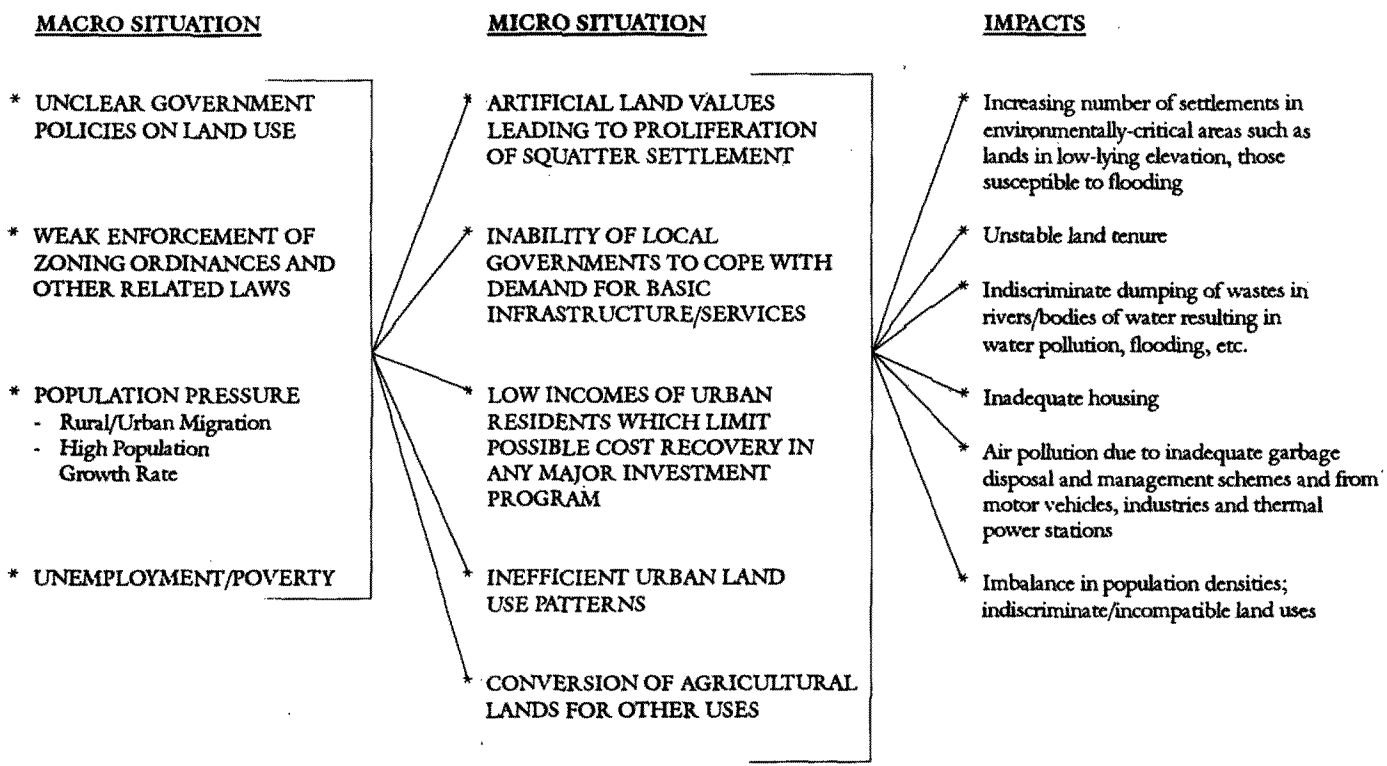


Figure 5.1 Analytical Framework for the Urban Environment

constituted over 12 percent of the national population and one-third of the entire urban population. By the end of this century, Metro Manila's population will reach 11.1 million.

A study comparing the levels of urbanization of the different Philippine regions shows that next to Metro Manila, Central and Southern Luzon are the more urbanized regions, followed by Central Visayas, Southern Mindanao and Western Visayas (Jimenez *et al.*, 1983). This indicates that certain parts of Luzon island will achieve a higher level of urbanization sooner than other areas and ahead of the other islands of the Philippines [see Table 5.1].

2. Housing in Urban Areas

As urbanization progresses, the growing demand for land has caused land prices to rise to prohibitive levels. In Metro Manila, Davao, Cebu and other rapidly urbanizing capital towns and cities, people are forced to reside in the urban fringes where land is comparatively cheaper. The poor are forced to settle in public or private land as well as river banks and flood-prone areas. The conversion of fertile agricultural land into urban uses has given rise to disputes. At the same time, slums and squatter settlements have become a permanent part of the urban landscape. There are 415 officially recorded slum and blighted areas in Metro Manila with an estimated population of 274,200 families. Nearly half of these families are said to be located in privately owned land. Population growth in these areas is estimated at 12 percent per annum (Von Einsiedel and Reforma, 1986).

One estimate is that there were four million people living in slums and squatter colonies in 1985. They comprise 10 percent of the total population and 25 percent of the urban population (Jimenez *et al.*, 1983). The National Housing Authority estimates that in Metro Manila, 33 percent of the population are considered slum or squatter dwellers. They occupy 695.5 hectares of land, two-thirds of which is government property. The discrepancies in these estimates illustrate the difficulty of monitoring slum or squatter populations. About 44 percent of Metro Manila dwellers live below the poverty line (3,292 pesos a month per family, as estimated by the Presidential Commission on the Urban Poor or PCUP). These people do not have access to credit and with the high cost of land, cannot afford decent housing. One study reckoned that 44.1 percent of all Metro Manilans are "house renters." Sixteen percent more were classified as "sharers or visitors" (the term given to those who double up with other families to rent rooms or who stay and

Table 5.1
Regional percent share of total urban population and urbanization levels and tempos, 1970-1980

Region	Percent of Total Urban Population			Level of Urbanization			Tempo	
	1970	1975	1980	1970	1975	1980	1970-75	1975-80
Philippines	**100.0**	**100.0**	**100.0**	**31.2**	**33.4**	**37.3**	**1.5**	**3.5**
Philippines (excldg. Metro Manila)	—	—	—	22.8	24.5	28.5	—	—
Metropolitan Manila	34.7	35.4	33.0	100.0	100.0	100.0	4.6	3.6
More Urbanized	40.3	42.1	44.0	27.3	30.0	34.9	2.7	4.7
3 Central Luzon	9.5	10.2	11.2	30.1	33.9	41.8	3.6	7.0
4 Southern Luzon	11.6	11.8	12.6	29.8	31.8	36.9	2.0	4.7
7 Central Visayas	7.3	7.0	6.8	27.6	28.9	32.0	1.3	3.0
11 Southern Mindanao	5.1	5.2	6.2	26.6	26.7	33.5	0.1	6.9
6 Western Visayas	6.8	7.9	7.2	21.5	26.7	28.3	5.9	1.7
Less Urbanized	**17.8**	**16.4**	**16.4**	**19.6**	**20.2**	**23.3**	**0.7**	**3.8**
1 Ilocos	**5.1**	**4.9**	**4.7**	**19.4**	**21.0**	**23.8**	**2.1**	**3.2**
5 Bicol	**5.0**	**4.2**	**4.2**	**19.2**	**18.4**	**21.5**	**-1.0**	**3.9**
8 Eastern Visayas	**4.1**	**3.5**	**3.4**	**19.4**	**18.7**	**21.8**	**-0.9**	**3.9**
10 Northern Mindanao	**3.6**	**3.8**	**4.1**	**20.9**	**23.2**	**26.6**	**2.8**	**3.8**
Rural	7.2	6.3	6.7	15.0	14.6	17.1	-0.6	4.0
2 Cagayan Valley	2.1	1.8	1.9	14.1	13.4	15.5	-1.4	3.6
9 Western Mindanao	2.6	2.2	2.4	15.6	14.9	17.0	-1.4	3.4
12 Central Mindanao	2.5	2.3	2.4	14.9	15.5	18.8	0.9	4.9

Source: Raymundo, 1983, Table 4.7.

share rooms for free indefinitely, for instance, sons or daughters and their spouses and children staying with their parents). The average Metro Manila household has 12 persons, a large proportion of whom are "sharers or visitors" (Jimenez *et al.*, 1983).

So far government pronouncements and attempts to enforce laws have had little impact on the development of squatter settlements. The housing backlog is expected to increase with the rising incidence of poverty, escalating land costs and lack of credit. In 1970, the National Economic and Development Authority (NEDA) estimated a housing backlog of only 123,506 dwelling units, with Metro Manila accounting for 4.28 percent. In 1977, unacceptable dwellings (*barong-barongs* or houses of makeshift materials) in Metro Manila were said to be 28.5 percent of total dwelling units. These are considered conservative estimates.

3. Availability of Basic Services

a. Water Supply

The Metropolitan Waterworks and Sewerage System (MWSS) provides piped water in the Metro Manila area while the Local Water Utilities Administration (LWUA) assists local governments in putting up water facilities in districts with a population of at least 30,000. In 1975, only 55 percent of urban households had piped water. In 1977, only 68 percent of Metro Manila residents were served by MWSS. Residents of slums and squatter communities are believed to obtain water from sources outside the home. One survey conducted among 1,197 households in low-income urban communities in Metro Manila, Cebu and Davao showed that only 16.7 percent had a direct water connection. A larger number depended on artesian wells, public faucets, and open wells. Water fetchers normally had to queue for one to three hours and up to four hours during summer months when water levels are low. Those who used artesian wells and open wells had to contend with gastrointestinal diseases, including parasites. In many urban areas, water is sold by street peddlers. The cost of water ranged from 15 centavos per 2.5 gallons to one peso for 7.3 gallons in Manila. On a monthly basis, one paid from 27.41 to 38.50 pesos in Cebu, and in Davao City, between 24.61 and 42.10 pesos (PCUP Report, 1988).

b. Sewerage and Drainage

A World Health Organization/World Bank Study states that "there are only six major cities in the Philippines with any kind of organized public sewerage." These are Baguio, Bacolod, Cebu, Davao, Zamboanga and Manila. Only 14 percent of Metro Manila is served by a sanitary system with a major portion of the area served by individual septic tanks directly discharging to rivers and other waterways and "contributing 70 percent of all the biodegradable pollutants flowing into the different river systems."

4. Pollution

a. Solid Waste

Municipal solid wastes or garbage are generated by domestic, commercial, industrial and institutional sources. A study conducted on Metro Manila by the Environmental Management Bureau of the Department of Environment and Natural Resources (DENR) states that one of the more serious environmental problems that confront the residents of Metro Manila on a daily basis is the pollution brought about by an inadequate solid waste management program. About 3,400 tons of solid wastes are generated daily in Metro Manila and of this, only 1,500 tons are collected and transported to existing dump sites. The balance of about 1,900 tons is either left on the streets, creating health and aesthetic problems; dumped in storm drains, esteros, canals, creeks or rivers; burned, creating air pollution; or recycled by scavengers.

About 50 percent of the solid waste generated comes from residential or domestic sources and contains a high percentage of putrescible food wastes. The practice of dumping solid waste into drains or natural drainage channels compounds the annual flooding problems since the carrying capacity of the region's drainage network is greatly reduced (Jimenez *et al.,* 1983). The consequences of open dumping are illustrated by the case of Smokey Mountain, a garbage dump at the juncture of Estero de Vitas and the Navotas River in Metro Manila. The site has been a garbage dump for more than 20 years. As a result, a mass of garbage covering 2,000 hectares has been formed, obstructing the natural movement of the waters which originally discharged into Manila Bay, thereby causing floods. Some 20,000 people live on Smokey Mountain, many of them engaged in recycling garbage for a living.

b. Water Pollution

The two main sources of water pollution in urban areas are domestic and industrial wastes. Since only 14 percent of Metro Manila's population is served by a sewer system, sewage is dumped into rivers and waterways. In addition, untreated or partially treated industrial wastes are being discharged into rivers. These organic pollutants contain toxic substances from hospitals and factories. Sewage, industrial wastes, garbage and other solid wastes lower the level of dissolved oxygen in rivers and other bodies of water, damaging aquatic life. In some instances, all dissolved oxygen in the water is used up in the decomposition of organic wastes and the water becomes anaerobic, turbid and foul smelling. Metro Manila river systems have been declared biologically dead.

Inadequate or no safeguards in the disposal of toxic wastes from industries have contributed to high levels of heavy metals in some river systems in Metro Manila [see Table 5.2]. The problems of water pollution are further aggravated by high levels of pesticide use, as revealed by the concentration of pesticides found in rivers. Surface runoff water washes the pesticide off the crops and farmlands into waterways [see Table 5.3].

One illustration of the consequences of uncontrolled dumping of wastes is the so-called 'red tide' phenomenon. From September 1988 until the early part of 1989, bays in the Philippines suffered from a condition said to be brought about by the abnormal and uncontrolled growth of phytoplankton caused by the high organic load in water bodies. Red tide covered all 90,000 hectares of Manila Bay. By October 1988, eight other bays in the country were affected, all of them rich fishing grounds. Eight deaths were reported from 73 cases of poisoning from eating contaminated fish and shellfish. As a result, authorities prohibited the eating of shellfish and other marine products from these areas, bringing economic hardship to fishermen. Without seafood, an important source of protein was lost from the diets of many Manila residents.

c. Air Pollution

Transportation in Metro Manila and other urban areas is predominantly road-based. Intra-urban transport consists of private cars, jeepneys, buses, taxis, tricycles and calesas, while buses, mini-buses and jeepneys provide services between Manila and adjoining towns and distant

Table 5.2
Concentration ranges of heavy metals in some river systems

River System	As of Year	Concentration Ranges (all in ppm except Hg which is in pob)			
		Copper	Zinc	Cadmium	Silver
San Juan	1982	bdc-0.09	bdc-0.67	bdc-0.01	bdc-0.02
	1984	bdc-0.06	bdc-0.31	bdc	bdc-0.01
	1985	—	—	— —	
Pasig	1982	bdc-0.08	bdc-0.78	bdc-0.06	bdc-0.04
Marikina	1984	bdc-0.91	bdc-0.48	bdc	bdc-0.05
	1985	bdc-0.04	bdc-0.14	bdc	bdc-0.02
Zapote	1982	0.01-0.10	0.02-0.07	bdc-0.07	bdc-0.07
Parañaque	1984	—	—	— —	
	1985	bdc-0.06	0.12-0.40	bdc —	
Tullahan	1984	bdc-0.12	bdc-0.19	bdc-0.05	bdc-0.06
NPCC allowable limits		0.02	2.0	0.01	0.05

Source: National Pollution Control Commission, 1982. Seventeenth Annual Report.

bdc = below detectable concentration
ppm = parts per million
Hg = mercury

Table 5.3
Pesticides levels (mg/1) in selected river systems

Pesticides	Pasig-Marikina	Parañaque-Zapote	San Juan
Alpha BHC	0.012-0.026	0.011-0.028	0.012-0.026
Gamma BHCC	0.013-0.24	0.014-0.024	0.016-0.022
Heptachlor	0.008-0.016	—	0.008-0.010
Epoxide	trace-0.026	0.006-0.012	trace-0.010
Aldrin	trace-0.008	trace-0.012	0.008-0.012
Dieldrin	—	trace-0.012	—

Source: National Pollution Control Commission, 1984 Annual Report.

provinces. There are presently 30,788 registered jeepneys and 2,132 buses in Metro Manila. Jeepneys operate on 438 routes while there are 123 bus routes. Traffic congestion occurs not only during peak periods, specifically on roads leading to the central business districts.

Metro Manila's air pollution is caused largely by motor vehicle exhausts. The National Economic and Development Authority states that in other urban areas, motor vehicles do not cause as much pollution as they do in Metro Manila. Conventional air pollution indicators reveal that Metro Manila's pollution problems are much worse than those of many western cities. For instance, from 1973 to 1980, the average concentration of sulphur dioxide in the atmosphere was 73 micrograms per cubic meter, exceeding that of New York, Los Angeles and Chicago and comparable to levels in Frankfurt and London. The average concentration of particulate matter was 85 micrograms per cubic meter, far exceeding that of Tokyo (65), New York (65) and London (31). High volume sample measurements of total suspended particulates (TSP) indicate that annual averages in Metro Manila can exceed 250 milligrams per cubic mater, surpassing the annual US average by over 200 percent.

The Department of Environment and Natural Resources (DENR) says that jeepney, bus and taxi commuters are exposed to excessive concentrations of respirable suspended particles (RSP) in the order of 1,000 milligrams per cubic meter. Millions more of Metro Manila residents are exposed to ambient concentrations of RSP in the order of 100 milligrams per cubic meter.

5. Flooding

About 2,304 cubic meters of garbage are thrown daily into Metro Manila's waterways, causing clogging and flooding during the rainy season. In addition, some 1.9 million people live in 4,600 hectares of flood-prone land. Every year, floods wreak damages averaging 900 million pesos. The three major causes of floods in Metro Manila are intense rainfall, limited capacity of inland drainage facilities, and the disappearance of 35 of some 95 esteros (or canals). Furthermore, flooding is aggravated by illegal fishponds constructed near residential areas.

GOVERNMENT'S RESPONSE

Many municipal, city and national governments all over the world have been unable to manage urban growth and to provide adequate services for urban residents. Metropolitan Manila is no exception. The economic activities in the city account for 32 percent of the nation's gross domestic product and its local governments receive one-third of all local government revenues. But the scale of poverty in the metropolis dwarfs investments in public services.

1. Water Pollution

a. As an initial response, the Department of Environment and Natural Resources in cooperation with other government agencies, the private sector and nongovernment organizations (NGOs), has embarked on a river revival program focused on cleaning up the Navotas-Malabon-Tenejeros-Tullahan river system. The project aims to lower the industrial pollution load of these rivers by 60 percent in 1992.

b. The Metropolitan Waterworks and Sewerage System is committed to implementing a basin-wide septic tank cleaning program that will lower the sewage load from the projected 1992 load of about 26.608 kilogram BOD (biochemical oxygen demand) to about 9,978 kilogram BOD per day.

c. The National Housing Authority aims to remove all squatter shanties along the 26-kilometer waterway, thus helping lower the pollution load.

d. The Department of Public Works and Highways aims to dredge the 26-kilometer waterway and build two parallel roads alongside it. Between 1990 and 1992, these programs were to cost US$ 25.75 million. Beyond 1992, a sewerage collection and marine outfall project will commence, costing an additional US$ 236.8 million. This will complete the full rehabilitation of the Navotas-Malabon-Tenejeros river system, making it capable of sustainable marine life once again.

e. The Manila Bay Clean Up Project is a comprehensive approach to cleaning up the individual sink systems of six major river networks

which empty their wastes into Manila Bay. These river systems are the following:

1) Navotas-Malabon-Tenejeros-Tullahan River System
2) Pasig-San Juan-Marikina River System
3) Las Piñas-Zapote River System
4) Parañaque River
5) Laguna Lake Basin
6) Meycauayan River

Specific activities for this project include the following:

1) Septic tank cleaning and sewerage collection and treatment for domestic sewage;
2) Individual or combined wastewater treatment plants for industrial firms;
3) Dredging of rivers to remove accumulated debris; and
4) Transfer of squatter families along river banks.

2. Solid Waste Management

The Smokey Mountain and Payatas dumpsites have both been earmarked for closure for more than a year now. Their closure, however, depends on the approval of the sanitary landfill in Carmona, Cavite, which local residents are protesting. There are plans to convert the Smokey Mountain and Payatas dumpsites into industrial-residential complexes. The cost of conversion is expected to reach two billion pesos per site. These areas, however, cannot be made immediately productive because of the dangers posed by decomposing organic material which produces methane gas.

3. Air Pollution

The response to air pollution has been limited to the effort by the DENR and other government agencies, the private sector and NGOs to enforce the anti-smoke belching law.

4. Metro Manila Authority

After much deliberation in both houses of Congress, President Corazon C. Aquino signed Executive Order No. 392 in January 1990. This

order constitutes the Metro Manila Authority (MMA) as an interim body prior to the passage of a law creating a body to govern the Metro Manila area. The MMA has jurisdiction over the delivery of basic urban services requiring coordination in Metro Manila. These services include, among others: land use planning and zoning, traffic management and control of operations during calamities and emergencies affecting public welfare and safety, and sanitation management. Changes in zoning and land-use classification, however, are subject to the approval of the Housing and Land Use Regulatory Board (HLURB). Under this setup, local government units shall continue to be primarily responsible for the administration of their respective political jurisdictions while the MMA shall attend to Metro Manila-wide and/or common problems or those transcending local boundaries. The authority had no visible impact in its first six months of existence.

SOME PRESSING POLICY ISSUES

It is clear that the urban environment faces serious problems and the responses to these have been mainly piecemeal and short-term. There is a need for a long-term strategy which takes into account the interrelationship between human activities and the environment, with the ultimate objective of achieving a balance between resource use and technological development. It is felt that this long-term strategy should consider the following issues.

1. The Need for Energy Planning

With the current energy shortage, two major issues have presented themselves: (a) the need for sustainable development based on a reduced primary energy use while still allowing economic growth; and (b) the need for energy planning to address the threat of the greenhouse effect. In the past, planning was done on the assumption that energy is available and inexhaustible and that the natural environment has the capacity to absorb energy use without harm.

The negative consequences of this assumption are now being felt. The Philippine urban environment must take into account the environmental impact of high-energy use. Policy-makers must now study the feasibility of tapping renewable sources of energy such as biomass, mini-hydro, windmills, etc. and of increasing and encouraging the use of more efficient modes of public transport. In addition, they should also look for more efficient urban

land use patterns where the location of major developments and transport routes shall be optimized to cut on travel time. Also needed are detailed siting and layouts to take advantage of topography and energy-conserving measures in the operation and maintenance of building facilities and services.

2. The Possible Negative Impact of Converting Agricultural Land to Urban Use in the Cavite, Laguna and Rizal (CALABAR) Provinces.

Metro Manila is part of a variety of ecosystems that include the Manila Bay Coastal Ecosystem, Laguna Lake Watershed, Novaliches-Montalban Watershed and Marikina and Pasig River Fresh Water Ecosystem for which an environmentally-sound management plan is necessary.

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CHAPTER 6
COASTAL AND MARINE ECOSYSTEMS

About two-thirds of the Philippine population live in coastal zones. This is not surprising because the Philippines is an archipelago of some 7,000 islands and has a coastline of over 18,000 kilometers.

Assessing the present state of the coastal zone environment is a complex task because several ecosystems are involved and the activities affecting these ecosystems are varied. For this reason, the scope of this study had to be limited to the three most important coastal ecosystems: coral reefs, mangrove swamps and seagrass beds.

In addition, this chapter will discuss marine fisheries in terms of fish capture and culture. Capture fisheries will be divided into demersal or bottom fishing and pelagic or surface fishing. Culture fisheries will focus on brackish water and marine culture activities.

THE PHILIPPINE COASTAL ECOSYSTEMS

1. PHILIPPINE CORAL REEFS: ECOSYSTEMS UNDER STRESS

Edgardo E. Gomez

A person on holiday who dons a face mask and swims over a pristine coral reef will be amazed at the kaleidoscopic scene under him. All colors of the rainbow will be seen coming from the most diverse assemblage of life on this planet. The reef fish come in all sizes, shapes, colors and speeds. The invertebrates are even more diverse, being motile or permanently anchored to the bottom. Many are soft to the touch; others are hard and rough. Some should not be touched as they can be deadly, such as the venomous cone shells and the deceptive cubomedusae or box jellyfish. Even the marine plants, often green but also brown, may come in surprising hues of red and purple swaying in the surge.

Such a scene cannot be precisely replicated on a television or movie screen or by colored photographs. But the coral reef's value is not only aesthetic. A coral reef is a geological structure of calcium carbonate created by living organisms, principally the scleractinian corals forming the framework or matrix and the calcereous remains of algae, mollusks, and echinoderms providing the mortar or cement. There are coral communities that may simulate the diverse life of a coral reef whatever be the substrate, but by definition, there are no artificial coral reefs.

In 1979, in a speech at a forum on natural resources conservation (Gomez, 1979), I outlined the significance of coral reefs. Coral reefs are important because first, they support fisheries productivity; second, they provide coastal protection; and third, they have aesthetic and recreational value. To these may be added their scientific and educational value as well as the discovery that reef organisms may be providing us with chemical substances that have pharmacological significance in addition to other non-food products such as construction materials. A more recent review paper on the value of Philippine coral reefs was authored by A.C. Alcala, E.D.Gomez and H.T. Yap (1987).

The Present Situation

Government officials and the press report a 70 percent destruction or degradation of our coral reefs. That figure was first used in a research of the Marine Science Institute which began an investigation of the coral resources of the Philippines in 1977 at the behest of the then Department of Natural Resources. In the published literature, the progression may be traced from 267 stations (Gomez, 1979), 381 (Gomez and Alcala, 1979), 619 (Gomez *et al.*, 1981), to 632 (Yap and Gomez, 1985). This last tabulation is presented here as Table 6.1 as it presents some detail of the coverage.

Two recent projects of the institute have yielded some survey data of a more limited coverage. Some five dozen stations (Pangasinan, Batangas, Oriental Mindoro and Palawan) were surveyed by the ASEAN/Australia Coastal Living Resources Project in 1986-1988 and 40 sites in western Lingayen Gulf were surveyed by the ASEAN/US Coastal Resource Management Project during the same period (Gomez 1989). The summary results of these are combined with those of the previous survey in Table 6.2.

It will be noted that there has been no significant change in the results although a different methodology was used (Dartnall and Jones 1986). If anything, there may have been a slight slip in the negative direction. The situation in 1990 may be inferred to be no different from the situation indicated in the table.

Environmental Issues

The causes of coral reef degradation have been discussed in some detail in previous papers (Yap and Gomez, 1985 and Alcala *et al.,* 1987), and therefore need only be outlined here. Natural causes include water movement, whether it be rhythmical like tides or catastrophic storms; geological dynamics which generally require long time periods; and biological interactions, principally predation. These are factors which corals and coral reefs have generally been able to cope with.

More problematic are the human activities causing reef destruction. These include siltation or sedimentation, fisheries-related destruction, particularly the use of explosives and poisons, the collection of coral and sand for construction, the collection of corals and other invertebrates for the ornamental trade, tourism-related degradation, and other pollution problems.

Siltation and sedimentation over and above the natural levels arise from forest destruction and other human activities in the watershed areas. The pressure of human activities in mountainous areas far inland has its effects downstream on the coastal zone.

Fisheries-related destruction, particularly that caused by blast fishing and the use of poisons, results from the synergism of greed and need, sometimes compounded by laziness and an outright disregard for the environment. Similar causes may be cited for the excessive collection of corals and other invertebrates for the ornamental trade.

The mining of corals and coral sand for construction purposes is often done out of convenience rather than necessity because there are alternative sources of construction materials. Tourism-related degradation can be minimized through adequate education and the enforcement of regulations insofar as tourists are concerned. When developers and resort operators are involved, the problems become more difficult.

Table 6.1
Status of Philippine coral reefs (living coral cover), 1982

Location	No. of Stations	Excellent (75-100%)		Good (50-74.9%)		Fair (25-49.9%)		Poor (0-24.9%)	
		No.	%	No.	%	No.	%	No.	%
LUZON									
1. Albay	9	0	0	1	11.1	5	55.6	3	33.3
2. Bataan	10	0	0	0	0	0	0	10	100.0
3. Batangas	25	0	0	6	24.0	11	44.0	8	32.0
4. Cagayan	4	0	0	2	50.0	2	50.0	0	0
5. Camarines Norte	13	0	0	1	7.7	7	53.8	5	38.5
6. Camarines Sur	2	0	0	0	0	2	100.0	0	0
7. Cavite	9	0	0	0	0	6	66.7	3	33.3
8. Isabela	3	0	0	2	66.7	1	33.3	0	0
9. La Union	5	0	0	1	20.0	2	40.0	2	40.0
10. Marinduque	5	0	0	0	0	4	80.0	1	20.0
11. Mindoro Occidental	31	1	3.2	8	25.8	15	48.4	7	22.6
12. Mindoro Oriental	11	1	9.1	2	18.2	4	36.4	4	36.4
13. Palawan	49	6	12.2	17	34.7	20	40.8	6	12.2
14. Pangasinan	37	0	0	8	21.6	14	37.8	15	40.5
15. Quezon	4	0	0	2	50.0	2	50.0	0	0
16. Zambales	12	0	0	2	16.7	3	25.0	7	58.3
Subtotal	229	8	3.5	52	22.7	98	42.8	71	31.0
VISAYAS									
1. Antique	12	2	16.7	10	83.3	0	0	0	0
2. Bohol	22	0	0	8	36.4	8	36.4	6	27.2
3. Cebu	64	6	9.4	14	21.9	27	42.2	17	26.6
Hilutangan Island	4	0	0	1	25.0	0	0	3	75.0
Mactan Island	15	1	6.7	3	20.0	3	20.0	8	53.3
Olango Island	7	0	0	1	14.3	4	57.1	2	28.6
Sumilon Island	4	0	0	3	75.0	0	0	1	25.0
4. Iloilo	64	9	14.1	18	28.1	17	42.2	10	15.6
5. Leyte	12	0	0	0	0	6	50.0	6	50.0
6. Negros Occidental	18	1	5.6	2	11.1	5	27.8	10	55.6
Refugio Island	4	0	0	1	25.0	1	25.0	2	50.0
7. Negros Oriental	98	5	5.1	20	20.4	41	41.8	32	32.6
Apo Island	5	0	0	5	100.0	0	0	0	0
8. Siquijor	31	0	0	9	29.0	9	29.0	13	41.9
Subtotal	360	24	6.6	95	27.1	131	35.4	110	30.8
MINDANAO									
1. Misamis Occidental	9	0	0	0	0	4	44.4	5	55.6
2. Misamis Oriental	1	0	0	0	0	0	0	1	100.0
3. Zamboanga del Norte	18	1	5.6	3	16.7	6	33.3	8	44.4
Aliquay Island	8	2	25.0	3	37.5	2	25.0	1	12.5
Selinog Island	7	0	0	0	0	1	14.3	6	85.7
Subtotal	43	3	7.0	6	14.0	13	30.2	21	48.8
TOTAL	632	35	5.5	153	24.0	242	38.3	202	32.1

Table 6.2
Status of Philippine coral reefs based on surveys by three projects

Source	No. of Stations	Excellent		Good		Fair		Poor	
		No.	%	No.	%	No.	%	No.	%
Yap and Gomez (1985)	632	35	5.5	153	24.0	242	38.3	202	32.1
ASEAN - Australia CLRP	59	—	—	9	15.3	30	50.8	20	33.9
ASEAN - US CRMP	40	—	—	18	45.0	17	42.5	5	12.5
Total	731	35	4.7	180	24.6	289	39.5	227	31.0

ASEAN = Association of Southeast Asian Nations
CLRP = Coastal Living Resources Project
US = United States
CRMP = Coastal Resource Management Project

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2. PHILIPPINE MANGROVES: THEIR DEPLETION, CONVERSION AND DECREASING PRODUCTIVITY

Prescillano M. Zamora

The mangroves are one of the easily recognizable indicators of maritime influence in the coastal zone. Universally considered unique plant formations, they consist of species belonging to various unrelated groups. Mangrove species vary considerably in their dependence upon littoral habitats. Where conditions are suitable, they may form very extensive and productive forests. Primary mangrove stands are often very heavy. For instance, in 1908 M.L. Merritt reported that in Mindoro a good primary mangrove forest may contain in certain cases 500 to 1,000 trees per hectare, each tree 10-30 centimeters thick and 6-14 meters high. In 1912 Foxworthy (as cited by Brown and Fischer, 1920) found old stands in Sibuguey Bay, Mindanao containing the enormous amount of 300-650 cubic meters per hectare (stacks) and elsewhere in Mindanao a virgin mangrove forest containing 149 trees per hectare with each tree over 25 centimeters in diameter 130 cubic meters per hectare. These examples are now difficult to come by in the remaining mangrove forest (Zamora, 1988).

Given suitable conditions for growth and development, mangroves colonize brackishwater habitats. With the passage of time, communities of plant and animal species are assembled which interact among themselves and with the physical environment (coastal soil, coastal waters) as an ecosystem. Mangroves not only dominate the brackishwater habitats and characterize the ecosystem but also define an economic resource. Thus, mangroves occupy a highly strategic position in the ecology and the economy of coastal areas.

As of 31 December 1988, the mangrove resource of the Philippines is represented by 139,725 hectares in varying states. They are geographically distributed thus (Bina, 1988):

Island	Hectares	Percent
Luzon	22,700	16
Visayas	37,325	27
Mindanao*	37,400	27
Palawan	42,300	30
Philippines	**139,725**	**100**

*Does not include Sulu and Tawi-Tawi

Ecological and Economic Values of Mangroves

I shall briefly review the various uses (values, functions) of mangroves in the country (see Figures 6.1 and 6.2)

In the Philippines, mangrove swamps have been, still are and will be directly economically beneficial to many coastal Filipinos (Zamora, 1989) as:

1. Source of forest products

a. poles for house construction and other uses (e.g., fish corral post substitutes)

b. firewood (fuelwood) for cooking

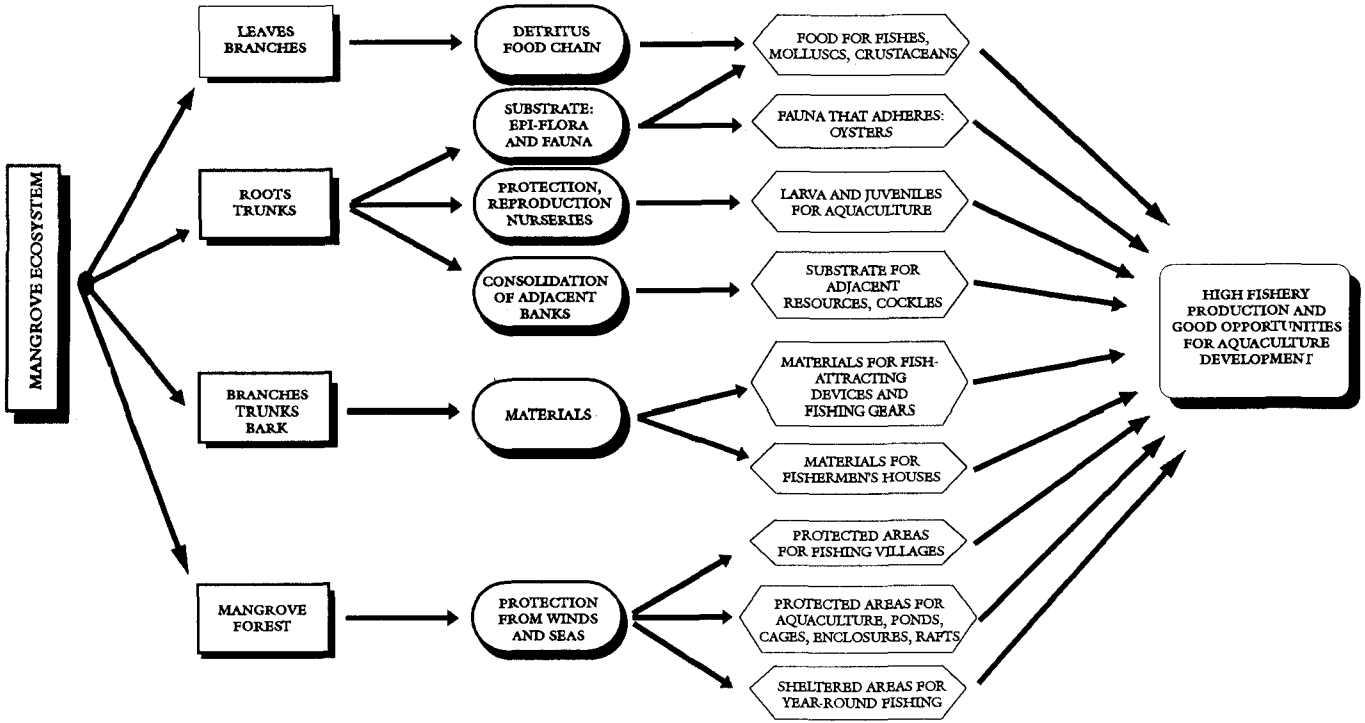
c. charcoal as source of income

d. tanbark for coloring *tuba* (fermented nipa juice) for domestic consumption and as source of income

e. *nipa* sap for various uses (*tuba*, vinegar, alcohol, sugar)

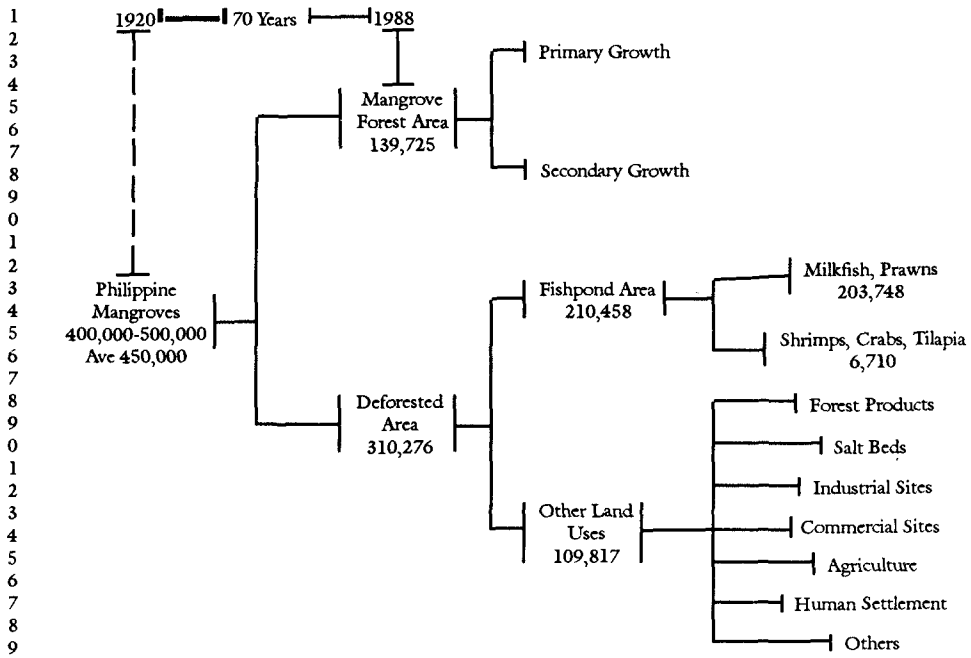
f. *nipa* shingles for roofing, for domestic use and as source of income

Figure 6.1
Some Functional Relationships of Mangroves with Artisanal Fisheries, Fishery Resources and Aquaculture



Source: Kapetsky J.M. 1987. Conversion of mangroves for pond aquaculture: short-term and long-term remedies, pp.96-106. In: Report of the Workshop on the Conversion of Mangrove Areas to Aquaculture UNDP/UNESCO Regional Mangrove Project RAS/79/002. 24-26 April 1986, Iloilo City, Visayas, Philippines

Figure 6.2
Estimated Area in Hectares of Existing Mangrove Forest and Mangrove Area Uses in the Philippines*



*Updated from Zamora 1981, unpublished.
For 1988, the annual rate of denudation is 4,432.5 hectares

2. Source of fishery products (mangrove-dependent species)

a. adult forms (finfish, shellfishes, prawns, mangrove crabs) for household consumption and as source of income

b. juvenile forms (fry) for food and for stocking fishponds as source of income

3. Sites for human activities other than forest product gathering, fishing or gleaning, such as

a. industrial waste disposal
b. human occupancy
c. commercial and industrial establishments
d. fishpondification

The term *"fishpondification"* is used here to refer to the conversion of mangrove swamps (natural system) into brackishwater ponds (artificial system) for rearing marine animals for food production (Zamora, 1988). Milkfish (*Chanos chanos*), prawn (*Penaeus monodon*), and crabs (*Scylla serrata*) are the major species raised in brackishwater fishponds (Serrano and Fortes, 1987). Milkfish is the dominant species grown but there has been a tendency to culture prawns in these ponds in recent years (Camacho and Corre, 1987).

Mangrove swamps are likewise beneficial indirectly to the coastal dwellers in various ways (Zamora, 1982). For instance, there are strong indications that the mangrove ecosystem (mangal):

1. exports detritus and nutrients which form the food base of a complex of marine organisms which in turn support valuable estuarine and nearshore fisheries such as finfish, shellfish, and crustaceans (Gomez, 1983; Reyes, 1983; Zamora, 1987).

2. serves as feeding, nursery or spawning grounds for economically important finfish, shellfishes, and crustaceans (Motoh and Solis, 1978; National Mangrove Committee, 1982; Pinto, 1985).

3. protects valuable properties by dampening storm surges and high winds associated with tropical typhoons (about 20 typhoons of varying intensities visit the country annually, Zamora, 1988).

4. performs a flood reduction function (where it occupies estuarines floodplains) which (function) may be lost if the mangrove swamp is filled up and converted into other uses.

5. helps prevent the erosion of river banks, thus protecting properties adjacent to them.

Controversial Issues

Depletion, conversion, decreasing productivity

In 1920, W.H. Brown and A.F. Fischer placed the area of mangrove swamp forest in the country between 400,000 and 500,000 hectares. The most recent estimate by the National Mapping Resources and Information Authority (NAMRIA) (Bina, 1988) placed the total mangrove area at 139,725 hectares. Subtracting the 1988 estimate (which is 139,725 hectares) from the 1920 estimate (which is 450,000 hectares), the difference comes to 310,275 hectares representing the deforested mangrove area over the past 70 years. In other words **nearly 70 percent of the total mangrove forest is denuded.** Based on these figures, it can be said that the denudation rate of the mangrove forest of the country is 4,432.5 hectares per year. A large proportion of the denuded areas (which comes to more than 210,457 hectares out of the 310,275 hectares) is now devoted to brackishwater fishponds (BFAR, 1987). It is for this reason that the conversion of mangrove swamps into capital-intensive brackishwater fishponds is considered the more controversial issue in mangrove ecosystem management. The increase in areal extent of mangroves has caused a growing concern among ecologists to be concerned that further fishpondification may have significant negative ecological and economic impacts on the nearshore ecosystem of the country.

National and international workshops, conferences and symposia have arrived at the consensus that fishpondication has contributed to the decline in the yield of other mangrove products.

Some information about the impact of clearing mangrove habitats on the productivity of fisheries areas near mangrove swamps, is available, as follows:

1. In the United States, a study by Mock (1966) demonstrates what can happen to a shrimp nursery area when it is altered, in this particular instance, by concrete bulkheading. The bulkheaded area harbored 2.5 times less brown shrimp (*Penaeus aztecus*) and 14 times less white shrimp (*Penaeus setiferus*) than the natural habitat. This was attributed to the reduced organic matter content and changes in the normal soft muddy substrates.

2. In Indonesia, Martosubroto and Naamin (1977) have attempted to relate surface areas of mangrove forest to the commercial shrimp catches in those areas and adjacent water. They obtained a linear relationship between these two variables. This relationship indicates that the shrimp production increases with the size of the mangrove forest area, implying that any reduction of the mangrove forest is likely to reduce shrimp production. Whether this relationship is one of cause and effect is not known; evidence is needed to show whether the destruction of mangroves has reduced the shrimp production over a wider geographical area between intertidal vegetation and commercial yields.

3. In Peninsular Malaysia, Gedney *et al.* (1982) also showed a statistical correlation between mangrove area and shrimp landings.

4. In the Philippines, using data from the Bureau of Fisheries and Aquatic Resources (BFAR) for the period 1976-1982, A.S. Camacho and T. Bagarinao (1986) have shown that municipal marine fish production is positively correlated with the area of existing mangrove swamps. They concluded that the leveling off of marine fish production during the past 10 years is in part due to the alteration or destruction of the mangrove environment in and around the country (see also Paw and Chua, 1988).

5. An issue of *CAMP Newsletter* carries the following statement on "Shrimp Pond Siting and Management Alternatives in Mangrove Ecosystems in Ecuador" by S.C. Snedaker, J.C. Dickinson II, M.S. Brown and E.J. Lahmann (1986):

> *A most pressing issue in CAMP programs worldwide is the effect of converting vast areas of mangrove to aquaculture, particularly to shrimp ponds. If too many ponds are created and mangroves converted, the supply of larvae stock for the ponds is depleted and other coastal fisheries degraded. Ecuador provides an example of massive conversion and subsequent depletion.*
>
> *The shrimp mariculture industry in Ecuador is the largest and most advanced in Latin America, as well as being a major source of foreign currency earnings for Ecuador. In recent years, the industry began facing a number of economic and technical problems, namely, the uncertainty and scarcity of shrimp postlarvae supply and the increased operating costs. In 1984-1985, a research project was undertaken to assess the relationship among shrimp pond siting and management practices, and the acknowledged reductions in mangrove forests and postlarvae stock.*
>
> *Among the conclusions distilled is that "conversion of mangrove forests for the construction of shrimp ponds is an ecologic and economic mistake."*

As earlier remarked, the mangrove ecosystem has many functions among which are nutrient export, breeding or nursery ground and erosion control. All these are important to the maintenance of the ecological stability of the ecosystem itself as well as to the surrounding nearshore ecosystem.

For aquaculture to function, the developer must change the mangrove from a natural to an artificial state. Once an area is converted into a fishpond, it is no longer able to function as a natural system. Thus, as a hectare of fishpond is improved, that same hectare can no longer be counted on to contribute to the productivity of the nearshore ecosystem. Thus, the continued reduction of mangrove forest area is predicted to have the following harmful effects:

1. decrease in nutrient export which affects organisms all the way up the food chain, including human beings;

2. decrease in the area available for protection and nursery grounds for seed fish needed for stocking fishpond; and

3. decrease in the catch of the other fishery sectors (Zamora, 1982).

Mangrove destruction affects the livelihood of a significant segment of the coastal population — 522,418 sustenance or municipal fishermen; 42,947 commercial fishermen; 170,000 fry fishermen; and 12,660 fishpond operators (Figure 6.3). It also has an adverse impact on both the "adult pool" and the "replacement pool" (fry for stocking fishponds). The effect may lead to "crashes" of these populations. When large numbers of populations are affected, the ecosystem itself will be affected.

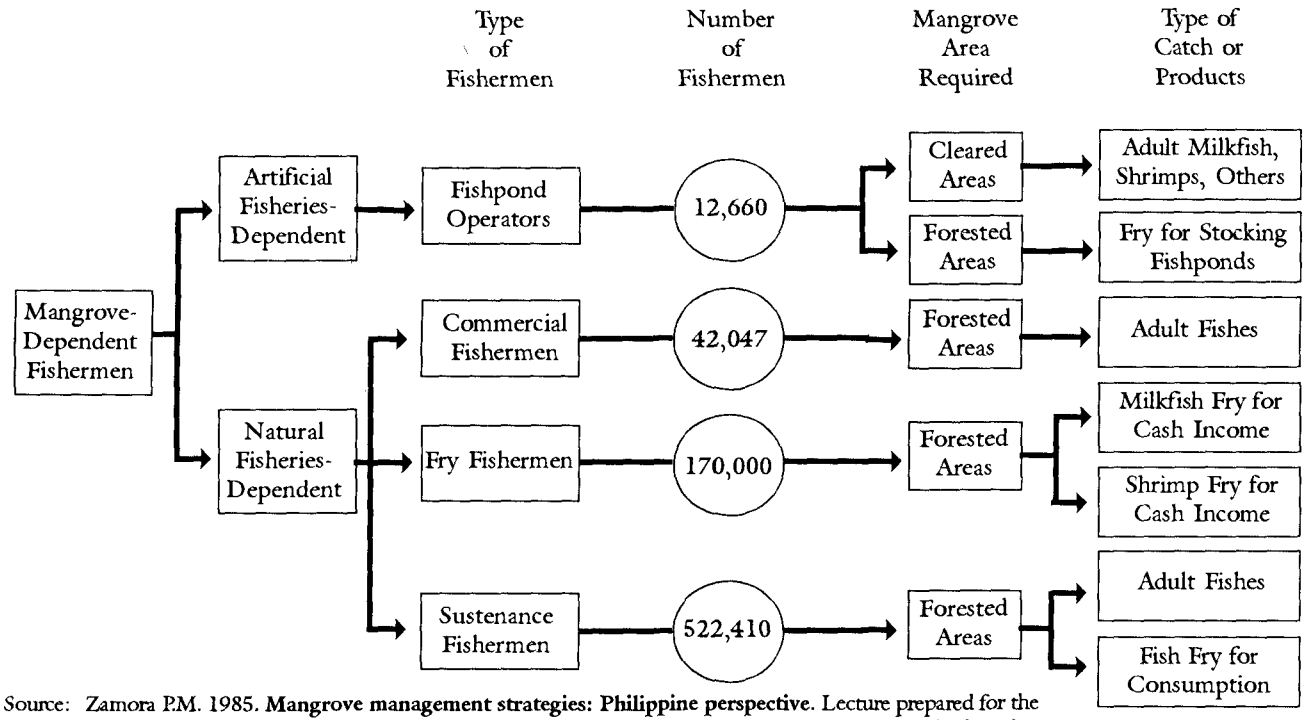
The continued proliferation of fishponds along coastal areas means the clearance of more vegetated areas and the subsequent diking and fertilization of the denuded areas. Such disturbance of the mangrove ecosystem is extremely harmful because:

1. all standing biomass is completely removed;
2. soil profile is totally disrupted or covered up; and
3. subsequent natural regeneration cannot take place (Zamora, 1988).

The precise effects of this artificial fish production technology on natural fisheries however, remain imperfectly known. If it is assumed that certain stages in the life cycle of some commercially important species of fish and shellfishes require the protection of the mangroves, then it follows that aquaculture operations will affect natural fisheries. While quick and lucrative economic returns and benefits from fishpondification contribute to the escalation of protein production, fishponds need fish and shrimp fry (Figure 6.4). The shallow littoral areas near mangrove areas are still the principal natural sources of seed fish for stocking fishponds.

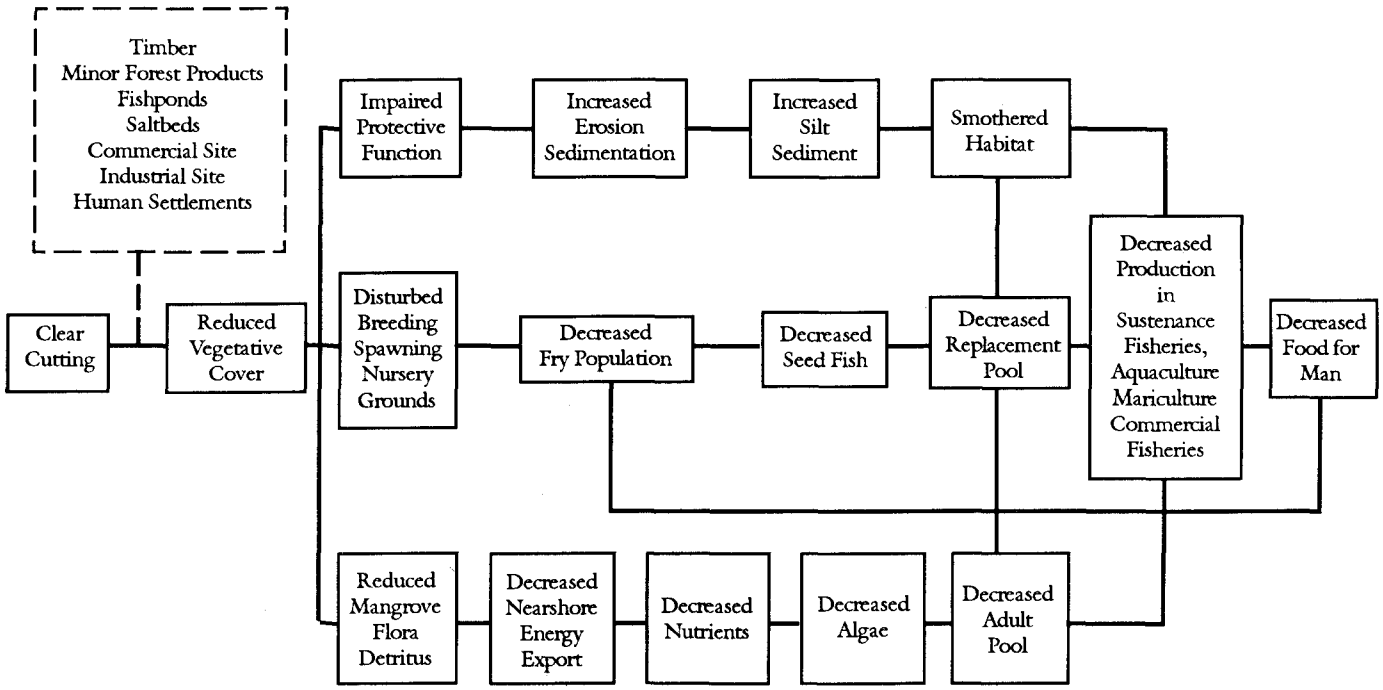
Furthermore, if it is assumed that four hectares of mangrove forest are required to support one hectare of intensive oyster culture, then it follows that further clearing of mangrove forests for aquacultural purposes will affect

Figure 6.3
Mangrove-Dependent Fishermen in the Philippines



Source: Zamora P.M. 1985. **Mangrove management strategies: Philippine perspective.** Lecture prepared for the UNDP/UNESCO Regional Mangrove Project RAS/79/002 Training Course on Life History of Selected Species of Flora and Fauna in Mangrove Ecosystems held on 2-16 October 1985 in Bangkok, Thailand.

Figure 6.4
Probable Chain of Effects of Clear-Cutting of Mangrove Vegetation Cover



Source: Zamora P.M. 1985. **Mangrove management strategies: Philippine perspective.** Lecture prepared for the UNDP/UNESCO Regional Mangrove Project RAS/79/002 Training Course on Life History of Selected Species of Flora and Fauna in Mangrove Ecosystems held on 2-16 October 1985 in Bangkok, Thailand.

mariculture. Presently, the country has only 139,725 hectares of mangrove forest and 310,275 hectares of denuded mangrove area, or a ratio of 1:3. This ratio is the reverse of what is claimed to be needed for intensive osyter culture.

Remedial Measures

In view of available data and information, among which are those I have cited above, the government became greatly concerned and formulated and implemented measures directed toward the protection and conservation of the remaining mangrove forest areas as well as the rehabilitation of the critically denuded mangrove areas.

Most of these measures are now embodied in a set of proposed regulations governing the utilization, development and management of mangrove resources formulated by the **Coastal Resources Management Committee** created by DENR Special Order 982 dated 25 October 1989. This committee replaced the former National Mangrove Committee.

These proposed regulations are meant to promote a mutually productive and long-term coexistence of artificial fisheries (aquaculture) and natural fisheries (municipal fisheries, including fry fisheries which is still the principal source of seed fish for stocking fishponds, and commercial fisheries) as well as to minimize environmental degradation of the mangrove and nearshore ecosystems.

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3. PHILIPPINE SEAGRASS ECOSYSTEMS AND THEIR RESOURCES: A SITUATIONER

Miguel D. Fortes

In every developing maritime nation, the coastal zone, with its enormous potential to produce food, will inevitably be used and exploited to feed a growing population. In the Philippines' coastal zone, the seagrass ecosystem is threatened by multiple demands. Because the country is an archipelago, population centers tend to develop around sheltered bays and estuaries, the very places colonized by seagrasses. Because these plants thrive in relatively shallow waters, they are subject to stresses caused by increasing human demands. It is not surprising, therefore, to see seagrass beds being filled, dredged and diked for conversion to other uses. These activities need to be examined.

Seagrasses: Definition, systematics and importance

Seagrasses are hydrophytic monocotyledonous plants that are completely adapted to the marine environment. They resemble true terrestrial grasses in possessing features common in their life history, i.e., rhizomes, which are buried in soft sandy or muddy bottom and erect leafy shoots in the water. Seagrasses, however, comprise only about 50 species falling into two families and 13 genera. Family Potamogetonaceae consist of ten genera and 39 species; family Hydrocharitaceae consists of three genera and 11 species.

The small number of seagrasses is not proportional to their ecological and economic importance. Due to their enormous quantities on dense beds covering large areas in the coastal waters, seagrasses perform a wide spectrum of biological and physical functions in the marine environment. These functions, summarized by E.J.F. Wood *et al.* (1969) and C. Den Hartog (1957), include substrate stabilization, sediment production, habitat and nursery for fish and many invertebrates, primary food source for fish,

turtles, *dugongs*, and invertebrates such as echinoderms, and an alternative feeding site for commercial and forage organisms. As a discrete ecosystem, seagrass beds interact physically with coral reefs and mangroves in the reduction of water energy, sediment relationships and flow regulation (UNESCO, 1983). Seagrass systems also tend to "leak" or export nutrients to nearby ecosystems.

It was Petersen (1891, 1918) who first evaluated the contribution of seagrasses to the coastal ecosystem via its fisheries. McRoy and McMillan (1977) showed that seagrass productivity is as high as those of the world's best agricultural crops, and this production is done without energy subsidies. Despite this high productivity, there are very few organisms which actually directly consume seagrasses.

The distribution of seagrasses within coastal areas dictates the kind of grazers that are associated with them. Vertebrates such as parrot fishes (*Scaridae*), surgeon fishes (*Acanthuridae*), green turtles and sirenia are the main consumers in the tropics (McRoy and Helfferich, 1980). A.C. Alcala (1986, personal communication) observed that rabbitfish (*Siganidae*) are also important grazers in local seagrass beds. In the more temperate regions, geese and ducks are the main consumers. Among the invertebrates, sea urchins are the main grazers, although they reportedly possess no enzymes that can digest the plant materials efficiently. Hence, only a small amount of energy stored in seagrasses is transferred to the next upper level in the tropic hierarchy.

Seagrass beds form a community frame that controls the structure of other communities. The well-known catastrophic effects of the "wasting disease" of *Zostera* beds along the coasts of the North Atlantic in the early 1930s attest to the fundamental ecological importance of the eelgrass community. The disease altered the structure and composition of the associated flora and fauna. It also drastically changed the salinity, temperature and the nutrient load of affected coastal waters. Fishery production declined and an almost complete reorientation in fisheries strategies had to be effected. This ecological catastrophe triggered renewed and significant research activities on seagrasses in most parts of the world.

The role of seagrasses at the ecosystem level is matched by their importance at the component level. McRoy and Helfferich (1980) considered their use under two time categories: historical and contemporary. The first

category includes their use by North American Indians for woven baskets and as a source of salt, soda and warmth. In coastal Denmark, seagrasses are used as stuffing for mattresses and bed ticks; as substitute for animal straw, roof thatch, upholstery material; as packing and stuffing material; and as a component for fertilizers. In the United States (US), they are used as insulation for sound and temperature. In Germany, seagrasses function as a substitute for cotton in the manufacture of nitrocellulose (Cottam, 1934) or are simply pressed into bales for shipment to manufacturers who derive products from them (Scagel, 1961). Soviet workers considered the commercial potentials of seagrass fibers (Anonymous, 1967). The Dutch built sturdy and durable dikes from eelgrass when bricks and concrete were not yet available. The Danes made cigars from eelgrass leaves. The Seri Indians used seagrasses in the making of children's toys.

The contemporary direct uses of seagrasses are related to their ability to trap and bind sediments and organic material. Hence, they are used in the filtration of sewage (McConnaughey, 1975) and stabilization of coastlines (Boone and Hoeppell, 1976). They are potential sources of useful chemicals (Ovodova *et al.*, 1968; Paimeeva, 1973; Dudkin *et al.*, 1975); raw materials in paper making(Leopold and Marton, 1974); fertilizer (van Breedbeld, 1966); and fodder (Bauersfekd *et al.*, 1969). Some seagrasses are used for direct human consumption. Ehrlich and Ehrlich (1970) postulated the development of "high yield strains of salt-tolerant terrestrial grasses" to solve the world's food problems.

From the viewpoint of productivity, the presence of extensive seagrass meadows is favorable and studies on our local seagrasses are most desirable. A greater portion of the Philippine population lives near coastal waters or along the shores of estuaries. It is almost certain that this percentage will increase in the coming years. A rising population will increase demands on the marine environment mainly as a producer of food, avenue of transportation, receptacle of wastes, living space, and source of recreational and aesthetic pleasure. Indeed, it is no wonder that seagrass beds are being diked, filled, dredged, and converted to other coastal uses.

At this point, it is imperative that we first know the seagrass resources we have as well as their role and contribution to coastal stability and productivity. A synthesis of this knowledge is essential for a wise,

predictive management of these resources. Only when this knowledge is available can we derive maximum benefits from these nearshore ecosystems.

Review of local seagrass literature: 1819-1988

Despite the diversity and abundance of seagrasses in Philippine waters, very few papers have been published on the local species. Available knowledge is based on unsystematic taxonomic accounts done discontinuously from 1819 to 1965. The earliest records date back to the collection of *Cymodocea serrulata* and *Enhalus acoroides* made by Perrottet in 1819 (cited by den Hartog, 1970). Blanco (1837) reported *Vallisneria sphaerocarpa* (*Enhalus acoroides*) from Zambales; the same species was reported by Merrill (1918) from Palawan. Ostenfeld (1909) recorded *Halophila ovata* (*H. minor*) based on Merrill's collection from Manila Bay. Mendoza and Del Rosario (1967) included some seagrasses in their vascular plant compendia.

More collections were made in the early and mid-1990s, but these were primarily incidental accounts on the seagrasses accompanying the seaweeds, which were the main object of the collections. Pascasio and Santos (1930) did a critical morphological study of *Thalassia hemprichii*, and J.S. Domantay (1962) reported eight species from the Hundred Islands in Pangasinan. The "collection" type of study on Philippine seagrasses culminated in 1965, with the research made by Doty and Alvarez in the Visayan region.

Subsequent records on local seagrasses started with the find of *Thalassia* from Sipalay, Negros Occidental (Fortes, 1977). H.P. Calumpong (1979) reported some seagrasses from Negros Oriental. P.A. Cordero (1981) illustrated, but with the names erroneously interchanged, three common species of seagrasses. M.D. Fortes (1981) made the first local taxonomic and distributional study of algal epiphytes on the leaves of *E. acoroides*. In addition, he (1984) reported *Halophila decipiens* from Zamboanga del Sur. The paper of Meñez *et al.* (1983) represents the most comprehensive taxonomic and distributional account of the country's seagrasses. However, it was primarily based on the monograph of den Hartog (1970), and old herbarium materials were used in the description of some of the species. In a more recent work, Calumpong *et al.* (1985) described the taxonomy and distribution of seagrasses from Davao Gulf.

With the exception of the distributional aspects of the local studies, no other work on Philippine seagrasses can be considered truly ecological. However, Fortes (1981) made the first account on the structure and productivity of the epiphytic community on *Enhalus* leaves at Calatagan, Batangas. He (1982) made a preliminary assessment of the organic matter contributions of dominant producer communities, including *E. acoroides,* at the same time. A joint Philippine-US research project dealing with the distribution, biomass and taxonomy of Philippine seagrasses was concluded in 1985. The first ecological assessment and transplant study in the Philippines involving seagrasses was conducted in Bolinao, Pangasinan (Fortes, 1984). This activity has been extended to rehabilitate degraded coastal areas in Puerto Galera in Oriental Mindoro, Marinduque, Bataan and Manila Bay. Two complete research projects looked into the identification and seasonality of some chemical constituents in *Thalassia hemprichii, Cymodocea rotundata* and *Enhalus acoroides.*

A significant contribution to our knowledge of Asian seagrasses was made by Fortes (1986) who completed a doctoral dissertation on the taxonomy and ecology of the Philippine species. In 1987, the first National Conference on Seagrass Management, Research and Development was held, mainly as an offshoot of a resurging interest in and awareness of the importance and role of seagrasses in tropical coastal resource management.

The most recent published contributions to local seagrass literature include those of J. Estacion and M.D. Fortes (1988) on the growth rates and production of *Enhalus acoroides*; Fortes (1988a) on the Indo-West Pacific affinities of the local flora; and Fortes (1988b) on the stresses on seagrass ecosystems in the East Asian region.

Seagrass Ecosystem Components and Uses

A high diversity of plants and animals resides in Philippine seagrass beds. This is due in large measure to the rich nutrient pool and the high diversity of physical structures that protect juveniles from predation. A greater percentage of the biotic component level — fish and shrimp — are probably the most important among these groups, although some coastal villages derive portions of their sustenance from other components of the grass beds. At the ecosystem level, a number of uses and potentials have been associated with the beds.

In this paper, only the major components of seagrass beds which contribute substantially to the coastal economy concerning conservation will be mentioned, *i.e.*, benthic seaweeds, epibenthic invertebrates, fish, and reptiles and mammals. In addition, some of the ecosystem uses of the habitat will be presented as a strong justification for its total management and conservation.

Benthic seaweeds

Although few seaweeds grow in seagrass beds, they exhibit great abundance and are harvested either as food (*e.g.*, *Enteromorpha* spp., *Ulva* spp., *Caulerpa* spp) or as a rich source of chemicals for industries (*e.g.*, *Gracilaria* spp., *Gelidiella acerosa*, *Sargassum* spp., and *Eucheuma* spp). It is of interest that the three largest seaweed-producing countries in the ASEAN region (Philippines, Thailand, Indonesia) produce at least 100,000 tons of dried raw seaweeds worth about 30 million US dollars annually (Rabanal and Trono, 1983). The primary components of the harvest are farmed *Eucheuma* and *Caulerpa* and natural stocks of *Gelideilla* and *Sargassum*.

Epibenthic invertebrates

This group comprises shrimps, sea cucumber, sea urchins, crabs, scallops, mussels, and snails. Shrimp production in the Philippines was 55,700 metric tons (MT) in 1982 (FAO Statistics, 1983). This production is directly associated with seagrass beds since it is known that shrimps spend the early stages of their life-history in these areas. Vergara and Fortes (1991) found that of the 1,491 tons trawled from seagrass beds, fish comprised 28.6 percent while shrimps comprised 71.4 percent.

In Bais Bay, southern Philippines, the edible mollusks harvested by fishermen yield 69 kilograms wet weight per hectare of seagrass beds (Alcala and Alcazar, 1984). In the same bay, A.C. Alcala (1979) reported that about 1,000-2,000 kilograms of the eggs of the sea hare, *Dolabella auricularia*, are gathered annually.

Coastal inhabitants of the Philippines gather sea urchins, sea cucumbers and other echinoderms from seagrass beds, mainly to supplement their daily nutrition and income. Gonads from the urchins are usually eaten raw with vinegar, serving as the "caviar" of the coastal Third World. Marketable crabs (*Portunus pelagicus* and *Scylla serrata*) are frequently caught by trawls in seagrass beds. Scallops and mussels are more common in muddy protected coves were seagrasses and mangroves abound.

Fish

The economic usefulness of a seagrass bed resides primarily in the fisheries it supports. In developing countries, coral reefs with their associated seagrasses can supply more than 20 percent of the fish catch (McManus, 1988). A total of 1,384 individuals and 55 species from 25 fish families have been identified from five seagrass sites in the Philippines (Vergara and Fortes, 1991). All members of these families have economic values mostly as food and aquarium specimens. Estacion and Alcala (1986) reported adults of about 52 fish species from 31 families in seagrass beds in Central Philippines. Carangids, clupeids, lutjanids, and scarids, all amply represented in the catch, are popular food fishes. At least 123 fish species representing 51 families have so far been reported from both natural and artificial seagrass beds in the Philippines (Fortes, unpublished report). All the species have known economic uses.

Reptiles and mammals

Some endangered species of reptiles and mammals have been reported in Philippine seagrass areas. Among these species, the green sea turtle (*Chelonia mydas*), the olive ridley (*Lepidochelys olivacea*), the loggerhead (*Caretta caretta*), and the flatback (*Chelonia depressa*), together with the wart snake (*Acrochordus granulatus*), are frequently found in dense seagrass meadows (IUCN/UNEP 1985). Sea turtles in the Turtle Islands off Sulu Sea include seagrasses in their daily diets (Estacion and Alcala, 1986). The sea cow (*Dugong dugon*), a mammal considered an endangered species in the region, feeds directly on seagrasses, especially *Cymodocea* and *Thalassia*.

At the ecosystem level, seagrass beds have the potential to filter sewage, thereby reducing the threat from pollution which would otherwise affect the components of both coral reefs and mangroves. Seagrasses are biotic heavy metal reservoirs or sinks in the marine environment (Wahbeh, 1984). But unlike the abiotic sediments which also act as heavy metal sinks, the seagrass bed may remobilize and transport these elements to higher trophic levels in the food chain (Burrell and Schubel, 1977).

The habitat is also known to stabilize the coast mainly due to its ability to trap sediments via the extensive mats of root and rhizome systems. Actual observation and simple experiments indicate that detritivores,

herbivores, carnivores, and omnivores comprise the trophic hierarchy involved in the processing and transport of organic detritus and nutrients from the ecosystem to consumers even in other nearby ecosystems. It is now indisputable that some seagrass beds in the Philippines are nursery grounds for a number of commercially important fishes and invertebrates. In the Pacific Northwest, there was a drastic 90 to 99 percent decline in black brant geese population since 1981, due to the disturbance and noise from boats near the large eelgrass meadows where the geese thrive (Reiger, 1982).

Susceptibility and Vulnerability of the Seagrass Ecosystem

Primarily because of their shallow existence, seagrass beds are susceptible and vulnerable to natural stresses as well as to acute and sometimes chronic human intrusions. In coastal Southern Asia, cyclones, typhoons, tidal waves, volcanic activity, pests and diseases, and population and community interactions (grazing and competition) constitute the natural stressors to this ecosystem (Fortes, 1988b). On the other hand, seagrass beds have been the object of relentless pressure associated with human needs for food production, transportation, waste disposal, living space, recreation, and aesthetic pleasure. Unfortunately, not all of these uses are compatible; in many cases, they are mutually exclusive (Fergusson *et al.*, 1980). From the point of view of management and conservation, environmental damage and degradation brought about by natural causes may not be as directly related to people's actions, attitudes and inadequacies. Hence, they will not be given emphasis in this part of the paper. What will be emphasized are the stresses under human control. It is unfortunate that in Southeast Asia, the effects of these factors are largely unquantified and unmitigated.

In the Philippines, some mesoscale changes are becoming easily observable in seagrass area. There are sudden changes in their species composition, stunting of growth, phenological alterations in relation to the seasons, and movement of ecosystem boundaries. These changes are symptoms of the large-scale, cumulative effects of subtle, unobservable alterations in the biological makeup of the units that compose the four different levels of organization of the biotic environment, namely: (1) biochemical and cellular; (2) organismal; (3) population; and (4) community.

The responses of organisms to degradative perturbations, categorized under these levels, are given below (modified from Capuzzo, 1981):

(1) CELLULAR
gametogenic cycle
nutrient storage
deformity
neoplasms and tumors

(2) ORGANISMAL
feeding
excretion
growth
fecundity
reproductive effort
larval viability
swimming

(3) POPULATION
biomass
productivity
age/size structure
recruitment
mortality

(4) COMMUNITY
biomass
species abundance
species distribution
species diversity
trophic interactions
energy flow
spatial variability
temporal variability

The susceptibility and vulnerability of the components of seagrass beds to environmental impacts can be manifested at each of the levels of organization before disturbances are actually seen at the population or community levels. Hence, impairment of feeding, growth, recruitment, development, and energetics resulting from disruptive activities of coastal inhabitants may result in alterations both in reproductive and developmental success and changes in community structure and dynamics. This in turn would manifest itself as the observable advance or retreat of the physical boundaries of the ecosystem. In addition, remarkable changes in the structure and species composition and spatial or temporal distribution occur.

Disruptions in the responses at a lower level of organization do not necessarily result in degeneration at the next higher level. Only when the compensatory or adaptive mechanisms at one level begin to fail do deleterious effects become apparent at the next level (Capuzzo and Kester, 1987). The "wasting" disease that almost completely decimated the eelgrass (Zostera) beds of the North Atlantic in the early 1990s attests to the weakness of such a compensatory mechanism in a seagrass ecosystem. While the exact cause is not yet fully understood, the death of the beds appears to be related to a major and abrupt change in the climatic (temperature)

regime (Rasmussen, 1977) or to increasing pollution (silt, toxic materials like heavy metals pesticides, PCB, detergents) of the Waddenzee (Phillips and Meñez, 1988).

There are indications that a similar catastrophe might occur in southeastern United States (Fonseca, personal communication). Lewis *et al.* (1985) documented the loss of 80 percent of the seagrass stands in Tampa Bay, Florida from 1880 to 1980, owing to the decline in water quality (increasing turbidity, toxicity) coincident with the influx of people into the area. On the other hand, the "Amoco Cadiz" oil spill in the coast of Roscoff, France in 1978 demonstrated that the seagrass ecosystem is a resistant unit: the oil pollution caused only a short-term change in diversity without really affecting the stability of the ecosystem (Jacobs, 1982).

Each species or small association of seagrasses grows between specific tidal levels. The long-term variations in sea level should lead to a migration of the grasses to depths where they can survive. The primary cause of the decline of seagrasses in Moreton Bay, Queensland was sand movement toward seagrass beds which smothered and displaced the grasses to greater depths beyond their ability to survive (Kirkman, 1978).

Perspective and Advancement in Seagrass Ecosystem Management

A crisis in perception concerning the management of seagrasses has arisen from the varied professional backgrounds, intents and goals of the individuals concerned with the issue. Ideally this should not be so: regardless of personal or academic makeup, resource management for a developing country like the Philippines should address problems at the gut level. It should develop and implement a coordinated scheme for the equitable and effective distribution of natural, socioeconomic, and institutional resources in order to conserve and maintain the multiple uses of the environmental resources. The differences, however, have more to do with the mechanics of management, rather than with the principles (although sadly, these are what are most often compromised).

From the point of view of an environmental scientist, management is a dynamic process in which the resource base is initially subjected to a thorough study so that its potentials, frailties and strengths are well

understood before the information is finally disseminated and the resource utilized on a sustainable basis. This aspect forms the basis of MANAGEMENT OF THE RESOURCE, in which the ecological information is tested and applied to optimize production with adequate provision for environmental protection. In this aspect of management, the manager considers, for example, the marine environment as the business realm and profit is an excess of the common currency (energy) produced by myriads of biotic environment.

When the results of the testing and application of marine ecological principles are packaged for dissemination to possible end-users, MANAGEMENT OF THE USE of the resource normally begins. This is where nonscientists have a role to play. In our system, however, a resource scientist has slowly become an economist, and at the same time an engineer, lawyer, farmer, or even community organizer, assuming the role of managing both the resource and its uses. Unfortunately, among this gamut of roles and responsibilities, the concerned individuals no longer knows what his/her function is. The question inevitably arises: Is this dilemma dictated by the system? Or is it a personal choice being exercised by the scientist? Unfortunately, it is both.

While much has been done to understand coral reefs and mangroves, less work has been done on seagrass beds. Moreover, data regarding interactions among this triumvirate of marine ecosystems still remain fragmentary and inadequate. However, there is a rapidly increasing consensus among marine scientists that in order to achieve any sustainable form of renewable resource development, more emphasis must be given to the interactions at the ecosystem level rather than at the lower levels of organization of the marine environment.

P.R. Burbridge (1988) notes that such an objective is attainable if priority is given to the study of factors such as the effects of changes in the hydrology of rivers, the conversion of swamp forests to agriculture, the reclamation of mangroves for fishponds, and their impact on marine fisheries and other activities. The prevailing sectoral approach to marine resource management and conservation is based on a single exclusive purpose, disregarding the fundamental concept of the biological continuum which is the key to the integrity of the marine environment as an integrated macroecosystem. Indeed, it is increasingly being realized in scientific circles that one of the causes of failure in marine resource management has been the failure of leaders and investigators to view the marine habitats as one interacting macroecosystem.

An integrated study of the seagrass-mangrove-coral reef ecosystem is the most practical approach toward the sustainable development and conservation of these ecosystems. It treats the resource base as a dynamic system where biophysical, sociocultural and economic factors continuously change and interact. From the discussions presented, it is clear that many species of fish, invertebrates, birds and mammals move between mangrove forests and seagrass beds, exchanging energy and energy sources. Tidal flushing and faunal feeding and movement extend the sphere of influence of seagrass beds and mangroves well beyond their physical boundaries. To save the mangrove trees would do the gray snapper little good if the associated seagrass beds are destroyed. On the other hand, pink shrimp populations will be enhanced by the preservation of seagrass beds and mangrove-lined waters.

Indeed, a most plausible (but for a poor maritime country like the Philippines, a most impractical) conclusion is that the best management practice is to preserve Philippine seagrass and mangrove ecosystems. Central to this concept is the preservation of adjacent ecosystems that are linked significantly by functional processes. In southwest Florida, the continued and enhanced role of the mangrove forests is highly dependent on the continual and effective preservation of the Everglades and Big Cypress Swamp.

Mitigation and Restoration

In developing countries, resource management decisions are normally compromises which place a higher premium on economic imperatives at the expense of the environment. Hence, the destruction of portions of seagrass areas is sanctioned with some specified precondition to at least mitigate the impacts in order to compensate for the unavoidable loss of important ecosystem components. At this point, two considerations must be made. First, if any biologically productive habitat is destroyed, it is improbable that its original productivity can be maintained. This is because the biological and physico-chemical interactions which took hundreds of years to evolve and be developed among its components are permanently disrupted. This is true even if a new habitat is established elsewhere within the system (Thayer *et al.,* 1984).

Secondly, mitigation rarely creates new and similar habitat where the original components would normally thrive. What current mitigation achieves is often a transitory enhancement, since no long-term additions to the system are realized. Only the creation of an entirely new, previously biologically desolate aquatic habitat (that has not been created at the expense of another biologically productive habitat) can be considered and allowed as true mitigation.

Transplantation

Seagrass transplantation has been developed as a viable means to initiate the recovery or restoration of degraded or destroyed coastal habitats. Restoration techniques using seeds, seedling, and vegetative materials offer an opportunity for investigating basic biological problems which may prove useful in understanding biotic responses to degradative impacts. With this information, techniques can be developed to recolonize areas which have lost their plant cover, or to create new areas that will restore and create associated plant and animal communities that lead to food resources.

Phillips (1980), applying most known techniques in seagrass transplantation, found differential success according to the species and methods used. He concluded that the sod method provided the greatest potential in the establishment and growth in all species tested. In the Philippines, Fortes (1984) initiated the first local transplantation of seagrasses as a means to rehabilitate highly silted areas in Bolinao Bay, Pangasinan.

In 1986, the Food and Agriculture Organization-National Environmental Protection Council tested the transplant and rehabilitation potentials of some selected seagrass species against pollution from phosphate, copper mine tailings and domestic industrial effluents. However, these two undertakings were basically experimental so that the results could not provide conclusive data as to the true restoration potentials of the seagrasses. In Calancan Bay, Marinduque, eight-month-old transplants (using plugs of *Halodule uninervis*, sprigs of *Cymodocea rotundata*, and seedlings of *Enhalus acoroides*) are showing highly positive indications (in terms of spread, mortality and growth rates) that the methods are potentially useful in rehabilitating a portion of the tailing causeway.

Artificial seagrass systems

A new approach that is gaining interest and acceptance in coastal restoration ecology utilizes artificial seagrass systems (ASS). Indirectly, it has been used to enhance the biological productivity of coasts (Barber *et al.* 1979) and sediment stability, especially of degraded fishery habitats. Apparently, the enhancement effect of the system is achieved via the creation of more ecological niches available for occupancy mostly by juveniles of fish and invertebrate fauna. In addition, the epibiota that grows on the system are direct food sources, while the system itself serves as a refuge and spawning ground, especially for fauna of economic value. It can also be surmised that the physical components of the ASS act as effective and durable structures in stabilizing the sediments.

J.D. Bell *et al.* (1985) have shown that the ASS attracts vagile macrofauna typical of seagrass beds. Hill (1988, personal communication)has demonstrated that strips of solar mat (plastic material used in heating swimming pools) established at five meters depth in a highly silted area are effective as artificial seagrass systems. Fortes and Espinosa (unpublished manuscript) found 986 individual fish representing 70 species and 27 families in Bolinao Bay (Pangasinan) from June 1988 to November 1989. Interestingly, these figures are significantly higher when compared to those they found from four natural seagrass sites in the bay in the same period (229 individuals, 29 species from 24 families).

These results indicate that the artificial structures indeed have great potential to attract fish. Of further interest are the percentages in species overlap between the two systems (in terms of fish families = 47.1 percent; species = 20.2 percent), which suggests that the ASS supports a relatively distinct ichthyofaunal composition. However, results from morphometric measurements also suggest that mostly juveniles and medium adults comprise the fish fauna. This finding confirms the nursery role of both systems.

As an important component of the Calancan Bay Rehabilitation Project in Marinduque Island, the use of ASS has been intensified primarily to attract fauna and improve the biodiversity of the lower western half of the mine tailings causeway at the bay. The system makes use of cheap plastic and PVC (polyvinyl chloride) materials, constructed to simulate stands of *Thalassia hemprichii* and *Halodule uninervis* (wide-leaf variety), and clumps

of *Enhalus acoroides*. Monitoring of the relative success of the system in terms of fish and invertebrate recruitment, yield, and epibiotic composition has recently been initiated. A cost-benefit analysis is being made to evaluate the economic feasibility of the system.

Management Goals and Needs

It is unfortunate that although schemes to manage coastal resources have been initiated and implemented for some time in the Philippines, there has been practically no significant positive result that will attest to their successful management and conservation. With the seagrass ecosystem in particular, similar efforts are as yet at the very initial stages. But there are indications that these systems will not suffer the fate which has befallen mangroves and coral reefs.

More important, the sets of activities proposed by Fortes (1987) for research and development (R & D) *vis-á-vis* seagrass beds are largely applicable to mangroves. Indeed, the striking similarity between these two closely evolved systems implies similarities in approach to understand their responses as an integrated system to environmental impacts.

Management goals

Management and conservation of Philippine seagrass beds as an ecosystem is difficult. This is in view of the current state of knowledge on the fundamental interactions that connect seagrass, mangrove and coral reef ecosystems. In addition, people in a developing country like the Philippines tend to put a higher premium on economic gains, no matter how short-lived these are, at the expense of marine environmental imperatives and without regard to the costs of ecosystem rehabilitation and restoration. It is therefore important for the management and conservation of these resources to adopt the following major goals:

1. To preserve the known natural interconnections of the ecosystems;

2. To protect their ecologically valuable and economically harvested fisheries;

3. To protect the coastlines from erosion, siltation and pollution;

4. To establish seagrass, mangrove, and coral reef reserves for research and educational purposes; and

5. To preserve the aesthetic and recreational qualities of the natural shorelines.

Management needs

To effectively address these management goals, certain other factors must be addressed. These necessary factors or attributes are based on the dictum: SOUND ECOLOGY IS GOOD ECONOMICS. These factors can be divided into technical or scientific needs and the administrative or socio-political needs.

Technical needs - Management and conservation within the physical boundaries of seagrass beds, mangrove forests and coral reefs cannot succeed without a sound ecological framework. Even the "lifting" of oceanographic principles, largely developed to manage and conserve temperate coastal resources, is an adequate basis for the management of these resources.

Management planning requires adequate field data for each specific ecosystem in order to identify those interconnections, dynamic qualities and populations which need protection and how these may be vulnerable to disruptive human influences. Individuals involved in the management process must base decisions on solid scientific grounds, not solely on the laws of short-term economics. Otherwise, remedial expense or irreversible losses will be encountered.

Technically, what is required is to identify and initiate studies in representative natural seagrass, mangrove and coral reef ecosystems in regional and local areas, so that we may know what constitutes harmful activity or change in the ecosystems. Without baseline data obtained from the few remaining natural and unspoiled systems, we will not have a measure of the human impact on these systems and will not attain management and stewardship of their resources.

In developing countries, it is not a sound policy to advocate the physical separation of the users from their source of nutrition and livelihood. However, the continued availability of resources depends on the maintenance of natural genetic and species diversity in these systems. Biological productivity depends largely on the availability of nutrients, light and temperature. Hence, the stability of the systems becomes a function of the stability of these factors and the genetic and species diversity present. Human interventions like farming of the desired species may increase the short-term productivity of ecosystems, but they may also lead to an extinction of genotypes and species or to the spread of less desirable ones.

Specifically, the key areas of research in the management and conservation of seagrass beds include:

1. Acquisition of baseline data on their interconnections and the quantification of these interactions with coral reefs and mangroves;

2. Time-series study on the stability dynamics of the ecosystem anchored on a thorough understanding of their biophysical and hydrological conditions;

3. Mapping of seagrass beds using remote sensing technology and ground truth surveys in order to pinpoint areas suitable for restoration;

4. Studies on the ecosystem-level functions in restored or rehabilitated seagrass areas;

5. Studies on the vulnerability of the ecosystem and their components, and their recovery from human impacts; and

6. Coordination of all technical information on the ecosystems and their resources.

Socio-political needs - The environmental crisis in our coastal zone is largely rooted in certain sociocultural values. It arises directly from the tendency of policy-makers to deal with environmental problems mostly with curative rather than preventive measures embodied in a framework of inconsistent policies. In order to obviate this problem, certain pointers, some

of which are not uncommon in marine resource management circles, need to be emphasized:

1. Ensure that local decisions and actions on ecosystems management are based on local perspectives;

2. Make the public aware and appreciative of the intrinsic value of the ecosystems in relation to the total environment and be sympathetic to and initiate positive action for the cause of the few who go out of their way to properly manage and conserve these ecosystems;

3. Formulate sound legislation that will prohibit specific activities that disrupt the ecosystem connections and degrade their resources;

4. Encourage and facilitate the coordination of all information with major coastal projects;

5. Incorporate a holistic approach in planning for both scientific research and decisions that are related to the marine ecosystem;

6. Encourage and facilitate cooperation among institutions and social groups on marine environmental issues;

7. Choose strategies that do not equate management with control; and

8. Inculcate environmentalism in all levels of the educational system and practice environmental ethics.

To effectively manage and conserve the seagrass ecosystems, it is necessary to relate them to management problems of associated nearshore habitats and adjoining tidal lands. It is the natural movement of water that provides the fundamental connections between the two ecosystems. Hence, in the planning process, it should be recognized that some activities in these associated areas can have far-reaching effects on seagrass sites through their influence on water quality.

Seagrass beds must be managed on the basis of a philosophy of conservation. Most important, management should begin by preventing further degradation and loss of the existing ecosystem while accommodating

traditional and contemporary needs, with adequate provision of reserves suitable for the protection of the biodiversity within them. These unexploited areas may serve as a refuge for flora and fauna and as a source of materials for restoring areas in which management strategies have failed.

As renewable resources, seagrass ecosystems must be managed on a sustainable use basis. This concept places economic benefits at par with the maintenance of the ecosystems as close to their original state as possible. However, depending on established priorities, a compromise may be reached which allows sustainable yield and reasonable resemblance to an undisturbed system.

During the First National Conference on Seagrass Management Research and Development in December 1986, Fortes (1987) proposed an R & D program for seagrass ecosystems and their resources. The central issue in the proposal was multidisciplinarity in approach because resource management

> *... begins with the ecologist's discussion of the productivity of the ecosystem, continues with the lawyer's discussion of the legal nature of resource utilization, includes the economist's concern for efficient use of equipment and facilities, and the politician's concern for proper allocation of the shore among the users.*

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THE PHILIPPINE MARINE ECOSYSTEM

Fishery production in the Philippines rose steadily until the early 1980s, when it started to level off. The rise was due to increased exploitation, while the decline took place when the maximum sustainable yield (MSY) of fishery resources had been reached. Yields for the period 1976-1985 are presented in Table 6.3 and shown graphically in Figure 6.5 from J.A. Ordoñez (1987).

1. Capture Fisheries

a. Status of Philippine Demersal Fisheries

When the Philippines declared an exclusive economic zone (EEZ) in 1978, the marine waters under the country's jurisdiction expanded from 1.6 to 2.5 million square kilometers. Despite this vast expanse, the productive shelf areas (0 to 200 feet deep) cover only 225,000 square kilometers or about 12 percent of the country's total marine waters.

Marine fisheries can be categorized into commercial and municipal sectors on the basis of the gross tonnage of fishing vessels used. Commercial fisheries are fishing operations involving the use of vessels of over three gross tons. These are mainly large-scale or industrial fishing activities. Municipal fisheries, on the other hand, include fishing activities using vessels three gross tons or less, even if these operations do not involve the use of motorcraft. These are mainly small-scale or artisanal fisheries.

The term "demersal resources" refers to fish and invertebrates living at or near the sea bottom. Demersal fisheries, therefore, include all fishing activities, municipal or commercial, directly or indirectly exploiting demersal resources. The commercial demersal fisheries mainly employ the trawl in soft-bottom areas, the *muro-ami* and hook and line in hard coral grounds, and the recently introduced Daseine in both soft and hard bottom grounds. Municipal demersal fishery employs primarily baby trawls, bottom gill nets, beach seines and push nets.

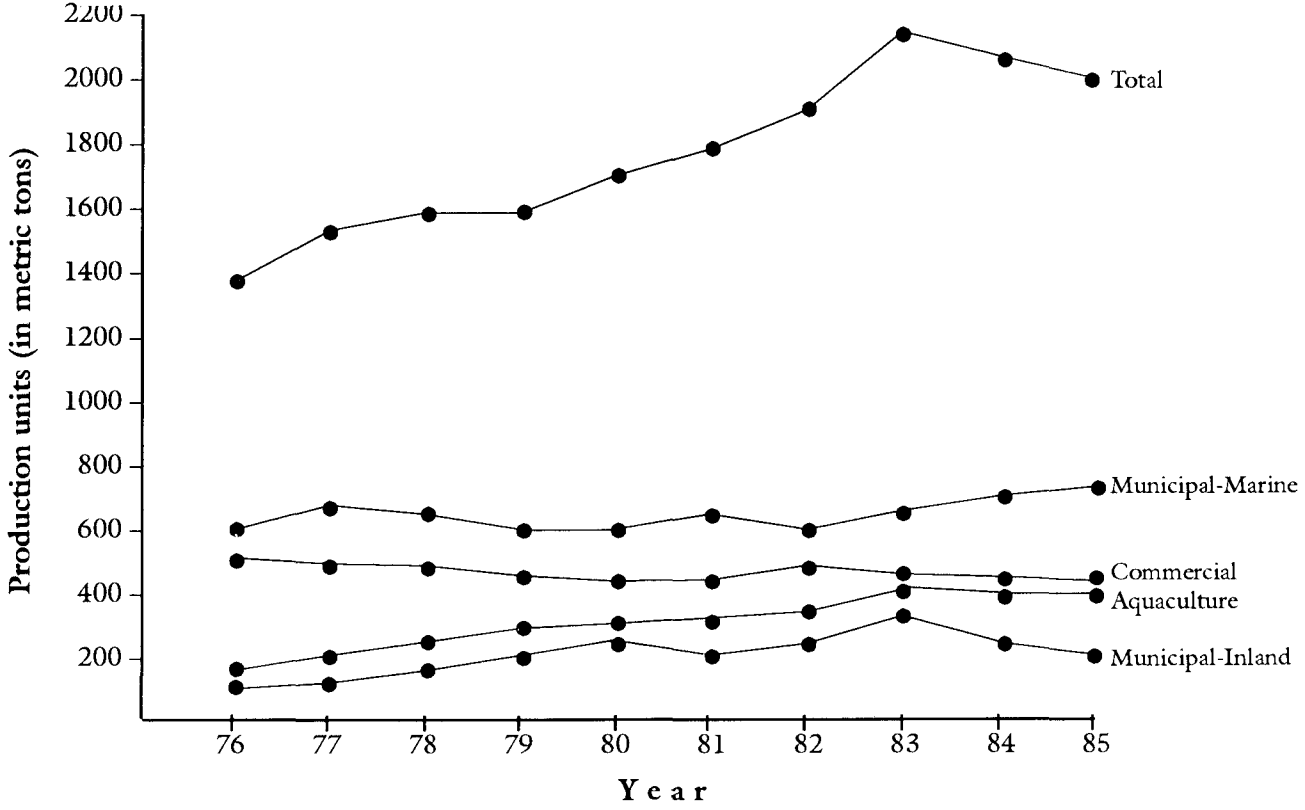
Figure 6.6 shows the total demersal landings from 1946 to 1984 for both the municipal and commercial sectors. The opposite trends in municipal (increasing) and commercial (decreasing) demersal landings may be due to the increasing economics of production and the "seven kilometers, seven-fathom ban" which has been beneficial to the municipal sector.

Table 6.3
Fish production from all sectors (in metric tons and peso value)

Year	Total		Commercial		Municipal				Aquaculture	
					Marine		Inland			
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1976	1,393,483	7,297,935	508,297	2,697,760	618,694	3,315,579	107,300	92,397	159,292	1,192,199
1977	1,508,855	8,809,203	518,165	3,543,212	710,840	3,821,675	116,260	193,383	163,590	1,250,933
1978	1,580,404	9,477,276	505,840	3,465,214	686,890	4,474,356	171,019	336,115	216,655	1,201,591
1979	1,581,303	10,536,747	500,747	3,512,246	635,538	4,872,344	203,820	491,948	271,198	1,660,209
1980	1,672,254	11,644,350	488,478	3,784,734	647,284	5,410,385	247,326	607,358	289,166	1,842,873
1981	1,772,897	13,953,798	494,768	4,124,641	709,989	6,263,374	228,639	700,263	339,501	5,865,520
1982	1,896,983	15,063,966	526,273	4,355,152	708,016	6,487,795	270,346	827,702	392,348	3,393,317
1983	2,110,230	18,981,459	519,316	4,642,692	770,988	7,463,081	374,853	2,076,516	445,073	4,799,170
1984	2,080,439	25,649,933	513,335	6,521,173	789,975	10,291,202	299,242	1,571,645	477,887	7,265,913
1985	2,052,111	31,297,268	511,987	7,857,178	785,132	12,795,450	260,250	1,920,279	494,742	8,724,361
	(99.97%)	(99.99%)	(24.94%)	(25.11%)	(38.25%)	(40.88%)	(12.68%)	(6.13%)	(24.10%)	(27.87%)

Source: Ordoñez, 1987.

Figure 6.5
Fishery Production Curves of the Various Sectors from 1976 to 1985



Source: Ordoñez, 1987.

Figure 6.6
Philippine Demersal Landings for the Period 1946-1984



Source: Silvestre, 1989.

Figures 6.7, 6.8, and 6.9 show the percentage contribution of demersal marine landings from the 1940s to 1985. It appears that demersal fisheries contribute from 29 to 42 percent of all marine landings. This percentage, however, has been declining since the 1960s (Silvestre, 1989). Available information shows that the extraction of demersal resources has peaked, to the extent that current extraction levels may already have exceeded available resources.

This is most apparent in the nearshore areas of traditional fishing grounds. Declining catch per unit of effort (CPUE), decreasing sizes of traditionally caught species, and high fishermen density all attest to overfishing. G.T. Silvestre *et al.* (1986) noted that the biomass of nearshore (0 to 100 meters deep) demersal stocks has declined to about 30 percent of the biomass levels in the late 1940s. P. Fox (1986) observed that the relative fish density is low in shallow areas where municipal vessels are dense compared to deeper areas where vessels are less dense. Based on information compiled by G. Silvestre and S. Ganaden (1987), the demersal stocks of many fishing grounds are fully exploited or overexploited with the exception of Palawan waters [see Table 6.4].

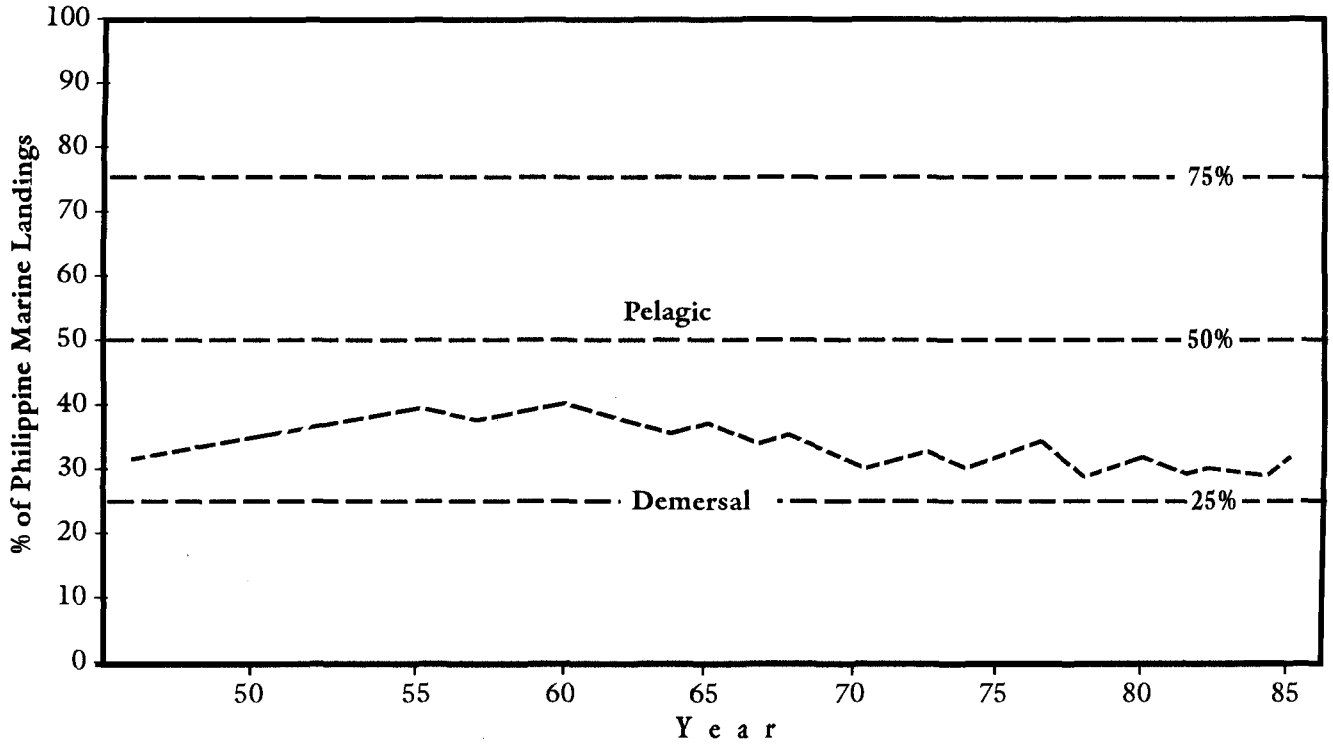
Compounding the problem is the use of explosives and other forms of illegal fishing. In addition, the use of small-meshed nets does not maximize the yield for trawl-caught species. Moreover, the denudation of mangrove and swamp areas, the destruction of coral reefs and uncontrolled runoffs from watershed areas have caused immeasurable damage to the marine ecosystem.

It is apparent that the demersal marine resources need improved management to regain sustainability. There is an urgent need to reduce fishing pressure through alternative employment opportunities for coastal communities.

b. Status of Pelagic Fisheries

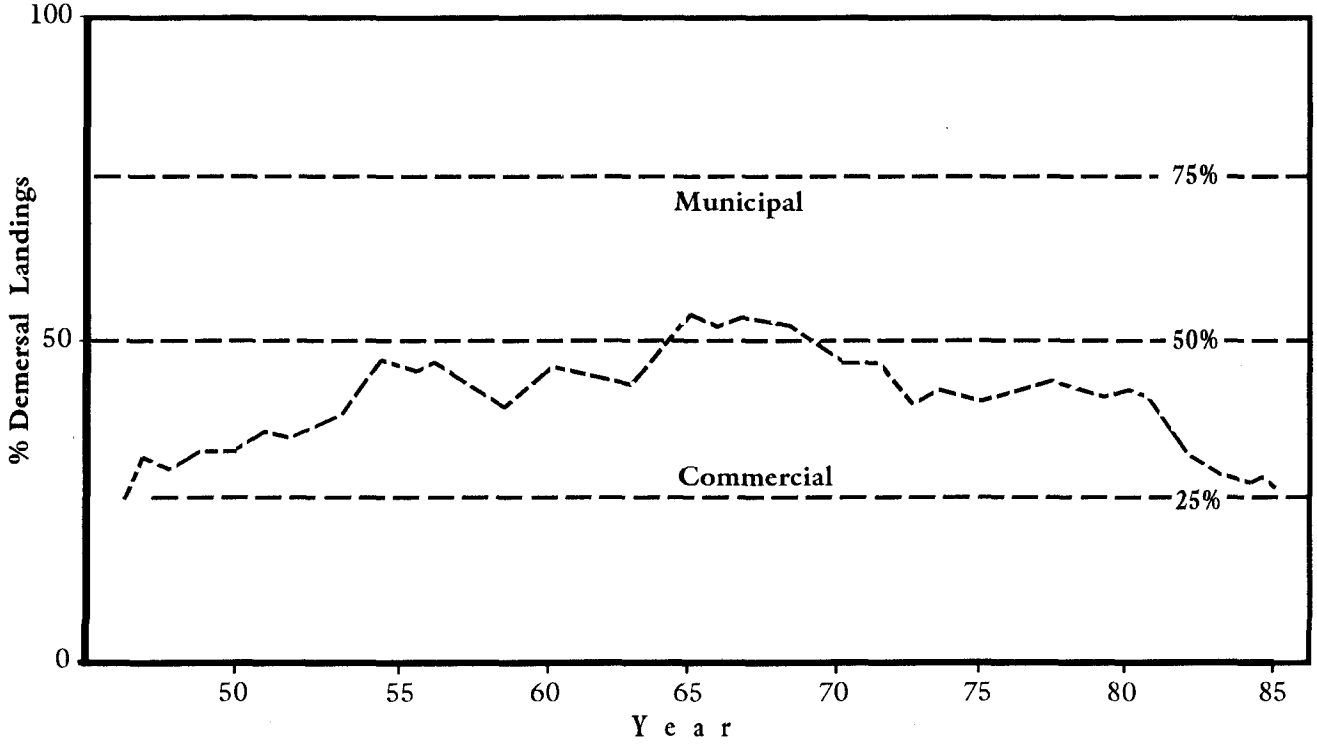
Pelagic fishing means exploitation of the diverse groups of fishes on the surface or near-surface layers of the sea. These are further divided into small pelagics and tuna or tuna-like species. The total pelagic fish production from 1946 to 1984 is shown in Figure 6.10 (Silvestre, 1989) which reveals that municipal pelagic landing is always higher than the commercial catch. Pelagic fish catch increased slightly from the 1950s to the 1960s and rose

Figure 6.7
Estimated Demersal Component of Philippine Marine Landings for the Period 1946-1984



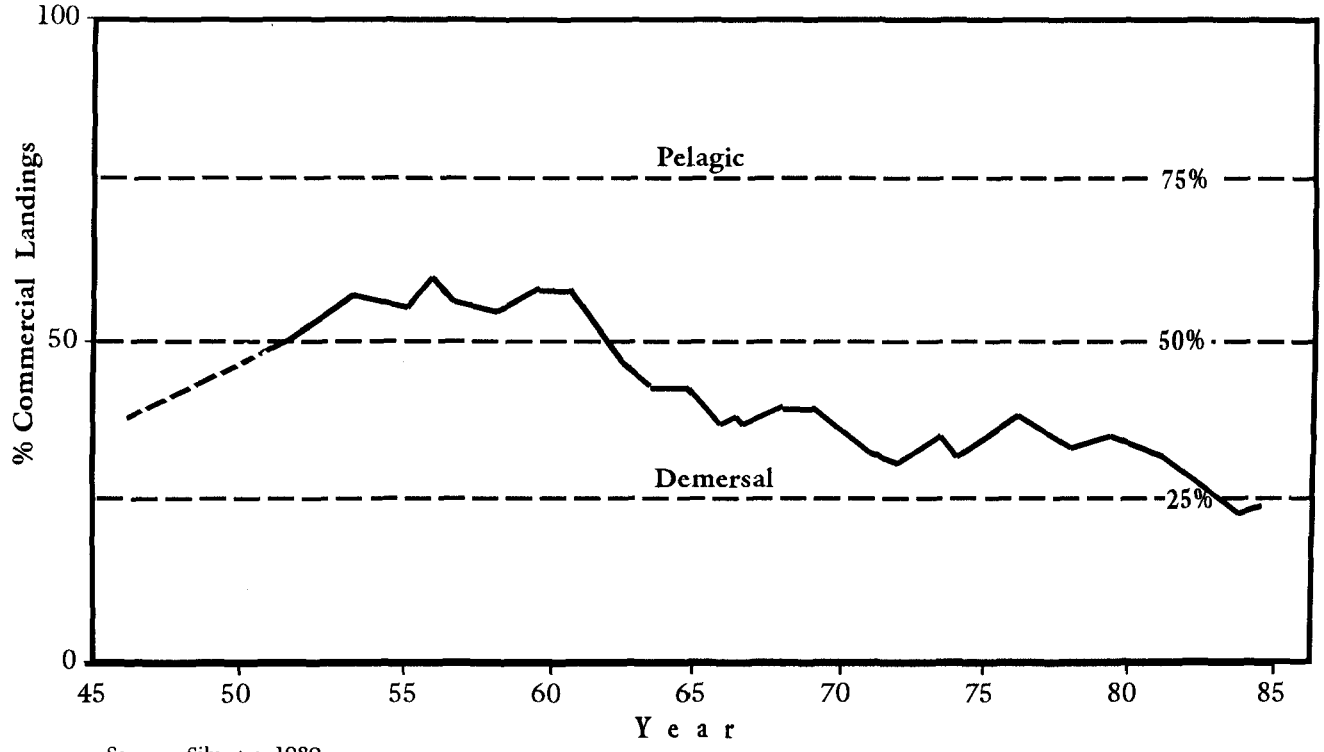
Source: Silvestre, 1989.

Figure 6.8
Relative Contribution (%) of the Municipal and Commercial Sectors
to Philippine Demersal Landings for the Period 1946-1984



Source: Silvestre, 1989.

Figure 6.9
Relative Contribution (%) of Demersal Landings of the Commercial Fisheries Sector for the Period 1946-1984



Source: Silvestre, 1989.

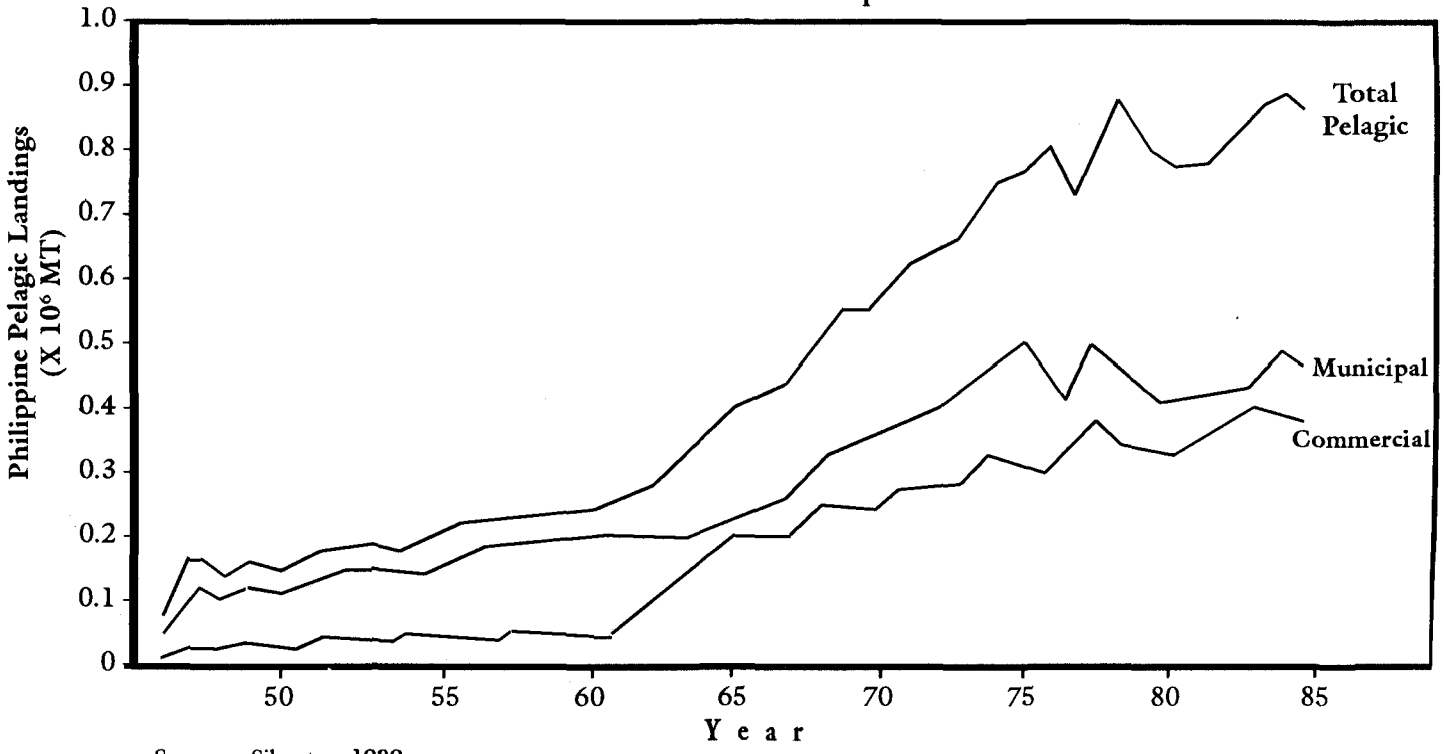
Table 6.4
Demersal resources potential of different fishing grounds

Fishing Grounds	Estimated Potential	State of Exploitation
I. Soft Grounds		
1. Visayan Sea	At least 100,000 MT	Overexploited
2. Samar Sea	Around 8,000 MT	Overexploited
3. Tayabas Bay	6,000 MT	Fully-exploited
4. Ragay Gulf	2,400 MT	Fully-exploited
5. Bohol Strait		Fully-exploited
6. Palawan Waters		Underexploited
7. Hinobaan and Sipalay Area	Very limited Trawable Area	Fully-exploited Fully-exploited
8. Sibuguey Bay		Fully-exploited
9. Illana Bay		Fully-exploited
10. Turtle Island to Lumbucan Island	More than 2,000 MT	?
11. San Miguel Bay		Overexploited
12. Leyte Gulf	Limited Trawable Area	?
13. North Coast		Fully-exploited
14. Lingayen Gulf		Fully-exploited
15. Manila Bay		Overexploited
II. Hard Grounds		
1. Lingayen Gulf		Overexploited
2. Babuyan and Batan Group		Underexploited
3. Western Coast of Ilocos Region		Underexploited
4. Catanduanes Coastal Water		Underexploited
5. Surigao del Norte Coast		Underexploited
6. Eastern Coast of Samar		Underexploited
7. Coron and Taytay Area	Very extensive area	Underexploited
8. Antique and East Passage	Less than 1,500 MT a year	Nearing full exploitation
9. South Negros to Bohol	Narrow and limited in area	Fully-exploited
10. North Coast of Mindanao	Narrow and limited in area	Nearing full exploitation
11. Illana Bay	More than 10,000 MT	Underexploited
12. Sulu Archipelago	MSY may be reached at 8,000 MT/yr	Underexploited
13. Turtle Island to Lumbucan Channel	More than 300 MT	Underexploited

Source: Silvestre, 1989.

MT = metric tons
MSY = maximum sustainable yield

Figure 6.10
Philippine Pelagic Landings for the Period 1946-1984 Based on Statistics from the Bureau of Fisheries and Aquatic Resources for Various Years



Source: Silvestre, 1989.

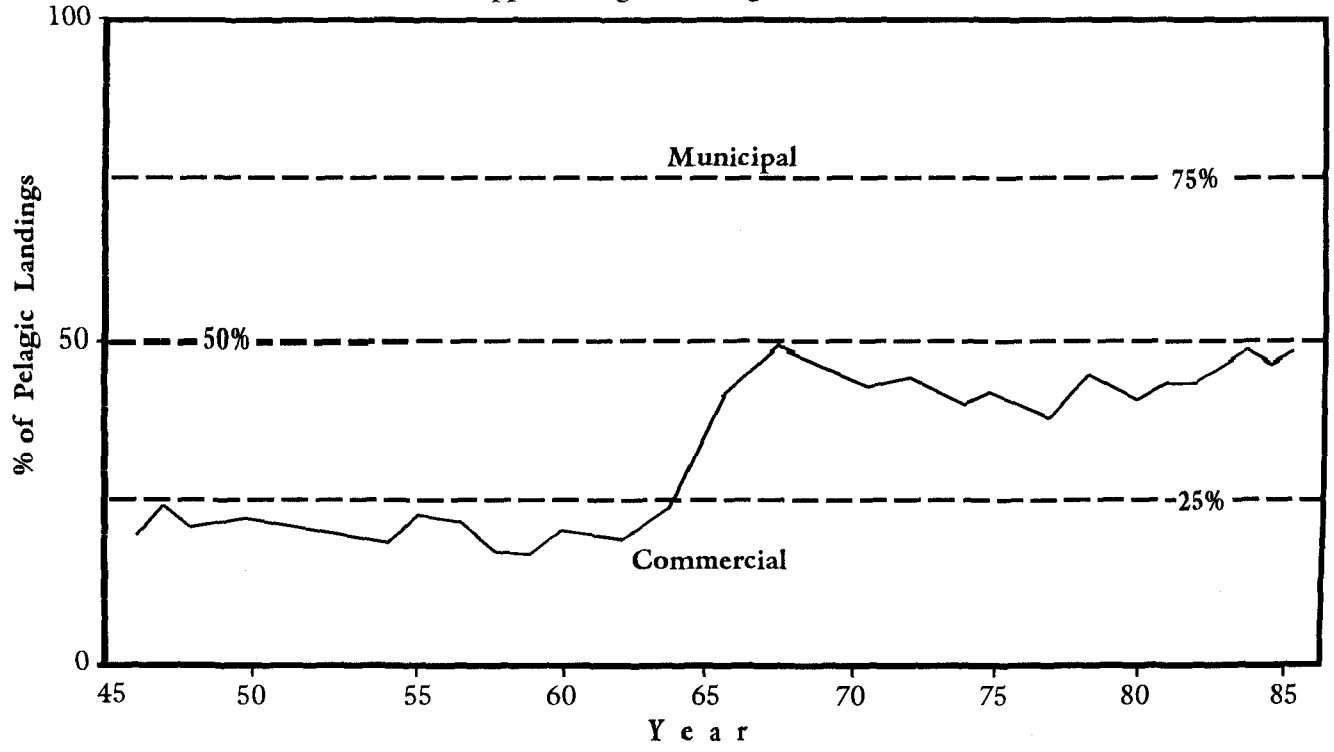
dramatically after that. The increases during the early 1960s can be attributed to the commercial sector, while those of the late 1960s and early 1970s came predominantly from municipal fishing. Some 75 to 80 percent of the pelagic fish catch from the late 1940s to early 1960s was contributed by municipal catch, which drastically declined relative to commercial pelagic fish catch until around the mid-1960s when the contributions of the two divisions became almost the same, and continued until around the 1980s (Figure 6.11) (Silvestre, 1989).

The small pelagic fishes comprise a great percentage of the total pelagic landings. From the mid-1970s to the early 1980s, the pelagic fish production was steady at around 0.5 metric tons (MT) per year [see Table 6.5], with roundscads comprising the greatest share (Dalzell and Ganaden, 1987b). There were fluctuations between years in the small pelagic fish landings which can be attributed to changes in abundance or to changes in fishing efforts.

During the 1970s, there was an apparent shift from small pelagic fishes to tuna fishery (Dalzell and Ganaden, 1987a). This is evident in the steady increase of tuna production from 1976 onward [see Table 6.6], even as small pelagic fish production remained steady. The frigate tuna accounts for 34 percent of total tuna production.

Despite increasing tuna production, there are some indications that tuna stocks are being overexploited. Silvestre (1989) noted local tuna harvests that are two to five times more than those of other regions in the world. Overfishing is evident in the case of both yellowfin and skipjack tuna fisheries. A great portion of Philippine landings of yellowfin and skipjack tuna is made up of immature fish, which are already becoming quite scarce in the country's territorial waters. Some experts see the beginning of a leveling-off involving pelagic fisheries as a whole. P. Dalzell and R. Ganaden's (1987a) paper on small pelagics demonstrated such leveling-off (Figure 6.12). Unless sound management measures are applied, the pelagic resources may begin to decline in the near future.

Figure 6.11
Relative Contribution (%) of the Municipal and Commercial Sectors to Philippine Pelagic Landings for the Period 1946-1984



Source: Silvestre, 1989.

Table 6.5
Annual landings (tons) of small pelagic fishes in the Philippines, 1976 to 1984

Species Groupings	Year 1976	1977	1978	1979	1980	1981	1982	1983	1984	$\bar{X}$	%
Anchovies	66,170	50,196	76,118	70,489	80,163	72,745	77,495	91,420	99,545	76,038	14.9
Big eye scads	42,478	55,992	46,488	47,027	47,032	33,609	27,232	22,502	37,513	39,985	7.8
Round scads	224,664	182,698	2,613	146,206	132,129	149,947	183,253	165,023	131,583	162,013	31.8
Sardines	61,668	127,721	149,665	106,403	117,348	136,871	147,746	161,484	109,027	123,104	24.2
Mackerels	63,461	53,773	63,451	56,886	46,513	47,387	43,736	62,898	60,482	55,399	11.2
Round herrings	44,029	60,768	35,763	23,970	34,128	28,360	21,166	20,507	35,125	33,757	6.6
Fusiliers	23,809	14,131	13,133	13,909	18,089	17,002	18,361	17,595	19,817	17,316	3.4
Total	526,279	545,279	527,231	464,890	475,921	485,921	518,989	531,429	493,092	507,611	

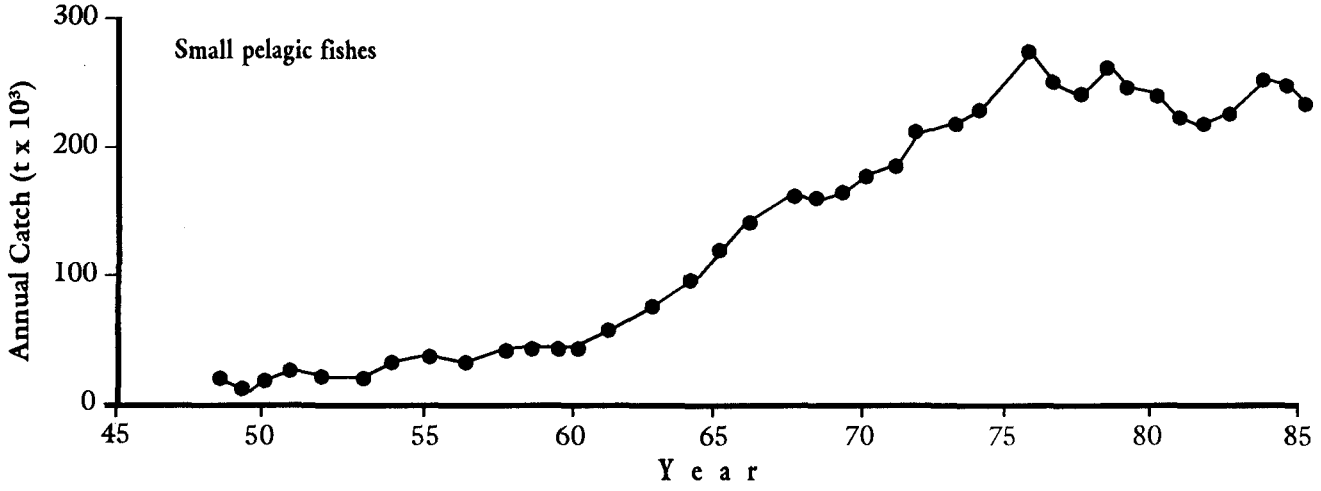
Source: Dalzell and Ganaden, 1978b.

Table 6.6
Annual total landings (metric tons) of tuna in the Philippines from 1976 to 1985

Species	Year 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	X	%
Frigate/ Bullet	28,328	43,007	50,899	79,909	96,874	78,248	67,363	74,333	80,305	95,718	69,498	33.5
Yellowfin	44,478	63,059	47,029	49224	48,023	56,176	51,922	62,092	58,924	62,493	54,522	26.3
Skipjack	29,174	55,090	49,730	45,084	31,178	38,439	50,795	57,068	44,671	60,536	46,177	22.3
Eastern Little	23,004	54,744	36,341	23,094	24,730	30,891	46,524	49,064	41,899	41,060	37,135	17.9
Total	124,984	215,900	183,999	197,311	200,805	203,754	216,604	242,557	225,799	261,607	207,332	100.0

Source: Aprieto and Ganaden, 1987.

Figure 6.12
Annual Variation in the Small Pelagic Fish Catch, 1948-1984



Source: Dalzell and Ganaden, 1987a.

2. Aquaculture

a. Brackishwater Aquaculture

Historical Background

Brackishwater aquaculture techniques have been used for many years, after Filipinos accidentally discovered milkfish in their salt beds. Since then, salt beds have been stocked with young milkfish during the rainy season and used for salt production during the summer. Through the years, the rising demand for animal protein spurred the construction of more ponds stocked with fingerlings. Later, more sophisticated culture techniques were used, including pond fertilization, feeds and feeding, and stock manipulation involving the culture of one or several species of fish.

Environmental Issues

In the early 1970s the Southeast Asia Fisheries Development Center (SEAFDEC) in Tigbuan, Iloilo attained a breakthrough when it completed the life cycle of the tiger shrimp or giant prawn, *Penaeus monodon* Fabricius. The species was made to breed in captivity, producing a year-round supply of seeds. Since then, fishpond owners attracted by the high price of prawns in the local and international markets have taken up prawn culture. Ponds were built in mangrove swamps, ricefields, sugarland and other areas close to the seashore. Today, there are an estimated 200,000 hectares of ponds all over the country, most of which are found in the Western Visayas and in the large areas of Luzon, stretching from the suburbs of Metro Manila up to Pangasinan.

Current aquaculture technology involves the treating of ponds with toxic chemicals, very high stocking density, and overdumping of feed beyond the biological and chemical oxygen demands of the pond environment. The occurrence of mass mortality is common, with the outbreak of diseases and parasites which sometimes cause production to drop to zero. Pond production and profits peaked in the mid-1980s, but soon afterward there was a glut in the world market and prices plummeted.

Some environmental issues concerning aquaculture have been raised in regional seminars and symposia. These are:

1) If the fishing industry were left uncontrolled, more and more mangrove swamps, ricefields and sugarlands, including some residential and commercial areas, would be converted to fishponds.

2) Soon, ponds, the estuarine area and the marine environment would be loaded with highly toxic and dreadful chemicals whose effects may be irreversible.

3) The overdumping of feeds in ponds pollute the aquatic environment.

4) The constant pumping of freshwater from deep wells in order to supply fishponds has caused the intrusion of saltwater into drinking water wells, as has been reported in the Negros Occidental areas.

Environmental Problem Analysis

1) Fishpond construction. The conversion of mangrove swamps, ricefields, sugarlands and other areas into fishponds creates environmental stress. Particularly harmful is the removal of green vegetation that consumes atmospheric carbon dioxide and converts it into living matter. In addition, agricultural land tenure is drastically affected by fishpond construction, especially in areas with ricefields and sugarland. Residential and commercial areas converted into ponds displace local inhabitants. In view of these problems, there should be no more construction of fishponds; instead, there should be a controlled intensification of culture techniques.

2) Use of chemicals. Toxic chemicals used by fishpond operators are believed to be responsible for the mass mortality of fish in the estuarine areas which takes place whenever fishpond operators drain the ponds. The use of chlorinated hydrocarbons and organophosphates has a harmful effect on the pond bottom where the fish and shrimp live. The concentration of these chemicals would eventually exceed tolerable limits and cause damage to the environment, including human beings. There should be constant monitoring of the concentration levels of toxic chemicals in the water environment. The disposal of these

chemicals should be regulated. All banned chemicals should be disposed of and only recommended chemicals should be used.

3) Feed dumping. Fishpond operators usually dump into ponds more feed than the fish can consume. The leftover food undergoes microbiological decomposition, resulting in increased chemical and biological oxygen demands of the pond environment. There is therefore strong competition for dissolved oxygen. Life-support systems, like aerators and paddle wheels, are usually used to compensate for the loss of dissolved oxygen in the water.

   A flow-through pond culture system produces polluted waters that are drained out of the ponds. The rivers, estuarine areas and marine environments end up receiving the polluted water. Moreover, siltation is accelerated by the partially decomposed feeds and other particulates that come with the water output from the ponds. The organic matter load of the water outflow from the ponds usually causes eutrophication in the estuarine and marine areas. In turn, this contributes considerably to the sudden bloom of phytoplankton. Sometimes, a sudden change of temperature and salinity may cause the bloom to die. But the ensuing decomposition increases the demand for dissolved oxygen and sometimes results in the mass mortality of other aquatic organisms.

4) Freshwater supply. Prawn culture is done in water with a salinity ranging from 15 to 20 parts per thousand (ppt). Since sea water has a salinity of 35 parts per thousand, freshwater is needed to dilute it. Deep wells are therefore constructed, usually right in the pond sites. Tremendous amounts of freshwater are then pumped out. This large-scale extraction of fresh water lowers the groundwater table. During summer when the water table is already low, pumping water can create a partial vacuum that causes the salt water to penetrate the soil, thus affecting the drinking water wells of the local community. The lowering of the water table also drastically curtails the amount of available water for plants and trees. It is recommended that outgoing irrigation water, rather than draining into rivers or seas, should be used for pond water instead.

b. Mariculture

Historical Background

The culture of organisms (finfish, crustaceans, mollusks and seaweeds) in the marine environment or mariculture came later than pond culture or aquaculture. It was not until the 1970s when people began to use tidal and subtidal areas along the shoreline. They constructed enclosures such as cages or pens and stocked them with fish like groupers and seabass. Some built wooden or bamboo structures for attaching spats of mussels and oysters. Others used the broadcast method, stocking tidal flats with young oysters and harvesting them when they reached marketable size. In the case of seaweed culture, floating or sinking nets and lines are used as seaweed culture media.

Environmental Issues

Research has been conducted on different mariculture methods and techniques for use for some species of fish, seashells and seaweeds. Technologies have already been developed and are currently in use for culturing green shells or mussels and oysters. Studies have also been done on the culturability of angel wing and razor clams both in ponds and in the tidal areas. Seaweeds are cultured in some areas around the country for food and/or production of carrageenan and algin and other derivatives for pharmaceutical needs.

Although mariculture uses vacant tidal and subtidal areas, it may in some cases compete with catch fisheries for space and obstruct water transportation. Pen and cage culture obstructs and slows down the flow of water current. This in turn accelerates siltation, resulting in the formation of sand pits and beach pools which might be hazardous to transportation.

The culture medium for seaweeds usually entangles the nets of trawlers and long-line fishing gears. Wooden and bamboo poles and rafts for oysters and green shell culture usually block sea transportation and destroy the aesthetic view of the beach areas.

The introduction of feeds in the cage and pens may cause the environment to change in terms of species composition, like the turning over of species or ecological succession of the different species components of the area. In most cases, unconsumed feeds pollute the waters and allow immediate

organisms like crabs and other free swimming finfishes and crustaceans to establish their population and compete for food with the resident species.

Environmental Problem Analysis

The problem of sea transportation can be minimized if municipal permits are required to build pens and cages and erect poles and rafts. This way, local authorities can supervise and better handle the situation. There should be proper zoning of the municipal waters so that areas for transport and mariculture can be delineated. Poaching can be minimized if activities are properly coordinated at the municipal level. Catch fisheries can be properly regulated and warning devices should be installed in the culture sites to avoid conflicts among those who also want to use the marine environment for swimming, boating, and other purposes.

CONCLUSION

Given the foregoing information on the coastal and marine ecosystems of the Philippines, it is possible to distill the key concerns and measures needed for this sector as a whole.

Key Concerns

1. Declining overall production, particularly demersal and small pelagic fisheries.
2. Overfishing and overgathering of marine products.
3. Destructive fishing leading to the degradation of supporting habitats and of coral reefs and seagrass beds.
4. Destruction of mangrove swamps.
5. Siltation and other pollution in coastal areas.
6. Poorly regulated coastal development, including tourism.
7. Threatened existence of rare species of marine life, especially the *dugong*, sea turtles, and giant clams.

Key Measures Needed

1. Regulate fishing by focusing on underexploited fishing grounds and reducing the pressure on overexploited areas.
2. Increase nondestructive aquaculture development, especially mariculture.

3. Stop destructive fishing and exploitation of rare species.
4. Ban further conversion of mangrove areas to other uses.
5. Properly manage coastal zone development, including tourism.
6. Reduce siltation and pollution in coastal zones by regulating activities in watershed areas.
7. Provide alternative livelihood to fishing communities to reduce the pressure on marine resources.

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CHAPTER 7
THE PHILIPPINE FRESHWATER ECOSYSTEM

Macrina T. Zafaralla

INTRODUCTION

The Philippines has rich resources of inland waters consisting of lakes and rivers probably as a consequence of the tectonic forces that led to the country's formation. It has 421 principal rivers with drainage areas ranging from 40 to 25,469 square kilometers (NWRC, 1976). It has 384 river systems with a combined area of around 31,000 hectares. Most of these are in Region III (Central Luzon) which has 27 rivers, followed by Region VI (Western Visayas) with 25 [see Table 7.1].

There are 69 lakes in the country [see Table 7.2], covering an area of around 200,000 hectares. The largest of these is Laguna de Bay which covers an area of around 90,000 hectares (Pacardo *et al.,* 1988). As of 1987, there were seven major reservoirs [see Table 7.3] with a total area of 18,770 hectares (Guerrero, 1987). These reservoirs are used primarily for power generation, fisheries, irrigation, and water supply. Some 97 smaller impoundments have also been built with a total area of 523.9 hectares.

In 1976, the National Water Resources Council (NWRC) reported four major groundwater reservoirs underlying the major river basins: Cagayan River Basin (10,200 sq. km.), Central Luzon (9,200 sq. km.), Agusan River Basin (8,500 sq. km.), and the Cotabato River Basin (6,000 sq. km.).

Table 7.1
Major rivers in the Philippines and their classification according to their best use (1974-1978)

Location	Name of River	Classification
Region 1		
Abra	Abra River-Upper	Class A
	Abra River-Lower	Class A
Benguet	Agno River-Upper	Class A
	Bued River	Class D
	Naguilian River-Upper	Class A
Ilocos Sur	Amburayan River-Lower	Class C
La Union	Barroro River	Class A
	Bauang River-Lower	Class C
	Naguilian River-Lower	Class C
Mt. Province	Amburayan River-Upper	Class C
Pangasinan	Agno River-Lower	Class C
	Balingcaguing River	Class B
Region 2		
None		
Region 3		
Bataan	San Juan River	Class C
Bulacan	Balagtas River	Class C
	Bambang River	Class C
	Binuangan River	Class C
	Bulacan River	Class C
	Bocaue River-Upper reach	Class A
	Bocaue River-Lower reach	Class C
	Calumpit River	Class C
	Guiguinto River	Class C
	Marilao River-Upper reach	Class A
	Marilao River-Lower reach	Class C
	Meycauayan River	Class C
	Polo River	Class C
Nueva Ecija	Pampanga River-Upper	Class A
Pampanga	Pampanga River-Lower	Class C
	San Fernando River	Class C
	San Juan River	Class C

Table 7.1 (continued)

Location	Name of River	Classification
Region 3 (continued)		
Tarlac	Bamban River	Class A
	La Paz River	Class A
	Rio Chico River	Class C
	Sorabia River	Class A
Zambales	Bucao River	Class B
	Lawis River	Class B
	Mabayuan River	Class A
	Sta. Rita River-Upper	Class A
	Sta. Rita River-Lower	Class C
	Sto. Tomas River	Class A
National Capital Region		
Metro Manila		
	Marikina River-Upper	Class A
	Marikina River-Lower	Class C
	Parañaque River	Class C
	Pasig River	Class C
	San Juan River	Class C
	Zapote River	Class C
Region 4		
Batangas	Binambang River	Class C
	Palico River	Class C
	Rosario River	Class A
	San Juan River-Upper	Class A
Laguna	Banadero River	Class C
	San Cristobal River	Class C
	San Juan River-Lower	Class C
	San Pedro River	Class C
	Sta. Cruz River	Class C
	Sta. Rosa River	Class B
	Tigas River	Class A
Marinduque	Boac River	Class C
	Mogpoc River	Class C
Quezon	Dumaca-a River	Class A
	Masin River	Class C
Rizal	Tenejeros-Tullahan River	Class C

Table 7.1 (continued)

Location	Name of River	Classification
Region 5		
Albay	Bombon River	Class A
	Tayli River	Class A
	Yawa River	Class A
Camarines Sur	Bicol River	Class A
	Pawili River	Class A
Region 6		
Aklan	Aklan River-Upper	Class A
	Aklan River-Lower	Class B
Antique	Cairnan River-Upper	Class A
	Cairnan River-Lower	Class B
	Cangaranan River	Class A
	Palinan River-Upper	Class A
	Sibalom River-Upper	Class A
	Sibalom River-Lower	Class B
Capiz	Alngon River	Class C
	Panay River	Class A
Iloilo	Alacaygan River	Class C
	Balantias River	Class B
	Barotac River	Class B
	Guimbal River	Class B
	Iloilo River	Class C
	Jalaur River-Upper	Class A
	Jalaur River-Lower	Class C
Negros Occidental	Himoga-an River	Class C
	Ilog River-Upper	Class A
	Ilog River-Lower	Class C
	Pontevedra River	Class C
	Salamanca River	Class C
	Sicaba River	Class C
	Sipalay River-Upper	Class A
	Sipalay River-Lower	Class C
Region 7		
Cebu	Sapang Daku River	Class E
Negros Oriental	Panamangan River	Class C
	Tanjay River	Class B

Table 7.1 (continued)

Location	Name of River	Classification
Region 8		
Leyte	Bao River	Class A
Samar	Taft River	Class C
Region 9		
None		
Region 10		
Agusan del Norte	Agusan River	Class C
	Cabadbaran River	Class A
	Magallanes River	Class C
	Tubay River	Class A
Bukidnon	Polangui River	Class A
Misamis Occidental	Clarin River	Class A
	Oroquieta River	Class A
Misamis Oriental	Cabulig River	Class A
	Cagayan River	Class A
	Gingoog River	Class A
	Iponan River	Class A
	Odiongan River	Class A
	Tagolo-an River	Class A
	Solana River	Class A
Surigao del Norte	Surigao River	Class A
Region 11		
None		
Region 12		
Lanao del Norte	Agusan River	Class

Water Usage and Classification

Fresh Surface Water	
Classification	**Best Usage**
Class AA	For source of public water supply. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A	For source of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
Class B	For primary contact recreation.
Class C	For the propagation and growth of fish and other aquatic resources.
Class D	For agriculture, irrigation, livestock watering and industrial cooling and processing.
Class E	For navigational use.

Table 7.2
Name and area of lakes in the Philippines

Region/Province	Name of Lake	Area (hectares)
Philippines		**Total 199,635.3**
Region 1		450.0
Ilocos Norte	Paoay	401.5
Ilocos Sur	+ Pinsal	10.0
Abra	+ Quimquimay	5.0
	+ Lumpo	5.0
Pangasinan	Loloog	22.9
	Paoao	5.0
Region 2		184.0
Cagayan	Cabalangan	184.0
Region 3		497.8
Tarlac	Ladiaoan	43.0
	Canarin	50.2
Zambales	+ Alindayat	130.0
	Looc	103.6
Nueva Ecija	Paitan	171.0
Region 4		122,750.9
Laguna-Rizal	* Laguna de Bay	89,076.3
Laguna	Sampaloc	105.4
	Palacpaquen	43.5
	Calibato	43.0
	Yambo	30.5
	Bunot	29.6
	Alligator	26.0
	Pandin	24.0
	+ Mohicap	14.0
	+ Caluangan	5.0
Batangas	* Taal	24,356.4
	Ticab	41.4
	Bagatan	5.2
Mindoro Oriental	* Naujan	7,899.6
	Caluangan	111.7
	Calapan	64.4
Palawan	Manguno	875.0
Region 5		5,496.1
Camarines Sur	Bato	3,792.5
	Buhi	1,015.8
	Baao	671.8
Sorsogon	+ Bulusan	16.0
Region 6	—	—

Sources: Census Atlas of the Philippines, 1940.
Bravo, S.A. 1970. The Development of Freshwater Fisheries Industry in the Philippines. *Philippine Fishery Journal* 8(3).

Table 7.2 (continued)

Region/Province	Name of Lake	Area (hectares)
Region 7		1,658.3
Negros Oriental	Balanan	5.0
	Balinsasayao	286.2
	Mantohod	106.5
	Danao	73.6
Cebu	Lanao	1,192.0
Region 8		458.1
Leyte	Danao	196.7
	Bito	169.7
	Danao	31.8
	Ibaq	15.3
	Maobog	14.1
	Lunay	10.7
	+ Davo	10.0
	Cambiraq	9.8
Region 9		365.2
Zamboanga del Sur	Wood	365.2
Region 10		21,727.2
Surigao del Norte-Agusan	* Mainit	17,430.2
Agusan	Pagusi	2,531.5
	Lumao	1,685.6
Bukidnon	Lamybyben	69.9
	+ Pinamalay	10.0
Regions 11 and 12		46,047.7
Lanao	* Lanao	33,999.7
	Butiq	514.0
	Dapau	266.6
	Putian	191.0
	Nunungan	117.6
	Talao	80.6
	Dagianan	80.5
Cotabato	* Buluan	6,134.2
	Labas	2,140.8
	Sebu	864.1
	Bingkong	491.2
	Lahit	248.8
	Maughan	212.3
	Balut	207.0
	Sultan	197.3
	Malinao	129.8
	Buranibud	102.2

* Major lakes

Table 7.3
Characteristics of the seven major reservoirs of the Philippines

Reservoir (location)	Area (hectares)	Elevation (meters)	Maximum Depth (meters)	Uses	Fishing Gear Used	Fish Caught	1986 Fish Production (tons)*
Ambuklao (Bokod, Benguet)	700	1,524	78	Power generation, fisheries	Gill net, hook and line	*Tilapia,* goby, mudfish, common carp	NA
Binga (Itogon, Benguet)	150	914	40	Power generation, fisheries	Gill net, hook and line, spear	*Tilapia,* goby, mudfish, common carp	NA
Magat (Ramon, Isabela)	4,460	1,500	80.5	Power generation, irrigation, fisheries	Gill net, hook and line, fish trap	*Tilapia*, catfish, goby, freshwater grunt, mudfish	6,726
Pantabangan (Pantabangan, Nueva Ecija)	8,900	230	28.9	Power generation, irrigation, fisheries	Gill net, long-line, hook and line, spear, fish trap	*Tilapia*, mudfish, common carp, milkfish, catfish, eel, gourami	NA

NA = not available

Table 7.3 (continued)

Reservoir (location)	Area (hectares)	Elevation (meters)	Maximum Depth (meters)	Uses	Fishing Gear Used	Fish Caught	1986 Fish Production (tons)*
Angat (Norzagaray, Bulacan)	2,300	102	94	Power generation, irrigation, water supply, fisheries	Gill net, long line, hook and and line, push fish trap	*Tilapia* (75 percent of catch), common carp, mudfish, milkfish	87
Caliraya (Lumban, Laguna)	1,160	3,305	20	Power generation, fisheries	Gill net, hook and line, longline, spear	Largemouth bass, *tilapia*, common carp, mudfish, goby, freshwater grunt	NA
Pulangui IV (Maramag, Bukidnon)	1,100	405	15 **	Power generation, fisheries	Gill net, hook and line	*Tilapia*, common carp, rohu	2.4

NA = not available

** mean value

Due to their expanse and number, bodies of water have become an integral part of daily Philippine life. In 1975, the estimated number of people living along coastal areas was around 19 million people or 55 percent of the country's population. No estimate is available for inland waters save for Laguna de Bay whose lakeshores are populated by approximately 65,000 people as of 1990.

Freshwaters have diverse uses: fishery, aquaculture, tourism, industry, agriculture, and domestic, like washing and bathing. Since such uses entail a body of water being the ultimate medium to transfer, dilute, and transform unwanted wastes, they render the resource a virtual sump for waste products. In this way, the water body becomes an expansive reservoir of substances and conditions that affront the senses, endanger human health and well-being, and threaten aquatic life.

Pollutants are categorized into eutrophying nutrients, organics, toxic and hazardous wastes, BOD/COD, pesticides, radioactive wastes, suspended and dissolved solids; and pathogenic organisms. The degree of pollution of the aquatic environment by any or a combination of these pollutants would depend on the nature of the pollutant being released, the amount released at a particular period of time, and the area affected by such release. Coupled with this is the degree of protection executed by its users.

This paper assesses the present state of freshwater resources — lakes and rivers — in the Philippines. The objectives are: (1) to put into perspective natural processes and phenomena that should be considered in the management of these resources; (2) to present in qualitative and quantitative terms the present state of some of the most studied bodies of water in the country; (3) to describe the problems and issues confronting these resources; and (4) to provide some recommendations on solving problems or avoiding them in the future. This assessment focuses on the problem of water pollution.

THE OFTEN IGNORED IMPORTANCE OF RIVERS AND LAKES

1. The Water Cycle

Rivers, streams and lakes play a vital role in the circulation of water on planet Earth. Rain clouds release their water on land, river, lake and sea. Rainwater in open areas infiltrate the soil, and percolate into the ground until it reaches the water table which it recharges. Water in excess of the soil's water holding capacity moves in rills and gulleys until these join streams that end up in rivers. The latter may open into the sea or a lake.

The sea is a vast reservoir of water from which millions of gallons of water evaporate daily. Soils without a vegetative cover lose water by evaporation. Land plants lose water via the processes of transpiration and evaporation (evapotranspiration). Evaporated and transpired water condense around minute particles called nuclei that abound in the atmosphere. Upon reaching a size too heavy to be held in suspension by air, the particle is pulled by gravity and reaches the ground in the form of rain.

2. Influence on Climate

Oceans exert a strong effect on the climatic conditions of coastal regions. The maritime climate in these areas is characterized by humid air, with the sea breeze dominating air movements. Similarly, the vastness of the store of water found in a big lake or reservoir also exerts considerable influence on local climate. The waters of Lake Lanao, for example, give rise to updraft clouds that form over the land and dissipate over the lake. As a result, the lake is often surrounded by clouds even when the sky is clear. D.G. Frey (1985) believes these conditions permit maximum insulation which in turn affects the lake's primary productivity. The typical mist enveloping Lake Buhi may arise from similar processes.

3. Nutrient Cycling

Rivers draining mountains are an effective vehicle for transporting materials like silt, pebbles, stones, rocks, and dissolved nutrients including living organisms. Strong headwaters developed during a strong rain scour the riverbed causing movement of the bedload — pebbles, stones, rocks and in extreme cases, boulders. Onrushing waters erode river banks. Bedload

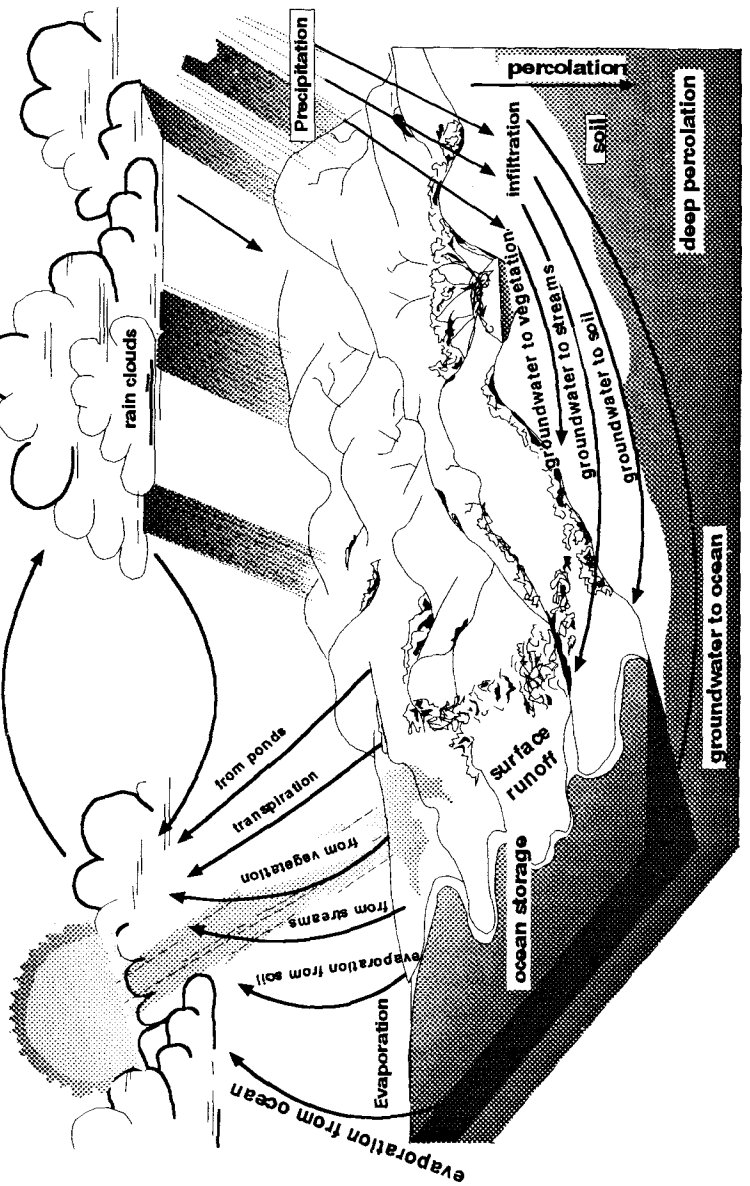


Figure 7.1. The Hydrologic Cycle (United States Department of Agriculture)

materials distribute themselves downstream according to their weight with the heavier materials staying closer upstream while the lighter suspended silt is carried downstream. The latter are responsible for forming the so-called deltas around the mouths of rivers. The disturbance of a forest by deforestation increases the silt load of streams and rivers.

Dissolved minerals in flowing waters may be attracted to silt particles due to the presence of negative charges on the latter. In their place of deposition, silt may release these absorbed minerals as conditions permit. Microscopic floating plants called phytoplankton together with the rooted aquatic vegetation make up the base of the aquatic food chain that benefit from this nutrient pool. Herbivores like the larvae of various forms of aquatic animals feed on the phytoplankton. Carnivores like fingerlings and shrimps feed on herbivores. Higher-level consumers, the nekton, feed on the lower carnivores. Thus, in bodies of water, foodwebs exist as they do on land. When these organisms die, their debris form a part of the nutritional intake of omnivores. That which escapes this form of consumers goes down to the bottom of the water where decomposition is brought to completion. Flowing waters transport both debris and minerals dissolved in water to sea and lake where they augment the supply in the extant nutrient pool.

4. Biological Reservoirs

Lakes count among nature's precious gifts. Where the sea is absent, a lake may serve as a fishing ground and place for aquaculture. Philippine lakes are a rich repository of freshwater fish species. Laguna de Bay has 23 varieties belonging to 16 families and 16 genera (Davies *et al.*, 1986 sensu Pacardo *et al.* 1988). Lake Buhi has 13 species, while Taal Lake has 18. The last two lakes are famous for two fish species of biological distinction: *Mistichthys luzonensis*, the smallest commercial fish in the world, which is found in Lake Buhi; and *Herengula tawilis*, a freshwater sardine, which thrives in Taal Lake.

Table 7.4 lists the species composition of these lakes. In addition to fish, a number of lakes also host rare species of other life forms. Taal Lake has been found to be the habitat of seven new species and five new varieties of freshwater algae. Man-made reservoirs pale in comparison with natural lakes in terms of fish species diversity (Baluyot, 1983). This is probably due to low fish introductions.

Table 7.4
Fish species composition of three Philippine lakes

Species	Common Name
Laguna Lake[1]	
Chanos chanos	*Bangus*; milkfish
Tilapia sp.	*Tilapia*
Therapon plumbeus	*Ayungin*; perch
Ophicephalus striatus	*Dalag*; snakehead
Clarias batrachus	*Hito*; catfish
Glossogobius giurus	*Biya*; goby
Aurius manilensis	*Kanduli*; catfish
Pontius javanicus	*Tawes*
Cyprinus carpio	*Karpa*; carp
Gourami sp.	*Gorami*; gourami
Anabas testudencus	*Martiniko*; climbing perch
Lake Buhi[2]	
Anabas testudineus	*Puyo*; climbing perch
Anguilla sp.	Freshwater eel
Clarias batrachus	Freshwater catfish
C. saccrocephalus	
Cyprinus carpio	Common carp
Labeo rohita	Indian rohu
Mistichthys luzonensis	Tabios; *sinarapan*
Glossogobius giurus	*Biya*
Ophicephalus striatus	Mudfish
Ospheronenus gourami	Gourami
Tilapia mossambica	
T. nilotica	*Tilapia*
Trichogaster pectoralis	*Plasalid*; *mirapina*
Yarmosa dispar	*Irin-irin*; goby
Macrobrachium sp.	*Buyod*, shrimps

[1]Inter-church Center for Development, 1983.

[2]Pahm, 1989.

Table 7.4 (continued)

Species	Common Name
Taal Lake[3]	
Anguilla mauritiana	*Igat*; English eel
Herengula tawilis	*Tawilis*; freshwater sardine
Carassius auratus	*Karpita*; golden carp
Clarias batrachus	Bangkok *hito*; catfish
Atherina forskalii	*Guno*; English silverside
Bombonia luzonica	*Bombonia*; English pipefish
Ophicephalus striatus	*Dalag*; mudfish
Datnia plumbeus	*Ayungin*; silver therapon
Apogon thermalis	*Muwang*; translucent cardinal fish
Caranx ignobilis	*Maliputo*; yellowfin jack
Toxotes jaculator	*Kataba*; archerfish
Oreochromis niloticus	*Tilapia*; Nile tilapia
Mugil dussumieri	*Banak*; greyish green mullet
Ophiocara aporos	*Bangayngay*; English sleeper
Glossogobius giurus	*Biyang puti*; white goby
Glossogobius celebius	*Bia ng bato*; rock goby
Mirogobius stellatus	*Dulong*; star goby
Oxyurichthys sp.	*Talimusak*; snake-scaled goby

[3]Vallejo, *et al.*, 1985.

To safeguard aquatic diversity and fishery productivity, fish sanctuaries have been established by legislation in four out of the 69 lakes in the country. The fish sanctuary of Laguna de Bay has a total area of 5,000 hectares; Taal Lake, 1,257 hectares; Lake Bato, 200 hectares; and Lake Buhi, 86 hectares (de Sagun, 1983).

5. Freshwater Resources in the Light of the Philippines' Economic Development

The Philippines has a coastal area of 18,417 square kilometers (White, 1987) and marine fisheries are spread over 395,400 square nautical miles of coastal and offshore areas (Tolentino, 1982). The total area of freshwaters is comparatively small [see Table 7.2]. Nonetheless, these form a major source of dietary protein and income for many coastal communities. Filipinos obtain 55 percent of their protein intake from fish. Their annual per capita fish consumption is close to 40 kilograms (Porter and Ganapin, 1988). Government reportedly has unsuccessfully tried to meet this local demand through a targeted yearly increase of five percent in fish production.

Contribution to GNP

The fishing industry contributes only a small portion, 4.5 percent, to the country's gross national product (GNP). Only 11 percent of the population derive its income from fishing compared to 25 percent from agriculture. Fishing employed some 1.04 million people in 1985, roughly three to four percent of the labor force that year. Of this number, 75 percent represent municipal fishing. Commercial fishing employed four percent while aquaculture employed 21 percent (WB, 1989).

Contribution to total fishery production

Municipal fishermen* who fish in coastal waters contribute 47 percent or almost one-half of the nation's total fish catch. As of 1988, around nine million Filipinos were probably supported by the output of this category. Commercial fishing contributes a smaller share in total production: about 26 percent. Aquaculture, which raises in captivity not only fish (*e.g.* milkfish and *tilapia*) but also prawn, shellfish and seaweeds, comprises 26 percent of the total fisheries production (Philippine Statistical Yearbook, 1989).

*Filipino municipal fishermen are categorized into three subsectors: marginal, small and lower middle fishermen. Marginal fishermen are those with nonmotorized fishing vessels or banca and who use crude fishing gears like cast nets. Small fishermen catch fish with motor boats of less than 16 horsepower engines while lower middle fishermen use high-powered fishing trawls (*suro*).

As of 1985, inland waters (*i.e.*, rivers, lakes and reservoirs) yielded around 260,000 metric tons of fish or roughly 12 percent of the country's total fish production. Lake production is increased by aquaculture. However, this technology can potentially shrink production in the open waters as records would show in the case of Laguna de Bay. In the 1960s, the lake's open fisheries yielded an average of 921 kilograms per hectare, and in 1988, 167 kilograms per hectare. In terms of total productivity, open fisheries netted 82,881 metric tons in 1968 which decreased to a mere 20,398 metric tons in 1980.

Extent of dependency

Since the greater part of the Philippine population depends on agriculture, the percentage supported by the fishing sector is small. Laguna de Bay gives some idea of the extent of this dependency. The fisheries of that lake supported only around 2.6 percent of the families in the entire lake basin which spans an area of around 380,000 hectares (Pacardo *et al.*, 1989). The number of lake dependents was reportedly on the rise: 45,815 fishermen in 1988, compared to only 9,813 in 1978. Current figures are expectably much higher.

Man-made reservoirs support a much smaller segment of the Philippine population. As of 1980 only around 20,000 families made a living from this resource (Roldan, 1980). The small rate of dependence seems to stem from the low secondary productivity of dams, which are constructed primarily for hydroelectric power generation and irrigation water supply. Only three out of the nine major reservoirs reported by Guerrero (1988) are known to yield a significant amount of fish, namely, the Magat, Angat and Pulangui IV dams.

The year 2000 has been foreseen by some as a period of escalating demand for domestic, industrial and agricultural water uses. The CALABARZON (Cavite, Laguna, Batangas, Rizal, and Quezon) area, earmarked for light industry development, counts among those that would be first to suffer from water shortage [see Table 7.5].

Table 7.5
Water demand by sector, 1975 - 2000 (JICA, 1990)

Sector	Water Demand (MCM/YEAR)							
	1975				2000			
	Laguna Lake Basin	Taal Lake Basin	Total MCM/YR	%	Laguna Lake Basin	Taal Lake Basin	Total MCM/YR	%
Agricultural	906.94	1,375.32	2,282.26	89	5,635.98	5,168.65	10,804.63	83
Industrial	14.5	0.60	15.10	1	355.44	9.94	365.38	3
Domestic	244.40	27.19	268.59	10	935.22	94.09	1,029.31	9
Total	1,162.84	1,403.11	2,565.95	100	6,926.64	5,272.68	12,199.32	100

THE STATE OF RIVER AND LAKE RESOURCES

1. Disturbed Water Regime

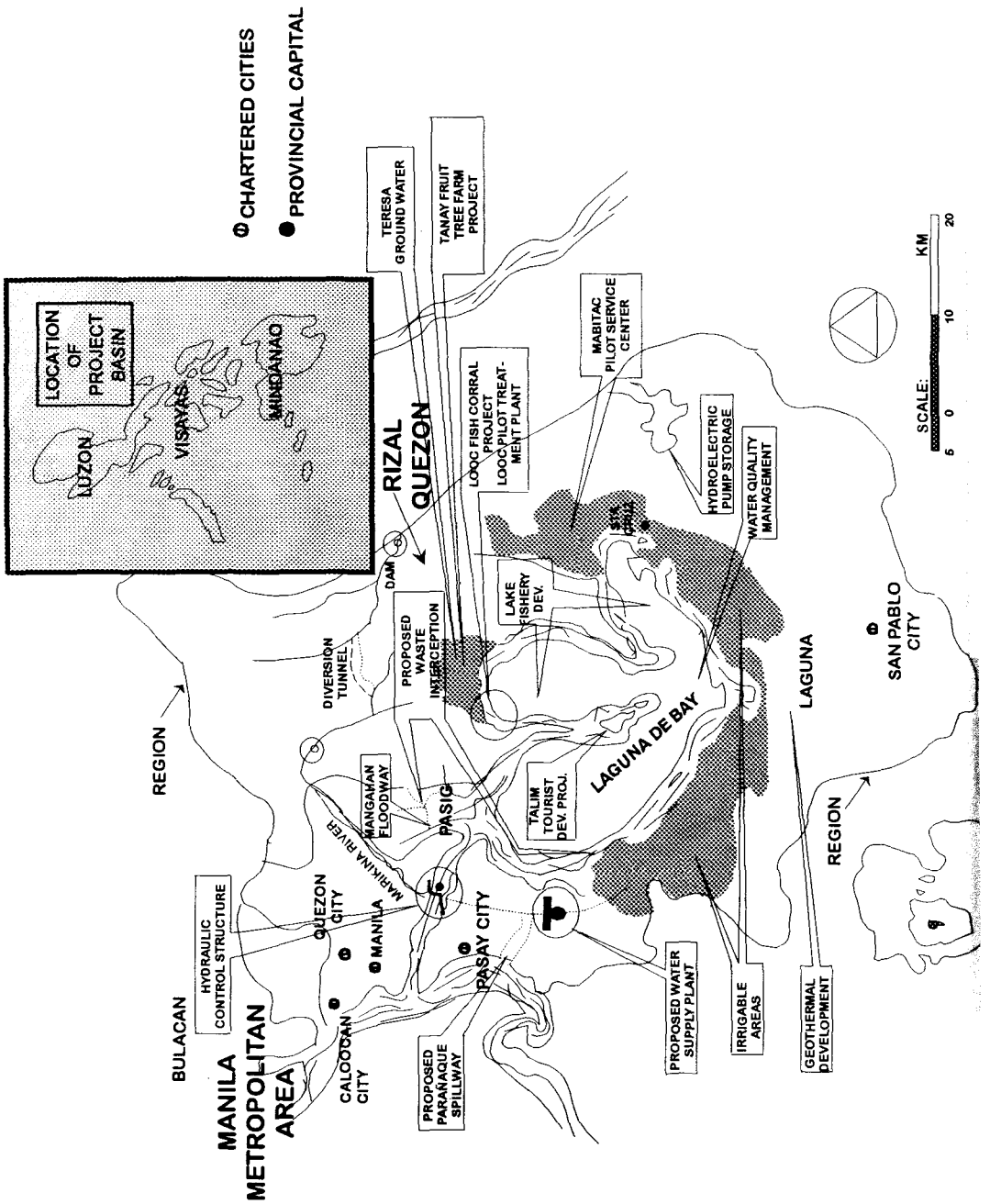
On a global scale, the 1930s is said to be the period when the most significant alterations on the water cycle were imposed by human activity. According to White (1988), it was during that time that the United States began harnessing rivers in order to control the volume and timing of their streamflow. The demands of water withdrawal, urbanization and reservoir construction reached a turning point. Such harnessing of water power enabled the US to take a lead role in planning and evaluating water development efforts. Its success at arid land reclamation, flood control and regional planning created the matrix of approaches in the alteration of freshwater resources which other countries later followed. These approaches called for new infrastructure vastly different from the artificial waterways and irrigation systems of the past. These management strategies were brought to the Philippines when it became an American colony. The present state of Philippine freshwater resources are partly a result of the adaptation of US-style methods of water management.

Flood Control/Irrigation and Water Impoundment Projects

a. The Mangahan Floodway

The Mangahan Floodway, a channelization project nine kilometers long, began in 1980 and was partially operational by 1988 (Pacardo *et al.*, 1988). It crosses the Marikina River north of the Laguna de Bay and traverses *barangays* Rosario and Mangahan [see Figure 7.2]. The floodway was conceived as a regulating infrastructure to divert flood waters from the Marikina River and impound this in Laguna de Bay during the rainy season. The projection was that when a lake level of 12.5 meters was exceeded, water will flow through the structure. The operation of the floodway in 1988 resulted in the worst flood ever suffered by the lakeshore towns. The rainy season of that year caused a tremendous rise in rivers like the Sta. Cruz which overflowed and kept underwater parts of the capital town of Sta. Cruz, Laguna until February 1989.

Figure 7.2
Laguna Lake Development Authority Main Project Location



b. Napindan Hydraulic Control Structure

The Napindan hydraulic control structure (HCS) is probably the most famous and currently the most maligned of all local dams. Built in 1977 (Pacardo *et al.*, 1987), the dam was constructed on the recommendation of foreign consultants who drafted a comprehensive development program for Laguna de Bay. As planned, the HCS is a pollution control and flood control infrastructure intended to prepare the lake for tapping as a source of domestic water supply by the year 2000. It was designed to be closed during the summer months so that the inflow of polluted Pasig River water into Laguna de Bay can be prevented. During the rainy season, it would be opened to allow for the flushing of the river while the tributary inflows were high.

Full dam operation began in 1982. But the HCS produced what lakeshore fishermen claimed were damaging results. In 1988, with the Mangahan Floodway already in operation and the last three months of the year still in the thick of the typhoon season, the Pasig and Marikina Rivers overflowed their banks and inundated shoreline areas for months. Lake salinity gradually diminished so that water hyacinths proliferated and posed navigational problems. Critics said that the lake failed to clear up like it used to prior to the construction of the HCS. Fishermen claimed that the lake fishery suffered from the altered water chemistry which adversely affected primary productivity.

c. Laguna de Bay Development Project-Irrigation Component

The ingenious mode of harnessing rain to irrigate the rice terraces of the Mountain Province is one of the first successful attempts of Filipinos at water management. The Spaniards left their own marks of irrigation culture. One of the oldest Spanish-built dams is at the Nangkaan River in Nangkaan, Cavite. But these early dams and irrigation canals do not compare with those of today.

One of the big irrigation projects in the country is the Laguna de Bay Development Project-Irrigation Component (LBDP-IC). It was designed to tap Laguna de Bay as a source of irrigation water by 1989 to boost agricultural production, increase farm income, and provide employment in the provinces of Laguna, Rizal, and Cavite (Pacardo *et al.*, 1989). The first of two phases aimed to irrigate 11,945 hectares of agricultural land (Davies *et al.*, 1986), representing roughly three percent of the total watershed area. This was started

in 1973 and completed in 1986. The second phase aims to irrigate a total of 14,440 hectares in the provinces of Laguna, Rizal and Cavite, thus bringing the managed area to 26,385 hectares or seven percent of the watershed. By project completion, the total irrigated area in the watershed will be from 30,000 to 57,000 hectares. This land area would reportedly produce 155,000 metric tons of rice and about 50,000 metric tons of vegetables annually. This will benefit around 15,000 people.

Analysts say that the proposed development will improve social and economic conditions in the watershed, especially since the project will boost vegetable and rice production. Metro Manila, which depends on the produce of surrounding provinces, will also be assured of food sufficiency. However, two risks are involved in the plan. First is the risk of unduly extending the lake's capacity to supply the amount of irrigation water needed. The second is the possibility of opening up more channels for the pollution of the lakewaters with agricultural chemicals and domestic wastes.

d. Pantabangan Dam

The Pantabangan Dam is the largest reservoir in Nueva Ecija. It has an area of 8,900 hectares and a maximum depth of 28.9 meters. Constructed in May 1969 at a cost of $34 million, it forced the resettlement of some 5,000 families in ten *barangays*. The declaration of martial law in 1972 facilitated the displacement of families from the tenanted farms which accounted for 88 percent (7,420 hectares) of the area inundated by the dam (dela Costa-Ymson, 1980). Today Pantabangan Dam is used primarily for power generation and irrigation. Currently, there is no complete data to enable evaluation of the fisheries in Philippine reservoirs.

e. Magat Dam

The Magat Dam in Ramon, Isabela comes second to Pantabangan with an area of 4,460 hectares. More than twice the depth of Pantabangan, the Magat dam is the only reservoir with a fish yield exceeding 1,000 tons—6,726 metric tons as of 1986. The Angat Dam in Norzagaray, Bulacan which has an area of 2,300 hectares and is the deepest reservoir with a maximum depth of 94 meters, had fish yield of only 87 metric tons in 1986.

Tilapia thrives in all major reservoirs, but it is clearly dominant in Angat Dam where it makes up 75 percent of the catch. Imported fish has also

been tried for seeding, particularly in Caliraya reservoir for the purpose of enhancing recreational fishing. Imported fish, however, did not thrive in this man-made lake that is mainly used the power generation, irrigation and fisheries.

The other reservoirs of significance are listed in Table 7.3. Some of these reservoirs have been incapacitated to levels not anticipated. One of the most extensively documented cases is that of the Magat Dam. High siltation rates caused by severe erosion in the denuded uplands have reduced the dam's operational life by 40 years. With this reduction, the amount of soil eroded and deposited elsewhere also exacted a price of 15 pesos per metric ton based on 1985prices (Sajise *et al.*, 1988). Some 2,050 metric tons per square kilometer per year of sediment is deposited at the dam site. This means that the watershed pays a toll of around 30,750 pesos per hectare of receiving area around the dam site.

Mine tailings also pose dangers to dams. Irrigation systems and the farms they water tend to be the most critically affected by mine wastes. The Agno River Irrigation Systems (ARIS) lost 75 percent of its efficiency to mine tailings which clogged the intake and delivery canals systems. As of 1976, the system's failure to meet water requirements meant 4.4 million pesos in crop losses. In 1988, Agno's actual service area was severely reduced to only 54 percent (Sajise *et al.*, 1988).

f. Chico Dam

The planned construction of the Chico River Dam in 1974 in the Cordillera region would have displaced 100,000 tribal people and inundated 341,000 hectares of ancestral lands (*Kapaligiran*, 1982). It was one of the three components of a bigger project that would have built three dams along the Chico River which would have supplied electricity and irrigation water. The two other dams would have been located in the towns of Bontoc and Sadanga in Mountain Province. The third was to have been in Kalinga-Apayao province, especially in the towns of Tinhalayan, Lubhagan and Tabuk. The third dam was strongly opposed by the tribespeople who saw it as a threat to their livelihood, their way of life and a desecration of their ancestral land (Domoguen, 1982).

g. Lake Buhi Water Development Project

This project is a component of the Bicol Integrated Area Development (BIAD Rinconada/Buhi/Lalo) Project funded by the United States Agency for International Development (USAID). Located in the province of Camarines Sur, the irrigation and hydropower generation project was put up by the National Irrigation Authority, tapping Lake Buhi as a reservoir. It was intended to irrigate some 10,000 hectares of ricelands which were already being served by the Rinconada Irrigation System. It was also designed to generate additional hydropower for the Daraga Hydroelectric Power Plant of the National Power Corporation.

The environmental and socioeconomic problems of this project became obvious even before the hydraulic control structure of the dam was constructed across the lake's lone outlet, the Tabao River. A drawdown below the normal — around 81 to 83 meters — threatened to expose the floating fish cages particularly in the eastern side of the lake. And the drawdown engendered other problems. There is limited arable land around the lake (Tagarino, n.d., unpublished), and exposure of some parts of the lake by drawdown encouraged the conversion of the dried up lake areas into cultivated land.

2. Pollution by Urban and Industrial Wastes

The use of rivers for transport dates back to ancient history. Moses was found by his would-be surrogate mother in a basket floating down the River Nile. Great cities sprang up along river banks, apparently to make use of flowing water for navigational purposes and to ensure the water supply of the urban population and its industries. The ancient city of Babylon grew on the banks of the Euphrates River, Paris astride the River Seine, New York City alongside the Hudson River, and Shakespeare's London along the River Thames. Manila is bisected by the Pasig River. Cities, however, have wrought havoc on rivers. The Pasig River provides glaring evidence of this fact.

The Pasig River stretches 25 kilometers before its waters are conveyed into Laguna de Bay by the Napindan River. Viewed from the air, the river appears like a treacherous, grey body arising from Manila Bay and slithering into the awesome chocolate brown expanse of the heavily silted Laguna de Bay. The Pasig serves as one of the final destinations of many *esteros* that are the sump of septic channels in Metro Manila.

The National Pollution Control Commission (1984) reports that 55 percent of the river's load is composed of undecomposed organic matter from domestic sewage and refuse. One newspaper article estimates that domestic waste comprises some 70 percent of the river's load. Of this, 30 to 45 percent comes from varied sources, including the 138 industrial firms lining the riverbanks. These firms discharge 11 million gallons of industrial waste water per year (Valerio, 1990). Some 300 gasoline stations and depots (NEPC, 1984) contribute to the pollution as they continually spill oil into the river. Equally guilty are industrial vessels, ferry boats, barges, tankers and boats that ply the waters daily.

Through the centuries, the river has lost its native species of fish. It no longer serves as the migration course for freshwater-seeking marine life because it is extremely polluted. The reduction in the number of fish species in Laguna Lake from 16 in 1969 to 11 in 1983 attests to this fact (ICED, 1983). One need not look twice at the filthy Pasig to know that it does not qualify as a resource for fisheries or for bathing and recreation.

If the Pasig River is in a bad state, the Malabon-Tullahan River System is worse off. The Asian Development Bank (ADB) reports that the river system has the worst state of flowing waters in the country (Diaz, 1990). This river north of Tondo receives all kinds of solid and liquid wastes from at least 209 industrial firms along its banks. It is now considered biologically dead, meaning no form of life survives in its polluted waters. Also critically affected by industrial waste and poor sewage disposal are the Zapote-Parañaque, Malabon-Navotas, Marikina River and Maypajo River (EMB, 1985). Four of Metro Manila's five major rivers, namely, Parañaque River, Pasig River, San Juan River and Zapote River, are in a state of ecological decay and are not habitable by fish. Only the Marikina River is an exception.

There are divergent views on the relative damage caused by different sources of pollution. The National Environmental Protection Council, (NEPC), now the Environmental Management Bureau (EMB, 1984-85), ranks the sources according to their decreasing importance as follows: domestic sewage and settlement activities, 70 percent; industry, 30 percent; and agriculture, mining and other metal-based industries, only a negligible amount. Ratings were determined from a number of considerations, primarily the readiness or ability of the pollutant to reduce the usefulness of water resources, the effects on the affected environment, and the duration of the effects. Human health and safety risks were also considered. A working knowledge of the nature of the pollutant sources sheds light on their relative importance.

a. Domestic (Urban) Pollutants

Sewage

Domestic wastes may be solid (*e.g.*, garbage) or liquid (sewage waters, house washing) and come not only from homes but also from schools, hospitals, and public facilities like theaters and bus stations. The pollution caused by these can be alarming particularly in the absence of a centralized sewage collection system. In the Pasig River one finds pipes jutting out of the concrete banks every 50 meters or so. They convey untreated domestic water. In other places small canals are excavated to direct untreated waters into ill-constructed drainage systems that empty into *esteros* which are killed by the practice in due time.

The construction of a decent centralized sewage collection system continues to be an elusive dream. In 1973 only 12 percent of the Metro Manila population benefitted from sewage collection service (NEPC, 1986). Applying this percentage to the 1975 population of 4.97 million, the number of people served adds up to only around 600,000! The figures taken in 1989 showed that only a little over 105,000 homes were served by the Metro Manila sewage collection system.

Conditions are not any better outside the metropolis. In Muntinlupa, Rizal, roughly 36 percent of all households studied (total = 2,645) had no latrines (SOGREAH, 1974). In Laguna, some 3,110 (30 percent) of the households studied did not have any form of latrine. The inhabitants of Talim Island in Laguna de Bay have practically converted the surrounding waters into a common sewage dump: all but a mere 5.4 percent of the 2,061 houses there have a waste disposal system.

Garbage

Perhaps no other Southeast Asian country has garbage problems of the same magnitude as that which plagues Metro Manila. Such problems date back to the Marcos era, when plastics gained popularity in the packing business. The administration of President Corazon C. Aquino failed to apply any long-term solutions.

The garbage problem is a complex one. The sheer volume to be collected reduces to nil the number of garbage trucks available to collect them. In worst cases, there are no such vehicles to carry the garbage away to a

suitable dumping ground. In the province of Rizal, only 33 percent of the households are served by garbage trucks. In Laguna only six out of 27 municipalities maintain garbage collection services.

People in general are not inclined to sort out their garbage, much less to dispose of these properly for collection by dump trucks. The Filipino practice of landfills, a borrowed technology, is incorrect. Garbage dump sites are ill-planned, and are sometimes not included in municipal development planning. Thus, people conveniently throw garbage near a sidewalk, in a vacant lot or in any place outside of their own backyard. Where present, rivers, lakeshores, and sandy beaches have been carelessly converted into dump sites. Consequently, for the affected rivers streamflow is obstructed, ponding sets it and water-related diseases spread to epidemic proportions.

Threats to the ecological integrity of aquatic ecosystems do not stem from solid wastes alone. Liquid wastes, such as those which come from abbattoirs, are just as formidable. Most of the tributary rivers of Manila Bay are degraded by incorrectly built latrines of households standing along the banks of these rivers. Where there is an attempt to adopt a technology for garbage management, e.g., landfill, incorrect practice has rendered the technology questionable and ineffective.

b. Industrial pollution

Table 7.6 shows the various types of industrial establishments near Laguna lake (Valerio, 1989). Majority are textile, rubber, plastic and synthetic factories. From 1980 to 1986, Metro Manila experienced the highest jump in the number of industrial firms which numbered 300 in 1981 and over 600 in 1983. On the other hand, roughly 30 percent of the water pollutive companies had pollution control facilities. Roughly three percent of the industrial firms in Metro Manila have pollution measures in place.

Industrial pollutants may be either solid or liquid. Dry industries release solid pollutants like sawdust. Cement plants are the worse generators of inorganic suspended materials, *i.e.*, cement dust. Liquid wastes may carry suspended solids that reduce the penetration of light into the water. When the suspended solids are decomposable, these add to what is called the biochemical oxygen demand (BOD). The tolerable BOD is 5 mg/L for Class A and B freshwater resources. For Class C the recommended BOD value is 7 mg/L and for Class D, 10 mg/L (DENR, 1990). For Class C waters, levels

Table 7.6

Number of industries by year of establishment and by geographical location, Laguna Lake watershed, 1963-1988

Year	Geographical Location				Total	Annual Growth Rate
	West Bay	Central Bay	East Bay	South Bay		
1963	103	6	1	7	117	
1964	115	6	1	7	129	10.26
1965	129	6	1	10	146	13.18
1966	143	6	1	10	160	9.59
1967	156	6	1	10	173	8.12
1968	182	8	3	12	205	18.50
1969	199	8	4	13	224	9.27
1970	214	13	4	15	246	9.82
1971	235	16	5	19	275	11.79
1972	245	18	5	21	289	5.09
1973	298	21	7	25	351	21.45
1974	345	22	8	28	403	14.82
1975	387	25	9	35	456	13.15
1976	431	30	11	48	520	14.04
1977	532	38	15	56	641	23.27
1978	559	38	15	64	676	5.46
1979	581	38	15	68	702	3.85
1980	637	40	17	73	767	9.26
1981	679	42	17	81	819	6.78
1982	720	50	18	92	880	7.45
1983	773	57	23	107	960	9.09
1984	796	58	24	113	991	3.23
1985	837	63	38	128	1,066	7.57
1986	868	67	38	128	1,102	3.38
1987	878	67	38	131	1,114	1.09
1988	954	69	39	136	1,198	7.54

Sources: Laguna Lake Development Authority, 1988.
HLDRB, 1988.

higher than the recommended value over the long term can mean impairment of the ability of the water to support fish life. It also means noxious odors and unsightliness.

Liquid wastes may also carry toxic and hazardous chemicals like acids, phenols, toluene, other hydrocarbons, and heavy metals, *etc.* The young fish are primarily susceptible to the effects of some of these when present in high concentrations. The ill effects of these on the biological health of Laguna de Bay have not been fully documented. Nonetheless, there is sufficient data to show that the lake's biodiversity has significantly diminished and that various forms of fish life already show alarming signs of heavy metal bioaccumulation.

Thermal pollution is caused by industries that discharge the heated water produced when compressors are cooled inside a power generation plant. The Sucat Power Station raises the temperature of lake water near its outfall by 4°C, enough to stimulate a higher rate of the cell division in the bloom-forming alga, *Microcystis aeruginosa*. Fish kills relate indirectly with thermal pollution because of this effect. The eventual collapse of an algal bloom results in oxygen depletion of lake waters which fish inside fish pens cannot tolerate, and so the fish die from asphyxiation.

3. Pollution by Agricultural Chemicals

Agricultural chemicals include both fertilizers and pesticides that are used to "control, prevent, destroy, repel or mitigate directly or indirectly any pest" (Rola, 1990). There are 41 generic names of pesticides in the market [see Table 7.7]. Each name carries a number of brand names which altogether add up to at least 280. Most of these are insecticides which account for 55 to 60 percent of the market, followed by fungicides with 20 to 25 percent, and herbicides with five to 16 percent (Magallona, 1980). Agricultural pesticides reduce losses due to pests by around 45 percent.

Government programs like the *Masagana 99*, *Masaganang Maisan*, and *Gulayan sa Kalusugan* are partly responsible for the wide adoption of pesticides which peaked in the 1970s. Today, pesticides draw much controversy in many Asian countries. The Asian Development Bank has classified 31 out of the 41 commonly used pesticides as slightly to extremely hazardous and extremely toxic. Of these seven have been banned by the Fertilizer and Pesticide Authority, namely, endrin, dieldrin, aldrin, ethylene dibromide (RDB), camphechlor (taxaphene), chlordineform and dibromochlorpropane (DBCP).

Table 7.7
Commonly used agricultural pesticides and the degree of their hazardousness

Pesticide	Degree	Pesticide	Degree
Ametryne	Slightly hazardous	Fenitrothion	Moderately hazardous
Atrazine	—	Fenthion	Highly hazardous
Azinphos-ethyl	Highly hazardous	Fenvalerate	—
Azinphos-methyl	Highly hazardous	Lindane	Moderately hazardous
BPMC	Moderately hazardous	MCPA	Slightly hazardous
Butachlor	—	Malathion	Slightly hazardous
Carbaryl	Moderately hazardous	Mancozeb	—
Carbofuran	Highly hazardous	Methamidophos	Highly hazardous
Cartap	Moderately hazardous	Monocrotophos	Highly hazardous
Chlorothalonil	—	Oxydemeton-methyl	Highly hazardous
Chlorpyrifos	Moderately hazardous	Paraquat	Moderately hazardous
Copper-oxychloride	Slightly hazardous	Parathion-methyl	Extremely hazardous
Cypermethrin	—	Permethrin	—
Dalapon	—	Phethoate	Moderately hazardous
2,4-D	Moderately toxic	Phorate	Extremely hazardous
DDT	Moderately hazardous	Phosphamidon	Extremely hazardous
Diazinon	Moderately hazardous	Propanil	Slightly hazardous
Dicrotophos	Highly hazardous	Propineb	—
Dimethoate	Moderately hazardous	Triazophos	Highly hazardous
Diuron	—	Tridemorph	Moderately hazardous
Endosulfan	Moderately hazardous		

Source: Handbook on the Use of Pesticides in the Asia-Pacific Region, 1987.

Those recommended for use under strict supervision are: aldicarb (temik), chlordane, heptachlor, DDT (dichlorodiphenyltrichloro-ethane), HCH (hexachlorocyclohexane), BHC (benzenehexachloride), lindane, paraquat, pentachlorophenol, 2,4,5-7 and methyl parathion (*Philippine Daily Inquirer*, 21 December 1989).

Chemicals used for pesticide production are extremely poisonous and are retained by all types of surfaces they come in contact with regardless of whether the original form or its product of decomposition is concerned. Sometimes the latter may prove more toxic than the initial compound. Atrazine is one with strong residual property; it remains unchanged for up to 12 months even when mixed with water or soil. Pesticides like these are easily transported by flowing water which dump them into a lake or sea where they accumulate. In a study by the Fertilizer and Pesticide Authority (1984), all Metro Manila water courses examined were found to carry minute amounts of pesticides. Some of these have found their way into living organisms, primarily those consumed by human beings like milkfish, catfish and mudfish caught in Laguna de Bay. In Los Baños, Laguna breast milk from some mothers were found positive for DDT .

The breakdown products of a pesticide may turn out to be more toxic and therefore more harmful even to nontarget species. They can activate the latent capability of some organisms to degrade chemical compounds, thus encouraging their multiplication at rates higher than what the pesticide can control. The *gamo-gamo* outbreak in Los Baños, Laguna and environs back in the late 60s and early 70s illustrates this fact.

Another example concerns the pesticide azinphosmethyl, a highly hazardous acaricide for the control of phyllids, aphids, bugs and a host of other insects of vegetables, grapes, cotton, citrus and top fruit. Following its repeated use, spider mites developed a new resistance that favored their reproductive rates. Attempts to curb a burgeoning pest population with overapplication of pesticides can diminish the rate of return on pesticide investment.

Many pesticides pose hazards outside of the place or site of their application. The spray drift of azinphosmethyl may threaten aquatic life. Water-insoluble endosulfan can be reduced to just half of the applied amount by rain and the rest deposited in the soil where it can reside for several weeks. Pesticide in the soil may percolate in water and end up in irrigation canals

joining a river. When in its active form in the new site, it can adversely affect nontarget fish species.

Humans are not spared from the hazards of pesticides. Although pesticide manufacturers insist that the chemicals cannot be accumulated by body tissues, the possibility of accumulation still remains. There are many cases of occupational poisoning and accidental ingestion from the failure to observe insufficiently known precautionary measures [see Tables 7.8 and 7.9]. The farm practice of washing pesticide containers in flowing streams increases the risk of pesticide poisoning of aquatic life.

Lindane and DDT are among those retained by the body. A class of pesticides like fenvalerate persists in body tissues without accumulation. Gusathion is not accumulated in body tissues but it may interfere with enzyme processes. The pesticide DDT falls under a class where the chemicals are accumulated and can enter the metabolic stream. In yet another class, these are not prone to accumulation but can lead to death when ingested in high concentrations. The action of pesticides ranges from the local to the systemic in both target and nontarget organisms. They may have residual action and secondary contact action. Symptoms of poisoning are cardiopulmonary, neurological and hematological in nature. Adverse dermal effects are common (Adalla and Rola, 1986; Pingali *et al.*, 1990; Rola, 1988). Much still remains to be disclosed regarding the health effects of pesticides in human beings.

4. Siltation

Removal of the forest cover of the uplands causes increased soil erosion rates that abnormally increase the silt load of rivers and streams. Natural catastrophes like earthquakes and volcanic eruption have their own share in heightening the problem of suspended load. Soil cultivation for agricultural production and infrastructure projects like road construction and dam building aggravate the situation. The transported silt ends up in receiving bodies of waters like lakes and seas. The impact areas of siltation suffer from shoaling. Cabuyao and Sta. Rosa rivers have been found to deposit silt into Laguna de Bay at the rate of from 0.02 to 0.76 cubic meters per hectare. The Pagsanjan and San Cristobal rivers by all appearances are likewise heavily loaded with silt. Just about every tributary of the Laguna de Bay are manifesting delta

Table 7.8
Cases of pesticide poisoning by type and by sex, in Loo and Atok, Benguet (Rola, 1988)

Types of Insecticide Poisoning	Loo 1977-1988		Atok 1977-1987		Total Loo & Atok	
	M	F	M	F	M	F
1) Occupational/Inhalation	790	28	9	3	88	31
2) Suicidal/Ingestion	83	105	13	15	96	120
3) Accidental	15	14	1	4	16	18
4) Undetermined	15	9	28	13	43	22
Total	**192**	**156**	**51**	**36**	**243**	**191**
Grand Total	**348**		**87**		**434**	

Sources of Basic Data: Lutheran Hospital, Buquias.
Benguet and Atok District Hospitals, Benguet.

M = Male
F = Female

Table 7.9
Cases of pesticide poisoning by type and by sex, in Cabanatuan and Pototan, Iloilo study sites, 1987 (Rola, 1988)

Type of Insecticide Poisoning	Cabanatuan 1978-1986		Pototan 1980-1986		Total Cabanatuan & Pototan	
	M	F	M	F	M	F
1) Occupational/ Inhalation	26	6	32	1	58	7
2) Suicidal/ Ingestion	11	24	22	31	33	55
3) Accidental	7	3	18	6	25	9
4) Undetermined	9	7	0	1	9	8
Total	**53**	**40**	**72**	**39**	**125**	**79**
Grand Total	**93**		**111**		**204**	

Sources of Basic Data: Ramon Tabiana District Hospital, Cabanatuan.
Iloilo and Pototan District Hospitals, Pototan, Iloilo.

formation at the mouth of rivers at various intensities. The Laguna Lake Development Authority estimated the total sediment inflow into the lake to be around 120,000 cubic meters per year. The marine environment has not been spared. Denudation of the Marikina watershed has caused some 200,000 cubic meters of sediments to be transported by the Marikina River to Manila Bay every year (Pacardo *et al.,* 1988).

Heavily silted areas suffer from a decimation of species diversity in bodies of water. Siltation leads to the shoaling of bodies of water. Shallow lakes like the Laguna de Bay lend their bottom sediments to easy stirring by turbulent waves. This makes for a ready recirculation of minerals that are stored there, causing the overlying water to manifest pulses of high nutrient conditions. Phytoplankton respond to this through overgrowth called algal bloom. Bloom-forming algae are the weeds of waters. Their dominance reduces the potential of other species to establish successfully. Easy stirring, however, also brings about turbidity that greatly reduces the photic zone. This could lower the potential primary productivity of the body of water during certain times of the year. At other times however, the productivity reaches unnaturally high levels due to an ample nutrient supply. This is what happens in Laguna de Bay.

Man-made structures like the Pantabangan Dam bear the brunt of the erosive human activities in the uplands. Contrary to predictions, the dam has been found to accumulate silt at a rate of 81 metric tons per year, not 20 metric tons per year as earlier estimated (Cruz *et al.*, 1987). Magat Dam is well on its way to having the fate of the Pantabangan Dam. Sediment load in this smaller dam increased by more than 50 percent causing the reservoir's life to be reduced to only 40 years. Some 83 percent of the 414,300 hectares comprising the dam's watershed is severely eroded (Sajise *et al.*, 1988).

The Agno River Basin is a classic case of a river ecosystem whose potential benefits were severely constricted by a sustained heavy silt load (Porter and Ganapin, 1988). As early as the mid-70s, this body of water was already in crisis: 58,415 hectares of five different watersheds overcome by severe erosion, top soil completely washed away, and 50 percent of the subsoil likewise gone. Nine mining companies stripped the forests bare (Coloma, 1984) and dumped mine tailings into the great river. By 1988, over 125,000 hectares of land were virtually uncovered and critically eroded.

In the Pampanga River Basin, siltation raised parts of the river bed above the level of its surrounding crop lands while around 871,000 hectares were eroded in various degrees. The Cagayan River watershed suffered a similar fate: 2.5 million hectares are eroded of which 60,000 hectares are critically eroded (Duldulao, 1978 sensu Porter and Ganapin, 1988).

The damage to the uplands that is a consequence of erosion does not only reduce biodiversity but also carries away precious nutrients from the already impoverished forest floor. Gong Wooi-Khoon (1982) estimated the amounts of nutrients resident in the litter fall of forest floor vegetation, as follows: 93.1 kg N/ha N; 5.8kg P/ha; 46.7 kg K/ha; 42.5 kg Ca/ha; and 26.5kg Mg/ha.

PROBLEMS AND ISSUES

1. Deteriorating Water Quality

It has often been said that we have enough good laws to protect our resources. And yet resources like our fresh waters are undergoing progressive deterioration. The uplands are continually destroyed, heightening erosion rates that lead to siltation problems that destroy fish habitat. Soil cultivation makes way for the introduction of toxic chemicals hazardous to fish and man. People carelessly dispose of garbage into water courses and lakeshores such that eutrophication and aesthetic problems ensue. Thus, fresh water bodies fail to serve their intended uses as a source of domestic water supply or as a place for recreation and fisheries.

2. Deteriorating Productivity of Aquatic Resources

Reduced productivity stems from the nonpreservation of fish habitat, destructive fishing methods, and over-fishing. The violation of regulations governing fish sanctuaries, the use of prohibited fishing gears and the ever-growing fishing pressure from an expanding population of fisherfolks decimate aquatic fish production.

Laguna de Bay may be regarded as a body of water presenting a worst state scenario for environmental degradation. The lake saw the boom age of the fishpen industry in the 70s. This was rather short-lived, manifesting an early decline by the early 80s [see Table 7.10]. The downfall of the fishpen

Table 7.10
Total productivity from open fishery and fish pens, Laguna Lake, 1963-1988

Year	Total Productivity (kilogram per hectare) Open Fisheries		Fish Pens
	Fish	Total Productivity	
1963	921	3,887	
1964	889	3,548	
1965	772	2,919	
1966	660	2,679	
1967	551	2,242	
1968	434	1,814	
1969	394	1,722	
1970	356	1,619	
1971	327	1,544	700
1972	274	1,432	180
1973	243	1,293	4,311
1974	277	1,295	4,071
1975	307	943	5,357
1976	313	1,170	8,362
1977	270	1,532	10,038
1978	243	2,200	6,286
1979	186	2,532	6,316
1980	181	2,532	3,569
1981	273	2,451	3,687
1982	326	3,332	2,000
1983	238	4,046	2,425
1984	340	3,736	2,640
1985	300	3,128	1,780
1986	350	2,886	1,436
1987	197	2,614	1,453
1988	167	1,950	1,818

Sources: Bureau of Fisheries and Aquatic Resources, 1988.
Laguna Lake Development Authority, 1988.

industry was probably precipitated by pollution and the expansion of the fishpen area to 30,000 hectares which is beyond the carrying capacity. The construction of the Napindan Hydraulic Control Structure probably worsened the situation. Open fisheries were harmed by the expansion of the fishpen industry. Fishermen had to go out further into the open waters to get a catch of less than two kilograms per fishing trip.

Forest denudation leads to elevated rates of siltation. The Laguna de Bay watershed has been steadily losing its forest cover over the years. Its forested area extended to 93,000 hectares (24.4 percent of the entire watershed area) in 1963. This declined to 47,250 hectares 10 years later. By 1983, a further decrement of 30,300 hectares took place, representing a 77 percent decrease from the 1963 level. As of 1988, the estimated forest cover around the lake was a mere 17,875 hectares, equivalent to around 19 percent of the original.

3. Shortened Life Span of Water-Related Structures

Forest denudation and other types of disturbance of the watershed that entail vegetation removal and earth moving activities have shortened the service life of dams and reservoirs. This does not only mean losses in billions of pesos of water sources covered with silt but also losses in agricultural productivity.

4. Displacement of Upland Communities

Reservoir building is the primary cause of water-related dislocation of upland communities. The displacement of families by the Pantabangan Dam is a socioeconomic and political issue with a profound impact on the affected human communities.

RECOMMENDATIONS

1. Clearly inform the users/beneficiaries of the resource about the aims and plans of management. People have the right to know what alterations are being planned by government concerning their natural resources. It is only when people are well-informed that their full support to development can be earned.

2. Involve the beneficiaries of the aquatic resource in planning for its development. Encourage participation in the implementation of laws and regulations. A continuing program should be designed for skill improvement to address a community-based type of resource management.

3. Develop nonwater-related means of livelihood in order to ease the pressure on aquatic resources. Government should allocate more funds for research and development (R & D) in off-water means of livelihood.

4. Address the root causes of water disturbances through the watershed approach to managing freshwater bodies of water.

5. Government to increase its budgetary allocation for basic and applied aquatic resources research. The additional funding should go to equipment upgrading, information flow and human resources development.

6. Balance economic benefits with biological diversity conservation. The introduction of fish for the purpose of increasing secondary production should safeguard ecological balance, sustainable production and aquatic health.

7. Develop a zoning program for all major lakes in the country to ensure space allocation for sanctuaries.

8. Embark on a continuing environmental information program. All forms of communications media should allocate some time for environmental consciousness raising among our people.

9. Redesign science courses in the primary and secondary schools to incorporate environmentalism. Teachers in the primary and secondary level of education should be retooled for them to be imbued with an environmental perspective that they can impart to their students.

10. Provide ample support to generators of information in academic and research institutions for them to go beyond data collection and publication in technical journals. Incentives by way of financial support for dissemination of information should be expanded.

11. Support religious groups and other nongovernment organizations that espouse environmentally sound activities like the so-called creation-centered spirituality.

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CHAPTER 8
THE POPULATION DIMENSION IN VARIOUS ENVIRONMENTAL SYSTEMS IN THE PHILIPPINES

Imelda Zosa-Feranil

POLICY AND VALUE FRAMEWORK

The 1987 Philippine Constitution provides that "The State shall promote a just and dynamic social order that will ensure the property and independence of the nation and free the people from poverty through policies that provide adequate social services, promote employment, a rising standard of living, and an improved quality of life for all" (Section 9, Article 11).

Taking off from the Constitution, the government's 1987 Population Policy Statement stresses the interrelationship among population, resources and the environment. Population factors affect resources and the environment, just as the availability of resources and environmental conditions affect population concerns.

The sectoral analyses of various environmental systems prepared for the UP Assessment Report have all identified increased resource use and environmental degradation as major problems. In turn, the causes of these problems have been traced to population and development pressures. In effect, the assessment on "Environment and Sustainable Development" reaffirms what are called ecological imperatives in the Philippine Strategy for Sustainable Development (PSSD-DENR, 1990):

> *Most Filipinos still depend on natural resource systems for their subsistence and must therefore confront the inexorable reality of ecological principles. Two-thirds of the Philippine population lives in rural areas and are dependent on agriculture, fishery and forestry. Soil erosion, deforestation, pollution and declining fish catch all point to the fact that the limits of the natural carrying capacity are already being exceeded. While it is true that we can extend the limits by technological fixes such as the green revolution and industrialization, these responses take time and the galloping population growth extinguishes whatever little gains we make.*

The official assessment of the environment emphasizes the following: poverty as a cause and a consequence of environmental degradation; equity of access to natural resources; the carrying capacity of ecosystems; and the need to meet the needs of future generations. To many Filipinos, however, meeting the needs of the future seems an abstract goal. For those with limited economic means, present survival overrides all other concerns. Marginal socioeconomic groups may not even be aware that they contribute to stretching the country's resource-carrying capacity beyond its limits, thus putting future generations in jeopardy.

One of the factors affecting sustainable development is population. The country's population size, growth and age structure are considered by both domestic and international policy-makers and planners as important factors that must be taken into account in any discussion of sustainable development.

CONCEPTUAL FRAMEWORK

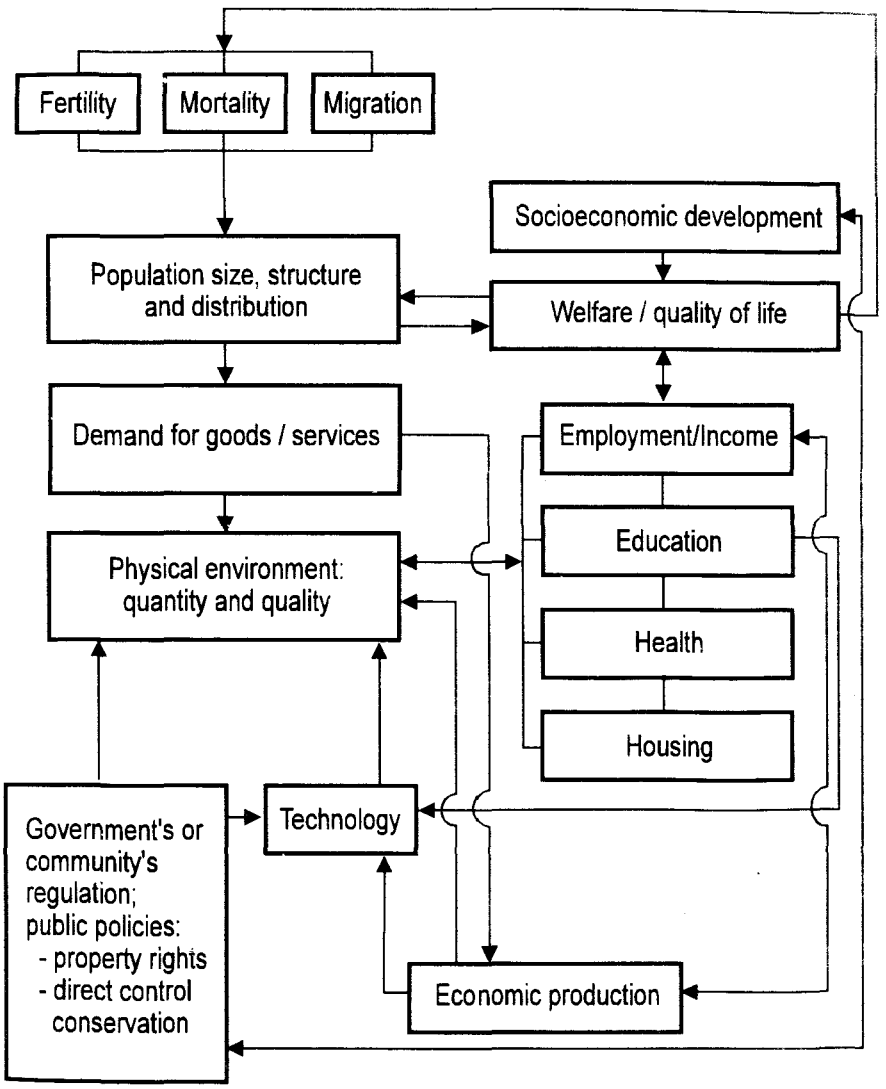
The framework of the United Nations Economic and Social Commission for the Asia Pacific (UN-ESCAP) shown in Figure 8.1 provides a picture of the conceptual linkages between population, environment and development.

As shown, three variables—fertility, mortality, and migration—determine demographic outcomes such as population size, age structure and population distribution. These population attributes in turn demand certain goods and services which can be met by nature and commodity markets or economic production. Both means, however, affect the physical environment quantitatively and qualitatively.

As the ESCAP framework emphasizes, the welfare of the population and improved quality of life are the ultimate goals of development. Population is one factor determining a society's demand for and supply of goods and services. Other related economic activities are also affected by population size. The distribution of population determines to a significant extent the access to, as well as allocation and use of resources.

Increasing overall demand and an expanding rural population expands cultivation outward into marginal lands and shortens fallow periods, resulting

Figure 8.1
A Conceptual Framework of the Interrelationships
Between Population and the Environment



in erosion, reduced soil fertility and deteriorating agricultural production. Expansion of livestock grazing as well as fuel and housing demands reduce forested areas. Flooding, water shortages during the dry season, siltation of rivers and coastal waters are some of the consequences of deforestation.

Population growth also means the increasing expansion of cities. Migration, as well as relatively high natural increase especially in urban slums, contributes to such urban expansion. Economies of scale, labor specialization and concentration of suppliers and consumers are the benefits of urbanization, but rapid growth combined with already large populations have strained the resources and service capabilities of cities.

Three immediate results of population growth in a given territory are: (1) reduced amount of space per person; (2) decreased per capita availability of natural resources; and (3) reduced potential influence of each individual in government decisions. Population concentration in less developed societies like the Philippines puts pressure on the capacity of governments to accommodate growing numbers at higher standards of living. Not only is physical space constrained; other problems include meeting adequately the social needs of the growing population quantitatively, oftentimes at the expense of quality.

The quality of the physical environment affects the quality of life variables (health, housing, education, employment and income) directly and indirectly. All these in turn affect the welfare of individuals in society. For example, polluted and contaminated water could cause diseases and lead to increased mortality. Landless individuals who comprise the "poorest of the poor" are forced to live in remote areas where they have very limited access to social services. Intense crowding and lack of sanitation facilities in urban slums transmit diseases quite easily. Acute respiratory infections, diarrhea and tuberculosis — diseases related to crowding — are some of the leading causes of mortality in the country.

Social conditions affect population in different ways. High infant mortality may positively affect fertility as parents may want to replace dead children. High density and rising costs of living space, however, may motivate people to have smaller families. A deteriorating environment with either low agricultural productivity or industry-related pollution may also lead to out-migration. Failure to deliver economic and social opportunities in rural areas may push more poor people to the cities and in turn add to the large populations of urban slums.

Organization of the Paper

This population paper for the Sub-Theme on Environment of the UP Assessment Project starts with a brief historical overview of population changes in the country in the context of increasingly greater pressure on dwindling resources. A more comprehensive demographic analysis of the population problem, however, was to be undertaken by the Sub-Theme on Population of the UP Assessment Project. The larger segment of this paper focuses on the population dimension in specific ecosystems. Some data are presented to provide a quantitative picture of population in different ecosystems. Selected population projections are also given to provide future scenarios assuming varied demographic trends. The last section provides recommendations for policy, planning and further research.

The discussion below uses very simple measures of the population dimension and how they can indicate stress: population size, growth rate, density and dependency ratios. It is recognized that these indices are not very accurate measures of population pressure, as the more precise indices of "overpopulation" are those that measure population-development-welfare components, especially income distribution and poverty, unemployment and underemployment, malnutrition and morbidity, mortality, and service inadequacy (quantity and quality of services).

But the limited information used below has to suffice pending the availability of more definitive data on even the most basic information: the population in different ecosystems. What are used below are at best rough estimates that need more verification, particularly from a more organized and systematic system of data collection.

PHILIPPINE POPULATION CHANGE: A MACRO-HISTORICAL PERSPECTIVE

At the start of the twentieth century, the Philippines was inhabited by only 7.6 million people. Toward the middle of this century, the population grew to 19.2 million. Very rapid growth occurred after that. By 1960, the population had grown to 27.1 million; by 1970, the number reached 36.7 million, a figure nearly double the mid-century population. The 1980 population of 48.1 million is two-and-a-half times more than the population just 30 years previously (Census of Population and Housing, 1980).

Several component demographic projections (NEDA-NCSO Inter-Agency Committee as presented by Engracia in 1983; United Nations Population Reference Bureau in its 1989 Data Sheet; and new UPPI projections in 1990 based on recent demographic surveys) point to the likelihood that the total population will exceed 60 million by 1990. To emphasize, the total population of the country today is more than three times the total number of inhabitants at the start of the 1950s. Over time, population density has also grown from less than 100 persons per square kilometer in 1960 to 160 by 1980 [see Table 8.1].

It is worth noting that although the Philippine population has increased substantially in terms of numbers, the population growth rate has actually decelerated since 1948. Concepcion (1978) emphasized that the all-time "highs" in population growth occurred during the 1948-1960 period (3.06% per year). The succeeding decades from 1960 to 1980 registered a slower growth rate of 2.75 percent per year. The 1970-1980 level, however, still ranked as the highest in Asia next to Pakistan (Concepcion, 1983).

As emphasized in the UN-ESCAP framework, three demographic processes determine how a population changes: fertility, mortality and migration. It has been noted that natural processes have been the major reasons for the rapid population increase (Concepcion, 1983; Engracia, 1983).

The difference between fertility and mortality rates in a given period is known as the "rate of natural increase." Fertility levels in the country have been high, although decline has also occurred. What should be noted, however, is that the very high fertility during the 1950s and the 1960s was accompanied by declining mortality. The result was very high natural increase, underlying the so-called "population explosion" registered during the immediate postwar years. The rate of natural increase, however, declined from the high level of 3.2 percent (or 32 per thousand) in 1960 to 2.8 percent in 1970 and 2.5 percent in 1980. Despite these changes, the 1980 rate still ranks high by international standards.

Some of the demographic manifestations of rapid growth are the very youthful age structure and high dependency ratio. In 1980, over two of every five Filipinos (or 42 percent) were less than 15 years of age. Figures for the 1960s and 1970s were even higher (equivalent to around 45 percent).

Table 8.1
Summary population-development data

Population	48.1 million	
Growth Rate 1975-1980	2.71 percent per year	
Doubling Time if 1975-1980 Growth Rate Prevails	25 years	
Land Area	300,000 square kilometers	
Population Density	160 persons per square kilometer	
Dependency Ratio	83 dependents per 100 working age members	
	N	%
Population under age 15	20.22 million	42.0
Population aged 15-64	26.20 million	54.5
Population aged 65+	1.60 million	3.3

Levi (1976) suggested that population pressure can be measured by the level of dependency. The greater the dependency ratio, the harder a given stock of labor will need to work to support dependents, in turn the greater the pressure to use whatever resources the particular labor force has on hand. Dependency ratios, measured in terms of the ratio of those in the dependent ages (youths less than 15 plus the older population aged 65 years and above) to the working age population (ages 15 to 64), are shown in Table 8.1. It is evident that dependency ratios were highest during the years of rapid growth (1948 to 1970) when every 100 persons in the working age groups supported 94 dependents.

The major component of Philippine dependency is the large youth population. Dependency ratios have actually gone down to a level of 83 in 1980 because of a decline in the birth rate. In turn this has resulted in decreasing proportions in the youngest age groups and commensurate increases in the proportions in the young adult ages. However, the Philippine dependency level in 1980 was still higher than the registered average of 76 among less developed countries for the same year (Feranil, 1983).

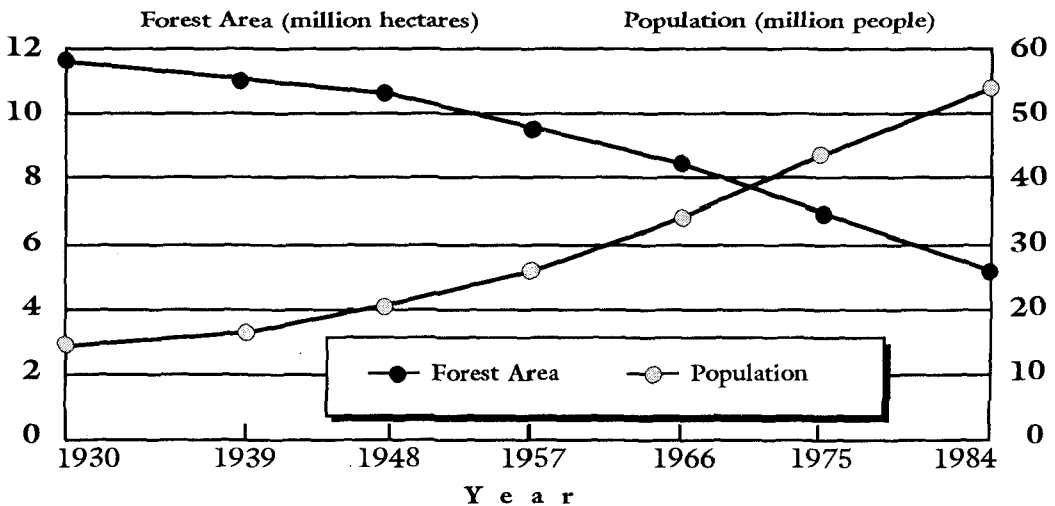
The Philippines is still in the rapid growth mode, its population continuing to increase in large numbers even if the rate of growth or natural increase has gone down. The young age structure includes a substantially large segment in the youthful childbearing ages that generates the large number of births each year. Teitelbaum (1978) showed that even if fertility in developing countries declined within the succeeding decade to the replacement level now characteristic of developed countries ("replacement fertility" meaning each mother replaced by only one daughter), their population would still continue to grow for 60 to 70 more years.

Long-term population projections for the Philippines (based on the NEDA/NCSO Inter-agency projections which are also shown in Figure 8.2) indicate that depending on the trend in fertility, the total population of the country by the year 2030 may vary from a low of 97 million to a high of 117 million. It is certain that the country's total population will continue to grow, whatever the course of fertility decline. Such growth also means increasing population density from 160 persons per square kilometer in 1980 to between 324 and 390 by 2030.

Such rapidly expanding numbers have implications for resources and the environment. More people means more needs — for food, clothing, and housing — have to be met. It also means changes in land-use patterns as well as more intense use of the country's resource base.

How does the population trend compare with trends in the environment and use of resources? Two data sources dramatically illustrate the contrast. Figure 8.2 from the Philippine Strategy for Sustainable Development (PSSD) shows on one hand, the declining forest resource and on the other, increasing population. Ordoñez (1987) indicates that the maximum yield of fish, a major component of the Filipino's diet, appears to have been reached even as the population continues to increase. While these are not the complete environmental picture, they pose important questions. What are likely trends in resources and environment in the face of rising population? What would be the environment picture in the future if strategies to reverse environmental damage do not succeed? What would be the quality of life in a future environment when even resource and environment problems abound?

Figure 8.2
Forest Area and Population, 1930-1984



THE POPULATION IN DIFFERENT ENVIRONMENTAL SYSTEMS

Population has a locational component. Thus, for example, encroachment into marginal lands may take different forms. In many cases, for those who are very poor and without land, this encroachment entails settlement in lands on steeper slopes, with marginal agricultural productivity, at coastal fringes, or in slums and squatter communities in densely populated urban areas.

But is this the case for the entire country? Is population pressure occurring in all land-resource systems or are there resource systems that are experiencing more or less stress compared to other ecosystems? This question cannot be answered completely because of the limitations of available data. However, some answers can be made by attempting first to distinguish the Philippine population according to the type of area they live in.

The Problem of Data

Population may be classified as either urban or rural (shown in Table 8.2). "Urban" here uses the official definition of the National Census and Statistics Office (NCSO) in the 1970, 1975 and 1980 censuses: (1) all cities and municipalities having a population density of at least 1,000 persons per square kilometer; (2) *poblaciones* or central districts of municipalities and cities which have a population density of at least 500 persons per square kilometer; (3) *poblaciones* or central districts regardless of population size which have a street pattern, at least six establishments (either manufacturing, commercial or industrial) and at least three public buildings (a town hall, church or chapel, a public plaza, park or cemetery, public school, hospital, health center or library); and (4) *barangays* having at least 1,000 inhabitants which have the characteristics cited previously above and where the occupation of the inhabitants is predominantly non-farming or fishing.

Classification of a *barangay* as urban is done primarily on the basis of population or some socioeconomic characteristics that an area has. All remaining areas are considered "rural." Such differentiation is the most common way of distinguishing populations. Data on rural-urban population distribution are easily obtainable from the census publications and available up to the municipal level, as it is a standard census classification. In 1980, there were 10 million urban residents in areas where density levels exceeded

Table 8.2
Delineation of the total Philippine population according to Urban-Rural Classification (based on the 1980 Census data)

Population Indicator	Number (in millions)	Percent of Total
Total Population	48.098	100.0
Urban	18.042	37.5
Cities/municipalities with minimum density of 1,000 persons per square kilometer	10.043	20.9
Cities/municipalities with minimum density of 500 persons per square kilometer	1.599	3.3
Cities/municipalities with density less than 500 persons per square kilometer but with urban characteristics	6.400	13.3
Rural	30.056	62.5

Source: National Census and Statistics Office, Special Report No. 4, 1983.

1,000. This is expected, given the pattern of concentration in urban areas. However, a large segment (6.4 million) live in relatively low-density areas. In contrast, there is hardly any corresponding data for the rural populations.

Another way of classifying populations is by distinguishing them according to the environmental systems that they reside in: upland, including forest and rangelands; lowland croplands; coastal-inland, coastal-marine; and urban. With the exception of "urban" which as stated above is based on demographic and socioeconomic characteristics of the area, all the other categories are land resource-based. There is, therefore, a problem in a classification scheme that uses different conceptual categories. Moreover, the statistical system of gathering population data utilizes administrative-political boundaries (*i.e.* province, municipality and *barangay*), rather than the type of land resource. This latter item will be discussed more fully in the sections dealing with the populations of specific environmental systems.

Baguio City provides a good example of the conceptual problems inherent in this classification scheme. Baguio City is considered "urban" because it has a population density exceeding 1,000 persons per square kilometer. The entire city is, however, located in a mountain zone, and inhabitants in its peripheral areas engage in some form of farming or forest occupations. But given demographic and other changes that have taken place there, its environmental system has been classified as a predominantly urban one.

The problems of the city of Baguio include relatively rapid population growth. Based on 1975-1980 growth rates, the city's 1980 population would double by 1997. This high growth rate in turn generates other problems that reflect the city's inability to meet increasing needs for education, health and environmental sanitation (Medium-Term Ilocos Region Development Plan, 1987-1992). Its increasing urban population also implies geographic sprawl as uplands around the city are converted into residential areas, putting lives at risk because of slope tampering and soil erosion. For purposes of monitoring ecological stress on two different ecosystems, it would be ideal if specific data, including urbanization statistics, can be provided on urban areas in upland sites.

The coastal environment is another source of "overlap" with the "urban" classification. Cruz (1988) noted that over one-half of the country's population resides in some 10,000 municipalities along coastlines. Of the 25 large urban centers in the country, 17 have populations exceeding 100,000 people who live along the coast. The issue of overlap may be different for an area like Metro Manila or the other larger cities like Cebu City which can be said to be highly urban environments. Although these cities are located along shorelines, and some *barangays* are on the coast, these areas may be so urbanized such that the lifestyles of the population living along the sea are to a certain extent affected by city life. Even if their male populations are mainly fishermen, the coastal populations can be said to manifest urban lifestyles in their market habits as well as much greater exposure to mass media. Their problems are also more urbanization-related: they reside in urban slums located in coastal *barangays*.

Different problems may be noted regarding the coastal populations of less urbanized areas. The population here may be marginal populations of both ecosystems, somewhat a part of the urban fringe because they are part of cities and municipalities, but they also have lifestyles that are more rural in character since their occupations are primarily subsistence-extractive in nature.

The common fishermen seen on small "*bancas*" along the coasts of most intermediate and small cities of the north, Bicol and other Southern provinces, Visayas and Mindanao are examples.

Another case of overlap involves people who live on hillsides located along the coast, on what are classified as mangrove forests, or what used to be areas where mangrove thrived but which have been reshaped by human settlements. There are hardly any data on the population residing in such lands. Even more problematic is the overlap across the different kinds of land used for agricultural purposes, as these extend from the lowlands, including coastal sites, to meadows and pastures, hillsides, and even forest zones. Some of the difficulties in attempting to delineate populations according to different resource systems can be gleaned from Table 8.3. This table was constructed based on 1980 population data although the population estimates on the different resource systems come from different sources.

One can note that of the 48 million Filipinos living in the country in 1980, 14.4 million were classified by Cruz, Feranil and Goce (1986) as living in the uplands. Included among these upland residents were the 11.1 million who resided in forest zones. Forest zone residents in turn included 5.8 million living in forest lands under public domain (non-alienable and disposable lands) and 4.6 million in alienable and disposable lands. An estimated 2.3 million were residents of areas also within forest zones but are considered urban by virtue of fulfilling the population density, size or socioeconomic criteria of the urban definition.

On the other hand, the proportion of the total population residing in coastal *barangays* amounted to 55 percent of the total population in 1980. There is a need to classify the coastal population along the lines that Cruz did for upland populations. Another problem is distinguishing the coastal-inland and the coastal-marine populations.

The population in the lowland farms can be arrived at by subtracting from the total rural population the number of people living in the uplands and coastal lands. However, the actual population residing in lands used for agriculture is likely to be much larger considering that over 60 percent of the entire population in 1980 were rural residents. Moreover, upland areas are also utilized for crops. The Agricultural Census, however, does not have data on the population residing in types of farms by land use. There is a need for data on the size of farm population or farm families, but the Agricultural Census is always undertaken independently of the Population Census. This is

Table 8.3
Delineation of the population according to the type of land resource resided on, 1980 Census

Land Resource Type	Number of Inhabitants (in millions)	Percent of Total Philippine Population
TOTAL	**48.1**	**100.0**
Upland	14.4	29.9
Forest Zones*	11.1	14.3
Forest lands* under public domain (excluding alienable and disposable)	5.8	12.0
Urban Areas* in Forest Zones	2.3	6.1
Coastal**	26.4	55.0
Urban	18.0	37.5

Sources: Upland population was estimated by Cruz, Feranil and Goce for the PIDS project (1986). The detailed subgrouping under the upland category* were estimated by Cruz (1988) based on DENR (1986) data.

** Coastal population from the designated 10,000 coastal municipalities (DENR) as cited in Cruz (1988).

understandable considering that both censuses are major undertakings. However, efforts to monitor population-development changes need to consider the shifts involving populations and families residing in farmlands.

A NOTE ON VARIED ESTIMATES OF UPLANDS AND FOREST POPULATIONS

Several attempts have been made to estimate the upland and forest populations of the country considering that the forest resource is perhaps the most endangered among the various ecosystems. The Philippine government defines "upland" as comprising (1) marginal lands with slopes 18 percent or higher; (2) lands within identified mountain zones, including tablelands and plateaus lying at high elevation; and (3) lands within terrain classified as hilly to mountainous (BFD, 1982). Some 14.9 million hectares or one-half of the entire country's land area fall under the upland classification. The Philippine government also uses the 18 percent cutoff as the reference point for delineating arable lands and lands reserved for permanent forests. The 18 percent slope cutoff that Cruz, Feranil and Goce (1986) used in delineating that upland population therefore included the segment living on forest lands. Of the 14.4 million residing in the uplands, 61 percent (or 11 million) lived in forest zones.

From official Bureau of Forest Development (BFD) statistics and LANDSAT [earth resources technology satellite] data evaluated by Revilla (1985), forest land use (encompassing production forest, agroforestry lands, and open lands/grasslands totaling 16.6 million hectares) amounted to 55.3 percent of the total land area of the country.

It is therefore not surprising that there are 302 municipalities in 60 provinces in the upland category (Cruz, 1986). Upland dwellers actually occupy about 40 percent of total forest and woodlands with population densities closely approximating the national average of 100 persons per square kilometer. The 40 percent occupied areas include only those lands that have been surveyed or reported and exclude a substantially large portion of the uplands which have already been opened up for settlement including 15 of the 39 proclaimed watershed sites in the country (Cruz, 1986).

The foregoing are arguments put forward to support the contention that the upland or the forest population is much larger than previously speculated. There are, however, problems in undertaking a direct count of forest occupants, especially in reference to the Inventory of Forest Occupants by the Department of Environment and Natural Resources (DENR). Advanced reports resulted in counting only 462,600 households or 2.3 million members in 1989. This figure is way too small. It is even far below the National Task Force's estimated 5.3 million non-Muslim hill tribespeople and unauthorized forest occupants in 1979, a figure based on data from the uncompleted Forest Occupancy census of the BFD (quoted also in Ooi's report to ISEAS, 1987).

One major problem of the 1989 count is undercoverage. Some of the 8,473 targeted *barangays* were not fully covered. Ranges of undercoverage were estimated to be between 31 percent for Region 12 and 97 percent for the Cordillera Administrative Region (CAR), while targets appeared to have been exceeded in other regions (104%-125%). It is not clear how overcoverage occurred although one can speculate that upon enumeration, an adjacent area was found to be also part of a forest zone. Clearly, a more systematic and accurate enumeration of the upland and forest population is badly needed. Given these problems of varied estimates, the Cruz *et al.* and SPOT [*Satellite pour Observation de la Terre*] estimates are used for this study.

THE POPULATION SIZE IN DIFFERENT ENVIRONMENT SYSTEMS

This paper attempted to provide estimates of the size of the population residing in different environmental systems. Table 8.4 gives these estimates but fails to distinguish data on the lowland and farm population. It is understood of course that many farms are located in upland areas. Urban populations are mostly located along coasts and lowland sites.

While there are existing data or estimates for the various environment categories, there are however hardly any estimates for the coastal population, although Cruz (1986) mentions 10,000 coastal *barangays* which she used as basis for her estimate of 26 million coastal residents. Lacking *barangay* maps for this study, we had to resort to estimating what percentage of a municipality is coastal, and then apply such percentage to the total municipal population. Much more verification is needed for this highly judgmental process of estimation.

Table 8.4
Population in different environmental systems by region, 1980 (in thousands)

Region	1980 Population							
		Upland*						
	Total[a]	Total	Forest Zone**	Population areas classified as urban	Net*** population occupying forest land	Coastal[a]	Urban[b]	Urban Lowland[c]
PHILIPPINES	48,098	14,400	11,075	2,258	8,817	10,768	18,042	15,784
National Capital Region Metro Manila	5,926	—	—	—	—	976	5,926	5,926
1 Ilocos	3,541	1,446	1,246	189	1,057	426	842	653
2 Cagayan Valley	2,216	1,129	1,017	136	881	148	370	234
3 Central Luzon	4,803	844	606	221	385	195	2,010	1,789
4 Southern Tagalog	6,119	1,299	985	62	923	1,730	2,269	2,207
5 Bicol	3,477	1,059	907	13	894	1,048	762	749
6 Western Visayas	4,526	1,478	1,146	171	975	1,073	1,285	1,114
7 Central Visayas	3,787	1,840	1,252	519	733	1,150	1,217	698
8 Eastern Visayas	2,800	945	754	51	703	1,336	611	560
9 Western Mindanao	2,528	570	306	231	75	940	440	209
10 Northern Mindanao	2,759	1,254	1,033	406	627	518	749	343
11 Southern Mindanao	3,347	1,834	1,235	229	1,006	634	1,133	904
12 Central Mindanao	2,271	743	588	167	421	244	429	262

Sources:
* Cruz, Zosa-Feranil and Goce (1986); Cruz (1988); BFD Annual Report.
** Includes only non-alienable and disposable or public forest lands.
*** Based on Swedish SPOT Figure (1988).
[a] Estimated independently for this paper by taking only a fraction of coastal municipalities.
[b] Based on 1980 Census published reports.
[c] Estimated independently for this paper by subtracting the upland urban population from the total urban.

The reader is therefore cautioned that due to the overlaps cited above, one cannot have an overall decomposition of the total population by environmental systems. The entries by area do not add up to the total.

As shown above, of the total population of the country in 1980, 14.4 million were upland dwellers, many of whom resided in forest zones. If we deduct the population classified as "urban" in these forest zones, 8.8 million is the net number occupying forest zones. Eleven million were coastal residents, while 18 million were found in urban areas. Of the total urban residents, 15.8 million were in the lowlands while 2.3 were upland dwellers.

The largest numbers of upland dwellers can be found in Southern Mindanao and Central Visayas. In terms of percentage, however, the areas where the upland population comprised very large segments of the regional total also included Southern Mindanao as well as Cagayan Valley and Central Visayas [see Table 8.4a].

The 11 million residing in forest zones amounts to close to a quarter of the total population. Cagayan Valley leads all regions in the country in terms of having the largest percentage of its population residing in forest zones. In terms of numbers, however, Central Visayas, Southern Mindanao and the Ilocos each registered over 1.2 million forest residents.

Tables 8.4 and 8.4a show that in 1980 around half a million people in either Central Visayas and Northern Mindanao lived in areas of forest zones already classified as urban owing to high population density or some socioeconomic development characteristics. In each of these regions, these urban residents in forest lands comprised close to 15 percent of each total region's population.

The largest urban population in numbers and percentage was that of Metro Manila, amounting to 5.9 million or 12 percent of the total population of the country. Two regions stand out because of their relatively very high percentage of urban residents: Central Luzon and Southern Tagalog. This is not surprising considering that they border the Metropolitan Manila area.

Table 8.4a
Percentage of the population in different environmental systems in each area, 1980

	1980 Population						
	Upland*						
	All Uplands	Forest Zone**	Population Areas Classified as Urban	Net Population Occupying Forest Land	Coastal[a]	Urban[b]	Urban Lowland[c]
PHILIPPINES	29.9	23.0	4.7	18.3	22.4	37.5	32.8
National Capital Region Metro Manila	—	—	—	—	—	100.0	100.0
1 Ilocos	40.8	35.2	5.3	29.8	27.6	23.8	18.4
2 Cagayan Valley	50.9	45.9	6.1	39.8	19.2	16.7	10.6
3 Central Luzon	17.6	12.6	4.6	8.0	4.1	41.8	37.2
4 Southern Tagalog	21.2	16.1	1.0	15.1	28.3	37.1	36.1
5 Bicol	30.5	26.1	0.4	25.7	30.1	21.9	21.5
6 Western Visayas	32.7	25.3	3.8	21.5	23.7	28.4	24.6
7 Central Visayas	48.6	33.1	13.7	19.4	30.4	32.1	18.4
8 Eastern Visayas	33.8	26.9	1.8	25.1	17.7	21.8	20.0
9 Western Mindanao	22.5	12.1	9.1	3.0	37.2	17.4	8.3
10 Northern Mindanao	45.4	37.4	14.7	22.7	18.8	27.1	12.4
11 Southern Mindanao	54.8	36.9	6.8	30.1	18.9	33.9	27.0
12 Central Mindanao	32.7	25.9	7.4	18.5	10.7	18.9	11.5

Sources:
* Cruz, Zosa-Feranil and Goce (1986); Cruz (1988); BFD Annual Report.
** Includes only non-alienable and disposable or public forest lands.
*** Based on Swedish SPOT Figure (1988).

[a] Estimated independently for this paper by taking only a fraction of coastal municipalities.
[b] Based on 1980 Census published reports.
[c] Estimated independently for this paper by subtracting the upland urban population from the total urban.

POPULATION DENSITY

Table 8.5 presents data on population density for selected areas only as these were the ones with readily available data. It is evident that there are a number of concerns here. One is that there are varying levels of density across the regions. Metro Manila is the most densely settled region while Cagayan Valley is the most sparsely populated.

Upland density levels in 1980 were lowest in the Cagayan Valley and Southern Tagalog, but highest in Central Visayas. However, the density of farm populations in upland areas being currently cultivated reached a level of 224 for the entire country and was high even for upland farm areas within sparsely populated Cagayan Valley, Southern Tagalog, Southern and Central Mindanao.

Feranil (1986), Cruz, Feranil and Goce (1988), and Cruz and Feranil (1988) also pointed out that even in 1980, there were already 12 provinces with upland density levels exceeding 200 persons per square kilometer. Steeper upland sites, with slopes of 30 percent or higher, have density levels varying from 50 to 250 persons per square kilometer. However, 43 of 709 municipalities in these highly sloped areas had population densities exceeding 200. Ten of these 43 municipalities registered densities exceeding 500 persons per square kilometer.

Density levels in the large cities are another cause for concern. The City of Manila is the most densely settled, with 42,571 inhabitants per square kilometer in 1980. Within Metro Manila, density levels ranged from 42,571 persons per square kilometer in the City of Manila to 7,015 persons per square kilometer in Quezon City. But the municipality of Navotas, primarily a coastal area, registered 48,518 persons per square kilometer in 1980. The other regions do not have as densely populated cities although those in Central Luzon, Western Visayas and the Ilocos registered notably high density levels.

POPULATION GROWTH

Population growth rates are shown in Table 8.6. The rapid growth of the country can also be seen as reflected in most regions although out-migration has played an important role in "toning down" the growth of regions like the Ilocos, Western and Eastern Visayas, Bicol, and Central Mindanao.

Table 8.5
Population densities in selected environmental systems by region, c. 1980

Region	Total[a]	Upland[b]	Farm Population in Upland Agricultural Land Area[c]	Density Level of Most Densely Settled City[d]	Name of City
PHILIPPINES	160	96	224	—	
National Capital Region					
Metro Manila	9,317	—	—	42,571	(City of Manila)
1 Ilocos	164	96	260	2,644	(Dagupan)
2 Cagayan Valley	61	48	202	—	—
3 Central Luzon	263	138	191	3,132	(Angeles)
4 Southern Tagalog	130	56	170	1,575	(Lucena)
5 Bicol	197	147	517	1,170	(Naga)
6 Western Visayas	224	147	293	4,372	(Iloilo)
7 Central Visayas	253	233	238	1,745	(Cebu)
8 Eastern Visayas	131	111	207	1,016	(Tacloban)
9 Western Mindanao	135	103	42	281	(Dipolog)
10 Northern Mindanao	97	107	182	551	(Cagayan)
11 Southern Mindanao	106	86	240	353	(Gen. Santos)
12 Central Mindanao	98	77	172	2,381	(Marawi)

a National Census and Statistics Office (NCSO), 1980 Census of Population.
b Cruz, Zosa-Feranil and Goce 1986.
c Swedish SPOT Survey 1989.
d NCSO 1980 Census Special Report No. 3.

Table 8.6
Annual rates of population growth, total, upland and urban population, by region, 1975-1980

Region	Total[a]	Upland[b]	Urban	Tempo of Urbanization[c]
PHILIPPINES	2.7	2.6	5.0	3.5
National Capital Region				
Metro Manila	3.6	—	3.6	3.6
1 Ilocos	1.6	1.9	4.1	3.2
2 Cagayan Valley	2.8	3.1	5.3	3.6
3 Central Luzon	2.7	2.6	7.1	7.0
4 Southern Tagalog	3.2	3.1	6.3	4.7
5 Bicol	1.7	1.4	4.7	3.9
6 Western Visayas	1.8	1.6	2.9	1.7
7 Central Visayas	2.3	2.3	4.4	3.0
8 Eastern Visayas	1.5	1.8	4.5	3.9
9 Western Mindanao	4.3	4.3	7.2	3.4
10 Northern Mindanao	3.6	3.7	6.4	3.8
11 Southern Mindanao	4.3	4.0	9.1	6.9
12 Central Mindanao	1.9	1.8	5.9	4.9

Sources: a Concepcion, 1983.
b Computed by Cruz, Zosa-Feranil and Goce, 1986 from the enumeration of populations reported by the Census for 1948 thru 1980.
c Raymundo, 1983. Tempo=urban-rural growth.

The upland growth rate was only slightly lower than that of the national growth rate. However, the uplands of the Cagayan Valley and Eastern Visayas appeared to have grown even faster than the total growth rate of these regions taken together.

Urban areas grew the fastest. This can be observed even when the measure known as tempo of urbanization is used (tempo = urban-rural growth). Rapid population buildup is expected in the urban areas due to the concentration of services and industries in these areas. However, there is concern about the capacity of industries and services to provide for growing numbers.

IMPLICATIONS OF PROJECTED POPULATIONS

Official population projections prepared by an Inter-Agency Committee of the National Economic and Development Authority (NEDA) came out with what are known as "low," "medium" and "high" estimates which uniformly assumed moderate mortality decline but varied paths regarding fertility decline, with the "low series" assuming rapid fertility decline and the "high series" assuming slow fertility decline. Summary figures resulting from these projections are given in Table 8.7. Over all, they indicate that regardless of the trend in fertility, the population will continue to grow and density levels will rise. However, dependency will start to decline, except that dependency will be highest in the high series.

The upland population of 17.8 million persons in 1988 could conceivably occupy all of public domain lands that were classified as alienable and disposable (3.34 million hectares). Assuming a standard household size of 5.6 persons, each household would be presently occupying a little over a hectare (1.02 hectares). This means that at the current level of population, if the government were to declare all disposable lands subject to land reform (e.g., under Program D of the Comprehensive Agrarian Reform Program), each family now residing in the uplands would receive an average of 1.02 hectares.

By the year 2000, assuming that each household in the uplands occupies one hectare, an additional 1.52 million hectares of forest lands would have to be cleared for agriculture, leaving less than 5.8 million hectares forest cover. By 2025, using the same allocation of one hectare per household, another

Table 8.7
Population projections and selected parameters

Assumed Population Trend	1990	2000	2010	2020
Total Population				
Low	60.6	71.3	80.6	90.0
Medium	61.5	75.2	87.2	97.7
High	61.9	77.2	92.5	105.9
Population Density				
Low	202	238	269	300
Medium	205	251	291	326
High	206	257	308	353
Dependency Ratio				
Low	70.43	53.38	43.38	44.75
Medium	72.71	61.17	49.78	44.01
High	73.87	65.10	56.20	48.87

5.24 million hectares would have to be converted. The remaining forest cover would then be less than one million hectares—a dramatic decline in forest cover from the current 51 percent of total land area in the country to less than 28 percent, or a rate of conversion due to upland agriculture significantly higher than the 1.2 percent per year conversion rate of forest lands due to logging (Umali, 1987).

Table 8.8 gives estimates of the projected population in the uplands and in urban areas. These figures show that the population in both areas will continue to grow with anticipated increase in the total population.

The best description of the situation in the uplands comes from Cruz (1988), who wrote of "the closing upland frontier."

Table 8.8
Population projections and corresponding populations in different environment systems

		1990	2000	2010	2020
		(number of people in millions)			
* Total Population	Low	60.6	71.3	80.6	90.0
	Medium	61.5	75.2	87.2	97.7
	High	61.9	77.2	92.5	105.9
* Upland Assuming that the 1975-80 growth rate will decline by 5% every 10 years		18.6	23.9	30.5	38.7
		(number of people in millions)			
* Urban	Low	25.9	34.4	—	52.6
	Medium	26.3	36.2	—	57.1
	High	26.4	37.2	—	61.8
% Urban		(42.7)	(48.2)	—	(58.4)
		(number of people in millions)			
* Metro-Manila	Medium	8.0	9.9	11.5	12.8

SUMMARY POINTS

The analysis presented above is still incomplete although the main findings support the contention of population pressure in varied environmental systems. What should also be noted is that there appears to be varying dominant population-environment problems in specific areas, and these may call for different research as well as policy measures.

Research Issues

1. Verification of population estimates of the different environmental systems.

2. Application of the methodologies used by various existing indirect attempts to measure the population in different environmental systems on the 1990 census.

3. Decomposing the growth of the population in varied environmental systems into their demographic components (i.e., fertility, mortality and migration).

4. Studies on the environmental impact of population changes, particularly those that measure stress in welfare terms.

5. Studies on the effects of environmental degradation on population processes.

Policy Issues

1. An integrated statistical system of gathering information on the various environmental systems, that pools together population, agriculture and land-use concerns.

2. A need to be more focused in addressing the problems of different environmental systems as some areas appear to have more potentials for "stress" than others.

3. Strong support for the Population Program.

4. Rationalization of environmental policies, especially in areas where diverse ecological characteristics are simultaneously found.

5. Strict implementation of zoning laws.

CHAPTER 9
SUMMARY AND GENERAL RECOMMENDATIONS

DEFINITION OF ENVIRONMENT AND GENERAL PRINCIPLES

The term environment is so broad that it could encompass almost everything. Environment is defined as,

> *the circumstances, objects or condition by which one is surrounded,*
>
> or
>
> *the complex of physical, chemical and biotic factors that act upon an organism or an ecological community that ultimately determine its form and survival.*

These definitions of the environment pose some problems in delineating areas of concern. For this reason, it is necessary to define broad **principles** that would serve as guideposts for delineating what constitutes environmental concerns. These broad principles are applicable to existing situations in the country.

GUIDING PRINCIPLES FOR DEFINING ENVIRONMENTAL CONCERN

1. Environmental concern should be focused on the **sustainability** of life support systems or ecosystems. Sustainability in this context involves environmental, social and technological factors which enable life support systems to perform their basic ecological functions.

2. Environmental concern should be **problem-focused**. Because human activities and their influence on ecosystems vary, environmental concern should always start with specific ecological problems faced by communities at a particular situation.

3. Environmental concern should be **development-oriented.** Environment and development are two sides of the same coin and these twin objectives should always be major concerns.

4. Environmental concern should be both **site-specific** and **system-based.** The fragmentary view and outlook of ecosystem management often brings more problems than solutions. The broad strategy, therefore, in promoting environmental concern is to have a system-oriented framework that at the time deals with site-specific environmental problems.

5. Environmental concern should deal with **ecosystems interactions and interrelationships.** This is necessary because various ecosystems are interrelated through the flow of energy and materials or by activities of people.

6. Environmental concern should deal with **long-term** strategies and scenarios on issues such as the relationships between population and environment. This is necessary as ecological processes are time-bound and have cumulative impact.

7. Environmental concern should take into account **global factors** because environmental problems transcend international boundaries. International environmental concerns are also very much affected by global forces and international policies such as, energy, international trade, international transport of hazardous chemicals and others.

8. Environmental concern should promote the **well-being of local communities** occupying a considerable area of the country. Most upland communities for example, are directly dependent on forest resources for their living.

9. Environmental concern should take into consideration the promotion of **equal opportunity and access to resources.** A growing population puts more and more pressure on the land as food production increases to meet rising demand. Upland communities are pushed farther into the wilderness in search of land to till. In the lowlands, agricultural lands shrink because of unproductivity or conversion to other uses. While the poor should have access to land and resources, they should

not jeopardize the future generation's rights or use of our natural resources.

GENERAL STATEMENTS ON STATE OF ENVIRONMENT AND PROBLEMS

The scope of environmental concern is broad. It should be defined in terms of life support systems (forest, agricultural, freshwater, coastal, and urban systems), and the capacity of these systems to support the needs of our people on a sustainable basis. It should also consider the impact of human activities on these life support systems.

The right of every Filipino to enjoy a productive and wholesome environment is guaranteed by our constitution, specifically in Article II, Section 16.

The present state of our environment **is already critical:**

The forest cover of the country is only 23 percent today compared to 60 percent 90 years ago. To bring the forest cover back to that level would take **177 years** at the present rate and efficiency of reforestation.

Agricultural production efficiency for important grain crops (rice and corn) has been going down since 1985. This is because of the expansion of agriculture into marginal lands and the degradation of the agricultural resource base as a result of soil degradation, pest infestation, chemical pollution, and the reduction of farm land in the form of housing and industry.

The rich freshwater endowment of the country is fast deteriorating, *e.g.*, 40 rivers (including all rivers in Metro Manila) out of 384 river systems are now considered biologically dead due to pollution; 480,802 hectares of freshwater areas are affected by saltwater intrusion.

The coastal habitat and resources have also considerably declined. Up to 70 percent of coral reefs have been destroyed. Mangrove areas have been reduced to only 30 percent (139,725 hectares). Seagrass communities have also been destroyed. Diminishing coastal resources

and improper fishing methods have resulted in declining overall fisheries production. Sustainable yield limits for fisheries may have been already exceeded.

In urban and settlement areas, the population growth and the lack of a planning framework upon which to base development activities have led to incompatible as well as inappropriate land uses. This, in turn, have become the main causes of environmental deterioration, *i.e.*, air and water pollution, problems of waste disposal, deteriorating health and nutrition status of people, greater disaster impacts, *etc.*

This state of our environment has caused:

* Low income and poverty;
* Displacement of cultural communities;
* Social conflicts and instability;
* Declining productivity of natural resource base;
* Poor health and nutrition; and
* Hydrologic instability and siltation.

Environmental problems during the next two decades will be exacerbated by:

* High foreign debt burden;
* Poverty;
* Rapid population growth;
* Inequity;
* Weak institutional capacity;
* Nonparticipation of local communities; and
* Possibly, a stagnant economy and nonresponsive political setup.

Long-term projections by NEDA/NSCO [National Economic and Development Authority/National Statistics Coordinating Office] the total population of the country by the year 2030 may vary from a low of 97 million to a high of 117 million. There is high population density in areas with relatively degraded conditions.

There are successful examples of locally-evolved and implemented natural resource management projects that we can draw lessons from, like

the, Bontoc system, Ifugao, Mangyan, Kalahan, SALT, Jose Panganiban, RRDP, and many more.

An environmental agenda for the next decade could be based on these successes.

THE ENVIRONMENTAL AGENDA

* Developing a rational land use plan adopted at all levels — national, regional, provincial, local — to ensure sustainable natural resources use and avoid conflicting use of resources.

* Protecting the remaining primary forests especially in critical areas (national parks, protection forest, nature reserves, watersheds) as well as endangered flora and fauna for maintaining biodiversity and ecological stability.

* Providing strong support for environment and population-related programs.

* Promoting and enhancing implementation of community-based, participatory and integrated approaches to natural resource management, taking off from successful examples.

* Providing adequate research and development support for long-term and priority concerns related to agricultural sustainability, management of logged over areas, upland, coastal and urban rehabilitation and management.

* Promoting environmental education and extension programs for all sectors of society.

* Establishing a network of government line agencies (Department of Environment and Natural Resources, Department of Agriculture and Department of Agrarian Reform), nongovernment organizations (NGOs) and academe for natural resource management at the national, regional, provincial and grassroots levels.

* Evolving a comprehensive national policy of environmental ethics and management which would encompass the promotion of environmental awareness and enforcement of legislation to protect and enhance the environment and encourage NGOs to participate.

* Recognizing the scale and nature of current urbanization and assessing the extent of deterioration so that the resource base can be rehabilitated and preserved.

* Developing an integrated plan for coastal zone and fishery resources management to include the following:

    - Regulation of fishing by focusing on underexploited fishing grounds and reducing pressure on overexploited areas;

    - More nondestructive aquaculture development especially mariculture;

    - A halt to destructive fishing and exploitation of rare species;

    - A ban on mangrove area conversion and the rehabilitation of degraded mangrove areas;

    - Alternative livelihood for fishing communities to reduce the pressure on marine resources.

* Adopting low-waste and environmentally sound technologies utilizing recycling, rehabilitation and renewability.

* Adopting agriculturally sustainable technology and practices such as organic agriculture, integrated farming and integrated pest management.

* Promoting economic incentive schemes for regulating the use of natural resources and pollution control measures.

* Developing and adopting an environmental master plan for major urban centers and the 179 Community Environment and Natural Resources Offices (CENROs) throughout the country reflective of the Philippine Strategy for Sustainable Development (PSSD).

* Developing a strong and effective preventive and anticipatory environmental management mechanisms such as the Environmental Impact System (EIS) at all levels (national, regional and local), hazardous biological and chemical handling and regulation, etc.

This agenda must be pursued vigorously through policy reforms, legislation and programs if sustainable development is to be achieved. The alternatives are short-term growth and probably even national suicide by installment.

UP-CIDS State of the Nation Assessment Program

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