PHILIPPINE BIODIVERSITY

AN ASSESSMENT AND ACTION PLAN

• DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

• UNITED NATIONS ENVIRONMENT PROGRAMME

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UNITED NATIONS ENVIRONMENT PROGRAMME

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CONTENTS

FOREWORD

Biodiversity Assessment and Action Planning

There is a growing recognition of the irreversibility of biodiversity loss from wanton habitat destruction, overexploitation and environmental and biological pollution. This threat of irretrievable loss has caused renewed interest in the re-assessment and re-direction of national efforts on biodiversity conservation from many sectors, and has challenged old notions of resource abundance and fragmented approaches in the design and implementation of conservation policies and programs. More recently, increasing information on the nature and extent of problems related to biodiversity and the threats that face it call for re-direction of planning and management, with a view to achieving more comprehensive and integrated results that would link human and biodiversity resource systems.

The integration of sustainable development objectives as set forth in the 1990 Philippine Strategy for Sustainable Development and the 1993-1998 Medium Term Philippine Development Plan, the Philippine Congress' ratification of the Convention on Biological Diversity, and the initial formulation of the Philippine Strategy for Biological Diversity Conservation (PSBDC) in 1994 consolidated the legal and institutional foundations for a concrete plan of action to conserve and develop biodiversity in a sustainable manner.

The stage for reform has therefore been set. The current assessment and efforts at planning, as put forth in this book, seek to build on these efforts by identifying concrete policy and management measures and developing programs and projects that would address pressing issues and concerns in biodiversity conservation and management.

Growing Foundation for Biodiversity Conservation

This book was designed for use not only by environmental planners and managers, but also by educators, students, businessmen and the general public. It hopes to create awareness, better understanding and greater appreciation of the importance of biodiversity and the need to conserve and use it in a sustainable manner.

Together with the proposed establishment of a Philippine Biodiversity Center, this book will form part of a growing foundation which shall keep the country in step with the times as it moves on to face the conservation challenges of the coming millennium.

VICTOR O. RAMOS
Secretary
Department of Environment and
Natural Resource

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This book is one of the major outputs of the Philippine Biodiversity Country Study (PBCS) Project which was a joint undertaking of the Department of Environment and Natural Resources (DENR) of the Government of the Republic of the Philippines and the United Nations Environment Programme (UNEP). It represents the culmination of hard work by people from a broad range of sectors, from government, non-government, and peoples' organizations, to universities, research institutions and individual stakeholders. I would like to thank all the organizations and individuals who contributed to this effort.

The DENR's Protected Areas and Wildlife Bureau (PAWB) implemented the project, while the United Nations Development Programme (UNDP) Philippines administered it on behalf of UNEP- the funding agency. Dr. Corazon Sinha, Mr. Wilbur Dee, and the Technical Review Staff of PAWB namely: Ms. Jean Caleda, Ms. Priscilla Calimag, Ms. Janette Garcia, Ms. Angelita Meniado, Ms. Norma Molinyawe, Ms. Armida Pullo, and Ms. Liz Cherry Solijon prepared the project document and facilitated the signing of the Memorandum of Agreement between DENR and UNEP. The DENR management led by Secretary Victor Ramos, Dr. Delfin Ganapin, Atty. Antonio La Vina, and Undersecretary Virgilio Marcelo; former DENR officials: Dr. Angel Alcala, Mr. Benjamin Bagadion Jr., Atty. Pablo Trillana, and Mr. Ben Malayang III; PAWB Director Atty. Wilfrido S. Pollisco and former PAWB OIC Assistant Director and Project Coordinator Dr. Lope Calanog all provided guidance, encouragement and support, and facilitated the involvement and cooperation of various agencies during the implementation of the project. The various field offices of the Department, on the otherhand, assisted the conduct of research and consultation with stakeholders in different regions of the country.

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The main writers of this book were a multi-disciplinary team of Filipino experts, namely: Prof. Ponciano Bennagen (Anthropology), Dr. Candido Cabrido (Land Use), Dr. Rogelio Concepcion (Agriculture), Mr. Wilbur Dee (Protected Areas), Dr. Miguel Fortes (Marine Ecosystem), Dr. Domingo Madulid (Forestry), Dr. Ma. Nimfa Mendoza (Environment and Natural Resources Accounting), Dr. Perry Ong (Zoology), Dr. Jose Padilla (Socio-economics), Dr. Corazon Raymundo (Demography), Dr. Macrina Zafaralla (Wetlands), and Dr. Prescillano Zamora (Botany). Most of these experts had their own study groups and support staff whose contributions I would also like to acknowledge. In particular, Ms. Ma. Midea Cabamalan, Ms. Norie Castro, Ms. Gilda Diaz, Dr. Victor Gapud, Dr. Ayolani de Lara, Mr. Jay Lincoln Lim, Dr. Ulysses Lustria, Mr. Eldrid Madamba, Ms. Angelita Meniado, Ms. Simplicia Pasicolan, Ms. Edna Samar, Dr. Rogelio Serrano, and Mr. Danilo Tolentino helped prepare the detailed ecosystem and sectoral reports on which this book was based. Dr. Wilfredo Cabezon prepared the Geographic Information System (GIS) maps together with Mr. Richmond Gonzales; while PAWB, Bookmark Inc., the Philippine National Museum and others provided the photographs.

Most of the data used in this Study came from secondary sources that were obtained from various libraries throughout the country. Notable among these were the libraries of the following institutions: University of the Philippines in Diliman, Los Baños, Cebu, and Iloilo, Don Mariano Marcos Memorial State University, Benguet State University, Central Luzon State University, Silliman University, University of San Carlos, Mindanao State University, Protected Areas and Wildlife Bureau, Department of Environment and Natural Resources, Ecosystems Research and Development Bureau, Bureau of Fisheries and Aquatic Resources, Philippine Rice Research Institute, National Post Harvest Institute for Research and Extension and Southeast Asian Fisheries Development Corporation. The Study also benefitted from relevant biodiversity publications provided by foreign organizations such as: the International Union for the Conservation of Nature, the Department of Environment, Sport and Territories of Australia, Instituto Nacional de Biodiversidad of Costa Rica, World Resources Institute, and UNEP.

In the preparation of this book, various workshops and consultations were organized by the project to obtain as much inputs as possible from various sectors, disciplines, and regions of the country. The following shared their

expertise and provided information and other forms of inputs in the preparation, review, and finalization of the Study: Ms. Christine Abellon, Mr. Dacilo Adap, Ms. Leila America, Mr. Godofredo Amper, Mr. Ferdinand Andres, Ms. Elena Arinzol, Mr. Cenon Atienza, Dr. Eliseo Banaynal, Dr. Zubaida Basiao, Mr. Ariel Betan, Mr. Roger Birosel, Ms. Teresita Blastique, Mr. Pio Bote, Dr. Romeo Bruce, Mr. Edgar Buenaventura, Ms. Dulce Cacha, Ms. Mary Jean Caleda, Ms. Priscilla Calimag, Mr. Ruben Callo, Mr. Rudy Cana, Dr. Evangeline Castillo, Mr. Nelson Castillo, Dr. Zenaida Catalan, Mr. Antonio Claparols, Dr. Rex Cruz, Dr. Reynaldo dela Cruz, Ms. Angelita Cunanan, Mr. Carlo Custodio, Ms. Elenita Dano, Ms. Medina Delmendo, Mr. Noel Duhaylunsod, Mr. Evan Eleazar, Ms. Evan Dispo-Emerenciana, Mr. Virgilio Fabian, Dr. Edwino Fernando, Ms. Zenaida Fontanilla, Mr. Floro Francisco, Dr. Victor Gapud, Ms. Janette Garcia, Ms. Rebecca Garsuta, Dr. Francis Gomez, Dr. William Gruezo, Dr. Ayolani de Lara, Ms. Amy Lecciones, Mr. Rene Ledesma, Ms. Daisy Leonor, Mr. Carlos Libosada, Dr. Suzanne Licuanan, Ms. Marlynn Mendoza, Ms. Norma Molinyawe, Ms. Shane Naguit, Ms. Ester Olavides, Mr. James Osin, Dr. Sabino Padilla, Dr. Tirso Paris, Ms. Simplicia Pasicolan, Dr. Francis Penalba, Ms. Armida Pullo, Dr. Herminio Rabanal, Dr. Gilda Rivero, Dr. Justo Rojo, Mr. Filemon Romero, Ms. Mariliza Ticsay-Ruscoe, Dr. Jose Sargento, Prof. Raul Segovia, Dr. Rogelio Serrano, Ms. Liz Cherry Solijon, Mr. Blas Tabaranza Jr., Mr. Danilo Tolentino, Dr. Teodoro Villanueva, Ms. Veronica Villavicencio and Dr. Flordelina Zuraek.

The study was also presented to the Philippine Council for Sustainable Development (PCSD), a multi-sectoral body tasked with formulating policies and overseeing the implementation of sustainable development initiatives in the country. The Council's Sub-Committee on Biodiversity in particular, contributed by suggesting some refinements, providing additional inputs and facilitating the endorsement of the National Biodiversity Strategy and Action Plan (NBSAP) to the President for approval. The following member agencies of the council deserve special mention: Alternative Community Education Services Foundation, Bureau of Agrarian Reform, Center for Alternative Development Studies, Department of Health, Department of Interior and Local Government, Earth Savers' Movement, Ecological Society of the Philippines, Episcopal Commission for Tribal Filipinos, Foundation for Sustainable Development Initiatives, Green Coalition, Green Forum, HARIBON Foundation, National Economic and Development Authority, Nature Crusaders of the Philippines Foundation, Philippine Association for Intercultural Development, Philippine Federation for Environmental Concerns, Philippine Institute of Alternative Futures, Philippine National Museum, Philippine Sustainable Development Network, Philippine Upland Resource Center, Southeast Asian Regional Institute for Community Education, Tribal Filipinos Apostolate, and Upland NGO Assistance Center.

During the publication stage, Dr. Virginia S. Cariño edited the manuscript and supervised the layout, design, and printing of this book. The general manager of Bookmark Inc., Mr. Jose Ma. Lorenzo Tan, provided unwavering support to the project, while its editorial team made sure that the text, graphics, layout, color-separation, and binding would come out neat, and the book printed on schedule.

The involvement of a diversity of groups and individuals in this endeavor attests to the multi-disciplinary and multi-sectoral nature of biodiversity and its requirements for conservation. The efforts of all these groups however, would not have come to fruition if not for the excellent orchestration and outstanding coordinative work of the National Biodiversity Unit of PAWB. This group organized the various workshops, consultations and meetings of the project, assisted the experts in integrating and revising the work, and the editor, in preparing the final manuscript for publication. On this particular note, I would like to acknowledge the contributions of Mr. Luis Eleazar and Ms. Angelita Meniado and the hard-working and dedicated staff, namely: Ms. Rebecca Conde, Mr. Eldrid Madamba, Mr. Rolando Orozco, Mr. Maximo Quimbo, Ms. Marqueza Reyes, and Mr. Salvador Soliven who all worked beyond the call of duty to ensure the successful completion of the Study.

This book is a milestone achievement which offers the first ever comprehensive assessment of Philippine biodiversity and a strategy and action plan for its conservation and sustainable use. It is expected to be updated as more information are generated, and as more people contribute to the cause of biodiversity. To the first batch of contributors, I thank and salute you all for a job well done.

CELESTINO B. ULEP
Coordinator PBCS Project and
Assistant Director, PAWB

EXECUTIVE SUMMARY

Background

In fulfillment of its obligations as one of the contracting parties to the Convention on Biological Diversity signed by 154 nations at the UN Conference on Environment and Development in Rio de Janeiro in June 1992, the Philippines undertook an assessment of its biodiversity through a grant from the United Nations Environment Programme (UNEP) to the implementing agency, the Department of Environment and Natural Resources (DENR). Based on this comprehensive assessment of the current status of the country's biodiversity, the problems, threats, issues, and gaps were identified. These formed the basis for a national strategy and action plan, whose goals are the conservation, sustainable utilization, and equitable sharing of the benefits of biodiversity by all Filipinos, present and future.

Biodiversity Inventory

To facilitate the assessment of the country's biodiversity, five biodiversity sectors were recognized: four ecosystems, namely forest, wetlands, marine and agricultural, and a special area of concern, the protected areas.

Floral Diversity in Philippine Forests

The flora of the Philippines is composed of at least 13,500 species which represent five percent of the world's flora. The ferns and fern allies, gymnosperms and angiosperms constitute 22.5 percent of the Malesian and 3.88 percent of the world's vascular flora.

Twenty-five genera of plants are endemic to the Philippines. Among these are the Rubiaceae family (four genera), the Asclepiadaceae and Orchidaceae (three each), the Melastomataceae, Loranthaceae, Zingiberaceae, and Sapindaceae (two each) and Compositae, Euphorbiaceae, Leguminosae, Rutaceae and Urticaceae (one each), and two endemic fern genera. Nineteen of these are monotypic.

Among flowering plant families, the Orchidaceae, Rubiaceae, Euphorbiaceae, Myrtaceae and Moraceae have the greatest number of indigenous and endemic species, while Graminae, Liliaceae, Ulmaceae, Leguminosae, and Rutaceae have lower endemism.

The gymnosperms are poorly represented with only 33 species and 18 percent endemism while there are 1,011 species of ferns and fern allies with 30 percent endemism. Recorded are about 506 species of mosses with 23 percent endemism. Liverworts and hornworts number to 518 species while more than 700 species of fungi and 790 species of lichens are on record. A further 5-8% of the country's flora are believed to be still unidentified.

Faunal Diversity in Philippine Forests

An estimated 1,084 species of terrestrial vertebrates are found in Philippine forests, of which 45 percent are endemic. Of these, 179 species are mammals with 61 percent endemism, 15 of which are still in the process of being named. There are 558 species of birds recorded in the country with 31 percent endemism, 38 percent of which are confined to single islands. About 71 percent are known to breed in a diversity of habitats from beach to montane forests but there are no breeding information on 40 percent of these breeding species. There are 252 species of reptiles with 63 percent endemism. There are four major subgroups of reptiles: the lizards (126 species, 75 percent endemism), snakes (112 species, 54 percent endemism), turtles (10 species, 10 percent endemism), and crocodiles (two species, 50 percent endemism). A total of 96 amphibian species are recognized taxonomically in the country, with 53 percent endemism. Most are also single-island endemics. Of these, four were introduced species in the country, namely: the marine toad *(Bufo marinus)*, the American bullfrog *(Rana catesbeiana)*, the leopard frog *(R. tigrina)*, and the Taiwanese frog *(R. rugolosa)*. The marine toad was introduced in the 1930s to control sugarcane beetle infestation while the last three were introduced for breeding and export as food. These species have escaped from captivity and are now widespread throughout the country. Their impact on indigenous species and the ecosystem, in general, are unknown.

The number of species of millipedes and centipedes is 54 and 44, respectively, while more than 20,000 species of insects have been identified. However, only the lacewings, fleas, caddisflies, two-winged flies, and butterfly species have been fully inventoried.

There are 341 species of spiders found in rice and non-rice habitats, which is less than two percent of the world's total. However, many more species remain to be discovered and identified, since more than 75 percent of these are new to science and live on habitats that have not been fully explored.

So far, 2,782 species of mollusks have been identified in all of the country's ecosystems. However, the level of endemism is undetermined but estimated to range from high to very high.

The level of endemism of invertebrates is generally poorly known but is suspected to be high. Endemism ranged from 44 percent to 87 percent with a mean of 64 percent for the six insect orders inventoried.

Eighty six species of birds found in the country are under various forms of threat, from being vulnerable to being extinct in the wild. Of these, 45 species are either extinct in the wild, critical, or endangered. Forty of the 45 aforementioned species are endemic, which makes the Philippines the number one country in the world in terms of number of threatened endemic species of birds.

In contrast, 30 species of terrestrial mammals are classified under various threat categories, from being rare to being endangered, while only two species of amphibians and three species of reptiles in Philippine forests are classified under various threatened categories. This number is definitely a conservative estimate as little information about these three groups, as a whole, is known.

The most threatened endemic mammal is the tamaraw, *Bubalus mindorensis,* while the most threatened endemic bird is the Philippine eagle, *Pithecophaga jefferyii.* Both species are estimated to have a wild population of less than 200 each. Both are also the subject of captive breeding studies with very limited success.

Diversity in Wetlands

Philippine wetlands are endowed with a rich diversity of flora (1,616 species) and fauna (3,308 species). These consist of algae (1,177 species), aquatic macrophytes (439 species), mollusks (728 species), insects (1,764 species), other arthropods (498 species), fishes (208 species), and waterfowls (110 species). These species represent the dominant components of the complex food webs that have evolved in the different wetland types. Sponges, cnidarians, free-living flatworms, annelids, and nudibranchs were not included in these inventories.

Diversity in Marine Ecosystem

At least 4,951 species of marine plants and animals are found in Philippine coastal and marine habitats. Fishes, non-coral invertebrates and seaweeds constitute the greatest numbers. One thousand three hundred ninety six species (1,396) or 28 percent are economically important, 403 or 10 percent are flagship species, while 145 species or 2.4 percent are under threat. Fifteen species are listed as endangered. Sixteen species or 0.3 percent of the fishes are endemic, while 123 or 2.2 percent are known indicators of environmental conditions.

Coral reefs are by far the most diverse or species rich with 3,967 species. Seagrass beds follow with 481 species and then mangroves with 370 species. Soft bottom communities have the lowest recorded species richness with 70 species. The 381 coral species and 1,030 species of fish recorded in Philippine coral reefs ranks the country second to the Great Barrier Reef in coral and coral reef fish diversity. The 16 taxa of seagrasses recorded in the Philippines gives the country the second highest seagrass species richness in the world.

Diversity in Agriculture

A total of 1,210 species of plants are relevant to agriculture with a variety of uses and values. Some have food values (477 species), feed values (363 species), medicinal/herbal values (627 species), and ornamental values (201 species). In addition, 35 species are considered as fiber crops while an undetermined number have industrial importance.

The National Plant Germplasm Resources Laboratory (NPGRL) in UP Los Baños, as of December 1994, maintains a total of 32,446 accessions of 396 species, while the Philippine Rice Research Institute (PHILRICE), as of 1992, maintains 12 species of wild rice from the International Rice Research Institute (IRRI) germplasm center and from its collections in the different parts of the country. The germplasm collection of the National Tobacco Authority (NTA) has increased to 488 accessions in 1995.

The Bureau of Plant Industry (BPI) reported that between 1980 and 1991, there was a substantial decrease in the population of 61 economically important crops such as coconut, coffee, fiber crops particularly abaca, kenaf, piña, and ramie, and mulberry while banana, cacao, rubber, and ipil-ipil dramatically increased in population. On the other hand, the domestic animal population in 1991 totaled 2,766,000 carabaos, 1,991,000 cattle, 286,000 horses, 7,479,000 hogs, 2,403,000 goats, and 56,000 other domesticated species. Aggregate poultry population, which includes chicken, ducks, quails, geese, turkeys, and pigeons, totals 101,235,000 heads. Only carabaos showed a substantial decrease in numbers.

Species and Ecosystem Diversity in Protected Areas

There are 290 sites all over the country that are classified under various categories of protected areas status such as National Parks, National Marine Parks and National Marine Reserves (67), Game Refuge and Bird Sanctuaries (8), Wilderness Areas (16), Watershed Areas (85), Mangrove Swamp Forest Reserves (27), Tourist Zones and Marine Reserves (56) and others (35). Ten of these sites have been identified as the priority sites for the implementation of Republic Act 7586 or the National Integrated Protected Areas System (NIPAS) Law. These include the Batanes Protected Landscapes and Seascapes (BPLS), Northern Sierra Madre Natural Park (NSMNP), Subic-Bataan Natural Park (SBNP), Apo Reef Marine Natural Park (ARMNP), Mt. Canlaon Natural Park (MCNP), Turtle Island Marine Natural Park (TIMNP), Mt. Kitanglad Natural Park (MKNP), Mt. Apo Natural Park (MANP), Siargao Island Wildlife Sanctuary (SIWS), and the Agusan Marsh Wildlife Sanctuary (AMWS). These ten sites were chosen because of the high level of species and ecosystem diversity and endemism in some (e.g., MANP, MKNP, NSMNP), unique ecosystems in others (e.g., NSMNP, TIMP, BPLS), and ecological roles and importance (e.g., AMWS, SIWS, NSMNP) or a combination of these values (e.g. NSMNP, SIWS, MKNP).

Rates of Change

The comprehensive assessment of the country's biodiversity shows an impressive record in terms of species diversity and endemism. But this does not reflect the extent of biodiversity loss that has occurred in the last decade or so in the different ecosystems of the country. Depending on when the inventory was conducted, the current species diversity may reflect either the current level or the remnant of a much richer diversity in the past. A third scenario could assume that more species remain unexplored/undiscovered and could constitute even twice the currently known number. If the last scenario reflects the real situation, then it is a race against time to understand the actual extent of existing biodiversity as part of our natural heritage before it disappears due to the rapidly expanding population and its concomitant overexploitation of resources that brings about a negative chain of reactions, e.g., tenurial problems, denudation of ecosystem and watershed areas, soil erosion, siltation, organic and chemical pollution, eutrophication, mangrove conversion, breakdown in food chain checks and balances. In many instances, the extent of habitat loss will provide a good measure of biodiversity loss.

To illustrate, the forest cover in the country has been reduced from more than 50 percent to less than 24 percent over a 40 year period (1948 to 1987); only about 5 percent of the country's coral reefs remains in excellent condition, 30-50 percent of its seagrass beds in the last 50 years, and about 80 percent of its mangrove areas in the last 75 years, have been lost. It has been estimated that about 50 percent of national parks are no longer biologically important.

Problems and Threats

Biodiversity loss in the Philippines stems from four broad categories: (1) habitat destruction, (2) overexploitation, (3) chemical or environmental pollution, and (4) biological pollution.

Habitat Destruction

Habitat destruction and loss can be traced to anthropogenic and nature-wrought causes. Anthropogenic activities include destructive and unsustainable practices such as (1) logging, (2) fires, (3) land conversion, (4) siltation, (5) destructive fishing methods, and (6) encroachment and occupancy in protected areas.

Nature-wrought destructions are due to natural calamities like volcanic eruptions, earthquakes, typhoons, and pests and diseases. The Mt. Pinatubo volcanic eruption has resulted in the loss of undetermined vital components of the tropical forest and marine waters of the Subic-Bataan National Park. It also resulted in the destruction of vast farmlands by its volcanic lava and subsequent lahar flows. Furthermore, agroecosystems that lie along typhoon paths suffer significant destruction annually.

Overexploitation

Population pressure, poverty and paucity of livelihood opportunities, dearth of values, and the "open access" nature of many bioresources all contribute to the overexploitation and non-sustainable use of our country's biodiversity.

In forests, commercial timber species (e.g., dipterocarps, kamagong, narra) as well as non-timber species (e.g., orchids, ferns, rattan, insects, birds, mammals) and animal products (e.g., birds' nests, guano), are overharvested. Mangrove timber are overharvested for fuelwood, animals for trade (waterfowls, reptiles) and fish and shellfish for food. In the marine ecosystem, commercially important species, notably tuna, shellfish and other edible species are overharvested. Agricultural ecosystems are hard pressed to yield greater harvests to feed the teeming population. Protected areas are not spared the onslaught of overexploitation from the greedy hands of man because of economic realities.

Chemical (Environmental) Pollution

Pollutants overwhelm our ecosystems and overtax the dispersal and self-cleansing capacity of our atmosphere, water bodies and land.

Forest ecosystems, in general, are less subjected to chemical pollution compared to other ecosystems with the exception of chemical defoliants usage. It is the wetland ecosystems that take much toll from chemical wastes from mine tailings, hazardous wastes from industrial plants, factory discharges, agricultural fertilizer and pesticide run-offs, and even household wastes. Marine ecosystems are subject to the same chemical pollutants as wetlands but they are less vulnerable because of their greater expanse. Oil slicks, however, inflict serious harm to marine habitats and their biota. Agricultural ecosystems are poisoned by intensive fertilizer and pesticide applications. Even useful non-pests and humans, as well, are threatened by this inappropriate farming method.

Biological Pollution (Species Level)

By and large, the successful introduction of exotic species occurred in wetland ecosystems, particularly in lakes and rivers, and has been at the expense of the endemic and indigenous species either directly through predation, competition, and hybridization or indirectly through parasites and habitat alteration. For instance, the original fish population of Caliraya Lake has disappeared with the introduction of the black bass, *Micropterus salmoides*.

Weak Institutional and Legal Capacities

Major drawbacks in biodiversity conservation and sustainable use include (i) inappropriate, overlapping, conflicting and obsolete policies and institutions, (ii) shortage of technical expertise, (iii) shortage of funds, (iv) weak information, education, and communication capacities, (v) inadequate policy mechanisms, and (vi) poor integration of research and development activities.

Strategy and Action Plans

In view of the problems and concerns which constantly threaten the future of the country's biodiversity and in consonance with the Convention on Biological Diversity's objectives of conservation, sustainable use, and equitable sharing of the benefits of the country's biodiversity, a National Biodiversity Strategy and Action Plan with modular programs and projects and corresponding resource requirements was formulated.

Six strategies and action plans were developed, anchored on the framework of man being at the center of ecosystems and resource interaction and the need to balance the utilization driven policy which entails modification of biodiversity for human needs with the conservation driven policy for maintaining natural biodiversity. These strategies and their respective thrusts are as follows: (I) Expanding and Improving Knowledge on the Characteristics, Uses, and Values of Biological Diversity, (II) Enhancing and Integrating Existing and Planned Biodiversity Conservation Efforts with Emphasis on In-Situ Activities, (III) Formulating an Integrated Policy and Legislative Framework for the

Conservation, Sustainable Use and Equitable Sharing of the Benefits of Biological Diversity, (IV) Strengthening Capacities for Integrating and Institutionalizing Biodiversity Conservation and Management, (V) Mobilizing an Integrated Information, Education and Communication (IEC) System for Biodiversity Conservation, and (VI) Advocating Stronger International Cooperation on Biodiversity Conservation and Management.

Strategy I has three thrusts: (1) Augmenting knowledge of species and ecosystem diversity, (2) Estimating current uses and values of biological diversity, and (3) Underscoring the need to hedge for the future.

The generation, expansion and updating of information on the extent of biological wealth is a basic requirement for biodiversity conservation and management planning. The need to characterize species in terms of conservation status, e.g., extinct, threatened, vulnerable, etc., is urgent for prioritizing conservation efforts. To maximize use, knowledge generated should be made accessible. Furthermore, the conventional valuation of the production of biological resources fails to account for depletion and loss of species, degradation of ecosystems, and loss of biological diversity. In most cases, highly valued biological resources are limited to the economically important or those that sustain human life. But from an ecological perspective, every species has an ecological niche that is necessary in sustaining other lifeforms. The lack of information on the ecological linkages among species or ecosystems, and hence, their monetary equivalents results in undervaluation and their subsequent degradation.

To some indigenous communities, some biological resources or sites are sacred and a source of cultural identity. This type of value attached to a resource contributes to its preservation or sustainable use. More fundamentally, local communities and especially indigenous peoples have a rich repository of knowledge and practices about the natural environment that contribute to biodiversity conservation. Many of these communities occupy territories, particularly forest areas, that harbor a variety of species. The cultural and spiritual values attached to biological resources by indigenous peoples constitute a part of the worth of these resources.

Wild life forms have been the sources of genes, chemicals, and elements to produce desirable attributes in plants and animals, to concoct drugs and medicines, and to develop products of commercial importance. The value of any living species may be accurately reflected not only in its current use but in its potential use as well.

The strategy contains three major programs, namely Biodiversity Inventory, Ecosystems Mapping and Data Validation, and Socio-Economic Studies.

The Biodiversity Inventory aims to fill the data gap concerning lack of baseline information, some of which are outdated (e.g., flora and fauna) while in others the data available are insufficient (e.g., microbial diversity). Sixteen projects are proposed that runs across the five biodiversity sectors.

Five projects are identified under the Ecosystems Mapping and Data Validation Program which aims to address a major data gap in biodiversity conservation work, i.e., the lack of accurate, updated, and ground-truthed maps of where the country's biodiversity are located.

The Socio-Economic Studies Program has five major projects. One aims to document and incorporate indigenous knowledge systems and practices on biodiversity conservation and sustainable development, while another project aims to do a valuation and accounting of direct and indirect goods and services from biodiversity and bioresources. The three remaining projects focus on demography and marine resources valuation.

Strategy II has three thrusts, namely: (1) Evaluating on-going and identifying in-situ and ex-situ biodiversity conservation and management approaches, (2) Consolidating research and development programs for ex-situ and in-situ conservation of biodiversity, and (3) Institutionalizing a nationwide network of conservation centers.

Various in-situ and ex-situ conservation programs are being undertaken, even while new ones are being proposed and planned. The effectiveness of these programs in conserving biodiversity needs to be evaluated in terms of the preservation, restoration and expansion of habitats, enhancement of the survival of target species, reduction or elimination of the threats to habitat destruction and species loss, among others. Other potential management approaches (e.g., indigenous management practices, ecotourism, and other community-based approaches) in in-situ and ex-situ conservation need to be investigated and incorporated into biodiversity planning. Other areas of research and development badly needed are those on interhabitat connectivity. By consolidating these activities, more focused and rigorous research and development programs can be pursued.

There are two major programs under this strategy: the In-situ Conservation Program and the Ex-situ Conservation

Program. Under the In-situ Conservation Program, the protection of habitats is deemed as the most effective way of conserving biodiversity, while rehabilitation and enhancement of damaged and critical habitats are equally important.

The Ex-situ Conservation Program is premised on the following principle: ex-situ conservation will be undertaken only as a last resort and only to complement in-situ conservation efforts. Four projects are proposed.

There are two thrusts under Strategy III, namely: (1) Aligning policies governing the utilization of biological diversity by pursuing a systematic policy evaluation, and (2) Devising policies that promote proper, sustainable, and equitable utilization of biological diversity.

Policy makers and law makers should influence/force resource users to act in consonance with the limits of biological resource regeneration, and indirect users to properly account for the consequences of their activities on the resources and the environment. Environmental and ecological considerations should not take a back seat in favor of development initiatives. Preferential access by indigenous peoples and marginalized users should be explicit and incorporated as a component of resource utilization policies.

Projects proposed under Strategy III are (1) the Codification of Laws Related to Biodiversity; (2) the Development of a Realistic System of Access Fees, Incentives and Penalties for the Utilization of Biological Resources and Biodiversity; (3) the Identification, Delineation, and Management of Ancestral Domain.

Three proposed activities are also proposed under Strategy III. One activity is on Policy Advocacy, while another is on the Formulation of Guidelines on Land Use Planning and Biodiversity Conservation and Integration thereof in the Plans of Concerned Agencies. A third activity is in the Assessment of Protected Areas under the Initial Components of NIPAS.

Strategy IV has two thrusts, namely: (1) Integrating the planning, implementation, evaluation and monitoring of biodiversity conservation and management in government and non-governmental sectors, and (2) Strengthening human resource capability in biodiversity conservation and management.

Two programs are proposed. These are the Institutional Capacity Building Program and the Human Resources Development Program.

The Institutional Capacity Building Program aims to identify the required functions of government and nongovernment institutions in biodiversity conservation and management. An assessment of current capacities of these institutions in carrying out such functions shall be done. Areas of weakness will be addressed by projects and activities specified in this program. Three projects and two activities are identified, the most important of which is the creation of a Philippine Biodiversity Center. Two corollary activities are included in this project. One is the establishment of the Philippine Marine Biodiversity Conservation Committee (PMBCC) while another activity is the expansion of the membership of the subcommittee on biodiversity of the Philippine Council for Sustainable Development.

The Human Resource Development Program has two projects: one aims to develop the technical capacity in Biodiversity Conservation Planning in the private sector and the other in the government sector.

One principal root cause of environmental degradation is incomplete appreciation of the environment and its biodiversity resources because of the highly "instrumentalized" educational system that deprives students of the opportunity to directly interact with the environment and biodiversity resources. Thus, there is a need to establish a curriculum drafting committee tasked to formulate curricula and develop courses that incorporate biodiversity conservation concerns in secondary and tertiary levels, validate the incorporation of these into existing education programs and pilot test the curriculum in selected schools.

There are four thrusts under Strategy V, namely: (1) Increasing access to updated biodiversity information and database systems, (2) Institutionalizing community-based biodiversity conservation education and research, (3) Harnessing traditional and alternative media to increase public awareness and support for biodiversity conservation, and (4) Encouraging and sustaining advocacy for biodiversity conservation.

Three programs are proposed under this strategy. These are the Biodiversity Conservation Awareness and Information for Local Communities Program, the Community-Based Biodiversity Conservation Education and Research Program,

and the Value Added Products and Alternative Sustainable Livelihood Development for Bioresources Dependent Communities Program.

Three projects are identified under the Biodiversity Conservation Awareness and Information for Local Communities Program, which aims to build up people's appreciation of the values, attributes, and conservation approaches to biodiversity resources at the community level to ensure people's participation.

Three projects are identified in the Community-Based Biodiversity Conservation Education and Research Program, which aims to ensure consistency and sustainability in the dissemination, promotion and implementation of relevant national policies and programs with truly grassroots participation.

Only one project is included under the Value Added Products and Alternative Sustainable Livelihood Development for Bioresources Dependent Communities Program, which aims to help local communities inhabiting biodiversity rich areas find and learn alternative sustainable livelihood and teach them skills to develop value-added products such as commercial processing of wild fruits to produce various types of jams so they have incentives to maintain and protect the natural vegetation. A "menu" of options of proven successful livelihood activities will be offered with due consideration of traditional indigenous knowledge systems.

Three thrusts have been identified for Strategy VI. These are: (1) Operationalizing specific country commitments made under the Convention on Biological Diversity and other similar agreements, (2) Creating institutions to oversee the international coordinated implementation of the Convention on Biological Diversity, and (3) Strengthening linkages of local non-government organizations with international counterparts for biodiversity conservation.

To fulfill our international commitments, programs and projects have to be developed and implemented, which the Subcommittee on Biodiversity under the Philippine Council for Sustainable Development is mandated to coordinate and oversee. However, the effectiveness of the subcommittee to fulfill its mandate is hampered by limited membership and insufficient and transient staff. There is a need to expand the membership of the subcommittee to include other stakeholders and the addition of permanent support staff. There is a need for an institutional framework to oversee the implementation of international agreements that will conserve biodiversity in a coordinated manner. An example is the proposal to establish an ASEAN Regional Center for Biodiversity Conservation to be hosted by the Philippines. At the 1992 Earth Summit in Rio de Janeiro, the International NGO Forum (INGOF) was organized by Philippine NGOs by the holding of parallel talks among NGOs from all over the world. These linkages should be enhanced to promote inter-country people-to-people contact and cooperation for biodiversity conservation. The center will serve as the central coordinating body of ASEAN member countries on studies related to the conservation of biodiversity, formulation and implementation of action plans for such, generation of ecological database and information, and the conduct of research and development, training and extension, and consultancy and advisory services.

LIST OF ACRONYMS

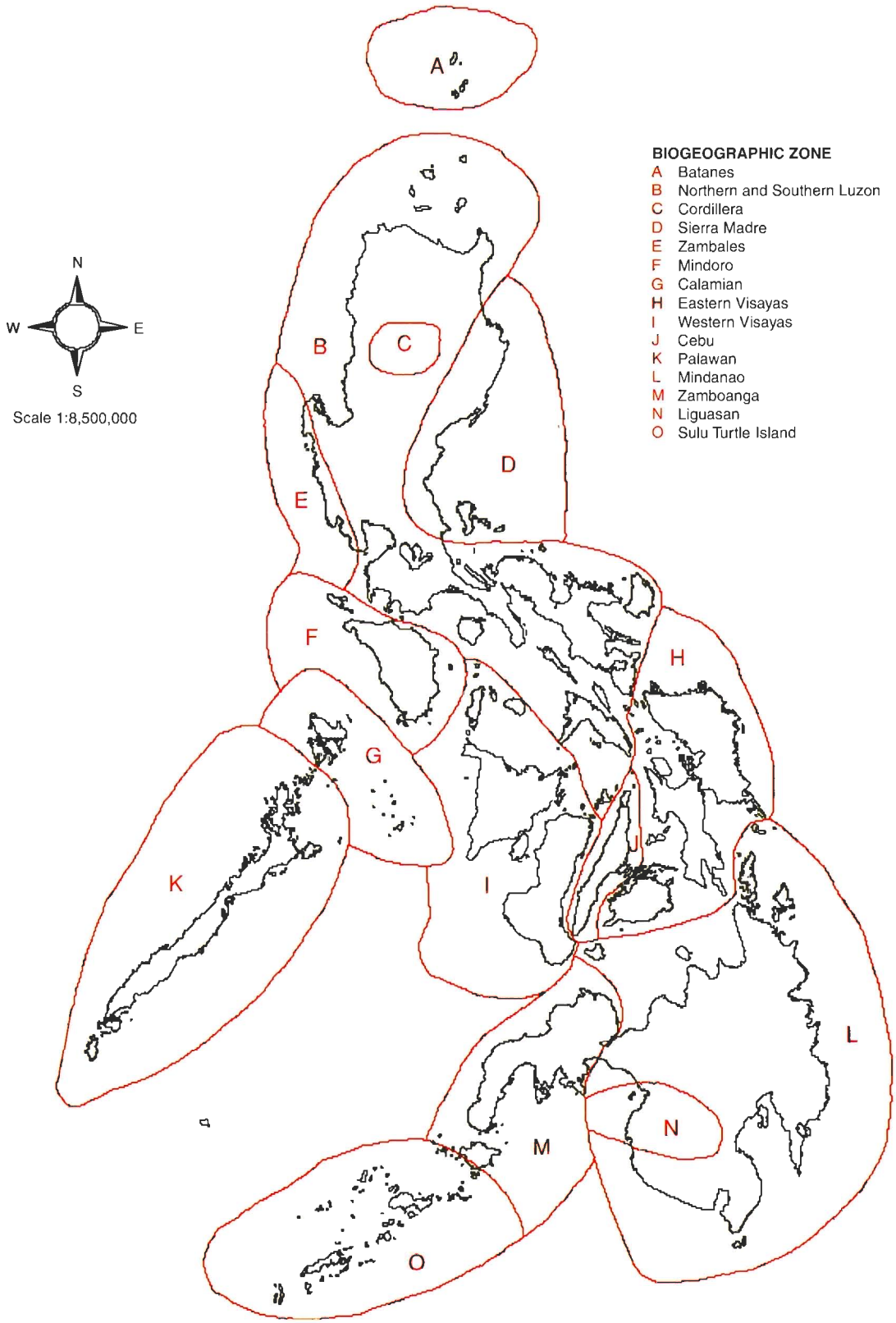
ADB – Asian Development Bank
AFF – Agriculture, Fishery and Forestry
AGR – Animal Genetic Resources
AMWS – Agusan Marsh Wildlife Sanctuary
ARMM – Autonomous Region of Muslim Mindanao
ARMNP – Apo Reef Marine Natural Park
ASEAN – Association of Southeast Asian Nations
ASU – Artificial Seagrass Units
AWB – Asian Wetlands Bureau
BAS – Bureau of Agricultural Statistics
BFAR – Bureau of Fisheries and Aquatic Resources
BSWM – Bureau of Soils and Water Management
BPI – Bureau of Plant Industry
BPLS – Batanes Protected Landscapes and Seascapes
BOU – British Ornithologists' Union
BZ – Biogeographic Zone
CAR – Cordillera Autonomous Region
CARP – Comprehensive Agrarian Reform Program
CENRO – Community Environment and Natural Resources Office
CEP – Coastal Environment Program
CFP – Community-based Forestry Program
CIDSS – Comprehensive Integrated Delivery of Social Services
CITES – Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CPPAP – Conservation of Priority Protected Areas Project
DA – Department of Agriculture
DAR – Department of Agrarian Reform
DENR – Department of Environment and Natural Resources
DMC – DENR Memorandum Circular
DNA – Deoxyribonucleic Acid
DOST – Department of Science and Technology
DOT – Department of Tourism
EBA – Endemic Bird Areas
EEP – European Endangered Species Breeding Program
ENRA – Environmental and Natural Resources Accounting
ENRAP II – Environmental and Natural Resources Accounting Project II
ENR-SECAL– Environment and Natural Resources Sectoral Adjustment Loan
EMB – Environmental Management Bureau
ERDB – Ecosystems Research and Development Bureau
EU – European Union
FAO – Food and Agriculture Organization
FIES – Family Income and Expenditure Survey
FLA – Fishpond Lease Agreement
FMDP – Fisheries Management and Development Program
FPE – Foundation for the Philippine Environment
FPRDI – Forest Products Research and Development Institute
GATT – General Agreement on Tariffs and Trade
GVA – Gross Value Added
GDP – Gross Domestic Product
GEF – Global Environment Facility
GMPS – General Management Planning Strategy
GNP – Gross National Product
GPEP – Grains Productivity Enhancement Program
GRDP – Gross Regional Domestic Product
GRBS – Game Refuge and Bird Sanctuary
GTZ – German Technical Assistance
ICLARM – International Center for Living Aquatic Resources Management
ICC – Indigenous Cultural Communities
IEC – Information, Education and Communication
IP – Indigenous People
IPAS – Integrated Protected Areas System
IPAS I – Integrated Protected Areas System Project I
IPB – Institute of Plant Breeding
IPR – Intellectual Property Rights
IRRI – International Rice Research Institute
ISFP – Integrated Social Forestry Program
IUCN – International Union for the Conservation of Nature and Resources/ World Conservation Union
JICA – Japan International Cooperation Agency
LBP – Land Bank of the Philippines
LDC – Livestock Diversity Conservation
LCRP – Living Coastal Resources Program
LGU – Local Government Unit
LIUCP – Low Income Upland Community Project

LLDA – Laguna Lake Development Authority
MAB – Man and the Biosphere
MANP – Mount Apo Natural Park
MASL – Meters Above Sea Level
MCNP – Mount Canlaon Natural Park
ME – Monitoring and Evaluation
MIS – Management Information System
MKNP – Mount Kitanglad Natural Park
MSI – Marine Science Institute, University of the Philippines, Diliman
MT – Metric Tons
NAMRIA – National Mapping and Resource Information Authority
NAST – National Academy of Science and Technology
NBU – National Biodiversity Unit
NCR – National Capital Region
NEDA – National Economic and Development Authority
NFP – National Forestry Program
NGO – Non-Government Organization
NICO – NIPAS Coordinating Office
NIPAS Law – National Integrated Protected Areas System Act of 1992
NIPAP – National Integrated Protected Areas Project
NPGRL – National Plant Genetic Resources Laboratory
NPPSC – National Program and Policy Steering Committee
NRMDP – Natural Resources Management and Development Project
NRMC-MNR – Natural Resources Management Center-Ministry of Natural Resources
NSIC – National Seed Industry Council
NSMNP – Northern Sierra Madre Natural Park
NSO – National Statistics Office
NTA – National Tobacco Authority
PA – Protected Area
PAMB – Protected Area Management Board
PAR – Photosynthetic Active Radiation
PAWB – Protected Areas and Wildlife Bureau
PBA – Philippine Biodiversity Assessment
PCARRD – Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCAMRD – Philippine Council for Aquatic and Marine Resources Research and Development
PCP – Pawikan Conservation Program
PCE – Per Capita Expenditure
PEBAP – Primate Exporters and Breeders Association of the Philippines
PENRO – Provincial Environment and Natural Resources Office
PFDPIN – Philippine Forestry Development Project in Ilocos Norte
PHILRICE – Philippine Rice Research Institute
PIA – Philippine Information Agency
PNICO – Provincial NIPAS Coordinating Office
PNM – Philippine National Museum
PSBDC – Philippine Strategy for Biological Diversity Conservation
PO – Peoples' Organization
RICH – Rescue for Important Conservation Hotspots
REECs – Resources, Environment, and Economics Consultants Inc.
RRDP – Rainfed Resources Development Project
RSPS – Retrospective Seasonal Production Signature
SBMA – Subic Bay Metropolitan Authority
SBNP – Subic-Bataan Natural Park
SEAFDEC – Southeast Asian Fisheries Development Center
SICEN – Seaweed and Invertebrate Information Center
SICONBREC – Simian Conservation Breeding and Research Center
SIWS – Siargao Island Wildlife Sanctuary
SPOT – Systeme Probatoire Observation dela Terre
SPS – Special Project for Scavengers
SUC/SCU – State Universities and Colleges
TIMNP – Turtle Island Marine Natural Park
TLA – Timber License Agreement
TRIPS – Trade Related Issues on Property Rights
TURF – Territorial Use Rights in Fisheries
TWINSPAN – Two Indicator Species Analysis
UNDP – United Nations Development Programme
UNEP – United Nations Environment Programme
UNESCO – United Nations Educational, Scientific, and Cultural Organization
UP – University of the Philippines
UPD – University of the Philippines Diliman
UPLB – University of the Philippines Los Baños
UPOV – International Union for the Protection of New Varieties of Plants
USAID – United States Agency for International Development
WB – World Bank
WCMC – World Conservation Monitoring Center
WRI – World Resources Institute
WWF – World Wildlife Fund for Nature or World Wide Fund for Nature

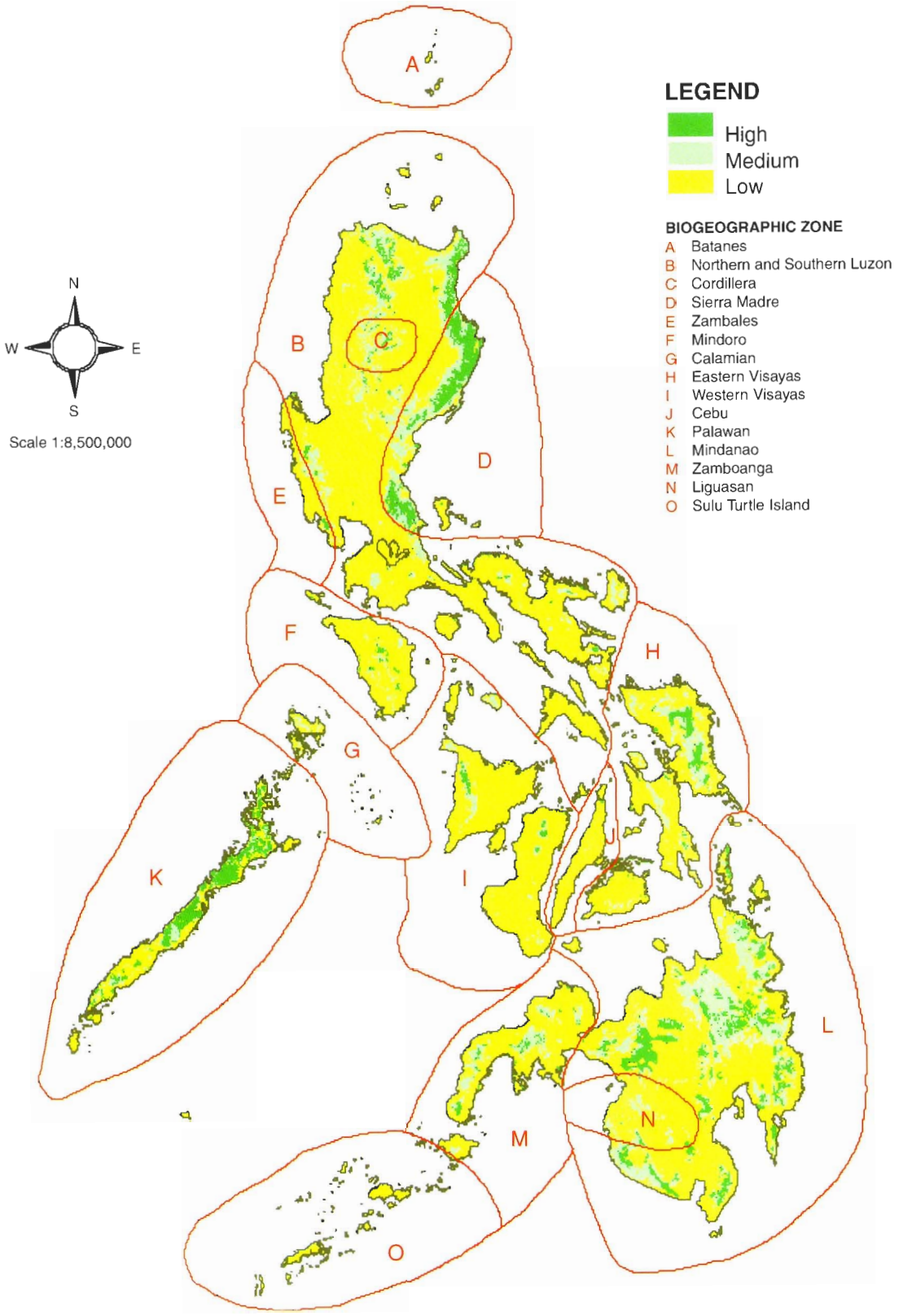
LIST OF TABLES

LIST OF FIGURES

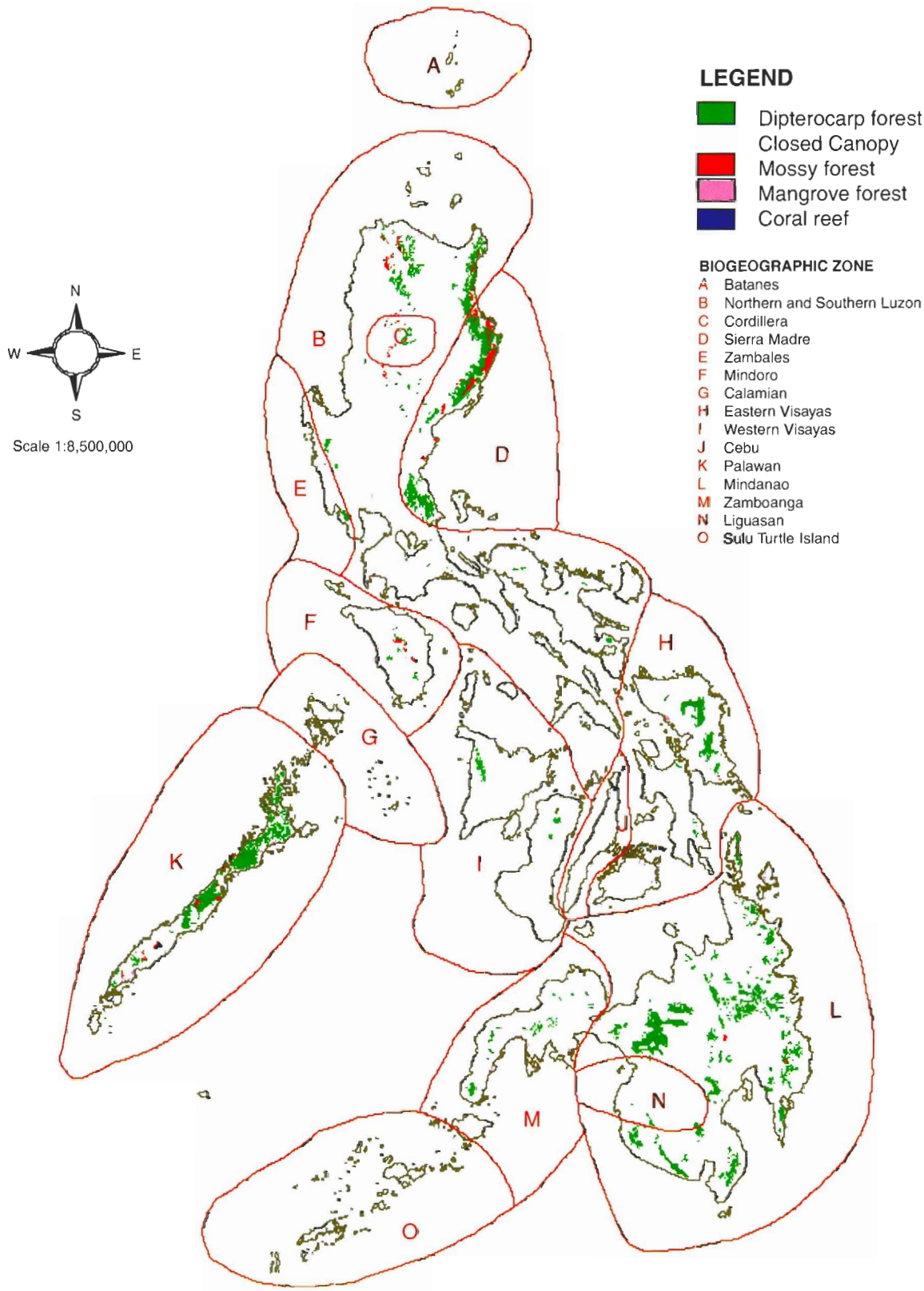
BIOGEOGRAPHIC ZONES
Philippines



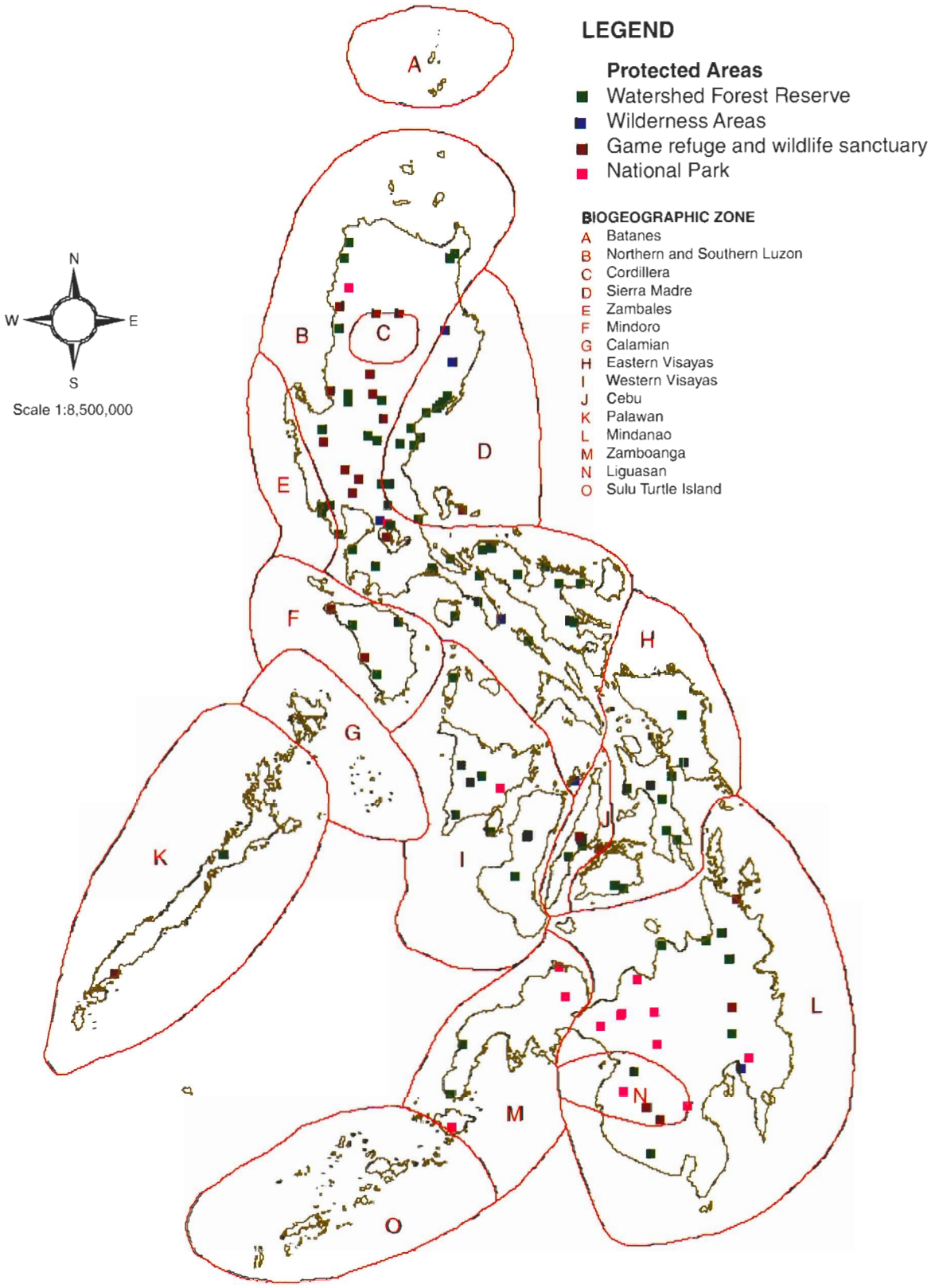
BIODIVERSITY QUALITY MAP
Philippines



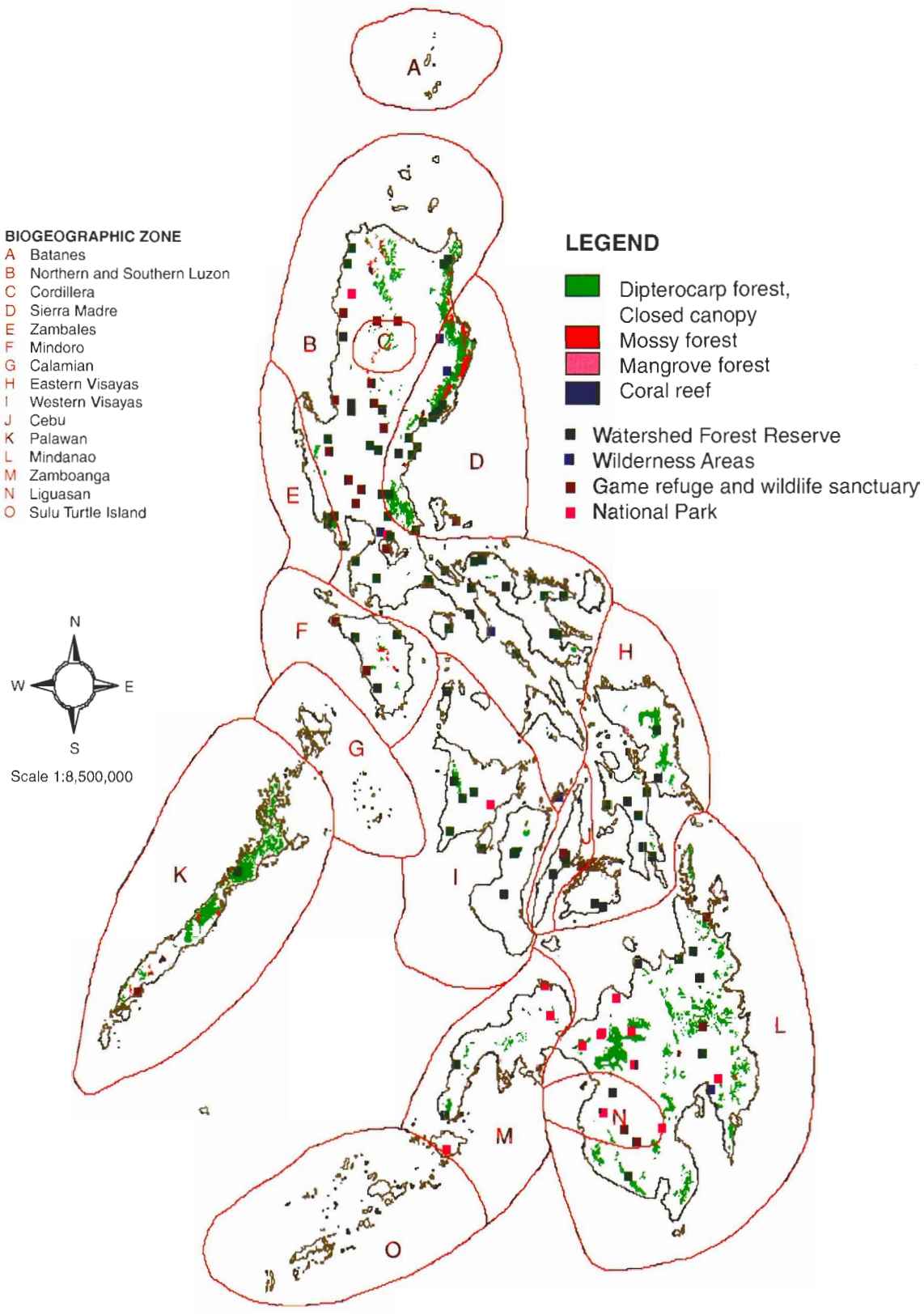
BIODIVERSITY-RICH ECOSYSTEM
Philippines



PROTECTED AREAS MAP
Philippines

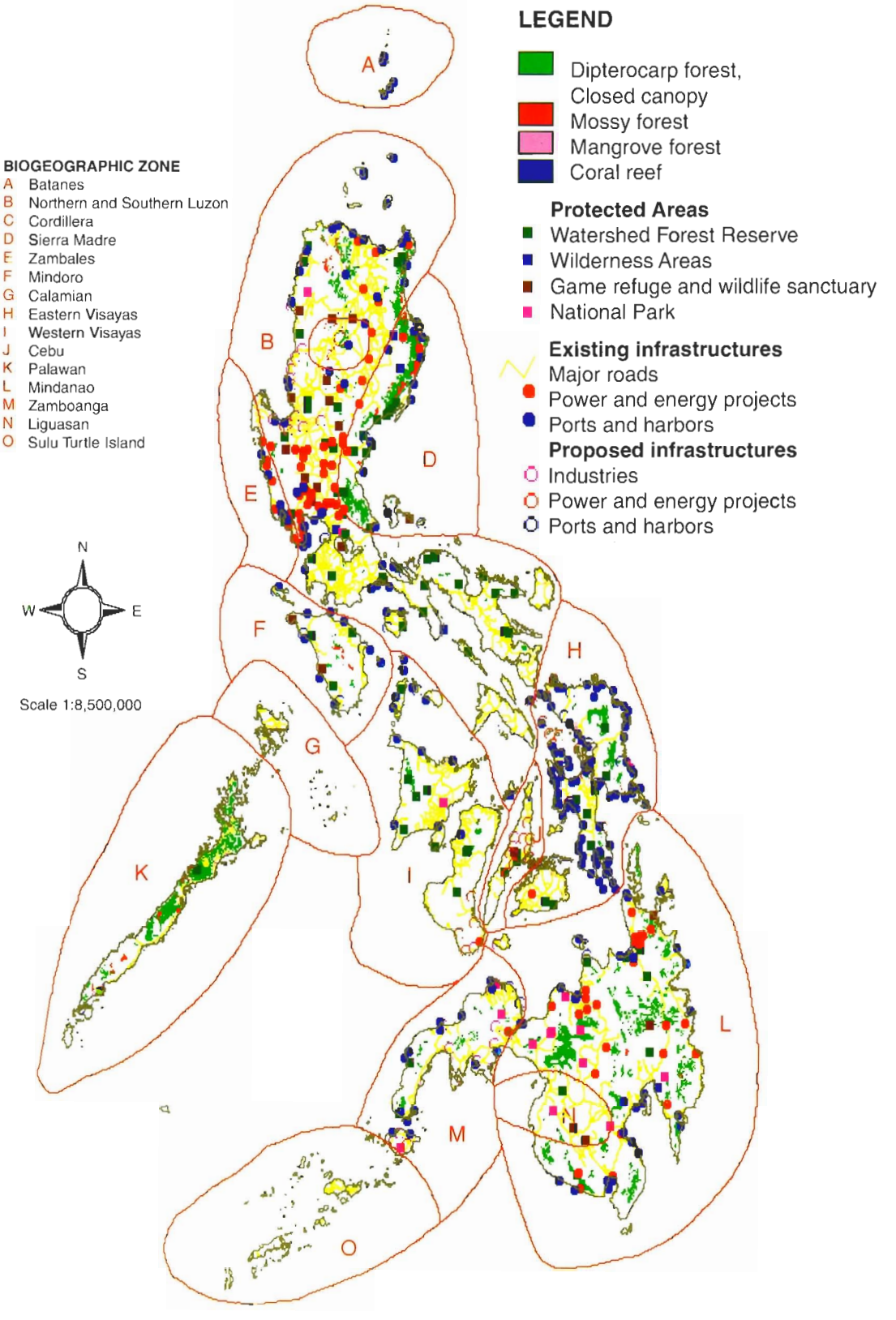


BIODIVERSITY-RICH AREAS
Philippines



THREATENED AREAS MAP OF BIODIVERSITY-RICH AREAS

Philippines



Philippine Biodiversity Assessment:

CURRENT STATUS

1.0 INTRODUCTION

A comprehensive assessment was undertaken on the current status of the country's biodiversity and bioresources in the five most significant "biodiversity sectors," namely: (a) forest ecosystem, (b) wetland ecosystem, (c) marine ecosystem, (d) agro-ecosystem, and (e) protected areas.

1.1 The Concept of Biological Diversity

This Philippine Biodiversity Country Study (PBCS) follows, as those of many countries in the world, the concepts of biological diversity and biological resources put forth in various publications or sources of information on biological diversity, e.g., McNeely et al. (1990), thus:

1.1.1 Biological Diversity

Biological diversity (also biodiversity) refers to the variety and variability among living organisms (monerans, protistas, fungi, plants, and animals) and the ecological complexes in which said organisms occur. Biodiversity is usually considered at three levels, namely, (a) genetic diversity, (b) species diversity and (c) ecosystem diversity.

(a) Genetic diversity is the sum total of genetic information, contained in the genes of individual organisms that inhabit the earth. Each organism is indeed a repository of immense genetic information which can be as much as 1,000 genes in single-celled organisms to more than 400,000 in flower-bearing plants and animals.

(b) Species diversity is the variety of living organisms on earth which is estimated to be between five and fifty million or more, although only about 1.75 million or 13 percent of the total number of species on earth have been described. A group of organisms genetically so similar that they interbreed and produce fertile offspring is called a species. Members of a species are usually recognizably different in appearance, allowing us to distinguish one from another, but sometimes the differences are subtle.

(c) Ecosystem diversity relates to the variety of habitats, biotic communities, and ecological processes in the biosphere as well as the tremendous diversity within ecosystems in terms of habitat differences and the variety of ecological processes. Ecosystems cycle nutrients from production to consumption to decomposition, water, oxygen, methane, carbon dioxide, and other chemicals like sulphur, nitrogen, and carbon, thereby affecting climate and weather. Two different phenomena are frequently referred to under the term ecosystem diversity: (i) the variety of species within different ecosystems: the more diverse ecosystems contain more species and (ii) the variety of ecosystems found within a certain biogeographical or political boundary.

1.1.2 Biological Resources

Biological resources (also bioresources) refer to living natural resources, including microorganisms, plants, and animals, plus the environmental resources to which the species contribute. Indeed, bioresources are the principal target of anthropogenic activities aimed at conserving biodiversity. Bioresources have two important features, a combination of which distinguishes them from non-living resources: (a) they are renewable if conserved, and (b) they are destructible if not conserved.

Conservation, thus, is key to the management of anthropogenic use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. The concept of conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment.

1.2 Measurement of Biological Diversity

Biodiversity has reference to the wealth of life forms found on earth. As stated earlier, these include the millions of different organisms, the genes they contain, as well as the complex ecosystems they constitute with their physical environment. One measure of biodiversity would be the number of species. Be that as it may, life on earth contains much greater variety than can be measured by species alone. Each species has its own variety, e.g. different races, strains, or breeds, and physical and biochemical differences among individuals. The different species interact to form communities and these in turn interact with the physical environment to comprise ecosystems. A number of species can survive in only one particular ecosystem, so that discourses involving biodiversity usually recognize the concept at three distinct levels as indicated above, thus: (a) genetic diversity, (b) species diversity, and (c) ecosystem diversity.

The extent of genetic diversity is difficult to quantify and will not be touched in this study. The science of examining gene sequences has been born and much work now is on-going in this respect. Genetic variation within a given species can be detected by physical characteristics or biochemical tests, one of the newest techniques being the polymerase chain reaction which enables one to detect differences in selected DNA sequences.

1.3 Biogeographic Profile

1.3.1 Geography

Geographically, the Philippines is part of Southeast Asia. It is situated between the equator and the Tropic of Cancer. Specifically, it lies between 4°23' and 21°25' north latitude and between 116°00' and 127°00' east longitude. It is bounded (a) on the north by the Bashi Channel, (b) on the east by the Pacific Ocean, (c) on the south by the Celebes Sea and (d) on the west by the China Sea.

The Philippines has a total land area of 299,404 sq km (115,600 sq. mi). Its fragmented layout gives it an exceptionally long total coastline of about 18,000 kilometers, which is longer than the US coastline. The islands stretch nearly 1,850 km in a narrow north-south configuration. Sixty kilometers off its southeast shores lies the Philippine Trench or Mindanao Deep which is 10,057 meters below sea level, the world's second deepest spot.

The Philippines is composed of 7,107 islands and islets; some 4,000 are named and 1,000 are inhabited. Its territorial waters cover 1,968,700 sq km. It is the world's second largest archipelago next to Indonesia with 17,000 islands, but is more compact.

The Philippines is composed of three main island groups: (a) Luzon, including Mindoro and Palawan Islands, (b) the Visayan Islands, and (c) Mindanao and the Sulu Group. Luzon and Mindanao are the largest islands, their combined area comprising about 70% of the total land area of the country. The 20 largest islands together with their areas (in sq km) are: Luzon (105,708), Mindanao (95,587), Samar (13,271), Negros (12,699), Palawan 11,655), Panay (11,520), Mindoro (9,826), Leyte (7,249), Cebu (4,390), Bohol (3,975), Masbate (3,250), Catanduanes (1,461), Basilan (1,248), Busuanga (971), Marinduque (899), Jolo (837), Dinagat (777), Tablas (666), Polilio (653), and Guimaras (580). The combined area of these 20 islands comprises about 96% of the total land area of the country. The larger islands have rugged mountainous interiors, mostly ranges running north to south. The highest summit is Mount Apo (2,954 meters) on Mindanao. Numerous peaks emerge above hills and valleys which, in turn rise from the narrow coastal plains, broader interior plains, and major valleys. In certain places, especially on the Pacific shores, the mountains drop steeply to the sea. Many islands have extensive offshore coral reefs. The Philippines lies on the volatile Pacific Ring of Fire and most of the highest mountains are volcanic in origin. Strong earthquakes occur randomly. Various stages of vulcanism are evident, from old volcanic stocks to extinct, dormant, and active ones. The most recent one that erupted is Mount Pinatubo in Central Luzon in 1991.

1.3.2 Climate

The Philippines has a warm and humid climate all year round. Prevailing winds govern the seasons. The southwest monsoon causes the rainy season, from June to October, while the northeast monsoon brings the warm dry season from November to February. The easterly North Pacific tradewinds induce hot dry weather from March to May. The climate varies somewhat by region. General day-time temperatures range from 30-36°C and night time temperatures from 21-24°C. Relative humidity varies from 71% in March to 85% in September.

On the average, nineteen major typhoons visit the Philippines every year causing great damage to life and property.

The Philippines has four climate types based on variations in rainfall distribution (Salita, 1978). These are:

(a) Type I. Two pronounced wet and dry seasons; wet during the months June to November and dry from December to May. This type of climate is found in the western part of Luzon, Mindoro, Palawan, Panay, and Negros. The controlling factor is topography. These regions are shielded from the northeast monsoon and even in good part from the tradewinds by high mountain ranges but are open to the southwest monsoon and cyclonic storms.

(b) Type II. No dry season with a very pronounced maximum rain period in December, January and February. Catanduanes, Sorsogon, eastern part of Albay, Camarines Norte, Camarines Sur, Eastern Quezon, Samar, Leyte, and eastern Mindanao have this type. These regions are along or very near the eastern coast and are not

sheltered from the northeasterly and tradewinds nor from the cyclonic storms.

(c) Type III. This is an intermediate type with no pronounced maximum rain period and a short dry season lasting from one to three months only. Areas under this type are the western parts of the Cagayan Valley, the eastern part of the Cordillera Region, southern Quezon, Masbate, Romblon, northeastern Panay, eastern Negros, central and southern Cebu, eastern Palawan, and northern Mindanao. These localities are only partly sheltered from the northeasterly and tradewinds and are open to the southwest monsoon or at least to frequent cyclonic storms.

(d) Type IV. Uniformly distributed rainfall. The regions affected by this type are the Batanes, northeastern Luzon, southwestern part of Camarines Norte, western parts of Camarines Sur, and Albay, Bondoc Peninsula, eastern Mindoro, Marinduque, western Leyte, northern Cebu, Bohol, and most of central, eastern and southern Mindanao. These regions are so situated that they are open to the northeasterly and tradewinds as well as the southwest monsoon and the cyclonic storms.

1.3.3 Centers of Diversity

The Philippines is characterized by (a) varying exposures to the shifting winds and typhoons, (b) great heights of numerous mountains, (c) peculiar distribution of rainfall, which in reality is conditioned by (a) and (b) above, and to be added here is (d) the Kuro-Siwo or Japanese current, which are warm equatorial waters flowing northward along the eastern coast of the archipelago. Such combination of factors have doubtless been responsible for the existence of the complex mix of ecosystem and habitat types that characterizes the Philippine landscape and waterscape and which include various terrestrial and aquatic types (Table 1).

Centers of Plant Diversity

To be earmarked as a center of plant diversity, a site (geographic unit) or a vegetation (community or ecosystem) type must have one of the following characteristics (Threatened Plants Unit, Kew, England: see Cox, 1988):

(a) The site or vegetation type should be species-rich even though the total number of species present therein may not be accurately known.

Table 1 *Ecosystem (habitat) diversity in the Philippines*

ECOSYSTEM DIVERSITY

A. Terrestrial Ecosystems
  1. Natural Ecosystems
    - Lowland evergreen rain forest
    - Lower montane forest
    - Upper montane forest
    - Sub-alpine forest
    - Pine forest
    - Forest over ultrabasic soils
    - Semi-deciduous forest*
    - Beach forest
    - Grassland
      - Upland
      - Lowland
  2. Man-made Ecosystems
    - Forest plantations
    - Agroforest areas
    - Protection forests
    - Agroecosystems
      - Low agrobiodiversity areas
      - Medium agrobiodiversity areas
      - High agrobiodiversity areas

B. Aquatic Ecosystems
  1. Natural Ecosystems
    - Freshwater Ecosystems (inland wetlands)
      - Lakes, ponds (lacustrine)
      - Rivers, streams (riverine)
      - Freshwater marshes (palustrine)
      - Peat swamps**
    - Brackishwater Ecosystems (estuarine) (coastal wetlands)
      - Mangrove swamps
      - Nipa swamps
    - Saltwater (marine) Ecosystems (coastal wetlands)
      - Mudflats (soft bottom ecosystem)
      - Seagrass beds
      - Coral reefs
  2. Man-made Ecosystems
    - Aquaculture ponds (coastal wetlands)
    - Reservoirs (inland wetlands)

**This corresponds to the tropical moist deciduous forest of Whitmore (1984).*
***These may be climax freshwater swamps (sensu Whitmore, 1984).*

(b) The site or vegetation type is known to harbor a large number of endemic species.

(c) The site may harbor a diverse range of habitat or ecosystem types, e.g., terrestrial, aquatic, etc.

(d) The site may have a significant number of species adapted to special edaphic conditions, like ultrabasic formation, limestone formation, etc.

Table 2 *Centers of plant diverstiy in the Philippines*

CENTERS OF PLANT DIVERSITY	ISLAND GROUP	BIOGEOGRAPHIC ZONE
1 Mount Iraya + Sabtang Island	Batanes	Batanes
2 Sierra Madre Mountains (Isabela)	Luzon	Sierra Madre
3 Mount Pulog (Benguet)	Luzon	Cordillera
4 Mount Arayat (Pampanga)	Luzon	Northern-Southern Luzon
5 Mount Makiling (Laguna)	Luzon	Northern-Southern Luzon
6 Lobo (Batangas)	Luzon	Northern-Southern Luzon
7 Mount Isarog (Camarines Sur)	Luzon	Northern-Southern Luzon
8 Mount Halcon (Mindoro)	Mindoro	Mindoro
9 Coron Island (Calamianes Group)	Palawan	Calamian
10 Palawan Mainland	Palawan	Palawan
11 Southern Samar	Visayas	East Visayas
12 Sibuyan Island (Romblon Group)	Visayas	West Visayas
13 Mount Canlaon (Negros Oriental)	Visayas	West Visayas
14 Mount Talinis + Lake Balinsasayao	Visayas	West Visayas
15 Mount Baloy (Central Panay)	Visayas	West Visayas
16 Mount Kitanglad (Bukidnon)	Mindanao	Mindanao
17 Agusan Marsh (Agusan del Sur)	Mindanao	Mindanao
18 Mount Apo (Davao City, Davao del Sur + Northern Cotabato)	Mindanao	Mindanao

In consideration of the foregoing criteria, 18 sites have been identified by the Threatened Plants Unit at Kew, England (see Cox, 1988) or recommended by Madulid (1993) as centers of plant diversity in the Philippines. These are listed in Table 2 together with their respective locations (Island Group, Biogeographic Zone). As may be gleaned from the table, these centers of plant diversity are located in six islands or island groups and in 10 biogeographic zones.

Table 3 summarizes the salient physical and biological features of the plant biodiversity centers. As may be discerned from the table, nearly all of the biodiversity centers represent various types of protected areas. Also, all are under some kind of threat in varying degrees. Each harbors species of great economic importance.

Outstanding examples of generic and species endemism have been specifically reported in some of the foregoing centers of plant diversity by Merrill (1922-1926) and recently by Madulid (1991).

Many of these endemic genera are monotypic, i.e., there is only one species. Some of the endemic forms are of unexampled economic worth, e.g., *Phoenix hanceana* var *philippinensis, Vanda sanderiana.* The conservation status of most of them is insufficiently known.

Many of the identified or suggested centers of plant diversity in the Philippines remain botanically undercollected or unexplored to this day, most especially the following:

a) eastern side of the Sierra Madre Mountains
b) Mount Guiting-Guiting in Sibuyan Island, Romblon
c) southern Palawan
d) limestone forest areas of Samar and Leyte
e) interior mountains of Mindanao (mountain divide between Bukidnon and Agusan Provinces)

As emphasized by Tan and Rojo (1988), among others, survey of these areas are expected to yield new and endemic taxa.

Centers of Animal Diversity

Various studies have divided the Philippines into a number of faunal provinces depending on the faunal group studied. Faunal groups include land mollusks (Cooke, 1892 cited in Dickerson, 1928), insects (Schultze, in Dickerson, 1928), freshwater fishes (Herre, in Dickerson, 1928), amphibians and reptiles (Taylor, 1922; Taylor, in Dickerson, 1928; Brown and Alcala, 1978, 1980), birds (Dickerson, 1928; McGregor, in Dickerson, 1928), mammals (Taylor, in Dickerson, 1928; Heaney, 1986, 1993), among others.

Table 3 *Salient physical and biological features of plant biodiversity centers (after Madulid, 1993b)*

SITE	SIZE	ALT.	FLORA	ECONOMIC PLANTS	VEGETATION	PROTECTED AREAS	THREATS	ASSESSMENT
Palawan	1,489,630 has.	2095m Mt. Mantalingahan	2000 + spp. flowering plants	Timber trees, rattan, palms, almaciga, orchids, nipa mangrove,	Lowland evergreen rainforest, lowland semi-deciduous forest, forest over limestone rock, forest over ultrabasic rock, mangrove forest, beach forest	MAB Reserve; NP (St. Paul Bay); Game Refuge & Bird Sanctuary; Mangrove Swamp Forest Reserve	Illegal logging, mining, Kaingin, tourism	Park under threat
Palanan Wilderness Area (Sierra Madre Mts.)	216,754.42 has.	1672m Mt. Cresta		Timber trees, rattans	Lowland evergreen rainforest, lower montane rainforest, forest over limestone, forest over ultrabasic soil, mangrove forest, beach forest	National Park, Wilderness Area	Illegal logging, kaingin	Greater part of forest still preserved
Coron Island	7,000 has.	?		Timber trees, fruit trees, orchids, mangrove, palm	Forest over limestone rock, beach forest, mangrove forest		Conversion of forest into cultivated lands, infrastructure development for tourism	Majority of the island in pristine state
Mt. Kitanglad	31,359.93 has.	2378.66m		Gymnosperm species, tree ferns	Grassland, shrubland, lowland residual evergreen forest, midmontane forest, upper montane forest	Natural Park	Natural fire, tourism, game-hunting	Park under threat
Mt. Halcon		2586m			Lowland evergreen rainforest, montane forest, grassland	Heritage Natural Park	Rattan gathering	
Mt. Apo	76,900 has.	2953m		Orchids, pitcher plants, almaciga Philippine oak (*Lithocarpus*), timber trees	Lowland evergreen rainforest, residual forest, montane forest, brushland, open land and cultivated land	Natural Park	Conversion to other land uses, kaingin, logging, tourism, influx of gold panners and treasure hunters, geothermal plant	Park under threat
Batanes (Mt. Iraya and Sabtang Island)	20,928 has.	1908m Mount Iraya		Philippine phoenix, ebony tree, *Podocarpus sp.*, orchids	Grassland, lowland evergreen rainforest, midmontane forest, summit grassland, beach forest and second growth forest	Protected Seascape and Landscape; Provincial Watershed Reserve	Typhoons and winds, overcollection of valuable species like *Arius* and *Phoenix hanceana* var *philippinensis*	Mt. Iraya is protected as watershed
Mt. Canlaon		2435m		Timber trees, orchids	Open grassland, cultivated lands, forest	Natural Park	Encroachment of squatters, over-collections of orchids	Park under threat
Mt. Makiling	4,244.37 has.	1030-1250m	2038 spp. of flowering plants	Timber trees. ornamental plants medicinal plants, oak tree	Lowland evergreen rainforest, mid-montane forest, montane forest	National forest Reserve, Mt. Makiling Botanic Garden	Encroachment, illegal logging, conversion to other land uses, geothermal plant	Reserve under threat
Mt. Pulog	11,500 has.	2922m		Pine tree and oak trees	Lowland grassland pine forest, montane forest, summit grassland	National Park	Natural and man-made fires, conversion into vegetable and cut flower gardens	Park under threat
Sibuyan Island Romblon	448 sq km	2052m Mt. Guiting-Guiting		Timber trees, palms, pandans	Lowland primary forest, montane forest, summit grassland, heath forest, mangroves, beach vegetation	Provincial Watershed, Proposed National Park	Carabao logging, rattan gathering slash-and-burn agriculture	Mt. Guiting-Guiting is under threat
Mt. Arayat Pampanga	102.9 sq km	1024.3M		Ornamental plants (i.e. *Cycas chamberlainii*), timber trees	Secondary growth semi-deciduous forest (teak forest)	National Park	Firewood gathering, conversion into agricultural plots, collection of floral species by lowlanders	Park under threat
Lobo, Batangas		45m		Philippine teak	Secondary growth semi-deciduous forest (teak forest)	(Not a protected area)	Conversion into coconut plantations firewood gathering, encroachment	Site under threat
OTHER SITES: Mt. Isarog (Camarines Sur)	10,112 has.	1966m		almaciga, rattans, timber trees, bamboo	Lowland dipterocarp forest, montane forest	National Park	Illegal logging	Park under threat
Southern Samar	13,000 sq km	up to 1000m		Timber trees, rattan, wild palms, pandans	Forest over ultrabasic rock, mangrove, forest over limestone, lowland dipterocarp forest	Mt. Sohoton National Park	Illegal logging, kaingin	Park under threat
Central Panay (Mt. Baloy)	11,513 sq km	2049m		Timber trees, rattans	Lowland evergreen forest, montane forest		Illegal logging, kaingin	Park under threat
Agusan Marsh	262.5 sq. km			Sago palm, *Terminalia sp.*	Lowland peat-swamp forest, sago palm grove, mangrove, *Terminalia* forest	Proposed National Park	High population density , kaingin, charcoal making, colonization	Marshland is under threat
Mt. Talinis\ Lake Balinsasayao Negros Oriental				Timber trees, rattans, orchids	Lowland dipterocarp forest, low-montane forest, marsh/lake vegetation	Provincial Watershed	Kaingin, conversion to vegetable garden	Park under threat

Most of these studies describe faunal provinces that coincide with Heaney's 1986 classification, which was based on the water level of less than 120 m than current depths during the Pleistocene (between 2.5 million years before present to recent). Thus, six major Pleistocene islands emerged, namely: the Greater Luzon, Greater Mindanao, Greater Palawan, Greater Negros-Panay, Greater Sulu, and Mindoro. These island groups and their subprovinces contain unique faunal assemblages, most of which are single island endemics, i.e., they cannot be found in other islands of the Philippines nor anywhere else. Thus, these island groups are centers of animal diversity.

Birdlife International, formerly the International Council for Bird Preservation, has divided the Philippines into nine endemic bird areas or EBA. An endemic bird area is an area where two or more restricted range species of landbirds are confined while a restricted landbird is defined as a species with a breeding range of less than 50,000 km^2. The EBAs in the Philippines are as follows: (a) the Luzon mountains, (b) the Luzon lowlands and foothills, (c) Mindoro, (d) Negros and Panay, (e) Cebu, (f) Palawan, (g) Samar, Leyte, Bohol, and Mindanao lowlands, (h) Mindanao mountains, and (i) Sulu Archipelago. These EBAs easily fit into Heaney's Pleistocene island groupings (Table 4).

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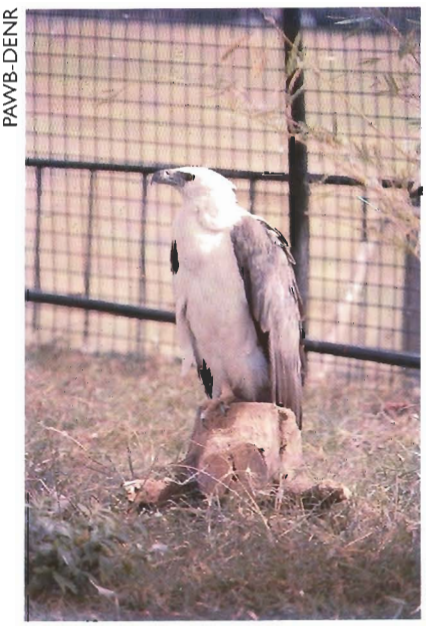

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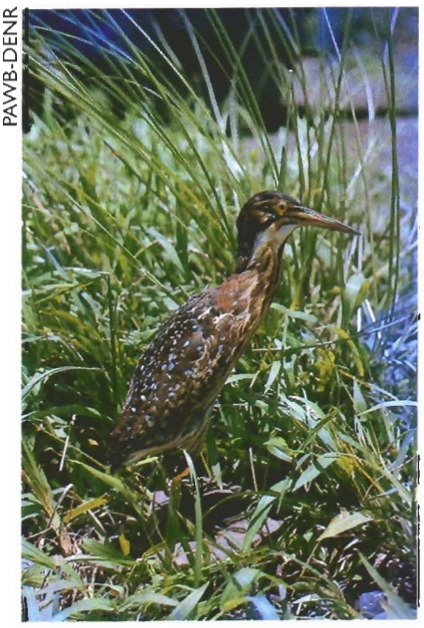

Table 4 Overlaps of the faunal regions devised for terrestrial vertebrates

MAMMALS (Heaney, 1986)	BIRDS (Bibby et al., 1992)	AMPHIBIANS AND REPTILES (Taylor in Dickerson, 1928)
Greater Luzon	(a) Luzon mountains and (b) Luzon lowlands and foothills,	Luzon, Mindoro, Panay, Negros, Marinduque, Masbate, Romblon,
Greater Mindanao	(g) Samar, Leyte, Bohol, and Mindanao lowlands, (h) Mindanao mountains,	Eastern Mindanao, Leyte, Samar, Bohol
Greater Palawan	(f) Palawan	Palawan
Greater Negros-Panay	(d) Negros and Panay, (e) Cebu	(included in Greater Luzon)
Greater Sulu	(i) Sulu Archipelago	Sulu Archipelago and Zamboanga
Mindoro	(c) Mindoro	(included in Greater Luzon)

Some small islands such as Sibuyan, Camiguin, and the Batanes-Babuyan group of islands harbor, or are suspected to harbor, unique endemic species. Special attention needs to be directed to these for conservation purposes through the conduct of field inventory on their biodiversity. To illustrate, a recent biodiversity inventory of Camiguin Island by Heaney's group has resulted in the addition of at least ten species to the list of mammals found in the island since the 1960s, three to four species of which are described for the first time. Heaney's group concluded that Camiguin Island, which is about 265 km^2, is now the smallest island in the Philippines to have unique species of mammals. It could also possibly be the world's smallest island to contain three unique species of mammals. The possibility that other such discoveries could be made once field inventories of the other least studied islands commence is so strong that this should be one of the priority areas for research in any biodiversity conservation program.

Centers of Marine Diversity

The Philippines can be divided into two distinct zones based on the distribution of the marine taxa, namely: a high diversity South China Sea Zone in the west (BZ W) and a lower diversity Pacific Ocean Zone in the east (BZ E). Furthermore, the Philippines can also be partitioned into five or six subregions based on the distribution of coral life form benthos and their associated reef fishes (Alino et al., 1993). These subdivisions coincide well with the reef groupings based on the bathymetric classification at 20-m isobaths proposed by the National Marine Science Institute, formerly UP Marine Science Center. Specifically, areas of relatively high marine biodiversity include: BZ 12 (Central Visayas), BZ 2 (North and Central Luzon), BZ 6 (Southern Luzon), and BZ 7 (Mindoro). Unfortunately, areas of high endemism cannot be delineated as these were not noted down in the records available.

The observed patterns of distribution and recruitment of marine organisms in the Philippines point to the importance of the northern part of the country in the South China Sea and the West Pacific regions. This is demonstrated by the straddling stocks of migratory species such as marine mammals, marine turtles, and fish species like tuna, mackerel, and sardines. It is postulated that the reef areas in the Spratly Islands may play a crucial role in being the source of larvae for the rest of the South China Sea area. On the other hand, larvae coming from Palawan could be carried down to Borneo or Malaysia. Hence, the Philippine reefs could be a rich source of genes and biodiversity in various parts of Southeast Asia. The distribution of the world's macrobenthic seaweeds may be due to the important biogeological role of evolution. However, other factors which exert immediate short term influence may be more operative in the current distribution of macrobenthic seaweeds in the Philippines (Fortes, 1991). Among these factors, tidal patterns, and the dominant airstreams and their effects on the current systems and rainfall distribution are significant factors in dividing the

country into two marine biodiversity zones. These divisions coincide well with the types of tides dominating the western and eastern sections of the country. At the west coast where the influence of the South China Sea is greater, mixed diurnal tides predominate. On the other hand, semi-diurnal tides predominate on the eastern side of the Philippines where the effect of the Pacific Ocean is greater. Along the Pacific coasts, the macrobenthic vegetation that make up the intertidal region is usually broken up into a series of zones where limits are correlated with the levels of critical tide factors (Doty, 1946). Variations of the tides provide sudden two- or three-fold increase in the exposure to changes in the environment. These changes are often sufficient to account for the abrupt restrictions in the vertical distribution and presence of species.

Horizontal atmospheric pressure variations are the primary driving force of ocean circulation. The principal airstreams that affect the Philippines are the northeast monsoon, the southwest monsoon, and the north Pacific trades. The current systems generated, together with the temperature and salinity features of the waters they carry, appear to exert significant positional effect on the flora of the eastern section of the country (BZ E). It should be noted that the eastern South China Sea has a slightly lower surface salinity than the Western Pacific waters. This is due to the admixture of river water in the former.

On the western side of the Philippines, the monsoons have greater effects on the water circulation compared to the eastern section. During the northeast monsoon, a cyclonic pattern of surface water movement develops a southerly flow along the western boundary and a northwesterly flow along the western coasts of Palawan and Luzon. The inflow of oceanic water into the South China Sea is through the strait between Luzon and Taiwan, while the outflow is largely through the Flores Sea and Celebes Sea. During the southwest monsoon, water movement in the South China Sea is generally northeasterly flowing out through the Strait of Taiwan and Luzon Strait. During both monsoons, however, water enters the South China Sea through the Visayan Islands from the western Pacific. This subsidiary flow may be the causal factor responsible for the closer affinity of the seaweed flora of the western Visayas, e.g. Panay and Negros Occidental, to that of the BZ E.

The division of the country into two marine biogeographic zones appears correlated with the prevailing types of climate which are dictated largely by rainfall. The western section of the country is generally characterized by two pronounced seasons: dry in winter and spring, wet in summer and autumn. Maximum rainy period is from June to September during the prevalence of the southwest monsoon. The eastern section of the country, on the other hand, is generally characterized by rainfall which is more or less evenly distributed throughout the year but with a pronounced dry season.

1.3.4 Life Forms and Endemism

The foregoing spectra of ecological niches or habitat types support innumerable lifeforms: monerans, protists, fungi, plants, and animals. The compilation from existing literature by the study allows for the interim conclusion that, indeed, the Philippines is characterized by high species diversity, as may be gleaned from Table 5.

The information that has so far become available to the study shows the following: (a) certain groups such as the ferns, certain families of flowering plants, reptiles, birds, and mammals show exceptionally high species endemism as may be gleaned from Tables 6, 7, 8 and 9. The same groups harbor quite a number of endemic genera which are monotypic.

1.4 Land Use and Biodiversity

Land development as a cause of massive biodiversity loss is a universally accepted phenomenon. It is a yardstick of the level of biodiversity disturbance. Diminution in the size of species-rich habitats, to a large extent, is caused by their conversion into agricultural and settlement areas. Changes in the use of the landscape become more intense as population exponentially grows. In the Philippines, widescale loss of biodiversity is attributed to clearing of natural vegetation and reclamation of wetlands to give way to agriculture, settlements, and industry. Threatening seriously ecosystem, species, and genetic diversity is the way land use changed over the last four decades, coupled with commercial extraction of forest and marine resources. Anticipating the way land conversion will affect the diversity of biological resources in the future is important in the formulation of policies and strategies to conserve these precious and vulnerable natural treasures. An assessment of the current and future land use changes and their effects on biodiversity loss follows.

Table 5 *Estimated number of species in the various groups of organisms (monera, protista + viruses, fungi + lichens, plantae and animala) in the Philippines*

MAJOR GROUPS	REPRESENTATIVES	TOTAL NUMBER OF SPECIES	NUMBER OF ENDEMIC SPECIES	% SPECIES ENDEMISM	SOURCES OF INFORMATION
I. Monera	Eubacteria, archaebacteria	–			
Monerans					
II. Prostista	Euglenids	–			Zafaralla (1995)
Protistas +	Chrysophytes	483			Zafaralla (1995)
Viruses	Dinoflagellates	7			Enriquez (1992)
	Protozoans	396+			Zafaralla (1995)
	Blue green algae	315			
	DNA + RNA-viruses	–			
	subtotal	1,201 +			
III. Fungi					
Fungi +	Egg fungi, Zygospore- forming fungi, sac fung, club fungi, imperfect fungi,	2,000+			Dogma (1986)
Lichens	Lichens (sac fungi + cyanobacterium or blue green algae)	789			Gruezo (1979)
	subtotal	2789+			
Algae	Green algae, brown algae, red algae				Trono (1988)
	subtotal	865+			
IV. Plantae					
Bryophytes	Liverworts + Hornworts	518	90	12	Tan (1981), Tan & Engel (1986), Iwatsuki & Tan (1979), Tan and Iwatsuki (1983, 1991)
	Mosses	753			
	subtotal	1,271			
Psilopsids	Whiskferns	3			Zamora (1970, 1976) Zamora (1971, 1988, 1995) Copeland (1958,1960), Price (1972), Zamora + Co. (1986)
Lycopsids	Clubmosses, quillworts	77+	38	49	
Sphenopsids	Horsetails	1			
Pteropsids	Ferns	950+	296	31	
	subtotal	1,031			
Cycads	Pitogo Oliva	4	2	50	Zamora + Co (1986)
Conifers	Pine, etc	24	3	13	de Laubenfels (1978), Zamora + Co (1986)
Taxads	Taxus	1			Zamora + Co (1986)
Gnetophytes	Gnetum	4			Markgraf (1954, 1972)
	subtotal	33			
Angiosperms	Monocots, dicots	8,120+	5,800	71	Zamora + Co (1986) Merrill (1923–1926)
	subtotal	8,120+			

Cont'n. ***Table 5***

MAJOR GROUPS	REPRESENTATIVES	TOTAL NUMBER OF SPECIES	NUMBER OF ENDEMIC SPECIES	% SPECIES ENDEMISM	SOURCES OF INFORMATION
V. Animalia	Sponges	100–200			
Poriferans	subtotal	100–200			Gomez E in Sohmer (1989)
Cnidarians	Hydras, sea anemones, jelly fishes, corals	400+			
	subtotal	400 +			Nemenzo (1981, 1986)
Platyhelminths	Flatworms, flukes and tapeworms	–			
Nematodes	Roundworms				
Annelids	Earthworms, Leeches, polychaetes	700+			Natividad and Palpalatok (1986)
	subtotal	700+			
Arthropods	Crustaceans	2000+			Gonzales P in Sohmer (1989)
	subtotal	2000+			
	Spiders	200+			Barrion (1995)
	Centipedes	44+			Wang (1950)
	Millipedes and	54			Wang (1950)
	Insects	20,000			Baltazar (1990, 1992)
	subtotal	23,000+			
Molluscs	Snails, slugs, clams, squids, octopus	8000+			Pagulayan (1995)
	subtotal	8000+			
Echinoderms	Sea stars, brittle star sea urchins, sea lilies, sea cucumbers	641			Garcia R (1992) Fortes (1995)
	subtotal	641			
Chordates	Tunicates	–			
	Lancelets	–			
	Fishes	2,175			Herre (1953)
	Amphibians	95	51	54	Espiritu-Afuang (1995)
	Reptiles:	251	158		Gonzalez (1995)
	snakes	112	61		
	lizards	127	95		
	crocodiles	2	1		
	turtles	23	1		
	Birds	558	171	31	Dickinson, Kennedy + Parkes (1991)
	Mammals	200+	110	51	Heaney et al, 1987, personal communication
	sub-total	3,326+			
TOTAL		**39,177 +**			

Table 6 *Species diversity and endemism in selected representative of flowering plants (Angiosperms: monocotyledons + dicotyledons)*

PLANT GROUPS	TOTAL NUMBER OF SPECIES	NUMBER OF ENDEMIC SPECIES	PER CENT SPECIES ENDEMISM	SOURCES OF INFORMATION
Bamboos (Poaceae)	45	7	15	Uichimura (1977)
Palms (include Rattans) (Arecaceae)	120	84	70	de Guzman and Fernando (1986)
Dipterocarps (Dipterocarpaceae)	39	22	56	Rojo (1979)
Orchids (Orchidaceae)	800	750	94	Davis and Steiner (1952)

Table 7 *Endemic genera of vascular plants (psilopsids, lycopsids, sphenopsids, ferns, gymnosperms + angiosperms or flowering plants) of the Philippines: families, distribution, habitat, and conservation status*

GENERA + (SPECIES)	FAMILY	DISTRIBUTION	HABITAT	CONSERVATION STATUS
FERNS				
Tectaridium (2)	Aspidianceae	Luzon, Leyte	Forest	Rare
Podosorus (1)	Polypodiaceae	Luzon	Forest	Rare
Nanothelypteris (4)	Thelypteridaceae	Luzon, Visayas	Forest	Insufficiently known
FLOWERING PLANTS				
Clemensia (1)	Asclepiadaceae	Luzon, Catanduanes, Leyte, *Mindanao*	Forest	Insufficiently known
Dolichestegia (1)	Asclepiadaceae	Bohol	Near seashore	Rare
Quisumbingia (1)	Asclepiadaceae	Luzon	Near seashore	Insufficiently known
Fenixia (1)	Asteraaceae	Mindanao	Damp rocky slopes	Rare
Reutealis (1)	Euphorbiaceae	Luzon, Negros, Mindanao	Forest	Insufficiently known
Luzonia (1)	Leguminosae	Luzon, Leyte	Forest	Rare
Cyne (2)	Loranthaceae	Samar, Mindanao	Forest	Rare
Thaumasianthes (2)	Loranthaceae	Samar	Forest	Rare
Astrocalyx (1)	Melastomaceae	Luzon, Catanduanes, Leyte	Forest	Insufficiently known
Carionia (1)	Melastomaceae	Luzon	Forest	Insufficiently known
Amesiella (1)	Orchidaceae	Luzon, Mindoro	Forest	Insufficiently known
Macropondanthus (1)	Orchidaceae	Luzon, Mindoro	Forest	Insufficiently known
Phragmorchis (1)	Orchidaceae	Luzon	Forest	Insufficiently known
Antherostele (4)	Rubiaceae	Luzon, Leyte, Samar, Mindoro	Forest	Insufficiently known
Greeniopsis (6)	Rubiaceae	Luzon, Mindoro, Samar, Leyte	Forest	Insufficiently known
Sulitia (1)	Rubiaceae	Mindanao	Forest	Insufficiently known
Villaria (4)	Rubiaceae	Luzon, Catanduanes, Samar Mindanao	Near seashore	Insufficiently known
Swingglea (1)	Rutaceae	Luzon, Palawan	Forest	Rare
Gleocarpos (2)	Sapindaceae	Luzon	Forest	Insufficiently known
Gongrospermum (1)	Sapindaceae	Luzon	Forest	Insufficiently known
Astrothalamus (1)	Urtacaceae	Mindanao	Thickets	Insufficiently known
Leptosolena (1)	Zingiberaceae	Luzon	Thickets	Insufficiently known
Vanoverberghia (1)	Zingiberaceae	Luzon, Visayas	Ravines	Insufficiently known
26 (45)	**15**			

Table 8 *Endemic genera of birds in the Philippines (sensu Dickinson, Kennedy and Parkes 1991)*

GENERA + (SPECIES)	FAMILY	DISTRIBUTION	HABITAT	CONSERVATION STATUS
Bolbopsittacus (1)	Psittacidae	Luzon, Samar, Leyte, Mindanao	Forest, forest edges, orchard + mangroves	Fairly common
Hypocryptadius (1)	Zosteropidae	Mindanao (Mt. Apo, etc)	Forest, forest edges	Common
Leonardina (1)	Timaliidae	Mindanao (Mt. Apo, Mt. Kitanglad, etc)	Montane forest	Uncommon
Micromacronus (1)	Timaliidae	Leyte, Samar, Mindanao	Forest, forest	Rare
Mimizuku (1)	Strigidae	Mindanao, (Zamboanga, Dinagat, Siargao)	Forest	Uncommon
Phapitreron (3)	Columbidae	Widespread	Primary + secondary forests	Common
Pithecophaga (1)	Accipitridae	Luzon, Samar, Mindanao	Primary forest	Rare + local
Rhabdornis (2)	Rhabdornithidae	Luzon, Catanduanes, Masbate, Samar, Leyte, Bohol, Negros, Panay, etc.	Forest, forest edges, secondary forest	Fairly common
Sarcops (1)	Sturnidae	Mindoro, Marinduque, Samar, Negros, Bohol, etc.	Forest, forest edges, secondary forest, clearings	Common
9 + (12)	**8**			

Table 9 *Endemic genera of mammals in the Philippines*

GENERA + (SPECIES)	FAMILY	DISTRIBUTION	HABITAT	STATUS
Alionycteris (1)	Pteropodidae	Mindanao	Forest	rare
Haplonycteris (2)	Pteropodidae	throughout the Philippines	Forest	vulnerable
Otopteropus (1)	Pteropodidae	Luzon	Forest	indeterminate
Anonymomys (1)	Muridae	Mindoro	Montane forest, 240 masl and above	unknown to uncertain
Apomys (11)	Muridae	Luzon, Mindanao, Mindoro, Sibuyan, Negros	Forest	stable
Archboldomys (1)	Muridae	Luzon	Forest	stable
Batomys (4)	Muridae	Luzon, Mindanao, Dinagat	Forest	unknown to common
Bullimus (2)	Muridae	Luzon & Mindanao	Forest	Common
Carpomys (2)	Muridae	Luzon	2500masl	unknown
Celaenomys (1)	Muridae	Luzon	unknown	unknown & uncertain
Chrotomys (4)	Muridae	Luzon, Mindoro, Sibuyan	Forest	stable to unknown
Crateromys (4)	Muridae	Dinagat, Biliran, Mindoro, Luzon	Forest	unknown
Limnomys (1)	Muridae	Mindanao	Forest	unknown
Palawanomys (1)	Muridae	Palawan	Forest	unknown
Phloeomys (2)	Muridae	Luzon	Forest	unknown & uncertain
Rhynchomys (2)	Muridae	Luzon	800m	uncertain & uncommon
Tarsomys (3)	Muridae	Mindanao & Sibuyan	Forest	unknown to uncertain
Podogymnura (2)	Erinacidae	Dinagat & Mindanao	Forest	vulnerable
Urogale (1)	Tupaiidae	Mindanao	Forest	stable
TOTAL = 19 + (46)				

1.4.1 General Land Use

An aggregated version of DENR's land-use categories (NEDA, 1991) using 1987 SPOT satellite data is provided in Table 10 and corresponding figure. Land intensively cultivated for agricultural crops covers about 9.7 million hectares or 33 percent of the total land area of the country. Forest lands comprise 19 million hectares or 64 percent although only 7.1 million hectares or 37 percent of these have forest cover. A large part of the country's forest lands, about 63 percent, is extensively utilized for agricultural crops. Of the 11,957.6 million hectares of extensively cultivated forest lands, 85 percent are cultivated areas mixed with brushland and grassland, and 15 percent are grassland/open grasslands. From these data and other land use studies, Cabrido and Samar estimated that in 1993, the total area of land utilized for agricultural crops was about 14 million hectares. This includes

Table 10 *General land use, 1987*

LAND USE CATEGORY	AREA ('000 ha.)	PERCENTAGE OF TOTAL AREA
Agriculture	9,728.80	33.0000
Forestry	19,062.60	64.0000
Settlement	131.40	0.0040
Mining and Quarrying	8.70	0.0003
Inland Fisheries	595.70	2.0000
Open Land	11.00	0.0008
TOTAL	**29,538.20**	**100.0000**

Source of basic data: Swedish Space Corporation (1988)

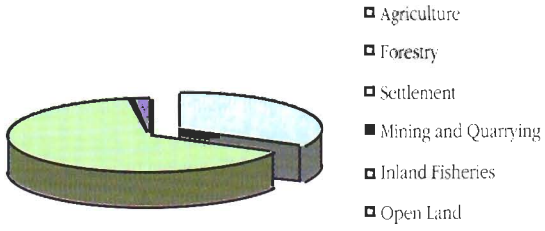

Figure 1 General land use, 1987

intensively cultivated lands (9.7 million ha), and agroforests (4.3 million ha).

Although the above statistics derived from the results of mapping give an estimate of forest land as 19 million hectares, the actual area of land officially classified as forest land is only about 15 million hectares (World Bank, 1989). Forest cover remains in about half of this classified forest land with closed canopy dipterocarp forest comprising 2.4 million ha; open canopy dipterocarp, 4.1 million ha; pine forest, 81,200 ha; mossy forest, 245,500 ha; and mangrove, 149,400 ha. Aggregate areas of settlements were mapped to be about 131,400 hectares (World Bank, 1989) but the actual area zoned for urban use was estimated by Marquez (1990) to comprise roughly about one million hectares. Lands categorized as open land comprising a total area of 11,000 hectares include barren lands (3,300 ha) and eroded lands (700 ha). Land used for mining and quarrying is about 8,700 hectares.

Inland fisheries cover a total land area of 595,700 hectares. This includes fishponds derived from mangrove (195,200 ha), other fishponds (10,100 ha), rivers (81,800 ha), marshy areas (103,200 ha), and lakes (205,400 ha). These land use information served as a baseline in the assessment of ecosystem diversity and mapping of biodiversity-rich areas.

1.4.2 Biogeographic Zones

Fifteen biogeographic zones were delineated based on floristic, faunistic, and geological composition of geographic areas in the country (Map 1). The 15 zones and their corresponding areas are given in Table 11 and Figure 2.

1.4.3 Ecosystem Diversity and Land Use Changes

The rate of change in the size of a given ecosystem provides an indicative measure of how fast ecosystems are lost. Biodiversity-rich ecosystems such as forests and mangroves are steadily dwindling and are being replaced by low biodiversity man-made ecosystems such as agroecosystems and urban ecosystems. There is currently no physical accounting

Table 11 *Areas of each biogeographic zones*

BIOGEOGRAPHIC ZONE	AREA (ha.)
Batanes	19,887
Calamian	164,554
Central Visayas	456,743
Cordillera	621,627
Eastern Visayas	2,156,908
Liguasan	1,109,423
Mindanao	7,035,944
Mindoro	1,018,068
North/ South Luzon	8,760,910
Palawan	1,258,920
Sierra Madre	1,680,159
Sulu	358,484
Western Visayas	2,649,736
Zambales	322,556
Zamboanga	1,668,032
TOTAL	**29,641,951**

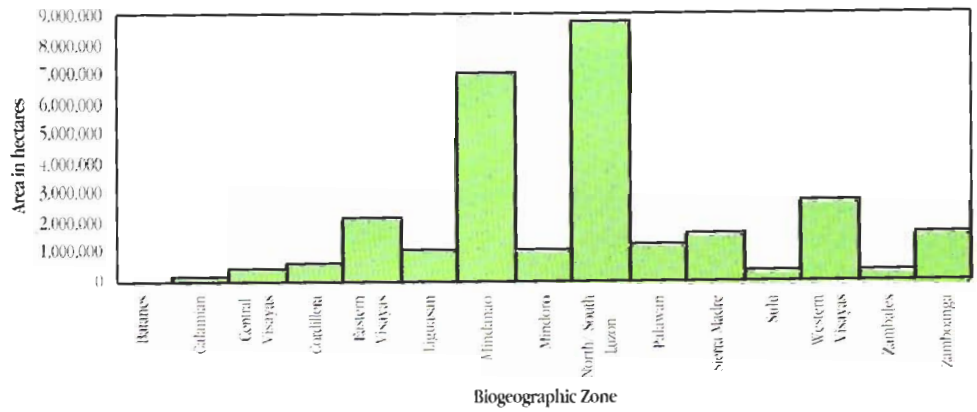

Figure 2 Area of biogeographic zones

record which shows the exact movement of one type of land use into another, thus making it difficult to present a balanced account of various land use conversions. Nevertheless, Table 12 relates the rapid loss of biodiversity-rich ecosystems to changes in land use.

As of 1990, total forest cover stood at 6.1 million hectares or 20% of total land area. Old growth dipterocarp forests have now dwindled to about 800,000 hectares with a loss of about 3.8 million hectares during the last forty years. Residual/ secondary growth forests grew during the period by about 200,000 hectares as a result of logging of old growth forests. Mangrove forests are now down to 133,000 hectares from about 375,000 hectares 40 to 50 years back due primarily to clearing of land for fishpond and urban use. Grasslands decreased by about 3.3 million hectares during the last 40 years due to the conversion of logged-over areas into agricultural plots by uplanders. Agroecosystems in the country, both lowland and upland, expanded during the past 40 years to about 10 million hectares. Urban ecosystems are apparently growing at a much faster rate. Within the short period of 1980-1990, they grew by 142,000 hectares or an average growth rate of 14,000 hectares per year.

Table 12 *Ecosystem diversity and land use changes*

ECOSYSTEM	TOTAL AREA ('000 ha) 1990	% OF TOTAL LAND AREA	CHANGE IN SIZE ('000 ha) 1950-1990	RATE OF CHANGE ('000 ha/yr)
Forest cover (all types)	6,100	20	8,800	220
Old growth forest	800	3	3,800	127
Residual/secondary growth forest	3,500	12	200 (1970-1990 only)	5
Grassland	1,812	6	3,388	85
Agroecosystem	10,002	33	4,276	107
Mangrove	133	0.45	242	6
Urban ecosystem	1,000	3	142 (1980-1990 only)	14

Source of data: Swedish Space Corporation 1988; Marquez 1990; NEDA 1992

1.4.4 Land Use and Biodiversity Quality

Evaluation of biodiversity quality is a subjective measure of the likely condition of biodiversity in a given land use. This measure is a qualitative assessment of the level of disturbance or loss of wild biodiversity within the land use type and is categorized as follows:

- high biodiversity: biodiversity is relatively intact
- medium biodiversity: moderate disturbance of biodiversity
- low biodiversity: biodiversity is highly disturbed or biodiversity loss is extensive

Land which are generally categorized under high biodiversity include closed canopy dipterocarp forests, mangrove forests, mossy forests, and coral reefs. Medium biodiversity areas include open canopy dipterocarp/residual, secondary growth and pine forests, and lakes and marshlands. Low biodiversity areas include cultivated grasslands and shrublands, intensively cultivated areas or agricultural lands, and built-up areas. Table 13 and Figures 3 and 4 provide an overall picture of the biodiversity quality of the various biogeographic zones. About 2.9 million hectares or 10 percent of the country's total land area is classified under high quality; 4.4 million hectares or 15 percent under medium quality; and 22.2 million hectares or 75 percent under low quality. Zones which have the largest proportion of their total land area with high biodiversity include Palawan and Sierra Madre. The location and extent of areas with high biodiversity quality are given in Map 2. These are the areas that require protection in order to conserve the remaining biodiversity in the country.

1.4.5 Biodiversity-rich Areas

Areas rich in biodiversity include the following: dipterocarp forests, mangrove forests, mossy forests and coral reefs; and protected areas such as watershed forest reserves, wilderness areas, game refuges, wildlife sanctuaries and national parks. Biodiversity-rich ecosystems are shown in Map 3

Table 13 *Biodiversity quality of biogeographic zones*

BIOGEOGRAPHIC ZONE	LOW QUALITY	MEDIUM QUALITY	HIGH QUALITY
Batanes	19,887	0	0
Calamian	112,251	37,126	15,177
Central Visayas	436,450	1,523	18,770
Cordillera	446,225	150,571	24,831
Eastern Visayas	1,882,145	394,292	240,471
Leguasan	965,260	122,587	21,576
Mindanao	4,486,166	1,613,906	935,872
Mindoro	923,259	56,564	38,245
North South Luzon	7,341,208	976,010	443,692
Palawan	589,932	135,601	533,387
Sierra Madre	646,739	54,620	492,800
Sulu	335,437	11,926	11,121
Western Visayas	2,476,122	113,247	60,367
Zambales	283,365	24,775	14,416
Zamboanga	1,323,057	240,599	104,376
TOTAL (ha.)	**22,267,503**	**4,419,347**	**2,955,101**
OF TOTAL	75	15	10

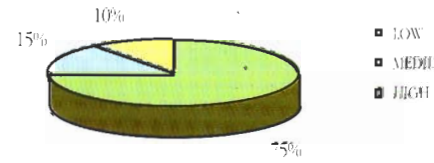

Figure 3 Land use and biodiversity quality

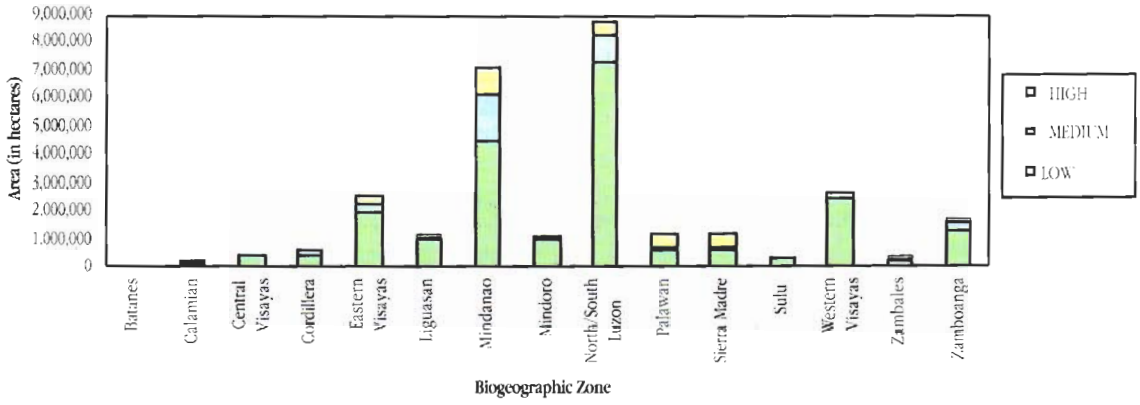

Figure 4 Biogeographic zones and biodiversity quality

and Table 14. Protected areas are considered important in biodiversity conservation because they contain a variety of flora and serve as habitats for endemic species of wildlife. The total area of hectares of national parks in the various biogeographic zones are shown in Table 15. It should be noted, however, that only a part and not the whole area of national parks, watershed forest reserves, wilderness areas, game refuge, and wildlife sanctuaries are actually biodiversity-rich. Due to the absence of disaggregated spatial data, the whole area of these protected areas has been mapped as biodiversity-rich areas.

The locations of biodiversity-rich areas that comprise the biodiversity-rich ecosystems (Map 3)

Table 14 *Biodiversity-rich ecosystems*

BIOGEOGRAPHIC ZONES	CLOSED CANOPY DIPTEROCARP	MANGROVE VEGETATION	MOSSY FOREST	CORAL REEFS	TOTAL AREA (ha)	% OF TOTAL AREA OF BIOZONES
Batanes	0	0	0	0	0	0.0
Calamian	0	1,944	0	13,233	15,177	0.5
Central Visayas	0	40	0	18,730	18,770	0.6
Cordillera	16,159	0	8,672	0	24,831	0.8
EasternVisayas	142,326	34,385	2,617	61,143	240,471	8
Liguasan	17,387	961	0	3,237	21,576	0.7
Mindanao	873,617	21,443	8,500	32,312	935,872	32.0
Mindoro	19,519	2,659	12,777	3,290	38,245	1.0
North/South Luzon	278,434	21,834	48,226	95,198	443,692	15.0
Palawan	403,896	31,582	39,372	58,535	533,387	18.0
Sierra Madre	373,081	3,284	108,599	7,836	492,800	17.0
Sulu	0	6,503	0	4,618	11,121	0.3
W. Visayas	40,446	1,558	1,665	16,698	60,367	2.0
Zambales	10,821	53	0	3,542	14,416	0.5
Zamboanga	59,927	17,059	0	27,390	104,376	3.5
TOTAL	2,235,604	**143,307**	230,428	**345,762**	**2,955,101**	**100.0**
	% OF TOTAL AREA OF BIOZONES	**5**	**8**	12	**100**	100.0

Table 15 *Areas of national parks by biogeographic zones*

BIOGEOGRAPHIC ZONES	TOTAL AREA (ha)	% OF TOTAL
Batanes	0	0.0
N/S Luzon	127,823	13.7
Cordillera	1,397	0.1
Sierra Madre	5,676	0.6
Zambales	32,705	3.5
Mindoro	97,100	10.4
Calamian	0	0
E. Visayas	13,062	1.4
W. Visayas	26,555	2.8
C. Visayas	12,647	1.4
Palawan	3,901	0.4
Mindanao	26,181	2.8
Zamboanga	259,849	27.8
Liguasan	295,183	31.6
Sulu	33,200	3.5
TOTAL	935,279	100

and protected areas (Map 4) are shown in a composite map entitled "Indicative Map of Biodiversity-rich Areas" (Map 5). This map provides an overall picture of the spatial distribution of areas which should be managed and protected because of their importance as areas characterized by richness in biodiversity.

1.5 Socio-Economic Profile

1.5.1 Demography

In evolution—in the demise and origin of species—human population has occupied a prominent and dominating place. Unfortunately, man's historical role has been mostly destructive inasmuch as they manipulate nature to their liking and benefit. Cultural and technological adaptations such as the invention of hunting and fishing, use of tools and implements, mastery of fire, agriculture and industry,etc., represent quantum leaps in man's attack on other species. The concepts of niching and diversification are used as coping mechanisms by living things inasmuch as no two species can live on exactly the same resource. Humans, however, can occupy every niche available to them, and usually emerge as winner in the competition for space and resources. In modern times, it is estimated that humanity uses about four per cent of the total solar energy and their activities may control up to 40 per cent of net terrestrial plant production. Thus, *Homo sapiens'* takeover of the biosphere is indeed a threat to other species.

The impact of the human population on biodiversity can be traced to three activities: growth or increase in numbers, consumption and technology. Historically and geographically, one or the other element predominates. In rich countries, habitat loss is primarily due to the impact of technology and consumption—all in the name of development for raised standards of living, recreation, housing, industry, etc. In developing countries, habitat loss is greatest where human population density is highest. It is therefore linked to rapid population growth in addition to consumption. The consequent increasing need for food, farm and urban land is in line with rising expectations and the quest for improved standards of living.

Human population dynamics and activities are therefore important areas of consideration in a study of biodiversity. In line with this, certain characteristics of the population like age, sex, education, residential distribution, occupation, and industry affiliation can provide important insights on the impact of the human population on habitats and vice versa.

Description of the National Population

The country's 69 million population grows at 2.4 per cent every year, placing it as one of the fastest growing populations in Asia. If this trend continues, Philippine population is likely to reach 78 million at the turn of the century and tripling may occur in a span of four decades. While population size *per se* may not be intimidating, the density of 230 persons per square kilometer of land is cause for apprehension *vis a vis* sustainability of resources, quality of manpower, and other development issues. Further, the distribution of the population in the 30 million hectares land area of the country is far from uniform. Wide variations in population pressure on the land and natural resource base of the biogeographic zones are highly apparent with Calamian as the most sparsely populated with 27.4 persons per square kilometer of land area and Central Visayas the most crowded at 501.

The variations are largely a function of three demographic processes: fertility, mortality, and migration. People living in floral and faunal havens demonstrate high fertility and relatively low mortality, which leaves on balance a higher natural increase in population. In addition to this, migration

has important biogeographic implications, more so at the province level (Table 16). The pattern of people's movements started as pioneer types with rural areas exchanging populations. In the 50s and 60s, vast tracts of prime agricultural land opened up economic opportunities in the provinces of Mindanao. The population was largely rural in the 1950s which became urban in the 1960s as development policies shifted to industrialization. The trek to urban areas continues and these are expanding and eating up the rural areas. This invariably means destruction of habitats, including flora and fauna, to give way to housing and other requirements of the fast urbanizing population. In the rural areas, people are being pushed by lack of livelihood opportunities to the uplands or urban centers. The changes in the land use pattern during the 1970s attest to the loss of productive forests and open grasslands in favor of croplands and urban areas and the cultivation of marginal lands.

Description of the Rural Populations of the 15 Biogeographic Zones

It is assumed that the rural areas of the biogeographic zones (BZs) have more diverse flora and fauna, hence the focus was made on the demographic characteristics of other areas. The succeeding discussions refer to the statistics presented in Figure 5 and Table 17.

Table 16 *Net migration rate by province*

BIOGEOGRAPHIC ZONE/PROVINCE	NET MIGRATION RATE (per 1000)	BIOGEOGRAPHIC ZONE/PROVINCE	NET MIGRATION RATE (per 1000)	BIOGEOGRAPHIC ZONE/PROVINCE	NET MIGRATION RATE (per 1000)
A. Batanes	-26	Albay	-27	J. Calamian Group	(?)
		Sorsogon	-42		
B. Cordillera		Catanduanes	-17	K. Palawan	32 T
Kalinga-Apayao	-17	Masbate	-61 T		
Mt. Province	-29	Sibuyan	(?)	L. Sulu	
Benguet	23			Sulu	-14
Ifugao	-14	E. Zambales		Tawi-tawi	-1
Nueva Viscaya	0	Zambales	-1		
Abra	-21	Bataan	17	M. Zamboanga	
				Zamboanga del Norte	-4
C. Sierra Madre		F. Mindoro		Zamboanga del Sur	-3
Cagayan	-21	Mindoro Oriental	-8	Misamis Occidental	-15
Isabela	-6	Mindoro Occidental	-10	Basilan	-7
Quirino	29				
Aurora	34	G. Western Visayas		N. Mindanao	
Northern Quezon	(?)	Negros Occidental	-18	Surigao del Norte	-15
		Negros Oriental	-27	Surigao del Sur	-9
D. North/South Luzon		Aklan	-9	Agusan del Norte	-3
Ilocos Norte	0	Capiz	-16	Agusan del Sur	57
Ilocos Sur	-10	Iloilo (and Guimaras)	-7	Camiguin	-13
La Union	2	Antique	-7	Davao del Norte	16
Pangasinan	-13	Romblon	-30 T	Davao del Sur	-1
Tarlac	-6			Davao Oriental	-29
Pampanga	2	H. Eastern Visayas		North Cotabato	-4
Nueva Ecija	-12	Northern Samar	-29	South Cotabato	19
Bulacan	19	Western Samar	-32	Sultan Kudarat	6
Rizal	97	Eastern Samar	-20	Lanao del Norte	1
Batangas	-4	Leyte (and Biliran)	-28	Lanao del Sur	-14
Cavite	51	Southern Leyte	8	Bukidnon	12
Laguna	40	Bohol	(?)	Misamis Oriental	5
Southern Quezon	-15 T				
Marinduque	-40	I. Central Visayas		O. Liguasan	
Camarines Norte	6	Cebu	-4	Maguindanao	-10
Camarines Sur	-18	Siquijor	-14		

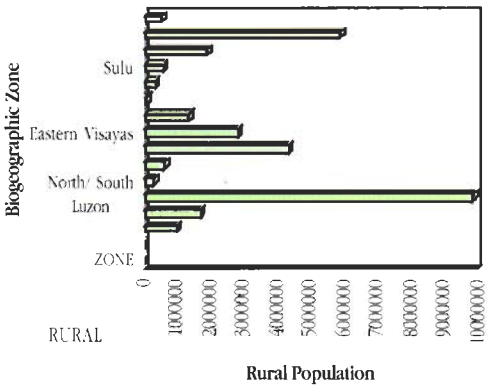

Figure 5 Distribution of population by biogeographic zone (1990)

In the 1990 census, Southern Luzon registered almost a third of the total rural population of 31.1M while Batanes registered about 10,000 rural people (Figure 5). Mindanao was the second most populous, providing residence to 19 per cent of the rural population. Except for Zambales, Southern Luzon and Central Visayas, the rest of the BZs are still largely rural. Sulu (82%), Sierra Madre (75%), Mindoro (72%), Palawan (69%), Liguasan (68%) and Eastern Visayas (70%) were the most rural in terms of proportion of people residing in rural barangays. The rapid urbanization between 1980-1990 has had minimal impact in these BZs.

The high population growth rate in the country has resulted in a young age distribution. This is reflected particularly in Mindoro, Liguasan, Eastern Visayas, Calamian, Palawan, Zamboanga, and Mindanao which have at least 43 percent of their population under age 15 in contrast with the national figure of 39.5

Table 17 *Projected rural population by biogeographic zone (in thousands)*

BIOGEOGRAPHIC ZONE	RURAL POPULATION 1990	PROJECTED POPULATION 1995	PROJECTED POPULATION 2000	PROJECTED POPULATION 2005
A Batanes	9,977	10,508	11,066	11,654
B Cordillera	982,832	1,019,853	1,061,272	1,111,796
C Sierra Madre	1,680,330	1,766,074	1,857,965	1,956,502
D North/ South Luzon	9,864,293	9,797,559	9,775,816	9,791,469
E Zambales	302,661	285,527	274,208	267,453
F Mindoro	599,124	614,913	631,201	648,004
G Western Visayas	4,311,307	4,461,216	4,622,922	4,797,466
H Eastern Visayas	2,810,194	2,784,374	2,762,071	2,743,066
I Central Visayas	1,324,728	1,376,266	1,429,832	1,485,507
J Calamian	30,242	34,242	38,770	43,898
K Palawan	332,163	375,224	423,866	478,815
L Sulu	573,511	637,519	710,259	792,997
M Zamboanga	1,902,249	1,883,080	1,867,283	1,854,837
N Mindanao	5,901,939	6,273,168	6,722,461	7,258,793
O Liguasan	513,747	577,032	648,112	727,948
TOTAL	31,139,297	31,896,555	32,837,104	33,970,205

Population is projected using the formula $P_n = P_0 (1 + r)^n$ where Po is the rural population in 1990 and n is the number of years.

per cent. Batanes, on the other hand, displays an older age distribution with seven per cent of the population belonging to the oldest age bracket while the rest of the zones have between one to four per cent in that category. A plausible explanation is that Batanes is an outmigration province where the young adults move out leaving the old people behind.

The national literacy rate of more than 90 per cent compares very well even with the developed countries. Sulu and Liguasan, however, barely made it to the 60 percent literacy level. The Muslim areas, in general, are characterized by low literacy levels while Batanes, Southern Luzon, and Zambales display a clear edge.

Overall, the BZs display low participation in the labor force with Sulu, Palawan, Sierra Madre, and Zambales hardly making it to the 50 percent mark. The highest labor participation rate is shown by Batanes (78%) and Cordillera (69%). The primary occupations are farming, fishing, and forestry in areas such as Palawan, Sulu, Zamboanga, Batanes, Cordillera, Mindoro, Mindanao, Liguasan, Eastern and Central Visayas. The resource extraction industries like agriculture, forestry, and fishery remain the backbone of the rural economies in terms of employment.

Rates of Change

The high population growth rate is projected to continue beyond the next century and the stabilization of the population will come way beyond that time. It is important to see the landscape of this growth inasmuch as the rural-urban patterns of change will impinge on the biosphere in different ways. Along this line, it is important to highlight the recent crossover in the rates of growth between urban and rural areas. Urban areas are now growing much faster than rural areas. This may be attributed to: a) the transfer of rural population to urban areas; b) reclassification of rural areas into urban in view of higher people concentration and loss of rural character; and c) the natural increase of the urban population. The first and second sources of growth are increasingly becoming more predominant. Urban population growth is expected to continue in the next 10 years although it may not reflect the national trend.

In the year 2005, it is projected that there will be almost 34 million people in the rural areas (Table 17). It portends a positive growth in all BZs except Southern Luzon, Zambales, Eastern Visayas, and Zamboanga where there is fast urbanization and outmigration. Very prominent as fast urbanizing provinces are Rizal, Bulacan, Bataan, and Pampanga. The loss of rural population will be heightened in the latter two provinces in view of the landscape destruction due to lahar. Of the strong outmigration provinces, only Northern Samar, Western Samar, Davao Oriental, Masbate, and Sorsogon are expected to register a declining growth inasmuch as natural increase still predominates as the factor in their population growth. The projected growth of population in the rural areas of the BZs is expected to be slower than in the past. It is expected, however, that this growth will further increase demand on land resources.

1.5.2 Anthropology

Local communities, particularly and especially indigenous cultural communities (ICCs) or indigenous peoples (IPs), play an important role in biodiversity conservation and sustainable development. Their importance arises from the following reasons: first, the ICCs/IPs occupy areas that are noted for their rich biodiversity (e.g., Grand Cordillera Central of North Luzon, Sierra Madre Mountain range, Zambales Mountain range, Iglit-Baco of Mindoro, Mt. Kitanglad and Mt. Apo of Mindanao); second, they have accumulated indigenous knowledge and practices supportive of biodiversity conservation and sustainable development; third, an increasing number of them have already organized to defend their rights to their traditional territories or ancestral domains, including the right to use customary laws, institutions, and indigenous knowledge systems concerning land and its resources.

Population

Statistical data on indigenous peoples are highly variable due to various factors, among which are: (1) the changing definitions of what is indigenous; (2) the increasing inter-marriage between linguistic groups thus blurring first language as a primary distinguishing marker for census-takers and speakers themselves; and (3) the relative inaccessibility of many of the indigenous communities. In any case, it is estimated that they constitute at least 10 percent of the total Philippine population (Table 18). Today, they are concentrated in the hilly and mountainous parts of the Philippines.

The indigenous peoples (IPs) of the Philippines are referred to by various generic names such as tribes, cultural minorities, ethnic minorities, and national

Table 18 *Population distribution of indigenous peoples of the Philippines*

BIOGEOGRAPHIC ZONE	INDIGENOUS PEOPLE	LOCATION	1990 POPULATION CENSUS	OSCC (Year)	DENR	OTHERS	%TOTAL 1990 POPULATION CENSUS
Batanes	Ivatan	Islands of Batan, Sabtang, Itbayat	14,230		12,000		94.7
Cordillera	Isneg	Kankanaey	12,003		56,000		2.6
			22,448				10.6
	Kankanaey	Ilocos Sur	10,919				2.1
		La Union	9,877				1.8
		Mt. Province	61,297		125,000		52.6
		Kalinga-Apayao	8,683				4.1
	Kalinga	Kalinga, Apayao	83,228		106,000		39.3
	Bontoc	Mt. Province	13,868		148,000		11.9
	Bugkalot	Nueva Vizcaya, Nueva Ecija	7,552			(ONNC,1993)	
		Quirino, Isabela					
	Ibaloi	Benguet	85,997		93,000		17.7
		Nueva Vizcaya	13,854				4.6
	Ikalahan	Benguet, Nueva Vizcaya				7,000 (Dolinen, 1995)	
	Ifugao	Ifugao	120,329		180,000		81.7
		Nueva Vizcaya	15,360				5.1
		Quirino	14,837				3
	Iwak	Mt. Province , Benguet, Nueva Ecija		544 (1993)			
	Malaweg	Kalinga, Apayao	2,541				1.2
	Tinggian	Abra	61,519		57,000		33.3
		Ilocos Sur	9,879				1.9
North/South	Agta	Camarines Norte		12,047 (1994)			
Luzon	Agta (Abiyan)	Camarines Sur			11,000		
	Agta	Camarines Sur	7,350		7,000		
	Itom	Albay		11,728 (1994)	11,000		
Zambales	Ayta	Zambales				19,742 (ONCC,1995)	
		Bataan				3,255 (PRRM, 1995)	
Sierra Madre	Agta	Cagayan & Isabela				3,000 (Estioko-Griffin,1995)	
	Dumagat	Aurora, Rizal		8,025 (1993)	26,000		
		Quezon		29,041 (1985)			
	Mangyan	Or. Mindoro	15,401				2.8
	Iraya	Uplands of Mindoro		21,855 (1985)	20,000		
	Alangan	Uplands of Mindoro			50,000		
	Taubuid	Uplands of Mindoro		56,594 (1985)			
	Buid	Uplands of Mindoro			2,000		
	Hanunoo	Uplands of Mindoro		78,647 (1985)	70,000		
	Ratagnon	Uplands of Mindoro				No data	
	Tadyawan	Uplands of Mindoro		63,136 (1985)	56,000		
	Batangan	Uplands of Mindoro		58,279 (1985)	52,000		
Calamian	Tagbanua	Calamian Island				No data	
Palawan	Tagbanua	Palawan	16,905		116,000		
	Batak	Palawan				424 (Eder, 1987)	
	Tao't-bato	Palawan	198		158		
Western Visayas	Ati	Aklan		361 (1995)	57,000		
		Antique		2,620 (1995)			
		Iloilo		1,103 (1995)			
		Negros Occidental		488 (1995)			
		Guimaras		428 (1995)			
	Corolanos	Negros Occidental		5,000 (1995)			
	Magahat				1,000		
	Bukidnon					No data	
	Sulod (Bukidnon)	Iloilo		3,500 (1995)	12,000		
Eastern Visayas	NONE						
Liguasan	Manobo	Maguindanao				No data	
	B'laan	Maguindanao				No data	
Mindanao	Atta	Davao	7,394				0.7
		Davao del Sur	5,931				0.4

Cont'n. ***Table 18***

BIOGRAPHIC ZONE	INDIGENOUS PEOPLE	LOCATION	1990 POPULATION CENSUS	OSCC (Year)	DENR	OTHERS	%TOTAL 1990 POPULATION CENSUS
	Banwaon	Bukidnon		53,400 (1985)	40,000		
	Bagobo	Davao del Sur	34,103				2.3
	B'laan	Davao del Sur	41,517		370,000		2.8
		South Cotabato	56,868				5.3
	Binukid	Bukidnon	48,108				5.7
	Bukidnon	Bukidnon	19,409		227,000		2.3
	Dibabawon	Davao	9,507				0.9
	Higaonon	Agusan,Bukidnon,Misamis Occ./Or.		206,834 (1985)	184,000		
	Kalagan	Davao del Sur	7,414		96,000		0.5
	Mamanua	Agusan del Norte				No data	
		Agusan del Sur				No data	
		Surigao del Norte			25,000		
	Manobo	Davao del Sur	41,517				2.8
		North Cotabato	25,212				3.3
	Mandaya	Davao Oriental	3,814		311,000		3.5
		Davao	17,957				1.7
	Mansaka	Davao	16,901		120,000		1.6
	Matigsalug	Bukidnon		130,050 (1985)	247,000		
		North Cotabato				No data	
		Davao			116,000		
	Tagakaolo	Davao del Sur	51,896		111,000		
	Talaandig	Bukidnon		144,942 (1985)	129,000		
	T'boli	South Cotabato	5,365		240,000		4.5
	Tiruray/Teduray	Maguindanao			190,000		
		Sultan Kudarat		180,626 (1985)			
		North Cotabato					
Zamboanga	Subanen	Zamboanga del Norte	2,707		280,000		0.4
		Zamboanga del Sur	6,178				0.4
	Kalibugan	Zamboanga del Norte	14,891		90,000		2.2

minorities. Excluded are the Christianized predominantly lowland groups and the Islamized groups considered in their totality as Muslims. Officially, the 1987 Philippine Constitution refers to these IPs as indigenous cultural communities (ICCs). Legally, Republic Act No. 7586 which provides for the establishment of a National Integrated Protected Areas System defines an indigenous cultural community as "a group of people sharing common bonds of language, customs, traditions, and other distinctive cultural traits, and who have, since time immemorial, occupied, possessed, and utilized a territory." On the other hand, the Executive Branch, thru the Department of Environment and Natural Resources (DENR), in its Department Administrative Order (DAO) No. 2, series of 1993, defines an indigenous cultural community as "a homogeneous society identified by self-ascription and ascription by others, who have continuously lived as a community on communally bounded and defined territory, sharing common bonds of language, customs, traditions, and other distinctive cultural traits, and who, through resistance to the political, social and cultural inroads of colonization, became historically differentiated from the majority of Filipinos."

For purposes of assessing ICCs/IPs and formulating a national strategy for biodiversity conservation, the DENR definition is appropriate because, among other things, it specifies that the people "have continuously lived as a community on a communally bounded and defined territory." Among these customs, traditions, and cultural traits are indigenous ecological knowledge and resource management practices that have helped sustain their ways of life as distinct peoples and communities, in their traditional territories, now also referred to as ancestral domain. DAO No. 2, series of 1993, defines ancestral domain as "all lands and natural resources occupied or possessed by indigenous cultural communities, by themselves or through their ancestors, communally or individually, in accordance with their customs and traditions since time

immemorial, continuously to the present except when interrupted by war, force majeure, or displacement by force, deceit or stealth. It includes all adjacent areas generally belonging to them and which are necessary to ensure their economic, social, and cultural welfare." These definitions affirm the communal and spiritual links of the ICCs/IPs to the land and its resources, in contrast to those of the non-IPs who already view land as commodity.

Historical accounts tell us that many of those referred to now as ICCs or IPs were concentrated in coastal areas before Spanish colonization. The interior areas were sparsely populated, with the possible exception of the Gran Cordillera Central of North Luzon, some interiors of Mindanao as well as the other bigger islands. Subsequently, the coastal dwellers were pushed to the hilly interior to which they have adapted remarkably up until the present. These successful ecological and cultural adaptations, however, have been under threat from various forces such as continued migration of lowlanders into the uplands, infrastructure projects and other state-initiated activities, militarization in connection with an active insurgency, and encroachment of monoculture agricultural plantations. Moreover, there is also the negative impact of Christianization upon the world view of ICCs/IPs. In particular, Christianization has undermined the indigenous worldview regarding the interconnectedness of people and the land often expressed in subsistence rituals where numerous spirits connect land and people. This has resulted in the rejection of beliefs and practices that have hitherto contributed to environmental conservation. The impact of these changes in world view on biodiversity loss is documented in the case of the Ibaloi of the Cordillera, the Mangyan (Hanunoo and Alangan) of Mindoro and the Tiruray of Mindanao.

Indigenous Resource Management: Sustainable Relationship Between Land and People

The ethnographic literature on ICCs/IPs normally includes discussion of the physical setting, kinship and social organization, political and economic organization, arts and crafts, religious practices and belief systems often lumped under the rubric of folklore. Such a comprehensive and holistic description of a people, usually focused on a village community, shows the interconnectedness or integration, of the various aspects of community life with the physical and natural base. In general, there are similarities in patterns of adaptation and integration but then also, cultural diversity emerges as an expression of specific adaptation to natural and biological diversity. While there are not too many ethnographies focusing on the precise relationships between biological and cultural diversity, those that do indicate a complex relationship. Indeed, it is said that biodiversity and cultural diversity are two sides of the same coin.

In their direct relationship with the land, practically all ICCs/IPs have at one time or another practiced hunting and gathering, fishing, and swidden cultivation (*kaingin* and *uma* in various Philippine languages) to survive. Sustainable swiddening takes place when the people-to-land ratio allows for long fallow periods (15 or 20 years, for some). At any one time, a household or family has two or more swidden fields in separate places. Each field would be planted to a wide range of crop varieties, planted at different times and harvested as they mature. To supplement local production, they have engaged in trade and commerce with neighboring groups including lowlanders. Trade items include non-timber forest products such as almaciga resin, orchids, bees wax, and honey and game meat. Some groups have practiced sustainable small scale mining, as in the Cordillera. A few also have engaged in cattle raising for subsistence and for trade. In this diversity of subsistence activities, swidden cultivation and agro-forestry, as well as hunting, have been practised best.

During the annual cycle, especially in site selection, sowing and harvesting, rituals are performed. Hunting and fishing activities also entail ritual performances. One may look at these rituals as a kind of productive social and cultural technology underpinning an integrationist and, consequently, conservationist view of land and people. On the other hand, it has been shown in the case of the Ibaloi of Benguet that rituals may be manipulated for selfish political and economic reasons, leading to the conversion of forest land to more commercially profitable vegetable production.

While there are cases of overexploitation of resources such as in fishing, hunting, and cutting of trees, still, many groups have a clear idea of what parts of the land to use for certain purposes. For example, in the Cordillera, the following are considered natural resources: (1) forest and forest products; (2) mountain springs for household and irrigation uses; (3) creeks and rivers for fishing, irrigation, and rituals; (4) swiddens for food production; (5) grassland for livestock and for housing materials; (6) minerals and mineral land;

(7) clay for pottery; (8) lands suitable for terracing for crop production; and (9) residential land.

The forest is not only useful as a direct source of food, tools, housing materials, adornment, and trade items but also as source of medicinal plants and pesticides. While in some cases, knowledge about these are specialized, in general, the members of communities are aware of the varieties and parts of the plants to be used. Often, use of these plants takes place in a ritual context. Specific sites of the landscape are often considered sacred and its protection entails the protection of the larger landscape or territory of which the sites are part. Since sacred sites are protected, they also contribute to the protection and conservation of the natural environment.

Because land and resources belong to the gods and spirits as well as ancestors, usufractory rights govern the use of these resources. In operational terms, the communities have evolved customary laws involving communally held resources and those that are considered privately held by individuals, households, clans and groups within the community. Such customary practices include a range of religious and social sanctions that, all told, prove effective in governing resource use and in settling conflicts that occasionally arise.

In the context of a nation state committed to a concept of land as a commodity, with all the state laws and policies entailed by this, customary laws governing tenurial arrangements remain unrecognized by the state. This conflict between customary laws and national laws is at the core of the conflict between ICCs/IPs and the state regarding land. In a growing number of cases, land use legally sanctioned by the state (e.g., infrastructure sites, monocrop agricultural plantations, industrial tree plantations, commercial mining) continue to undermine the integral relationship between ICCs and their lands. Where land itself is tantamount to cultural identity, the net impact of this is seen by ICCs/IPs as "development aggression" leading to ethnocide and hence loss of cultural diversity. In turn, this could lead, to biodiversity loss, as in fact, it already has in many places in Mindanao and in the Cordillera of Northern Luzon.

State Policies on Land and Indigenous Cultural Communities/Indigenous Peoples

Indigenous peoples and including lowland farmers who have practiced traditional multicrop agriculture have contributed, by and large, to the conservation of biological diversity. Unfortunately, there have been several state laws and policies with their roots in the colonial past, that have severely undermined this capability. Recent legislations and international agreements have tried to address this problem but are either weak or ambiguous. In some, as in Republic Act 7942, also known as the Mining Code, mining explorations have led to conflicts between ICCs and mining firms over rights to ancestral domains.

At the very foundation of state laws and subsequent policies on land and ICCs/IPs is the Regalian doctrine. Strictly, the Regalian Doctrine is not a legislative issuance and is even regarded as "legal fiction." As a doctrine it has its roots in Spanish colonialism: by reason of conquest, all lands in the archipelago that became the Philippine nation state became the property of the Spanish Crown. This doctrine was carried forward by the American colonizers and later embodied in a number of Philippine laws and the different Philippine Constitutions, including the latest, the 1987 Philippine Constitution. Adherence by the state to the Regalian Doctrine has prevented the indigenous peoples from claiming private communal rights to their traditional territories, now known in the 1987 Philippine Constitution (Section 5, Article XII) as ancestral domain and in the case of the Cordillera peoples of Northern Luzon and the Muslims of Mindanao, as autonomous region (Article X). This has undermined the capability of indigenous peoples to continue practicing their indigenous resource management practices.

It must be pointed out, however, that the recognition by the State of indigenous peoples' rights to their ancestral domains does not guarantee the conservation of biodiversity. Because of the intensifying exposure of indigenous peoples to the various forces and agents of environmentally unsustainable economic growth, the indigenous peoples themselves have to be able to improve upon their already sustainable resource management by incorporating inputs from outside. They need to strengthen their organizational capability to deal with the numerous threats to their land and to biodiversity.

It is strongly suggested that the provisions on ancestral lands and domains in the 1987 Philippine Constitution as well as some jurisprudence should be interpreted liberally in full recognition of the rights of indigenous peoples. After all, the benefits from such State recognition would redound not only to the indigenous peoples but also to everyone

who stand to benefit from well-conserved biodiversity. And that means the present generation as well as those yet to come.

Other relevant provisions of the 1987 Philippine Constitution are: (1) Section 22, Article II. The State recognizes and promotes the rights of indigenous cultural communities within the framework of national unity and development; 2) Section 5, Article XII. The State, subject to the provisions of the Constitution and national development policies and programs, shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and natural well-being. Congress may provide for the applicability of customary laws governing property rights or relations in developing the ownership and extent of ancestral domain.

These Constitutional provisions are meant to support the struggles of indigenous peoples for their right to self-determination, that is, their right to take control of the direction of their development as distinct cultural communities, or as peoples. With their rights to their traditional territories protected, the IPs/ICCs could continue to enhance their traditional resource management practices which have hitherto contributed to the protection of biodiversity-rich areas. Unfortunately, the legislature has not yet enacted the enabling laws to fully implement the Constitutional mandate.

Pending the enactment of appropriate legislation, the executive department, through the DENR, by virtue of DAO No. 2, series of 1993, is now undertaking identification and delineation of ancestral domains being claimed by a growing number of ICCs/IPs. The process ends with a grant of a Certificate of Ancestral Domain Claim (CADC). It is only a claim and not a title and is admittedly inadequate to protect the rights of the IPs to their ancestral domain. As of 15 April 1996, 43 CADCs have been awarded to ICCs in the Cordillera, in Zambales, in the island of Mindoro, in Bohol, and in Mindanao.

1.5.3 Economic Profile

The developments in and the structure of the Philippine economy in recent years is assessed with focus on economic characteristics that may impact on biodiversity.

Aggregate Economic Activity

The Philippines' GDP for 1993 was estimated to be P733,097 million (at constant 1985 prices; See Table 19). For 1990 to 1993, the country's GDP grew at an annual rate of about 0.57%. Next to NCR with a gross regional domestic product (GRDP) of 218,184 million (1985 prices), the Southern Tagalog Region (Region 4) had the highest GRDP estimated to be 115,863 million (1985 prices).

Table 19 *Gross regional domestic product (in million pesos; at constant 1985 prices), 1981-1993*

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Nationwide		630,645	653,469	665,718	616,963	571,884	591,423	616,926	658,583	699,451	720,691	716,523	718,942	733,097
NCR	Metro Manila	184,222	191,923	201,703	180,909	164,246	169,358	180,609	196,878	213,778	221,182	217,042	214,419	218,184
CAR	Cordillera							11,342	11,977	13,299	13,242	13,404	14,018	13,854
Region 1	Ilocos Region	25,022	25,927	25,987	24,949	25,033	26,947	18,294	19,238	20,463	20,872	20,807	20,349	20,373
Region 2	Cagayan Valley	18,706	18,994	18,736	17,128	15,309	15,668	13,087	14,211	14,990	14,930	14,247	14,260	14,293
Region 3	Central Luzon	58,338	61,298	61,196	57,044	53,774	54,853	57,459	61,831	64,158	69,437	67,205	71,042	72,812
Region 4	Southern Tagalog	93,137	96,776	95,834	89,958	82,615	86,473	90,978	98,333	104,972	109,432	110,404	114,052	115,863
Region 5	Bicol Region	19,513	20,728	21,340	20,496	19,366	19,530	18,913	20,105	21,044	22,393	22,291	21,818	22,443
Region 6	Western Visayas	48,279	50,758	50,911	46,265	42,418	43,554	44,858	46,700	50,114	50,571	51,769	53,293	55,067
Region 7	Central Visayas	39,121	40,816	42,183	39,838	35,754	37,680	39,662	43,107	45,813	47,080	47,238	46,684	47,551
Region 8	Eastern Visayas	15,452	16,136	16,624	17,548	16,218	16,057	16,175	17,483	17,373	17,454	18,325	17,037	17,264
Region 9	Western Mindanao	20,122	20,413	20,896	19,969	18,561	19,163	19,191	19,705	20,215	21,250	21,077	21,416	22,010
Region 10	Northern Mindanao	37,042	37,163	37,252	33,419	32,412	33,239	34,381	35,603	37,313	37,064	36,714	36,659	37,652
Region 11	Southern Mindanao	47,833	48,086	47,959	45,755	43,727	45,317	48,383	48,691	50,461	50,057	50,441	49,218	50,013
Region 12	Central Mindanao	23,858	24,451	25,097	23,686	22,452	23,582	23,592	24,720	25,458	25,727	25,558	24,677	25,719

Notes: 1. Regional levels may not add up to national levels due to rounding
2. Cordillera Administrative Region (CAR) data started only in 1987

Data as of July 1994
Source: 1994 Philippine Statistical Yearbook

Table 20 *Per capita gross regional domestic product, 1981-1993 (at constant 1985 prices)*

REGION/YEAR		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Nationwide		12,731	12,868	12,789	11,564	10,461	10,560	10,756	11,215	11,639	11,722	11,397	11,188	11,167
NCR	Metro Manila	29,930	30,248	30,841	26,841	23,660	23,695	24,559	26,039	27,520	27,738	26,540	25,587	25,432
CAR	Cordillera							10,522	10,869	11,811	11,505	11,398	11,681	11,309
Region 1	Ilocos Region	6,927	7,042	6,923	6,518	6,414	6,773	5,497	5,675	5,928	5,938	5,815	5,583	5,500
Region 2	Cagayan Valley	8,194	8,117	7,810	6,965	6,073	6,064	5,695	6,035	6,212	6,042	5,634	5,510	5,398
Region 3	Central Luzon	11,793	12,090	11,777	10,712	9,856	9,813	10,035	10,546	10,689	11,305	10,698	11,061	11,093
Region 4	Southern Tagalog	14,707	14,852	14,297	13,047	11,654	11,866	12,150	12,784	13,293	13,502	13,281	13,383	13,269
Region 5	Bicol Region	5,463	5,666	5,700	5,349	4,938	4,868	4,607	4,789	4,902	5,103	4,971	4,763	4,797
Region 6	Western Visayas	10,391	10,675	10,463	9,292	8,330	8,364	8,427	8,586	9,020	8,916	8,943	9,025	9,146
Region 7	Central Visayas	10,101	10,328	10,462	9,686	8,523	8,808	9,093	9,696	10,111	10,199	10,048	9,754	9,764
Region 8	Eastern Visayas	5,408	5,545	5,611	5,814	5,278	5,132	5,078	5,391	5,263	5,195	5,358	4,894	4,874
Region 9	Western Mindanao	7,716	7,643	7,643	7,137	6,483	6,544	6,410	6,437	6,463	6,651	6,461	6,431	6,477
Region 10	Northern Mindanao	12,993	12,679	12,368	10,810	10,199	10,185	10,263	10,356	10,582	10,253	9,907	9,655	9,682
Region 11	Southern Mindanao	13,829	13,541	13,158	12,234	11,399	11,520	12,000	11,784	11,924	11,550	11,371	10,846	10,776
Region 12	Central Mindanao	10,196	10,175	10,173	9,355	8,642	8,849	8,632	8,822	8,864	8,745	8,483	7,999	8,144

Source: 1994 Philippine Statistical Yearbook

The Southern Tagalog Region also had the second highest annual growth rate in GRDP, while Western Visayas Region (Region 6) had the highest rate of growth over the period 1990-1993.

Per capita Income

The estimated annual per capita GDP and GNP for years 1990 and 1993 have been declining by an annual rate of 0.4 percent and 0.2 percent, respectively, over the period 1990-1993 (Table 20). However, the per capita personal consumption expenditure had grown positively by 0.15 percent annually (Tables 21a and 21b and corresponding figure). Across regions, the per capita gross regional domestic product interestingly can be divided into two: that of NCR, Regions 4, CAR, 11, 3, 7, 10, 6, 12; and that of regions 9, 1, 2, 8, and 5. The NCR had the highest per capita gross regional domestic product (GRDP), followed by Southern Tagalog Region (Region 4), while the Bicol Region (Region 5) had the lowest. There is an overwhelming income difference between NCR and other regions, though generally, almost all regions, except for the Western Visayas Region (Region 6), showed declining annual rates of per capita GRDP. From 1990-1993, only the Western Visayas indicated an increase in the per capita GRDP, an annual rate of 0.85 percent, while Cagayan Valley (Region 2) showed the largest decline. However, though the GRDP indicated income differences, one should be aware of its limitations in indicating general welfare and well-being of the population.

Family Expenditure

The data for the distribution of total family expenditures in 1991 shows that out of the P622 billion of total family expenditure, about 48.5 percent was spent on food, with 44.7 percent going to food consumed at home. Over the 1965-1991 period, there was a declining trend in food expenditure as a proportion of the total family expenditure. In 1991, medical expenditures comprised about 1.8 percent and only 0.4 percent of the total expenditure was spent on recreation. A comparison of the expenditure shares of medical care and recreation across the years 1985, 1988, and 1991 indicates volatility in these expenditure shares (Table 22).

Employment

Based on the October 1993 National Statistics Office (NSO) employment data, about 46 percent of employed persons were in the agriculture, fishery and forestry (AFF) sector of which 74 percent were

Table 21a *Per capita gross national product, gross domestic product and personal consumption expenditure, 1981-1993 (at constant 1985 prices)*

ITEM	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1. Gross domestic product	12,730	12,869	12,787	11,564	10,461	10,561	10,755	11,216	11,638	11,722	11,397	11,188	11,167
2. Gross national product	12,683	12,725	12,600	11,210	10,171	10,342	10,562	11,113	11,468	11,782	11,561	11,454	11,483
3. Personal consumption expenditures	8,235	8,312	8,157	7,981	7,698	7,765	7,887	8,184	8,396	8,650	8,649	8,738	8,813
Population* (in million persons)	49.54	50.78	52.06	53.35	54.67	56.00	57.36	58.72	60.10	61.48	62.87	64.26	65.65

*Based on the latest census of population

Data as of May 1994
Source: National Statistical Coordination Board

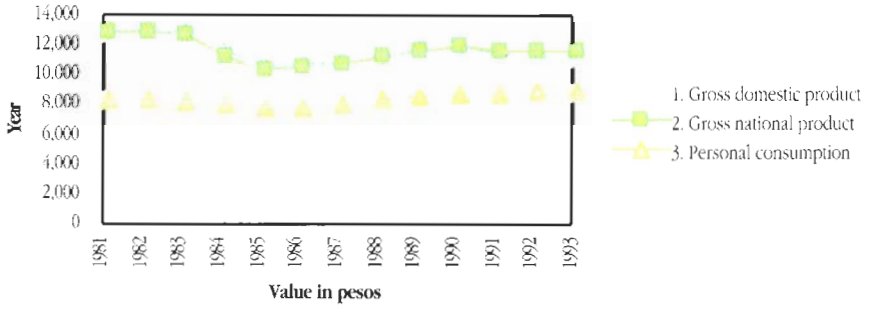

Figure 6 Per capita gross national product, gross domestic product and personal consumption expenditure (1981-1993) (estimates in constant 1985 prices)

Table 21b *Growth rates in per capita GNP, GDP and PCE (in percent)*

	1981-1993	1983-1993	1990-1993
GDP	-1.086	-1.123	-0.404
GNP	-0.825	-0.771	-0.214
PCE	0.567	0.647	0.156

Table 22 *Percentage distribution of total family expenditures by major expenditure group, Philippines in 1965, 1971, 1985, 1988, and 1991*

EXPENDITURE GROUP	1965	1971	1985	1988	1991
Total family expenditures (in thousand pesos)	**14,748,076**	**28,430,424**	**264,551,855**	**342,578,100**	**622,616,202**
Percent	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Food consumed at home	50.8	51.0	48.8	47.3	44.7
Cereals and cereal preparation	21.1	19.6	18.5	15.9	14.5
Roots, tubers, fruits & vegetables	5.0	5.5	5.3	5.8	5.4
Meat, meat preparations, dairy products and eggs	8.4	9.7	10.3	10.3	10.6
Fish and marine products	9.3	8.9	7.9	7.5	7.1
Coffee, cocoa and tea			1.6	1.7	
Non-alcoholic beverages			1.1	1.7	
Food, N.E.C.			4.0	1.3	
Miscellaneous	6.9	7.4	6.7	7.9	7.1
Food regularly consumed outside the home	2.9	2.7	3.1	3.4	3.8
Alcoholic beverages	1.6	1.7	1.1	1.1	1.0
Tobacco	3.2	3.3	2.3	2.1	1.7
Housing	9.1	9.4	12.7	12.8	13.2
Fuel, light and water	3.6	3.6	5.5	5.2	5.7
Household furnishings & equipment	2.0	2.3	1.9	2.2	2.5
Household operations	2.5	2.4	2.4	2.5	2.7
Clothing, footwear & other wear	6.5	6.2	3.6	4.2	3.7
Personal care and effects	2.5	2.2	2.1	3.3	3.3
Medical care	1.7	1.8	2.1	0.5	1.8
Transportation & communication	2.6	2.9	4.4	4.7	5.4
Recreation	1.8	1.8	0.4	2.9	0.4
Education	3.5	3.7	3.5	4.2	3.0
Gifts and contributions	0.9	0.6	1.0	1.0	1.0
Taxes paid	0.6	0.3	1.0	2.3	1.4
Special occasions	2.7	2.5	2.2	3.3	2.4
Other expenditures	1.5	1.5	1.8	1.8	1.9
Non-durable furnishings	-	-	0.4	0.4	0.3
Durable furniture and equipment	-	-	1.5	1.8	2.1
Rent/Rental value of occupied dwelling unit	-	-	11.4	11.7	12.4
House maintenance & minor repairs	-	-	1.3	1.1	1.1
Miscellaneous expenditures		-	3.2	-	-

Source: Family Income and Expenditures Surveys (FIES), National Statistic Office

Note: Final results of the 1988 FIES exclude data for Rizal Province as fire destroyed accomplished questionnaires of this province.

male. The 1991 Family Income and Expenditure Survey reports that 36 percent of families had agriculture, fishery, and forestry as the main source of income; in rural areas, this proportion rises to 55 percent. Minimum wage rates for the agricultural and non-agricultural sectors are set at the regional level. In 1993, the range of daily minimum wage rates for agricultural workers was ₱79-₱108 for plantation workers and ₱58.50-₱97.50 for non-plantation workers. For non-agricultural workers, the corresponding range of minimum wage rates was ₱90.42-₱119.42. Hence, the statistics indicate the social impact of the AFF sector. The large number of persons engaged in the AFF sector is not proportional to their contribution of a mere 23 percent in value added to GDP. Note that agricultural wages are lower than non-agricultural wages (Table 23a).

Biological Resources and the National Economy

There is a notion that the Philippines has an agriculture based economy. While agriculture constitutes a considerable economic activity, its contribution to GDP is not as expected. Forestry and Fishery are lumped with agricultural crops and livestock in the system of national accounts. In 1993, the AFF sector accounted for 23 percent of GDP; industry and services contributed 34 percent and 43 percent, respectively, to GDP in terms of value added (Table 23a and 23b and Figure 7). Over the

Table 23a *GNP and percentage share to GDP by industrial origin, 1981-1993*

Industry	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Agriculture, fishery & forestry	23.544	22.900	21.719	23.218	24.577	24.640	24.381	23.580	22.870	22.303	22.740	22.752	22.760
Industry sector	40.997	40.546	40.406	38.582	38.068	34.690	34.589	35.235	35.625	35.459	34.712	34.409	34.346
Service sector	35.459	36.554	37.876	38.200	40.355	40.670	41.029	41.185	41.505	42.238	42.548	42.839	42.894
Gross domestic product	630.642	653.467	665.717	616.962	571.883	591.423	616.923	658.581	699.448	720.690	716.522	718.941	733.097

Table 23b *GDP by Industrial origin, 1981-1993 (billion pesos)*

Industry	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Agriculture, fishery & forestry	148.4784	149.6439	144.5871	143.2462	140.5517	145.7266	150.412	155.2934	159.9638	160.7355	162.9371	163.5735	166.8529
Industry sector	258.5443	264.9547	268.9896	238.0363	217.7044	205.1646	213.3875	232.051	249.1784	255.5495	248.7191	247.3804	251.7895
Service sector	223.6193	238.8683	252.147	235.6795	230.7834	240.5317	253.1173	271.2366	290.3059	304.405	304.8658	307.9871	314.4546
Gross domestic product	630.642	653.467	665.717	616.962	571.883	591.423	616.923	658.581	699.448	720.690	716.522	718.941	733.097

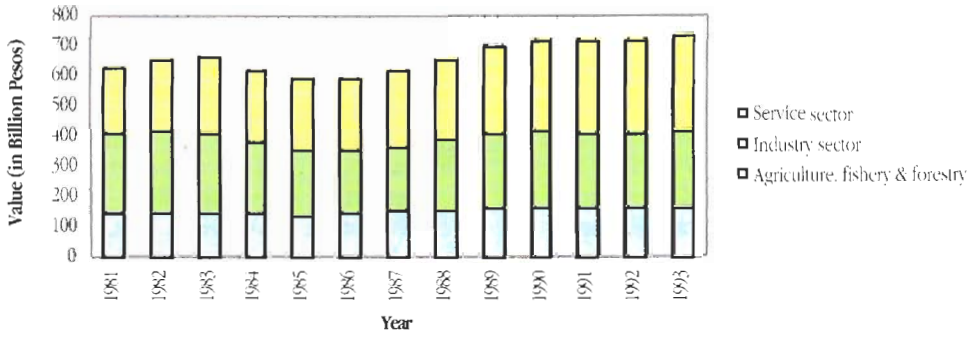

Figure 7 Gross domestic product by industrial origin

ten-year period, 1983-1993, the service sector had the highest annual growth rate at 2.2 percent; agriculture grew in the same period at an annual rate of 1.4 percent while industry shrunk at an annual rate of 0.7 percent. There has been a change in the structure of the economy in terms of sectoral contributions of value added to GDP. Whereas the AFF sector's share had remained relatively constant at the 22-25 percent range, the service sector in 1993 had become the dominant contributor compared to 1981 when industry had the biggest share. Hence, there has been greater movement of resources to the service sector away from industry.

Within the AFF sector, agriculture had the largest value added contribution. In 1993, the shares in the AFF value added of the agriculture, fishery, and forestry sectors were 78 percent, 20 percent, and 2 percent, respectively. In terms of value added shares in GDP, the contribution of the agriculture, fishery, and forestry sectors were 18 percent, 4.0 percent, and 0.5 percent, respectively. The much larger value added contribution of agriculture relative to forestry may partly explain the larger conservation related government expenses of the DA relative to the DENR. However, it can also be argued that the market failures which may provide a rationale for government intervention are more severe in the environmental and natural resource sector. Markets for agricultural products are more well established compared to those of environmental and resource goods some of which are unpriced or priced below their social value. The externality and property rights problems may also be more pervasive in the environmental sector. It is recognized that the problems of the environmental sector also exist in agriculture.

Over the period 1981-1993, agriculture and fishery posted positive annual growth rates of 1.7 percent and 2.2 percent, respectively, while forestry had an average annual decline in value added of 12.1 percent. This could be partly explained by some logging activities that were unreported or illegally conducted. The decline in value added for forestry is more severe in the more recent period 1990-1993 where the annual rate of growth in value added was negative 21.8 percent. The recent decline may have been exacerbated by the selective logging ban (Table 24). It must be noted also that the published national accounts do not cover non-marketed, nature-based household production though the NSO is moving in the direction of incorporating such activities. The USAID funded environmental accounting project ENRAP.1f reports an upward adjustment of about a quarter of the value of the forestry sector's marketed output for the year 1988 if fuelwood gathering is taken into account.

In agriculture, there was a higher rate of growth in value added in domesticated exotic species compared to crops in the period 1981-1993. During this period, domesticated exotic species grew in value added at annual rates of 4.0 percent and 5.5 percent, respectively. The corresponding rates for palay, corn, and other crops are 1.9 percent, 2.7 percent, and 1.3 percent, respectively. Value added

Table 24 Annual growth rate of gross value added GVA) in agriculture, fishery, and forestry (AFF)

	1981-1993	1983-1993	1990-1993
Agriculture	1.700	2.592	2.151
Palay	1.912	2.653	0.827
Corn	2.676	3.170	0.785
Coconut including copra	(4.651)	(4.312)	(1.224)
Sugarcane	(0.028)	0.828	12.911
Banana	(2.370)	(2.569)	1.677
Other crops	1.337	2.140	1.283
Livestock	3.949	4.690	2.209
Poultry	5.484	6.124	6.716
Fishery	2.161	0.857	1.968
Forestry	(12.107)	(12.581)	(21.826)
GVA in AFF	0.977	1.433	1.253
Gross domestic prod.	1.262	0.969	0.571

in coconut and banana production declined by 4.6 percent and 2.4 percent, respectively, during the same period.

A regional breakdown of the AFF value added is presented in Table 25 and Figure 8. The regions with the highest shares in AFF value added are Southern Tagalog (Region 4), Southern Mindanao (Region 11), and Western Visayas (Region 6), in that order. In the 1981-1993 period, the highest annual rate of growth in AFF value added, 2.3 percent, was posted by Central Luzon (Region 3). But in the more recent 1990-1993 period, Western Visayas (Region 6) enjoyed an increase in per capita income (gross region domestic product) of 5.3 percent annual rate of growth, in contrast to most regions. Southern Mindanao (Region 11), on the other hand, experienced a decline at an annual rate of 0.7 percent in AFF value added.

Table 25 Gross value added in agriculture, fishery, and forestry by region (in million pesos; at constant 1985 prices), 1981 to 1993

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
NCR	0	0	0	0	0	0	0	0	0	0	0	0	0
CAR							2,556	2,749	2,821	2,665	2,712	2,805	2,909
Region 1	9,520	9,778	9,040	8,709	9,115	9,787	7,830	8,312	8,730	9,125	9,217	9,074	9,160
Region 2	7,002	6,943	6,555	6,577	6,843	7,238	6,911	7,828	7,851	7,796	7,377	7,536	7,587
Region 3	12,547	12,757	12,040	11,749	11,530	11,920	12,944	13,242	14,463	15,849	16,230	16,237	16,575
Region 4	25,214	26,185	25,848	25,680	24,845	26,264	27,052	28,251	29,647	30,193	30,636	31,018	31,528
Region 5	8,382	8,564	8,401	8,301	8,496	8,248	8,020	8,457	8,644	8,567	8,797	8,557	8,654
Region 6	16,668	17,690	16,789	17,089	15,083	15,249	16,045	16,182	17,106	16,718	17,599	18,934	19,503
Region 7	5,968	6,150	6,064	6,102	5,676	5,857	5,834	6,166	6,698	6,915	7,302	7,098	7,423
Region 8	6,366	6,529	6,128	6,198	6,180	6,302	6,209	6,510	6,271	5,953	6,014	6,006	6,062
Region 9	10,129	10,051	9,877	10,103	9,939	10,123	10,087	10,248	10,218	10,660	10,505	10,846	11,098
Region 10	13,737	13,272	12,850	12,246	12,177	13,117	14,073	14,217	14,660	13,860	13,994	14,158	14,592
Region 11	22,508	21,461	21,047	20,674	20,520	20,525	21,807	21,613	21,296	20,976	21,381	20,520	20,783
Region 12	10,438	10,260	9,947	9,818	10,149	11,095	11,047	11,518	11,561	11,458	11,172	10,782	10,981
Nationwide	148,479	149,641	144,586	143,247	140,554	145,725	150,414	155,292	159,964	160,734	162,937	163,571	166,853

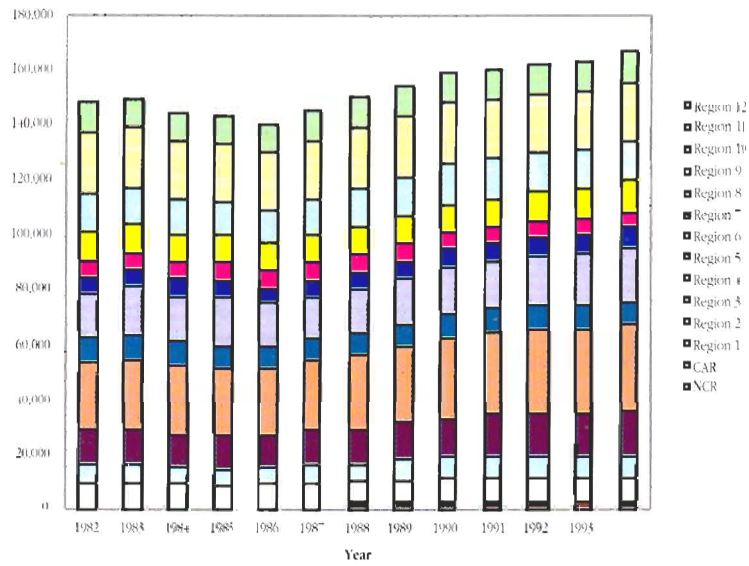

Figure 8 Gross value added in agriculture, fishery, and forestry by region

2.0 STATUS OF BIODIVERSITY

2.1 Diversity in Forest Ecosystems

2.1.1 Introduction

The existence of diverse natural forest formations in the Philippines could be due to the strong influence of varying physical and climatic factors, e.g. soil type, rainfall, and altitude. The various forest formations are characterized by distinct species composition and associations, community structure, and diversity indices. Over the years, botanists have described, classified and reclassified natural forests in the Philippines (see Whitford, 1909, 1911; Velasco and Vera-Santos, 1953; Cadiz, 1986; Forest Management Bureau, 1988; FMB-GTZ, 1988; Fernando, 1989; Tan and Rojo, 1989; Madulid, 1994). The most recent classification of forest types devised by Madulid in 1994 is a modification of Whitmore's (1984) concept. The dominant plant species, geographical distribution and altitudinal range of these forest types are summarized in Table 1 and described below:

Lowland evergreen rainforest. The most widespread type found all over the country from 0-1,000 meters above sea level (m.a.s.l.) dominated by dipterocarps, palms, legumes, and orchids.

Lower montane forest. Lithocarpus and liliaceous species dominate this forest type. It is found in the Central Cordillera, Benguet, and Mt. Province at 1,000-1,500 m.a.s.l.

Upper montane forest. At altitudes 1,500-2,400 m.a.s.l., a distinct association of *Agathis philippinensis, Phyllocladus, Podocarpus, Dacrydium*, Vaccinium *spp.* and other ericaceous plants characterize this forest type found on Mt. Pulog, Mt. Apo, Mt. Halcon, and Mt. Kitanglad.

Sub-alpine forest. Ericaceous life forms, species like *Rhododendron and Vaccinium*, and other high altitude species like *Decaspermum, Lycopodium,* and *Styphylea* dominate this forest type on Mt. Apo and Mt. Pulog at altitudes over 2,400 m.a.s.l.

Pine forest. A pure stand of *Pinus insularis (P. kesiya)* and *Pinus merkusii* maybe found at 1,000 m.a.s.l. in Benguet, Central Cordillera, Zambales, and Mindoro.

Forest over limestone. This is a distinct type of vegetation found over karst or calcareous limestone substrates, with a relatively lesser density and diversity compared to lowland evergreen rainforest. High endemism is marked because of specific adaptability to soil type, poor water holding capacity, and poor nutrient availability. *Veitchia merrillii, Dracaena sp., Sterculia spp., Hoya spp.,* and orchids


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dominate this forest type found in Pangasinan, Bulacan, Samar, Palawan, and Cebu at 0-900 m.a.s.l.

Forest over ultrabasic soils. Forests found in ultrabasic soils also yield numerous unique species highly adapted to substrates high in minerals like chromite. Limited to this type of substrate, their distribution coincide with major faultlines in the Philippines where ultramafic or ultrabasic soils were exuded out by past major events of diastrophism. Significant stands are found in Palanan, Palawan, Siargao Island, and Zambales from 0-900 m.a.s.l. dominated by *Scaevola micrantha, Brackenridgia palustris* var. *foxworthyii, Phyllanthus* spp., and *Exocarpus latifolius*.

Semi-deciduous forest. This forest type corresponds to Whitmore's (1984) tropical moist deciduous forest. This is found in the eastern Sierra Madre Range and Palawan where distinct seasonally dry climate predominates. *Pterocarpus indicus, Vitex parviflora,* and *Garuga floribunda* are some of the common species found at 1000 m.a.s.l.

Beach forest. In coastal areas throughout the country, a strand of vegetation composed of species adapted to sandy soils. *Barringtonia racemosa, Erythrina variegata, Acacia farnesiana, Prosopis vidalianus,* and *Casuarina equisetifolia* dominate in this forest type. Sand creeping plants like *Ipomoea* and *Cyperus spp.* are also found extending seaward.

Mangrove/Nipa forest. Rhizophoraceae species and other associated species comprise the mangrove


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forest and occur as dense stands or narrow belts on shorelines extending seaward and in mouths of rivers where fresh and saltwater mix. A transition to nipa *(Nypa fruticans)* forest stand is commonly found in estuarine to freshwater conditions.

Freshwater swamp forest. Inland to 200 m.a.s.l., vast swamp lands yield successional forest formations of varying species composition depending on the water level. Legumes and cyperaceous species are common, while *Terminalia catappa* and *Metroxylon sagu* may occur as dense stands in drier and water logged areas, respectively.

Two forest types were not included in the above classification pending further investigation. These are the *peat swamp forest* in southern Leyte and in some parts of Mindanao and the *tropical semi-evergreen rainforest* on the western side of the archipelago including some parts of Palawan (Fernando, 1989). However, based on Whitmore's description of a peat swamp, those described by Fernando (1989) may actually be climax freshwater swamp forest (Madulid 1994). These suspected peat swamps need to be studied further to validate Fernando's claims. Furthermore, Whitmore (1984) defined tropical semi-evergreen rainforest as a formation influenced by a short dry period. In the Philippines, there are areas which experience short dry periods but their species composition and forest structure must at least be determined to clearly distinguish them from a tropical lowland evergreen rainforest (Madulid, 1994). The Yakal-Lauan and Lauan-Apitong subtypes described by Whitford (1911) could fall under this category (Fernando 1989).

Two other types of forests were not included in the above classification. These are the *grasslands* and *caves*. Grasslands are considered a forest type because of their inclusion in the legal definition of

forests. Generally referred to as grazing lands, grasslands are areas covered by short and tall herbaceous formation dominated by grasses, legumes, and composites with shrubs or small trees appearing isolated, regularly spaced or in clumps (Aguilar, 1995). They cover 10.6 million ha, majority of which are located in Isabela, Nueva Vizcaya, Nueva Ecija, Bukidnon, Cordilleras, Rizal, Palawan, Romblon, Masbate, Cagayan, Cotabato, and Zamboanga (Forestry Statistics, 1993). A total of 124 plant species have been recorded in Philippine grasslands. Four grassland communities have been identified, according to the dominant plant species, namely: *Themeda triandra, Imperata cylindrica, Chrysopogon aciculatus* and *Capillipedium* parviflorum (Sajise et al. 1976).

A specialized ecosystem in the forest is the cave ecosystem. Habitats associated with caves include soil and litter in limestone forests, the superficial underground compartment, cave streams, sump zone, and cave floor habitats. In the Philippines, biodiversity and ecology of caves are poorly known. Observations on the flora around the caves reveal that the vegetation is often dominated by *Ficus* species with roots densely crawling above cave roofs and penetrating the crevices extending to the ceilings of the cave. The mouths of caves are sparsely covered with vegetation, mostly ferns and mosses. Insectivorous bats and civets are common dwellers in caves and their vicinities. Birds like swiftlets *(Collocalia spp.)* are also common cave inhabitants. Not much is known of the macro- and micro-invertebrates in caves. Some of the caves of high biodiversity significance and with a protected status are the St. Paul's Subterranean River in Palawan, Sohoton Caves in Samar, and Callao Caves in Cagayan.

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Data on species composition, dominant species, indicator species, diversity indices, structure of lesser known types of forests in the Philippines such as high altitude forest, forest over limestone, forest over ultrabasic soils, semi-deciduous forest, upper montane forest, and freshwater swamp are unavailable, if not wanting. Information attributed to tropical lowland evergreen rainforests must be reviewed to distinguish variations between tropical lowland evergreen forest, tropical semi-evergreen forest, and semi-deciduous forest.

2.1.2 Biological Characteristics of Philippine Forests

Floral Diversity in Philippine Forests

The flora of the Philippines is composed of at least 13,500 species which represent five percent of the world's flora. The fern and fern allies, gymnosperm, and angiosperm flora represent 22.5 percent of the Malesian and 3.88 percent of the world's vascular flora.

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There are about 8,000+ species of flowering plants and at least 3,200 of these are unique to the Philippines (Madulid, 1993a). Present estimate is lower than that made by Merrill more than 70

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years ago who claimed that almost 68 percent of the total species are endemic to the country. This estimate is not definitive and subject to change based on current inventory and research on Philippine plants.

A high generic endemism is recorded for the Philippines. Lately, Johns (1995) added two more genera of ferns and one flowering plant. The Rubiaceae family has four endemic genera, followed by Asclepiadaceae and Orchidaceae with three each, and Melastomataceae, Loranthaceae, Zingiberaceae, and Sapindaceae with two each. The families with 1 endemic genus are Compositae, Euphorbiaceae, Leguminosae, Rutaceae, and Urticaceae. The two endemic fern genera are *Psomiocarpa* (*Tectaria* group); these have been reduced to *Tectaria* and *Nannothelypteris* (Thelypteridaceae). The list of other endemic genera in the Philippines are found in Madulid (1991a). Nineteen of these are monotypic.

Of the flowering plant families, the Orchidaceae, Rubiaceae, Euphorbiaceae, Myrtaceae, and Moraceae top the list in having the greatest number of indigenous and endemic species. Gramineae, Liliaceae, Ulmaceae, Leguminosae, and Rutaceae have lower percentage of endemism among the plant families in the country (Steiner, 1953).

The gymnosperms are poorly represented with only 33 species and 18 percent endemism (Zamora and Co, 1986).

Ferns and fern allies number to about 1,011 species. Endemism is estimated at about 30 percent (Zamora and Co, 1986).

There are about 506 species of mosses in the Philippines and 116 or 23 percent of these are confined to the country (Del Rosario, 1986). Liverworts and hornworts number to 518 species (Tan and Engel, 1986).

Fungi are estimated to come up to 700+ species and lichens to 790 species.

About five to eight percent of the flowering plants, mosses, fungi, and lichens, five percent of the ferns and liverworts, and five percent of the gymnosperms and algae are believed to have not yet been named up to now.

A detailed list of plant groups in the Philippines is provided by Sohmer (1989) and the IPAS Report (1992).

Faunal Diversity in Philippine Forests

Several inventories of the different faunal groups have been made. The process is continuing and will definitely yield new counts as more habitats are explored. Animals found in Philippine forests can be divided into two major groups: vertebrates and invertebrates. Vertebrates, excluding freshwater fishes as this group is part of the wetlands' biodiversity, recorded in Philippine forests number 1090 species. Of these, 491 or 45 percent are endemic (Table 26).

VERTEBRATES

There are 179 species of mammals, 15 of which are still in the process of being named (Heaney 1986, Heaney 1993; Dans 1995). Endemism of Philippine terrestrial mammals is very high at 61 percent or 110 species.

About 558 species of birds have been recorded in the country and 171 of these are known to be found only in the Philippines (Dickinson et al. 1991). Of these, at least 66 are known to be single-island endemics (Gonzales and Rees, 1988). About 71 percent or 397 species are known to breed in a diversity of habitats from beach to montane forests. However, no breeding information is available on 40 percent or 157 species of these breeding species (Dickinson *et al.* 1991).

Gonzalez (1995) reviewed the number of reptiles in the country and counted 252 species, of which 63 percent or 159 species are endemic. Reptiles are classified into four major subgroups: the lizards (126 species, 75 percent endemicity), snakes (112 species, 54 percent endemicity), turtles (10 species, 10 percent endemicity), and crocodiles (2 species, 50 percent endemicity).

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Table 26 *Number of animal taxa in Philippine forests and levels of endemism*

ANIMAL GROUP	TOTAL NO. OF SPECIES	SPECIES PER TAXA	NO. OF ENDEMIC SPECIES	REFERENCES (compiled from sources cited below)
INVERTEBRATES	23000+			Wang 1950
Millepedes		54		Wang 1950
Centipedes		44		Baltazar 1990
Insects		20000		Platnick 1989 (in Barrion 1995)
Spiders		34000 (estimated worldwide) 341 (in rice and non-rice habitat)		Barrion 1995 Faustino 1928 in Pagulayan 1995
Molluscs		2782		
VERTEBRATES	1084		491	(compiled from Heaney *et al.* 1987; Heaney *et al.* in press; Wilson and Reeder 1993; Dans 1995)
Mammals	179 (15 unnamed)		110	
Volant		73		
Non-Volant		106		
Birds	556 + 2			(compiled from Dickinson *et al.* 1991; Tabaranza and Mallari 1995)
Breeding		397	171	
Reptiles	252		159	Gonzales (1995)
Lizards		126		
Snakes		114		
Turtles		10		
Crocodiles		2		
Amphibians	95		51	Espiritu-Afuang (1995)

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A total of 95 amphibian species are recognized to be found in the country, of which 54 percent (51 species) are considered endemic (Espiritu-Afuang, 1995). Most are also single island endemics. On the other hand, three species are known to have been introduced in the country. The first to be introduced was the marine toad, *Bufo marinus*, which was brought in the 1930s to control beetle infestation of sugar cane. The next to be introduced in the 1970s was the American bullfrog, *Rana catesbiana*, for breeding and export as food. In the 1990s, a third species, *Rana rugulosa*, was found in various parts of Southern Luzon and believed to be introduced for breeding and export as food (A. Diesmos, personal communication). Diesmos also believes that the latter two species have escaped from captivity and are now widespread throughout the country.

INVERTEBRATES

There are 2782 species of mollusks found in the country (Faustino, 1928 in Pagulayan, 1995). The level of endemism is considered to range from high to very high.

The number of species of millipedes and centipedes is 54 and 44, respectively (Wang, 1950), while the number of insect species has surpassed the 20,000 mark (Baltazar, 1990). However, only the lacewings, fleas, caddisflies, two-winged flies, and butterfly species have been fully inventoried (Baltazar, 1990, 1991).

The number of spiders found in rice and non-rice habitats is 341 species, which is less than 2 percent of the world's total (Barrion, 1995). Many more species remain to be discovered and identified, if Barrion's work is to be a gauge and when least studied ecosystems and islands are inventoried. Of the 341 species reported, 257 species are new to science.

The level of endemism of invertebrates is generally poorly known, but is suspected to be high as gleaned from Baltazar (1990, 1992). Endemism ranged from 44 percent to 87 percent with a mean of 64 percent for the six insect orders she reviewed.

2.1.3 Rates of Change

Forest Cover

Several studies and maps have been published on the remaining forest cover in the country (Forest Management Bureau, 1988, 1991; Forest Management Bureau-German Technical Assistance 1988; National Mapping and Resource Information Authority, 1988; Swedish Space Corporation 1988). However, there are some variations in estimates of the different groups. To illustrate, the Forest Management Bureau-German Technical Assistance group (1988) placed the remaining forest cover in 1987 at 64,606 km^2 or 21.5 percent of the total land area of the country while the Swedish Space Corporation (1988) estimated it at 70,226 km^2 or 23.4 percent of total land area. By 1991, the Forest Management Bureau reported only 60,100 km^2 of remaining forest cover (Table 27 and corresponding figure). The annual rate of reforestation from 1983 to 1991, however, continued to increase from 1,050 km^2 to 1,900 km^2 (Forest Management Bureau, 1988).

Between 1948 and 1987, it is estimated that the forest cover decreased from 50.5 percent to between 22.2 percent to 23.7 percent. This loss of

Table 27 *Philippine forest cover*

YEAR	AREA	% OF TOTAL LAND AREA
1920	187,000	62.33
1934	170,000	56.60
1968	160,000	53.30
1969	104,000	34.00
1976	85,000	28.00
1980	74,000	24.60
1983	73,000	24.30
1988	64,000	21.50
1990	62,000	20.70
1991	60,100	20.03

FMB Philippine Forestry Statistics, 1991

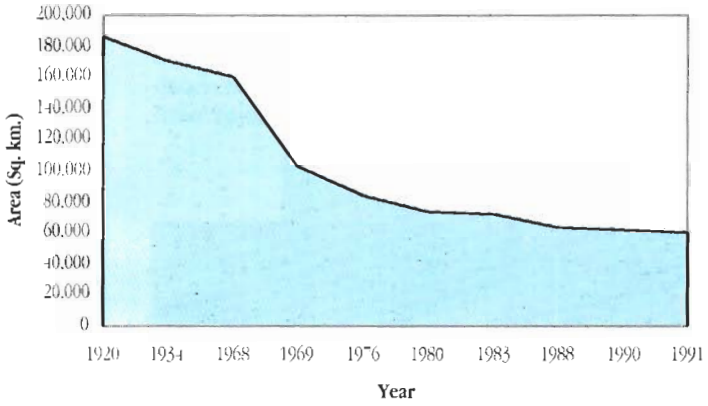

Figure 9 Philippine forest cover

forest cover coincides with the doubling of areas devoted for agriculture and the expansion of urban areas. Furthermore, there was also an increase in the category "others," which implies that forest land, agriculture land, and urban areas are being used for purposes that are unclassified.

Threatened Forest Species

Eighty six species of birds found in the country are under various forms of threat and the classification ranges from being vulnerable to being extinct in the wild. Of these, 45 species are either extinct in the wild, critical, or endangered. Forty of the 45 aforementioned species are endemic birds, making the Philippines, the number one country in the world in terms of threatened endemic species of birds.

In contrast, 30 species of terrestrial mammals are classified under various threat categories, from being rare to being endangered (IUCN, 1994). This number is definitely a conservative estimate as various on-going inventories, once completed, will come out with more species in this list.

Only two species of amphibians and three species of reptiles in Philippine forests are classified under various threatened categories. This is definitely an underestimate as little information about these two groups, as a whole, is known. There is a paucity of information on the conservation status of the other groups of animals, particularly the invertebrates.

The most threatened endemic mammal is the tamaraw, *Bubalus mindorensis*, while the most threatened endemic bird is the Philippine eagle, *Pithecophaga jefferyii*. Both species are estimated to have a wild population of less than 200 each. Both are also the subject of captive breeding studies with very limited success.

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2.1.4 Uses and Values of Forest Biological Resources

Forest species provide a multitude of goods and services to man. These range from filling sustenance needs to meeting commercial production demands. The former are harvested and consumed directly by local populations to meet their daily needs and do not usually go through the market. These include firewood, medicinal plants, food plants, ornamental plants, light construction materials, fodder, game meat, etc. On the other hand, timber, resin, rattans, bamboo, and honey, among others, are usually collected on a commercial scale and go through markets.

Most upland households depend largely on the forest for their fuelwood needs. Branches and leaves are collected and rarely do trees get cut for this purpose. Species used as fuelwood are usually found in secondary growth forests or in the peripheries of primary forests and include *Cordia dichotoma, Antidesma bunius, Antidesma ghaesembilia, Flacourtia indica, Syzygium lineatum*, and *Psidium guajava*. Mangrove species also yield good sources of fuelwood. Examples of these are *Bruguiera sexangula, B. cylindrica, Rhizophora apiculata*, and *R. mucronata*.

Lory Tan

The forest also provides a source of herbal medicine to local populations, particularly to indigenous people who possess a wide knowledge on the medicinal uses of plants. Plants or plant parts such as roots, rhizomes, leaves, bark, and fruits are collected, prepared, and administered to treat illnesses such as fever, skin diseases, abdominal pain, bleeding, nervous disorders, post-natal problems, as well as those believed to be inflicted by supernatural forces. Many of these plants have already been domesticated and cultivated in backyard gardens by indigenous people, upland settlers, and even by the urban populace. Forest plants that yield medicinal products belong mostly to the families Apocynaceae, Zingiberaceae, Solanaceae,

Leguminosae, Rutaceae, Labiatae, Euphorbiaceae and Liliaceae (Madulid, 1992).

Food plants include those gathered, cultivated, and eaten as starch food, grains and cereals, stem, leaf, and flower vegetables, fruit and seed vegetables, condiments, and beverages. Many of these include species under the families Palmae, Gramineae, Araceae, Dioscoreaceae, Rutaceae, Lauraceae and Myrtaceae. In some upland localities, the staple food are underground crops instead of rice or corn. Species rich in starch include sweet potatoes (*Ipomoea batatas*), taro (*Colocasia esculenta*), ubi (*Dioscorea alata*), wild yam (*Dioscorea esculenta*), arrowroot, cassava (*Manihot esculenta*), bia (*Alocasia macrorrhiza*) and bagang (*Amorphophallus campanulatus*). Many domesticated perennial species, now widely distributed in the tropics, originated and still have wild populations in our forests. Some of these are the pili nut (*Canarium ovatum*), mabolo (*Diospyros blancoi*), bago (*Gnetum gnemon*), santol

Lory Tan

(*Sandoricum koetjape*), jackfruit (*Artocarpus heterophyllus*), marang (*Artocarpus odoratissima*) and jambolan (*Syzygium cumini*) (Smith et al. 1992).

Palms probably provide the most diverse uses for local households. Sap is taken from nipa (*Nypa fruticans*) and lumbia (*Metroxylon sagu*). Anahaw (*Livistona rotundifolia*) provides food with its bud and young nuts, construction materials with its leaves and trunks, and developing shoots as vegetables. The buri (*Corypha elata*), the largest indigenous palm species, provides food with its pith and trunk, seeds for ornaments, sap as an alcoholic drink, kernels of young fruits for sweetmeats, leaves for curing tobacco, ribs for broom making, and unopened leaves for hats, fans, mats, bags, and baskets (Garcia et al., 1983; Madulid, 1991b). Rattans support the handicraft and furniture industry, aside from providing materials for personal trappings.

Throughout the country, meat is gathered from wild animals like the Philippine deer (*Cervus mariannus*), wild pigs (*Sus* spp.), wild chicken or 'labuyo' (*Gallus gallus gallus*) and doves (*Chalcopaps indica*). As part of their rituals, cloud rats (*Crateromys*

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Lory Tan

Lory Tan

schadenbergi) are hunted in the Cordilleras. Other animal products exploited are swiftlets' nests, guano, honey and bees wax, and leather from animal skin. Furthermore, many species of animals such as cockatoos, mynahs, eagles, monkeys, snakes, turtles and butterflies are collected and traded as pets, albeit illegally.

Timber production is largely based on the indigenous dipterocarp species which include palosapis (*Anisoptera* spp.), apitong (*Dipterocarpus* spp.), manggachapui (*Hopea* spp.), yakal (*Hopea* spp.), guijo (*Shorea* spp.), Philippine mahogany, red or white lauan (*Shorea* and *Parashorea* spp.), manggasinoro (*Shorea* spp.), and narig (*Vatica* spp). Other non-dipterocarp species which are also sources of timber are narra (*Pterocarpus indicus*), molave (*Vitex parviflora*), acacia (*Acacia* spp.), mahogany (*Swietenia* spp.), *Calophyllum* spp. and *Diospyros* spp.


Lory Tan

Indigenous people and forest dwellers also gather minor forest products from several species of rattan. In the past, these forest products supported a flourishing furniture and handicraft industry in the country. However, this has become a dwindling resource because of overcollection. Species which are commonly gathered for this purpose are sika (*Calamus caesius*), arorog (*C. javensis*), palasan (*C. merrillii*), tumalim (*C. mindorensis*), limuran (*C. ornatus*), and *C. scipionum*. Other rattan species of minor uses are lasi (*C. bicolor*), arugda (*C. arugda*), hamlis (*C. discolor*) and abuan (*C. diepenhorstii*) (Dransfield and Manokaran, 1993) and nito (*Lygodium* spp.), a species collected in large quantities.

Resin, another non-timber forest product, is extracted from almaciga (*Agathis philippinensis*). The collectors apply the crude and destructive method of debarking the tree. This unsustainable practice is endangering the low population of almaciga in the wild.

Many wildlife species are also bred and traded in commercial quantities. Among these are two species of butterfly (*Graphium agamemnon* and *Papilio rumanzovia*) which are exported by the thousands as pupae and dried adult specimens. The Flora Farm in Cauite, Marinduque is one of the eleven farms accredited by the Protected Areas and Wildlife Bureau (PAWB) to breed butterflies.

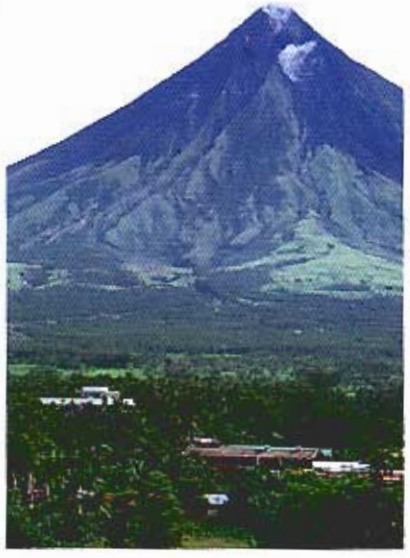
The demand for monkeys as experimental animals and source of polio vaccine and the law on the phase-out on the collection and trade of wild monkeys have encouraged commercial companies to engage in the captive breeding of monkeys. To date, there are six companies in the primate trade namely, A.T. Viri Primate Breeding Corporation, Del Mundo Trading, Ferlite Scientific Research, Inc., Amo Farm, Scientific Primates Filipinas, Inc. and the Simian Conservation Breeding and Research Center (SICONBREC). These six companies are organized under the Primate Exporters and Breeders Association of the Philippines (PEBAP). Recently, however, all the monkeys in one of the companies, Ferlite Scientific Reserve, Inc. were humanly disposed of because two of the monkeys were found positive for the Reston strain of the Ebola virus.


Lory Tan

The diverse forms of life in the forests provide many benefits and services which are non-measurable. These services deal primarily with the functions of ecosystems such as the maintenance of nutrient and water cycles, energy flow, regulation of climate, soil production and protection,

hydrological stabilization, evolutionary processes, and vegetation dynamics (McNeely et al. 1990). They also provide aesthetic (e.g., Mt. Mayon in Bicol), recreational (e.g., Mt. Arayat in Pampanga), sociocultural (e.g., Mts. Halcon and Iglit-Baco in Mindoro), scientific (e.g., Mt. Kitanglad in Bukidnon), educational (e.g., Mt. Makiling in Laguna), spiritual (e.g., Mt. Banahaw in Quezon) and historical (e.g., Bataan National Park) values.

Lory Tan



The foregoing indicates the long tradition in the use of wild plants and animals from the country's forests. There is an increasing focus on the management of multiple uses of forest resources. The concern over sustainability arises primarily from the encroachment of human population and the conversion of forest lands to agricultural areas. Emerging views focus not only on the production of timber but also on other forest products and services. The question of sustainability of harvesting non-timber forest products is related to the rate of extraction or harvesting and the rate of natural replacement. The rate of extraction is influenced by economic factors such as the cost of extraction, opportunity cost of labor, household incomes, consumption patterns, and the use of non-timber forest products as inputs in production activities.

Reforestation

Reforestation is one measure to replace fast disappearing forest resources. It is done by the government sector, primarily the DENR, and the private sector which includes the holders of timber license agreements and other non-government organizations. Timber licenses are privileges granted by the state to individuals or groups to utilize forest resources, timber and non-timber, within a forest land with the corresponding responsibility to develop, protect, and rehabilitate the same land. The licenses are either long term, short term, or provisional.

There is no consistent pattern in the number of hectares annually reforested. It reached lows of 24,000 hectares in 1985 and 19,000 hectares in 1993. In 1988, the area reforested increased by about 60 percent from the previous year. In 1989-1991, the government embarked on a massive reforestation project and 191,663 hectares were reforested in 1991. Generally, the government accounts for a greater percentage of the reforestation efforts. However, in 1993, about 67 percent of the reforestation was done by the private sector, mainly by timber licensees (Table 28 and corresponding Figure 10).

Valuation of Forest Products

In 1993, the gross value added (GVA) of the forestry sector was 3.5 billion (at constant 1985 prices) which was 2.1 percent of the total GVA of the resource sector–agriculture, fishery, and forestry. The forestry sector contributed only 0.5 percent of the country's gross domestic product. The national income statistics do not include non-marketed, nature-based household production. Fuelwood gathering is estimated to be about a quarter in value of the forestry sector's marketed output (ENRAP II, 1994) and the associated imputed labor income is about double at 175 percent of the labor income reported in the national accounts. Based on the 1991 Family Income and Expenditure Survey (FIES), there are about 45,000 families whose main source of income is forestry and hunting as an entrepreneurial activity. Of these, about 70 percent are in rural areas and about 70 percent have annual incomes less than 30,000.

Timber Products

Roundwood is wood in its natural state, felled or otherwise. It comprises all wood from the forest such as sawlog/veneer log, pulpwood, fuelwood, and other industrial roundwood. In terms of volume of production measured in cubic meters, sawlog/veneer log, followed by pulpwood, comprise the major share of roundwood production (Table 29). Both

Table 28 *Area reforested annually 1981-1993 (in hectares)*

YEAR	NEWLY PLANTED AREA			
	GOVERNMENT SECTOR		PRIVATE SECTOR	
	DENR	OTHER AGENCIES	TIMBER LICENSEES	OTHERS
1981	50,707	2,589	20,096	11,149
1982	31,202	3,999	21,588	6,473
1983	27,155	15,084	31,703	4,596
1984	15,520	568	14,186	8,661
1985	12,201	483	8,138	3,399
1986	22,495	1,931	6,572	2,000
1987	27,558	1,285	7,956	3,012
1988	30,890	336	25,126	9,831
1989	82,966	6,486	32,087	9,865
1990	146,718	7,231	35,1153	4,271
1991	72,238	1,364	18,089	1,348
1992	24,504	–	11,685	4,600
1993	6,347	–	12,692	172

Source: Forest Management Bureau, DENR

a_ Including Enrichment Planting of Timber Licenses

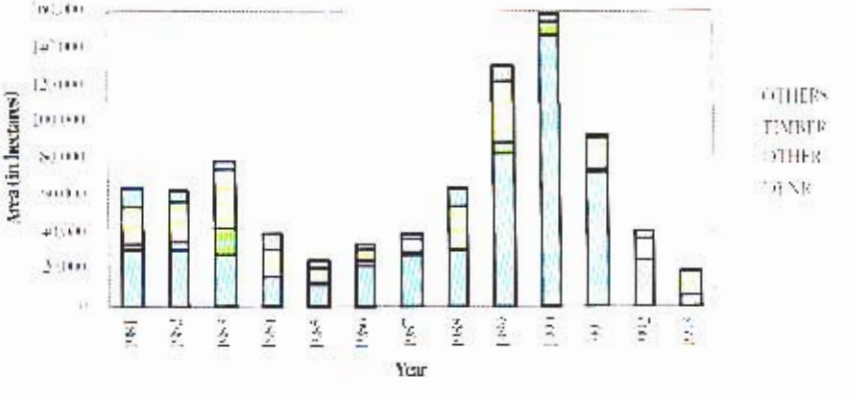


Figure 10 Area reforested annually 1981-1993 (in hectares)

Table 29 *Quantity of production of logs, lumber, plywood, veneer, and other processed wood products 1981-1993*

YEAR	WOOD PRODUCTS (in thousand cubic meter)				OTHER PROCESSED WOOD PRODUCTS (in thousand metric tons)			
	LOGS	LUMBER	PLYWOOD	VENEER	PAPER-BOARD	FIBER-BOARD	PARTICLE-BOARD	BLOCK-BOARD
1981	5,420	1,219	157	364	247	–	–	6
1982	4,589	1,200	422	159	225	–	–	10
1983	4,168	1,222	459	116	215	–	8 b_	10
1984	3,872	1,234	438	84	251	–	3 b_	12 b_
1985	3,568	1,062	350	77	155	–	2	7
1986	3,434	977	424	73	185	–	4	21
1987	4,147	1,233	517	75	65	–	–	15
1988	3,809	1,033	415	85	244	36	–	20
1989	3,169	975	344	61	239	...	...	9
1990	2,503	841	397	49	175	...	...	17
1991	1,922	726	321	54 a_	392	...	...	6
1992	1,458	647	330	80	...	...	...	5
1993	1,022	440	261	65	...	...	...	4

Source: Forest Management Bureau, DENR

a_ *Excluding data for the autonomous Region of Muslim Mindanao (ARMM)*
b_ *Industrial-use only*

sawlog/veneer log and plywood production have been declining, with pulpwood increasing its share in production particularly in 1992 and 1993 (Table 30). Data on log production by species in 1993 is given in Table 31. In terms of volume, the top species used are tanguile and gubas; commonly used also are mayapis, almon, red lauan, bagtikan, white lauan, and moluccan sau. Table 32 presents the data on the downstream production of logs, lumber, plywood, veneer, and other processed wood products. The general decline in the quantity of downstream timber products produced reflects the decline in forestry primary production.

Non-timber Products

Official harvest statistics on 13 non-timber forest products were compiled by the Forest Management Bureau of the DENR (Table 33). By 1992, harvest statistics were given for only seven of these products. The statistics indicate a general decline in harvest relative to 1990 levels except for anahaw leaves, unsplit rattan, and nipa shingles. Regional production data for 1993 is given in Table 34. Rattan was harvested from all regions of the Philippines except Western Visayas (Region 6). The biggest source of rattan and bamboo in 1993 was Southern Mindanao (Region 11). Bamboo and nipa shingles were also harvested from several regions.

Other kinds of non-timber products harvested from one or two regions only are as follows: (1) Almaciga resin—Southern Tagalog, Eastern Visayas; (2) Anahaw leaves—Cagayan Valley, Bicol; (3) Bamboo stumps—Ilocos; (4) Diliman and other vines—Southern Tagalog; (5) Palmabrava trunk—Cagayan Valley, Bicol; and (6) Split rattan—Cagayan Valley

Cagayan Valley (Region 2) and Bicol (Region 5) have the most variety among the reported kinds of non-timber forest products.

Forest charges are charges paid to the national government for the extraction of a forest resource

Table 30 Roundwood products share in total production, 1981-1983 (in percent)

YEAR	TOTAL	LOG			FUELWOOD/FIREWOOD		
		SAWLOG/ VENEER LOG	PULP-WOOD	POLES & PILES	MANGROVE	UPLAND	CHARCOAL
1981	100.00	88.49	8.95	0.36		1.70	0.51
1982	100.00	85.00	11.57	1.60	0.30	1.48	0.04
1983	100.00	81.36	16.11	0.84		1.03	0.66
1984	100.00	67.20	23.06	0.21		8.29	1.24
1985	100.00	81.37	9.40	0.38		7.92	0.92
1986	100.00	85.79	8.86	1.06		3.48	0.81
1987	100.00	80.23	16.01	1.27		1.81	0.68
1988	100.00	81.81	15.80	0.23		2.08	0.08
1989	100.00	86.91	10.91	0.68		1.46	0.03
1990	100.00	83.05	12.90	0.46		2.58	1.00
1991	100.00	72.91	16.30	0.56		7.85	2.38
1992	100.00	45.53	27.72	8.59		10.13	8.03
1993	100.00	59.46	20.92	8.33		8.51	2.78

Source: Forest Management Bureau, DENR

Table 31 Log production by species (in thousand cubic meters)

	PHILIPPINES	CAR	REGION 2	REGION 4	REGION 5	REGION 10	REGION 11	REGION 12
Almon *(Shorea almon)*	84	–	–	–	–	2	79	2
Apitong *(Dipterocarpus grandiflorus)*	38	–	a	–	–	1	25	–
Bagtikan *(Parashorea plicata)*	70	–	1	–	–	3	55	–
Binuang *(Octomeles sumatrana)*	13	–	1	a	–	1	11	–
Gubas *(Endospermum peltatum)*	125	–	–	a	–	121	4	–
Guijo *(Shorea guiso)*	3	–	–	–	–	–	2	–
Loktob *(Duabanga moluccana)*	4	–	a	1	–	–	4	–
Mangasinoro *(Shorea philippinesis)*	a	–	a	–	–	–	–	–
Mayapis *(Shorea squamata)*	87	–	10	–	–	–	69	3
Mollucan Sau *(Paraseriantes falcataria)*	64	–	–	3	–	a	52	–
Nato *(Palaquim luzoniense)*	7	–	–	–	–	12	7	–
Palosapis *(Anisoptera thurifera)*	1	–	a	a	–	a		–
Red Lauan *(Shorea negrosensis)*	84	12	11	1	–		50	5
Tanguile *(Shorea polysperma)*	183	–	16	5	–	1	60	8
Tiaong *(Shorea angaboensis)*	a	–	–	2	–	94		–
Toog *(Combetodendron quadrialatum)*	20	–	–	–	–	–	17	3
White Lauan *(Pentacme contorta)*	65	–	10	1	–	1	46	4
Yakal *(Shorea astylosa)*	a	–	–	–	–	–	a	–
Others	42	–	3	8	a	9	16	3
TOTAL	**890**	**12**	**52**	**22**	**a**	**245**	**497**	**28**

Source: Timber Licensees' Reports

a – less than one thousand

Note: CAR – *Cordillera Autonomous Region*
Region 2 – *Cagayan Valley*
Region 4 – *Southern Tagalog*
Region 5 – *Bicol*
Region 10 – *Northern Mindanao*
Region 11 – *Southern Mindanao*
Region 12 – *Central Mindanao*

Table 32 *Quantity of production of logs, lumber, plywood, veneer, and other processed wood products, 1981 to 1993*

YEAR	WOOD PRODUCTS (in thousand cubic meter)				OTHER PROCESSED WOOD PRODUCTS (in thousand metric tons)			
	LOGS	LUMBER	PLYWOOD	VENEER	PAPER-BOARD	FIBER-BOARD	PARTICLE-BOARD	BLOCK-BOARD
1981	5,420	1,219	457	364	247	–	–	6
1982	4,589	1,200	422	159	223	–	–	10
1983	4,468	1,222	459	146	213	–	8 b/	10
1984	3,872	1,234	438	84	251	–	3 b/	12 b/
1985	3,568	1,062	350	77	155	–	2	7
1986	3,434	977	424	73	183	–	4	21
1987	4,147	1,233	517	75	65	–	–	15
1988	3,809	1,033	415	85	244	36	–	20
1989	3,169	975	344	61	239	...	...	9
1990	2,503	841	397	49	175	...	...	17
1991	1,922	726	321	54 a/	392	...	...	6
1992	1,438	647	330	80	...	...	...	5
1993	1,022	440	261	65	...	...	...	4

a/ Excluding data for the Autonomous Region of Muslim Mindanao (ARMM)
b/ In thousand cubic meters

Source: Forest Management Bureau, DENR

Table 33 *Non-timber forest products harvested, 1976 to 1993 (in thousands)*

YEAR	ALMACIGA RESIN (kg)	DILIMAN and other VINES 1/(kg)	SPLIT RATTAN (kg)	SALAGO BARK (kg)	TANBARK (kg)	BURI-MIDRIBS (piece)	NIPA SHINGLES (piece)	ANAHAW LEAVES (piece)	BAMBOO and BOHO (piece)	HONEY (Liter)	UNSPLIT RATTAN (linear meter)
1976	590	3	197	47	785	69	630	–	76	–	7308
1977	648	3	66	–	131	–	736	–	787	2	3751
1978	617	63	186	36	21	36	1492	–	426	27	6889
1979	317	–	1055	191	41	–	809	–	1769	53	10628
1980	506	4	348	543	10	32	2624	–	327	2	12758
1981	476	31	1177	673	859	308	2978	40	885	1	33511
1982	1407	21	195	258	83	97	4126	22	647	94	15594
1983	462	13	73	83	52	57	3166	96	410	1	24244
1984	191	12	2770	144	98	155	1757	6	309	–	25370
1985	380	39	72	47	53	48	2675	31	644	1	19437
1986	386	3	249	156	1020	33	3989	–	428	1	28588
1987	485	8	98	2	33	5	3579	2	402	*	33902
1988	700	–	54	8	–	41	2504	9	133	–	34215
1989	472	35	30	2	–	88	5298	16	204	*	33254
1990	943	–	10	6	30	58	8023	2	984	–	19266
1991	780	104	568	–	–	16	14719	41	892	*	25732
1992	634	163	30	–	–	–	12634	33	704	–	22693
1993	567	84	1	–	–	–	9018	42	475	–	24845
	576										

1/ Includes lingiw and nito

Source: Forest Management Bureau, DENR

Table 34 Production of selected non-timber forest products by region: 1993

REGION	ALMACIGA RESIN (kg)	ANAHAW LEAVES (piece)	BAMBOO (piece)	BAMBOO STUMPS (kg)	DILIMAN & OTHER VINES (kg)	NIPA SHINGLES (piece)	PALMABRAVA TRUNK (piece)	SPLIT RATTAN (kg)	UNSPLIT RATTAN (linear meter)
CAR			8,000						602,500
1			17,180	12,000				1,400	29,760
2		10,000	9,000			2,701,647	4,090		647,264
3			79,960						587,287
4	569,095				84,450	69,762			4,488,029
5		31,500	31,897			1,771,700	5,704		89,044
6						3,291,164			
8	67,000					73,164			1,577,271
9						446,000			155,665
10						664,200			5,122,117
11			329,278						11,446,868
12									1,510,801
ARMM*									689,000
Philippines	**576,095**	**41,500**	**475,315**	**12,000**	**84,450**	**9,017,637**	**9,794**	**1,400**	**24,845,436**

** Autonomous Region of Muslim Mindanao.*

Source: 1994 Philippine Statistical Yearbook

Table 35 Forest charge collections on non-timber forest products, by region: 1993 (in pesos)

PRODUCT/REGION	PHILIPPINES	CAR	1	2	3	4	5	8	9	10	11	12
Almaciga resin	576,095	–	–	–	–	569,095	–	67,000	–	–	–	–
Anahaw leaves	250	–	–	10	–	–	240	–	–	–	–	–
Bamboo	74,580	–	5,850	2,000	8,250	–	47,481	–	–	–	9,975	–
Diliman & other vines	3,040	–	–	–		3,040		–		–	–	
Nipa shingles	151,895	–	–	103,839	–	175	42,270	–	1,611	1,197	2,021	–
Palmabrava	37,002	–	–	17,138	–	–	19,554		–	–	–	–
Unsplit rattan	11,350,415	164,200	–	476,415	11,101	1,565,702	30,987	625,901	501,372	1,206,034	6,414,725	504,073
TOTAL	**12,172,283**	**164,200**	**5,850**	**599,612**	**19,384**	**2,108,312**	**140,532**	**692,901**	**502,865**	**1,207,231**	**6,427,323**	**504,073**

Source: Forest Management Bureau, DENR

or its product (B. Lansigan, personal communications). In 1993, total forest charges collected by the national government amounted to 12.2 million, which is over a tenfold increase from the 1990 collection. This increase may likely be due to better collection efforts on the part of the government. A regional breakdown of forest charge collection in 1993 is presented in Table 35. Southern Mindanao (Region 11) paid the most in forest charges mainly from unsplit rattan. In 1993, the charges on unsplit rattan accounted for 93 percent of the total forest charge collection of the national government.

Table 36 shows the forest charge rates for selected non-timber products by region. The forest charge for every kilogram of almaciga resin in the two regions that produce it. Regions 4 (Southern Tagalog) and 8 (Eastern Visayas), is P1.00. The forest charge rates for other non-timber forest products are not as consistent as that of almaciga resin. For instance, the rate for unsplit rattan is P1.89 per 1,000 linear

Table 36 *Forest charge rates for selected non-timber forest products, by region: 1993 (in pesos)*

REGION	ALMACIGA RESIN (per kg)	ANAHAW LEAVES (per 1000 pcs)	BAMBOO (per 100 pcs)	DILIMAN & OTHER VINES (per 100 kg)	NIPA SHINGLES (per 100 pcs)	ALMABRAVA TRUNK (per pc.)	UNSPLIT RATTAN (per 100 linear mts)
Philippines	1.00	6.02	15.48	3.60	1.68	3.78	45.60
CAR			0.00				27.26
1			54.05				0.00
2		1.00	22.22		3.84	4.27	73.59
3			10.56				1.89
4	1.00			3.60	0.68		35.55
5		7.62	148.86		2.39	3.43	34.80
6					0.00		
7							
8	1.00				0.00		45.45
9					0.55		66.14
10					0.18		38.63
11			3.05				56.04
12							58.46
ARMM*							0.00

*Autonomous Region of Muslim Mindanao

meters in Region 3 (Central Luzon) while in Region 2 (Cagayan Valley) the rate is about 40 times higher at 73.59 per 100 linear meters. Surprisingly, in Western Visayas (Region 6), no charges were collected for the 3.3 million nipa shingles produced although the region itself harvested the largest volume of nipa among the 14 regions. Likewise, there was absence of charges for unsplit rattan in Region 1 (Ilocos) and ARMM, bamboo in CAR, and nipa shingles in Eastern Visayas (Region 8). The variation in forest charge rates across regions for a given product can be due either to problems in data collection or actual variations in the administration of the tax collection.

Table 37 lists the animals used by indigenous groups for food, medicine and other purposes. Note that the animals are not the usual commercial domestic exotic species consumed or utilized by Westernized society. Hence, for indigenous groups, the conservation of biodiversity and protection of the habitat of the wildstock is of significant importance for the preservation of their cultural practices.

2.2 Diversity in Wetland Ecosystems

2.2.1 Introduction

The following types of wetlands were assessed: lakes and reservoirs, rivers, marshes and swamps, bays and islands, and covered the following biotic groups: microalgae, aquatic macrophytes, aquatic invertebrates (including aquatic insects), fishes, and waterfowl.

Lory Tan

***Table 37** Wildlife used by indigenuos groups, their location, and uses*

LOCATION OF INDIGENOUS GROUPS	WILDSTOCK	USES
Cordillera and Northern Luzon (CAR, Regions 1 and 2): *Kankana-ey, Ifugao* Kalinga Apayao, Abra, Mt. Pulog, Ifugao, Imugan Nueva Viscaya, Benguet, Isabela	lizard, snake	symbol of life, used on tombs and weaving design
Central Luzon and Bicol (Regions 3 and 5): *Dumagat, Aeta, Agta*	hornbill, wild pig, bato-bato	
Iloilo (Region 4): *Batak, Tagbanua* Mindoro (Region 4): *Hanunuo*	monkey, deer, wild pig, wild chicken manog (snake); mangkal; maninina; bukaran; ibid; halo (bayawak-lizard); kabog (bat); madal (white-widcat); garong (black-wildcat); pispis; periko; igbas; tulihao alimukon; pitaw marin; umbok; tikling; kalaw; tirik; maya; agdal; sai-log-sili (ell); kagang (crabs); awis; tabang (shrimp); banag; agnos; tambariko; etc.	for food
Mindanao (Regions 9-12): *T'boli, Moro-Magindanao; Manobo; Moro-Tamuag; Lumad-Tedurag/Tiruray*	wildpig & hornbill	for food and decorations. The beak is burned and the smoke is inhaled by asthmatic persons
	monkey (skell)	for medicinal purposes: to cure human skin diseases and anti-plague for chicken
	sawa (snake)	for food; for medicinal purposes for gall bladder and rheumatism
	usa (deer)	the horn is burned for "*panosa*" for decorations and clothing
	milo (civet cat)	for decoration; textile; symbol

Source: Nozawa, Cristi Marie. "Community Involvement in Wildlife Conservation," Enviroscope Vol. VII no. 8, 1993

Lory Tan

2.2.2 Biological Characteristics

Philippine wetlands are endowed with a rich diversity of flora (1,616 species) and fauna (3,675 species). These consist of algae, aquatic macrophytes, aquatic invertebrates, insects and fisheries, which represent the dominant components of the complex food webs which have evolved in the different wetland types. While inventories of these groups have yet to cover the 78 lakes, 421 major rivers, the four major swamps/marshes and the many bays, estuaries and mudflats of the country, the initial biodiversity records (5,291 species) are impressive enough.

The algae, which contribute substantially to the primary productivity of wetlands, e.g., lakes, marshes, river systems, and reservoirs, include 1,177 species in 212 genera and six classes. Of the 360 species of blue-green algae reported, however, about 70 percent often occur in terrestrial habitats. In terms of species richness among biogeographic zones, BZ D (Southern Luzon) appears to have the highest diversity, which may not reflect the true situation because this is also the zone with the highest concentration of phycologists and algal studies. Moreover, the fact that comprehensive studies of algae have been conducted in very few lakes, e.g., Taal Lake, Laguna de Bay, Lake Buhi, Looc Lake, the two Mt. Pinatubo Lakes, the extent of algal endemism cannot be assessed until thorough surveys of Philippine and Asian wetlands shall have been done. However, these efforts may no longer prove useful for many rivers which are increasingly being polluted by agricultural, industrial, and domestic wastes, rendering them inhabitable for beneficial aquatic organisms.

Aquatic macrophytes of Philippine wetlands include 431 species of angiosperms, one bryophyte species and seven species of ferns and allies in 73 families. Out of 439 species, only 13 are endemic, less than one percent, while most of the species are widespread throughout the Philippines and other regions of the world.

Ten classes of invertebrates representing 1,703 species have so far been recorded from Philippine wetlands, with the mollusks (728 species) and arthropods other than insects (498 species) as the biggest groups. In terms of species richness, biogeographic zones F (Mindoro, 607 species), D (Southern Luzon, 429 species) and I (Central Visayas, 280 species) exhibit the greatest diversity of wetland forms. Sponges, cnidarians, free-living flatworms, annelids, and nudibranchs have yet to be included in future inventories.

The insects, ordinarily excluded from most biodiversity/wildlife studies, cover 1,764 species in 395 genera, 73 families and 9 orders for Philippine wetlands. Actual surveys may reveal more numerous species than are already known. Of these, 1,146 species are endemic (64.97 percent endemism), often confined to specific localities within the country. At the order level, however, endemism is much higher, e.g., pygmy locusts (84.7 percent), caddisflies (82.1 percent). The high endemism of insects of wetlands, therefore, is justification enough to merit research into their roles in the ecological communities which characterize each wetland type. In terms of endemic species richness among biogeographic zones, out of 1,146 endemic species, BZ N (Mindanao) appears to exhibit the most number of endemics having 358 species, followed by BZ D (North, Central and Southern Luzon) with 327 endemics, BZ B (Cordilleras) with 81 endemics and BZ K (Palawan) with 65 endemics.

A partial inventory of the important wetland species of fisheries and aquaculture, both in the wild and/or cultured in inland waters, covers 208 species. Of these, 102 species are finfishes, 59 are mollusks and 47 are crustaceans. Among the finfishes, ten marine species have been cultured in pens or cages by mariculture. While the number of endemic species has yet to be determined, at least 17 species are considered exotic or introduced to the Philippines. Many species which were previously confined to individual or several lakes have now extended their range of distribution. Some species, however, have remained confined to individual lakes, e.g., tawilis *(Harengula tawilis)* and maliputo *(Caranx sp.)* in Taal Lake, goby *(Hypseleotris agilis)* and paitpait *(Punctius binotatus)* in Lake Mainit, with about 14 species in Lake Lanao.

One hundred and ten species of waterfowl were recorded in the last five years of annual census (1990-1994). These include (a) swimmers such as the ducks and geese (Anatidae), (b) aerialists such as the terns (Sternidae) and gulls (Laridae), (c) large waders such as the herons and bitterns (Ardeidae), rails, gallinules, and coots (Rallidae), (d) small waders such as the plovers (Charadriidae), sandpipers, curlews, godwits, and snipes (Scolopacidae), painted snipes (Rostradudidae) and stilts (Recurvirostridae).

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2.2.3 Rates of Change

This impressive record of biodiversity, however, does not reflect the extent of biodiversity loss that has occurred in the last decade or so in the different wetlands of the country. Depending on when the inventory for each group was made, the current species diversity may reflect either the current level or the remnant of a much richer diversity in the past. A third scenario could assume that more species remain unexplored/undiscovered and could constitute even twice the currently known number. If the latter scenario reflects the real situation, we find ourselves racing against understanding the actual extent of existing biodiversity as part of our national heritage and the rapidly expanding population and its concomitant overexploitation of resources in and out of the wetlands, bringing about a negative chain of reactions, e.g., overfishing, tenurial problems, denudation of watershed areas along and around river basins and lakes, soil erosion, siltation, organic and chemical pollution, eutrophication, mangrove conversion, breakdown in food chain balances and the checks and eventual death of aquatic organisms. In many instances, the extent of habitat loss will provide a good measure of biodiversity loss.

2.2.4 Uses and Values of Wetland Biological Resources

The value of wetlands are many. In terms of primary productivity, they exceed the net primary productivity of the tropical rain forest and the tropical seasonal forest. Although the combined biomass of all wetland types is way below the biomass of woodlands and shrublands, there are particular wetlands, e.g., swamps and marshes, which may exceed the production or biomass of cultivated land.

On a global scale, wetlands are a precious and one of the richest repository of biodiversity. Wetland vegetation prevent export of topsoil through erosion. They buffer the effects of typhoons particularly on coastal human settlements that are open to the ravages of turbulent waters. Waterfowl and various forms of wildlife find their abode in wetlands which are the venue for the yearly flight out of temperate climes of migratory birds. The water supply of groundwater and surface waters depend on wetlands for continued flow. Wetlands are a source of food and means of livelihood, not to mention their role as a repository of genetic diversity. Revenues from wetland products prop up the economy of nations blessed with extensive wetlands like the Philippines.

Philippine wetlands offer a wide array of amenities, foremost of which is as a major source of food. The most commercial resources are the fisheries. In 1990 alone, Philippine fish production was 2.2 million MT, representing 2.3 percent of the world's production, placing the Philippines at the 11th rank among 80 fish producing countries of the world. From 1982 to 1991, the average production slightly increased to 2.219 million MT with a value of P36.5 M. The major fish catch species showed a declining trend over a 10 year period. However, production of cultured species in fish cages increased substantially throughout the country with the advances in aquaculture techniques, e.g., intensive density stocking and intensive feeding.

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In relation to the country's gross national product (GNP), the 1987 data show that the fisheries sector account for just five percent of the GNP. It is estimated that about one million fishermen and fish farmers were directly employed by the fishing industry. At present, fisheries products constitute

about 3.4 percent of the total national foreign exchange earnings and the value of fisheries exports increased steadily from 532 M in 1978 to 6.445 B in 1987. The increase is attributed to the growth in tuna fisheries and the rapid expansion of high value cultured shrimp and seaweed exports. The 10 major Philippine exports in 1987 included shrimp/prawn (1st), followed by tuna, seaweeds, shellcraft articles, cuttlefish/squid, fish kept alive for transport, clam shell meat, milkfish, capiz shells, and sea cucumber.


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Many other uses of wetlands difficult to measure in monetary value, at this stage when biodiversity inventories remain incomplete, are catchment areas or water management areas, navigation, nature conservation area, sanctuaries for protected species, agroforestry, flood control, education, community-based type of resource, scientific research and a rich repository of genetic and biotechnological material for future food and food ingredient sources, new varieties, medicine, ornamental species, cosmetics and pesticide products. The stage of biotechnology development in the country in terms of tapping biological resources in the wetlands is at best in the pioneering/infant level. From the ecological perspective, all species in specific wetland bodies are essential components of the food web.

Algae are significant in water quality studies where the structure and function of phytoplankton communities can measure the impact of physicochemical changes. In effect, algae are utilized as water quality indicators. Algal standing crop and primary productivity are also used to predict fish yield. When satisfactorily refined, this type of information can serve the needs of resource managers. Microalgae have gained importance in health, nutrition, and medicine. The single-cell proteins, *Chlorella* and *Spirulina* are recognized health foods that are sources of vitamins, carotene, and high quality protein. Fish, chicken, and humans benefit from their nutritional properties. Not a few have borne witness to the cancer curing effect of *Spirulina*.

In general, aquatic macrophytes are beneficial to the ecosystem. They are important in soil stabilization of riverbanks and lakeshore lines, provide food and shelter to fish and other organisms, and help in water purification and nutrient cycling. Some plants are of direct importance to man. Species like *Ipomoea aquatica*, *Nelumbo nucifera*, *Rorippa indica*, *Sagittaria sagitifolia*, *Eichhornia crassipes* and *Typha angustifolia* have edible parts, while plants like *Acorus calamus* are utilized in folk medicine. The water fern Azolla is now widely used throughout the country as an organic fertilizer in lowland ricefields. Aquatic macrophytes are sources of animal feeds, chemicals, fibers for paper-making and materials for handicrafts. They are also used for green manuring and composting, as aquarium specimens and in providing aesthetic value to landscapes.

Arthropods, mollusks, echinoderms and the zooplankton (rotifers, cladocerans, copepods) are of ecological, biomedical, and general economic importance. For instance, many species of crabs, clams, oysters, mussels, snails, and sea cucumbers are utilized as food. Apart from their food value, the shells of mollusks are used by the shellcraft industry thus providing additional sources of income. As filter feeders or detritus processors, bivalves help in the recycling of nutrients and are used also as indicators of pollution in aquatic ecosystems. Some freshwater snails serve as intermediate hosts to a number of helminth parasites (trematodes) and are therefore of human and veterinary medical concern. The zooplankton, on the other hand, are important in that they not only serve as food to other aquatic organisms but are also useful as biological indicators in water quality studies. Moreover, some species of marine mollusks like the cone shells, *Conus* spp., are being used in biomedical research. A number of neuropeptides

have been isolated from these animals and they are thus considered as very valuable tools in neuroscience (Cruz, 1990).

Wetland insects play various roles in maintaining biotic communities of different habitats, from saprophytic to predacious habits. They often serve as food for other organisms like fish. Predacious groups contribute to the ecological balance within the habitats through regulation of populations of prey species.

The Philippines is characterized by high endemism mainly due to its geographical position in the humid tropical belt and geological history as tectonic and island arc formations. Its nearness to the Sunda Shelf has also contributed to the spread of Indomalayan components into many parts of the country, particularly Palawan, Sulu via Borneo and Sulawesi as well as for Mindanao. The Philippines, therefore, is a veritable haven for systematic and biogeographic research, particularly on evolutionary mechanisms related to speciation, the role of islands in evolution of insect groups, the role of mountain ranges and associated forests and water bodies to evolutionary processes, etc. One result is an array of morphological and ecological adaptations in insects of wetlands. This rich historical evolutionary heritage makes the Philippines a unique gigantic natural laboratory from which one can learn much regarding living forms and their origins and adaptations to changing environments.

2.3 Diversity in Marine Ecosystems

2.3.1 Introduction

Biodiversity within the three coastal marine habitats, namely, *coral reefs*, *seagrass beds*, and *soft bottom communities* was considered. While mangrove forests are very much a part of this marine macroecosystem in the tropical world, they are only partially included in specific sections of the report if only to emphasize the inherent connectivity that exists among the ecosystems. (see Section 2.1)

2.3.2 Description of Biodiversity and Biological Resources

Composition and Characteristics

Results of inventories so far conducted in Philippine coastal and marine habitats indicate that at least 4,951 species of marine plants and animals exist (Table 38). Among the taxa represented, fishes, non-coral invertebrates and seaweeds occur in greatest numbers. One thousand three hundred ninety six species or 28 percent are economically important, 403 or 10 percent are flagship species, while 145 species or 2.4 percent are under threat. Fifteen species are listed as endangered. Sixteen species or 0.3 percent, all fish, are endemic, while 123 or 2.2 percent are known indicators of environmental conditions.

In terms of their distribution among the ecosystems (including mangroves) along Philippine coasts, coral reefs are by far the most diverse or species rich with 3,967 species (Table 39). Seagrass beds follow with 481 species and then mangroves with 370

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Table 38 Composition and current characteristics of biodiversity in Philippine marine environments

TAXON	NO.	IMPT	ENDEM	THREAT	ENDAN	FLAG	INDIC
Marine fungi	7						
Seagrasses	16	3				15	3
Seaweeds	1,062	531		60			12
Bluegreen	65						
Green	266						
Brown	182						
Red	549						
Corals	381					381	
Other Inverts	1,616	152		44			
Annelids	101					101	
Arthropods	257						
Echinoderms	641						
Molluscs	538				3		7
Sponges	31						
Jelly fish	48						
Fish	1,851	672	16			7	
Mammals	18	18		18	1		
Reptiles	20						
Snakes	15	15		15	7		
Turtles	5	5		5	4		
TOTAL	**4,951**	**1,396**	**16**	**145**	**15**	**403**	**123**

THREAT threatened, IMPT economically important, ENDEM endemic, FLAG flagship, INDIC indicator ENDAN endangered

Table 39 Distribution and number of marine species among the coastal ecosystems (including mangroves)

	SEAGRASS	CORAL REEF	SOFT BOTTOM	MANGROVES
Seagrass	16	14	3	2
Seaweeds	154	1,043	0	72
Corals	8	381	0	0
Other Invertebrates	73	1,485	67	39
Fish	218	1,030	0	241
Mammals	1			
Reptiles	11	14		16?
TOTAL NO.	**481**	**3,967**	**70**	**370**

species. Soft bottom communities has the lowest recorded species richness with 70 species. The 381 coral species and 1,030 species of fish recorded in Philippine coral reefs ranks the country second to the Great Barrier Reef in coral and coral reef fish diversity. The 16 taxa of seagrasses recorded in the Philippines gives the country the second highest seagrass species richness in the world.

The total number of species so far described gives us some idea of the minimum extent of Philippine marine species richness, while knowledge of the distribution of species in the better known categories gives us an impression of the way in which species richness is allocated between the biogeographic zones and ecosystems. The results of this assessment indicate that especially for the invertebrates and soft bottom communities, the number of described species do not account for the major portion of the country's biodiversity. However, those taxa that are the most numerous may represent a highly biased sample, while the


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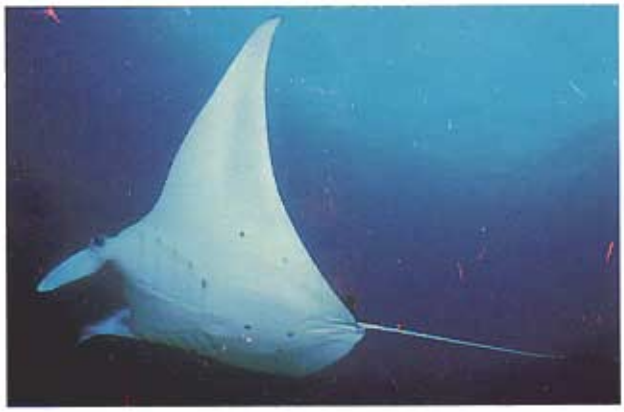
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least accessible, less readily available for easy investigation, and of less economic importance, represent the under represented group.

Table 40 summarizes the important features of the coastal marine habitats in the Philippines.

Species and Habitat of Special Concern

Special attention to single species and ecosystem as well are given because they offer remarkable meaning to the conservation of marine biodiversity in the Philippines and Southeast Asia, thus: sea cow, sea turtles, the giant clam, and the seagrass bed. Not only that the species are listed as threatened to extinction, and the ecosystem is a 'hotspot' (an area rich in total numbers of species or numbers of a particular kind or category of species) and is ecologically intimately linked to the survival especially of the first two species, but their natural stocks are disappearing along the region's coasts at a rate faster than we are acquiring the needed information to protect them.

In a sense, all species and ecosystems are of equal importance since all are survivors of 3.5 billion years of change. But certain species and habitats such as those mentioned above are more 'important' than others, this attribute arising pragmatically from their traditional use for instance, as food, or subjectively accorded to the species by people due to admirable traits the species possess.

2.3.3 Rates of Change

Due largely to the constraints in defining ecosystem boundaries, it is extremely difficult to measure existing areas of any given habitat or ecosystem and even more problematic to estimate their rates of change or loss. In large part this is because habitat alteration covers a wide spectrum of change, from short-term, slight and reversible disturbance to complete and effectively irreversible destruction. This is compounded by the dynamic nature of ecosystems on a time scale ranging from hours to millions of years. In the Philippines where about five percent of the coral reefs remain in excellent

Table 40 *Features of Philippine coastal marine habitats*

ECOSYSTEM	DEFINITION	DESCRIPTION	DISTRIBUTION	USE	THREATS
Coral reef	system on calcareous foundation of plants and animals which have developed their own biogenic substrate	shallow, less than 50 m, clear waters; circumtropical; high-low energy system	fringing throughout the country; oceanic and flatform reefs present	ornaments; fisheries; tourism; construction materials; fish pens; seaweed culture; industrial uses	mining; cyanide, blast, muro ami fishing; crown-of-thorns; land-based pollution; siltation; storms; El Niño; tourism; expanding coastal population;
Seagrass bed	dominated by flowering plants living totally submerged	usually shallow to subtidal waters; 20-30 m beds found in clear waters	reef and non-reef (in coves and sheltered bays)	spawning, nursery grounds; food production; fertilizer; roofing materials; substrate stabilizer; fisheries	siltation; trawling; wastes and effluents; seaweed farming; dredge and fill; reclamation, shell collection; anchor damage; sand mining
Soft Bottom	areas with substrate of fine particulate matter, mud or sand	shallow coastal areas associated with estuaries and deep water inter-reefal areas	within most bays and after reef slopes of islands	fisheries; mariculture; dredging habitat for fish, squid, etc.	pollution; trawling; reclamation; intensive mariculture; increased sedimentation; pesticides
Mangrove forest	intertidal plants living in sheltered low energy areas	often associated with estuarine systems; intertidal	island and riverine types	firewood; spawning, nursery grounds; fishing; lumber; aquaculture; land stabilizer	fish pond conversion; reclamation; human population expansion; over exploitation; pollution; mining; poultry; pests/diseases; solid wastes; salt production

condition, 30-50 percent of its seagrass beds lost in the last 50 years, and about 80 percent of its mangrove areas lost in the last 75 years, it is difficult to define an undisturbed ecosystem or habitat that could serve as a standard against which to measure degree of disturbance and rates of change.

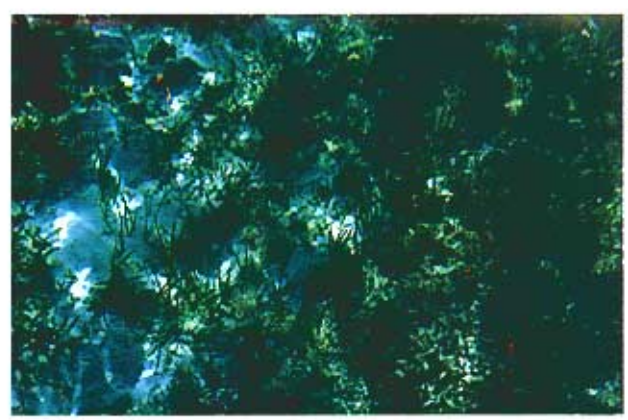
Given more time, essential aspects of the country's biodiversity program would be given due attention such as the seagrass ecosystems where the Retrospective Seasonal Production Signature (RSPS) method could prove useful, or some coral reef systems where sufficient required information are available, or on target organisms associated with these habitats, e.g. siganid fish or seaweeds.

2.3.4 Uses and Values of Marine Biological Resources

Within the coastal zone lies the highest biodiversity known for the marine environment in the Philippines. In this zone reside about 59 percent of the country's total population and this is where about 70 percent of the 1,525 municipalities in the country including ten of the largest cities are located. This indicates how the lives of most Filipinos are closely linked with the sea and its biodiversity. The coastal zone serves as a rich source of fish and other aquatic products, a primary mode of transportation, a major site for human settlements, a breeding ground and habitat for wildlife, and a predominant feature of the country's natural beauty. Much of the growth along this area comes from using the coastal zones' renewable resources, i.e., crops, seaweeds, water, crustaceans, fish, etc. This shallow portion of the sea, the beaches, gulf, and coves provide significant livelihood opportunities and recreational values. Part of the vast wealth of resources of the coastal areas is the high species diversity of flora and fauna.

Lory Tan

A root cause of coastal habitat loss stems from the failure of the present economic order to put a value on the coastal zone components and the interactions among them. In most Southeast Asian countries, destruction of coral reefs for trade of precious biological materials, conversion of seagrass beds to create seaweed farms, or to build access roads, fish ports, and other industrial facilities, happen for two reasons: to meet the need for increased food production or hard currency, regardless of whether that production is sustainable or not; and because seagrass systems, like the other natural systems, are often undervalued.



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Today we are stuck with the notion introduced by Giarini (1980) that in economic planning and decision making, it is an 'objective yardstick' to measure in monetary terms all factors that contribute to economic development. In the process, however, we should realize that we face the dilemma of pricing the priceless, of quantifying the unquantifiable, of creating common standards for things apparently unequatable (de Groot, 1992). Fonseca (personal communication) argued that trying to determine the monetary value of an obviously rich and biologically diverse resource as a seagrass ecosystem may be a waste of time, for this will only hamper its development. But until better instruments and methodologies are found, giving money value to ecosystem functions, where possible, may help convince decision makers and financiers of development projects of the importance of nature conservation and the true meaning of environmentally sustainable economic development. The valuation process has drawn ecologists and economists together with the view that the exercise is for the purpose of management. This exercise has led to better approximation of the true worth of the environment. The low values attached to coastal resources are the principal reason for their continued destruction and degradation.

Seagrass beds are precious coastal resources being threatened by both natural and man-induced perturbations. The natural functions of seagrass systems, specifically, their capacity to provide goods and services that satisfy and sustain human needs, are best performed when the beds are intact and undisturbed. However, in developing countries of Southeast Asia and due largely to pragmatic reasons, seagrass areas may have other functions manifested not in their natural intact conditions, but as transformed habitats, e.g., elimination functions (Table 41). In spite of their vital importance to our ecology, little is known about the functioning of seagrass systems and details on their operation, maintenance, adaptation, and evolution are still poorly understood. In order to better incorporate ecological information into the planning and decision making process, it is essential to increase our knowledge on the many functions provided by both natural and semi-natural or artificial seagrass systems. Having done so, a concerted effort to manage the seagrass resources in the region can be ventured into with greater wisdom.

Attempts to give monetary values to goods and services from seagrass beds have been made. The values were estimated based primarily on the fisheries the beds support. Thus, at Cairns, North Queensland, Australia, fisheries supported by seagrass beds produce about A$700,000 annually (Coles, 1986). More recently, Watson et al. (1993) estimated the potential total annual yield from Cairns Harbor seagrasses for the three major commercial prawn species to be 178 tons/year with a landed value of A$1.2 million/year. In Puget Sound, Washington, U.S.A., a 0.4 hectare of eelgrass bed was valued at US$12,325 annually. The value considered the amount of energy derived from the system as well as the nutrition it generated for oyster culture and commercial and sport fishing, among others. Under conditions found in Southeast Asia, revenues derived from seagrass fisheries alone could be substantial. If calculations are even only partially correct, and if applied to local seagrass resources, the economic value of seagrass beds would be considerably higher (Fortes 1989).

In 1993, the gross value added (GVA) of the fishery sector was P32.6 billion (at constant 1985 prices) which was 19.6 percent of the total GVA of the resource sectors–agriculture, fishery, and forestry. The fishery sector contributes 4-5 percent of the country's gross domestic product. Based on the 1991 FIES, there are about half a million families

Table 41 Elimination functions of seagrass habitats in coastal East Asia (modified from Fortes, 1989)

		INDO	MALA	PHIL	SING	THAI
Aquaculture						
fish		I3	I2	I3	X	I2
crabs	X	X	I1	X	I1	
prawns	I2	X	I2	X	IW	
Ricefields		X	X	X	X	X
Sugarcane		X	X	I1	X	X
Palm plantation	X	X	X	X	X	
Other agriculture		X	X	X	X	X
Pasture		X	X	X	X	X
Solar salt		I1	X	I2	X	X
Industrial development	I2	I2	W3	W3	W3	
Urban development	I2	W2	I3	W3	I3	
Ports		X	X	W3	W3	I1
Airports		X	X	I1	I3	I1
Recreation		X	W	W3	W2	I3
Mining		X	I1	I3	X	I2
Waste disposal	X	W	W2	X	X	
Flood run-off engineering	X	I1	I2	X	X	
Boat traffic		I	X	W2	W2	I1

I: use is restricted *1: to minor use* *Indo: Indonesia* *Sing: Singapore*
W: use is widespread *2: to moderate use* *Mala: Malaysia* *Thai: Thailand*
X: information inadequate *3: to major use* *Phil: Philippines*

dependent on fishing as an entrepreneuria activity and as major source of income. Of these families, about 70 percent are in rural areas and about half have annual incomes less than 30,000 pesos.

Fish resources may be classified into pelagic and demersal species. Pelagic species dwell on the upper levels of the water while demersal species are bottom dwellers. The data used in this study classifies fish production into commercial, municipal, and aquaculture fishing. Commercial fish production includes production from commercial fishing vessels. Municipal fishing includes production from capture activities in municipal and inland (fresh) bodies of water such as lakes and rivers. Aquaculture activities cover brackishwater fishponds, freshwater fishponds, fishpens and fishcages, and culture of oysters, mussels and seaweeds in marine areas. The data on the quantity and value of fish production for the period 1950-1993 are given in Table 42 and Figures 11a and 11b.

Fish catch and production has been generally increasing for all kinds of fishing since 1950; this is an expected occurrence with the increase of human population. The greatest rate of increase has been for aquaculture, followed by commercial fishing. Since 1983, and more pronounced in the 1990-1993 period, there has been a decline in the catch of municipal fishing. In 1950, municipal fishing accounted for 64 percent of the total value of fish

Table 42 *Fisheries production from marine waters of commercial fishing vessels*

YEAR	QUANTITY ('000 MT)	VALUE (P M)
1950	47.9	44.1
1955	107.2	75
1960	120	93.6
1965	300.1	572.1
1970	381.9	614.8
1971	382.5	879.2
1972	424.8	1106.1
1973	465.4	1261.6
1974	480.8	2389.5
1975	498.6	2549
1976	508.2	2697.8
1977	518.2	3545.2
1978	505.8	3465.2
1979	500.7	3512.2
1980	488.5	5784.7
1981	494.8	4124.6
1982	526.3	4355.2
1983	519.3	4642.7
1984	515.3	6521.2
1985	512	7857.2
1986	546.2	9247.9
1987	591.2	9820.7
1988	600	10272
1989	637	11033.4
1990	700.6	12410.6
1991	759.8	15244.6
1992	804.9	16800.6
1993	845.4	18365.3

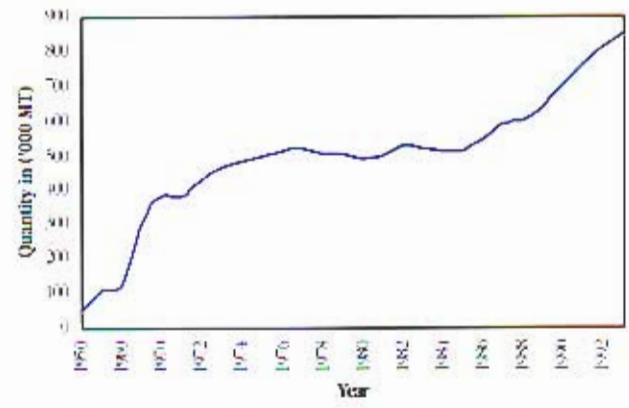

Figure 11a Fisheries production from marine waters of commercial fishing vessels (1950 to 1993)

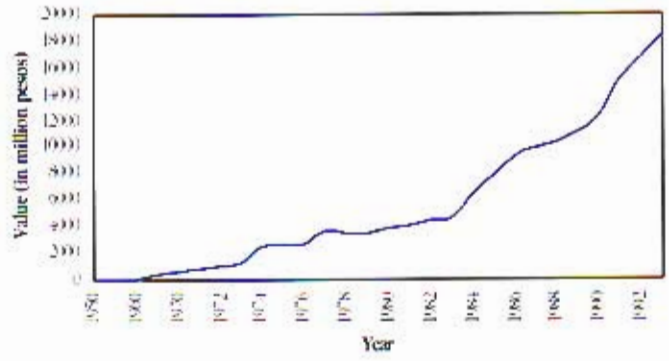

Figure 11b Value of fisheries production from marine waters of commercial fishing vessels (1950 to 1993)

production; its share has halved to 32 percent in 1993 with aquaculture having the biggest share– 42 percent of the total value of fish production. Hence, if we discount scale effects, there has been a long-term trend away from municipal fishing towards aquaculture and commercial fishing.

The rates of increase of fish prices have been most favorable to aquaculture, particularly in the 1983-1990 period. The price increases for aquaculture products, rather than the increases in its catch, have a stronger effect on the increasing values or revenues of aquaculture and commercial fishing. Though there has been a general decline in the yield of municipal fishing, its revenue has been increasing which may indicate a relatively inelastic demand for municipal fishing catch. (Tables 43 and Figures 12a and 12b).

Table 43 Quantity and value of fish production by type of production (quantity in thousand metric tons and value in million pesos) 1950 to 1993

YEAR	TOTAL		COMMERCIAL FISHING [1]		MUNICIPAL FISHING [2]		AQUACULTURE [3]	
	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE
1950	220.2	215.2	47.9	44.1	146.8	138	25.5	33.1
1955	362.9	322.4	107.2	75	219	201.5	36.7	45.9
1960	444.6	464.4	120	93.6	261.6	274.6	60.1	96.2
1965	667.2	806.5	300.1	372.1	303.9	328.2	63.2	106.2
1970	988.9	1725.2	381.9	614.8	510.5	857.7	96.5	252.7
1971	1025.1	2351	382.3	879.2	542.9	1123.8	97.9	328
1972	1122.4	2827.6	424.8	1106.1	598.7	1389.1	98.9	332.4
1973	1204.8	3295.4	465.4	1261.6	639.8	1599.5	99.6	434.3
1974	1268.4	5569.7	480.8	2389.5	684.5	2395.7	113.2	784.4
1975	1336.8	5919.1	498.6	2549	731.7	2561	106.5	809.1
1976	1393.5	7297.9	508.2	2697.8	726	2308	159.3	1192.2
1977	1508.9	8809.2	518.2	3543.2	827.7	4015.1	163.6	1250.9
1978	1580.4	9477.2	505.8	3465.2	857.9	4810.5	216.7	1201.6
1979	1581.3	10536.7	500.7	3512.2	839.3	5364.2	241.2	1660.2
1980	1872.2	11644.4	488.5	3784.7	894.6	6017.8	289.2	1841.9
1981	1772.9	13953.8	494.8	4124.6	938.6	6963.7	339.45	2865.5
1982	1897	15064	526.3	4355.2	978.3	7315.5	392.3	3393.3
1983	2110.2	18981.5	519.3	4642.7	1145.8	9539.6	445.1	4799.2
1984	2080.4	25649.9	513.3	6521.2	1089.2	11862.8	477.9	7265.9
1985	2052.1	31297.3	512	7857.2	1045.4	14715.7	494.7	8724.4
1986	2089.5	37331.5	546.2	9247.9	1072.4	17251.5	470.9	10832.2
1987	2213	37349.4	591.2	9820.7	1060.9	16107.5	560.9	11313.6
1988	2299.7	42118.2	600	10272	1068.5	16633.1	599.5	15213
1989	2371.1	45093.7	637	11033.4	1104.6	18387.7	629.3	15672.6
1990	2503.4	52177.2	700.6	12410.6	1131.9	19300.1	671.1	20466.5
1991	2599	60033.3	759.8	15244.6	1146.8	22132.6	692.4	22656.1
1992	2625.6	65443.5	804.9	16800.6	1084.3	22656.4	736.4	25986.5
1993	2643.23	70269.4	845.4	18365.5	1030.5	22185.3	767.53	29718.8

Sources: 1950 to 1979, Bureau of Fisheries and Aquatic Resources
1980 onwards, Bureau of Agricultural Statistics, Department of Agriculture

1/ Includes production from commercial fishing vessels.
2/ Includes production from capture activities in various municipal and inland fresh bodies of water such as lakes, rivers, etc.
3/ Includes production from aquaculture activities as brackishwater fishponds freshwater fishponds culture of oysters, mussels and seaweeds in marine areas and fishpens fishcages in lakes, etc.

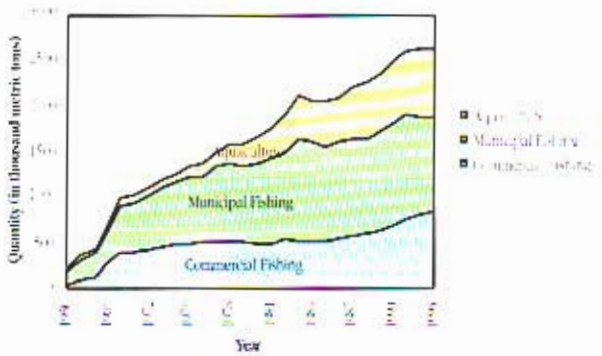

Figure 12a Quantity of fish production by type of production 1950 to 1993

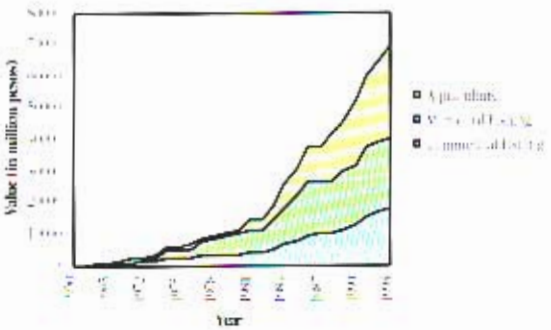

Figure 12b Value of fish production by type of production 1950 to 1993

In 1992, total aquaculture production was 736,000 metric tons with 48 percent of the total weight from seaweeds and 32 percent from brackishwater fishponds. In value terms, brackishwater fishpond production accounts for 74 percent, production from freshwater fishponds, fishpens and fishcages for 18 percent, seaweeds for 6 percent, and oyster and mussel for 2 percent (Tables 44, 45, 46 and 47).

Over the 1990-1992 period, freshwater fishponds, fishpens and fishcages had the largest rate of increase in quantity and value. However, fishpen production declined during the 1983-1992 period; its 1992 production quantity is about 40 percent of its 1983 level. For the 1990-1992 period, there was a significant increase in the value of seaweed production which grew at an annual rate of 38.5 percent; this can be due to the high rate of increase in prices for seaweed during this period. Among the aquaculture products, seaweeds had the largest price increase, with an annual rate of 26 percent during this period. The value (revenue) response for freshwater fishpond, fishpen, and fishcage production was due more to the increase in quantity produced than to the increase in prices. For other aquaculture products, price increase was the determining factor in the increased revenue. For brackishwater fish, oyster and mussel, and seaweed, the annual rates of increase in prices were greater than the corresponding quantity responses for the 1990-1992 period. The figures also indicate that demand for brackishwater fish is relatively inelastic; despite the decline in quantity produced, there was still an increase in the value of production. Hence, the favorable price environment may partly explain the increase in value of most aquaculture products during the period 1990-1992. However, since

Table 44 *Aquaculture production by type of production (in thousand metric tons) 1983 to 1992*

	1983	1,984	1985	1986	1987	1988	1989	1990	1991	1992
Brackishwater fishpond	184	199	199	207	235	240	254	268	291	235
Freshwater fishpond	12	13	16	16	30	33	34	36	38	49
Fish Pen	83	82	52	41	36	29	24	24	26	33
Fish Cage	5	7	7	9	18	18	20	21	24	34
Oyster	11	15	15	16	10	12	13	13	12	15
Mussel	18	20	23	12	12	16	16	18	17	20
Seaweed	132	142	183	169	221	256	269	291	284	350
Total Aquaculture	**445**	**478**	**495**	**470**	**562**	**604**	**630**	**671**	**692**	**736**

Source: Bureau of Agricultural Statistics

Table 45 Value of aquaculture production by type of production (in million pesos) 1983 to 1992

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Total Aquaculture	**4,799**	**7,265**	**8,726**	**10,832**	**11,422**	**15,215**	**15,712**	**20,466**	**22,646**	**25,986**
Brackishwater fishpond	3,123	5,117	6,522	8,682	9,131	12,756	12,878	16,762	18,449	19,296
Freshwater fishpond	112	167	282	365	612	748	855	1,333	1,350	2,229
Fish pen	1,107	1,357	1,203	1,035	732	574	654	685	815	1,324
Fish cage	37	86	136	223	361	417	479	570	676	1,161
Oyster	49	95	78	86	53	75	89	126	109	171
Mussel	120	162	201	107	102	140	152	194	207	278
Seaweed	251	281	304	334	431	505	605	796	1,040	1,527

Source: Bureau of Agricultural Statistics

Table 46 Percentage share of aquaculture production by type of production (in percent) 1983 to 1992

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Total Aquaculture	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Brackishwater fishpond	41.348	41.632	40.202	44.043	41.815	39.735	40.317	39.940	42.052	31.929
Freshwater fishpond	2.697	2.72	3.232	3.404	5.338	5.464	5.397	5.365	5.491	6.658
Fish pen	18.652	17.155	10.505	8.723	6.406	4.801	3.810	3.577	3.757	4.484
Fish cage	1.124	1.464	1.414	1.915	3.203	2.980	3.175	3.130	3.468	4.62
Oyster	2.472	3.138	3.03	3.404	1.779	1.987	2.063	1.937	1.734	2.038
Mussel	4.045	4.184	4.646	2.553	2.135	2.649	2.54	2.683	2.457	2.717
Seaweed	29.663	29.707	36.970	35.957	39.324	42.384	42.698	43.368	41.040	47.554

Source: Bureau of Agricultural Statistics

Table 47 Percentage share of value of aquaculture production by type of production (in percent) 1983 to 1992

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Total Aquaculture	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Brackishwater fishpond	65.08	70.43	74.74	80.15	79.94	83.84	81.96	81.90	81.47	74.26
Freshwater fishpond	2.33	2.3	3.23	3.37	5.36	4.92	5.44	6.51	5.96	8.58
Fish pen	23.07	18.68	13.79	9.56	6.41	3.77	4.160	3.35	3.6	5.10
Fish cage	0.77	1.18	1.56	2.06	3.16	2.740	3.050	2.79	2.99	4.47
Oyster	1.02	1.31	0.89	0.79	0.46	0.49	0.57	0.62	0.48	0.66
Mussel	2.50	2.23	2.30	0.99	0.89	0.92	0.97	0.95	0.91	1.07
Seaweed	5.23	3.87	3.48	3.08	3.77	3.32	3.85	3.89	4.590	5.88

Source: Bureau of Agricultural Statistics

brackishwater fish accounts for the bulk of the value of aquaculture production, it is of utmost importance to conserve coastal fishery resources, like mangrove areas. (Tables 48, 49 and 50).

Table 48 *Annual growth rate of aquaculture production by type of production (in percent)*

	1983-1992	1990-1992
Total Aquaculture	5.750	4.732
Brackishwater fishpond	2.756	-6.359
Freshwater fishpond	16.920	16.667
Fish pen	-9.741	17.260
Fish cage	23.757	27.242
Oyster	3.506	7.417
Mussel	1.178	5.409
Seaweed	11.444	9.670

Table 49 *Annual growth rate of value of aquaculture by type of production (in percent)*

	1983-1992	1990-1992
Total Aquaculture	20.645	12.682
Brackishwater fishpond	22.427	7.293
Freshwater fishpond	39.439	29.512
Fish pen	2.089	39.027
Fish cage	46.653	42.718
Oyster	14.898	16.496
Mussel	9.784	19.708
Seaweed	22.216	58.504

Table 50 *Annual rate of change of aquaculture prices by type of production (in percent)*

	1983-1992	1990-1992
Total Aquaculture	14.085	7.591
Brackishwater fishpond	19.144	14.579
Freshwater fishpond	19.242	10.839
Fish pen	13.017	18.503
Fish cage	18.520	12.163
Oyster	11.006	8.452
Mussel	8.507	13.565
Seaweed	9.607	26.292

Fishery product exports consist of fish and fish preparations, shell by-products and miscellaneous fishery products. Export quantities and values are given in Tables 51and 52, and Figure 13, respectively, for the 1976-1990 period. Possible data errors are noted below the tables. Since 1980, about 80 percent of the value of fishery exports has been derived from fish and fish preparations.

Imports of fishery products are classified into canned fish; fresh, frozen or chilled fish; fish meal; and others. Import quantities and values are given in Tables 53 and 54, and Figure 14, respectively, for the 1976-1990 period. A cursory look at the column entries shows wide variability in the figures. This variability can be attributed either to poor data collection or to the foreign trade regime for fish imports which are quite volatile or unstable.

If we assume that at least the total export and import values are reliable, then it can be interpreted that the Philippines has been a net exporter of fishery products (Table 55 and Figure 15). This possible result is expected since the Philippines is archipelagic. Moreover, the trade surplus in fishery products has been consistently increasing.

Table 51 *Exports of fishery products by kind (in metric tons) 1976-1990)*

YEAR	TOTAL EXPORTS	FISH AND FISH PREPARATION	SHELL AND BY-PRODUCTS	MISC. FISHERY PRODUCTS AND BY-PRODUCTS
1976	25,654	12,575	6,702	4,377
1977	37,534	25,313	7,496	6,725
1978	48,438	27,853	5,725	14,880
1979	64,890	42,098	5,147	17,645
1980	76,179	56,211	4,310	15,658
1981	85,736	62,327	4,118	17,291
1982	68,265	47,210	3,118	17,957
1983	75,589	53,019	3,376	19,194
1984	63,055	47,888	1,974	13,193
1985	626,077	589,958	6,399	29,720
1986	101,453	60,662	7,663	33,128
1987	111,830	70,757	9,680	31,393
1988	128,903	91,304	10,137	27,462
1989	145,099	104,652	9,056	31,397
1990	143,049	103,211	4,351	35,487

Source: National Statistics Office

Note: Possible data errors are (1) 1985 entries for total exports and for fish and fish preparation, (2) 1988 entry for shells and by-products

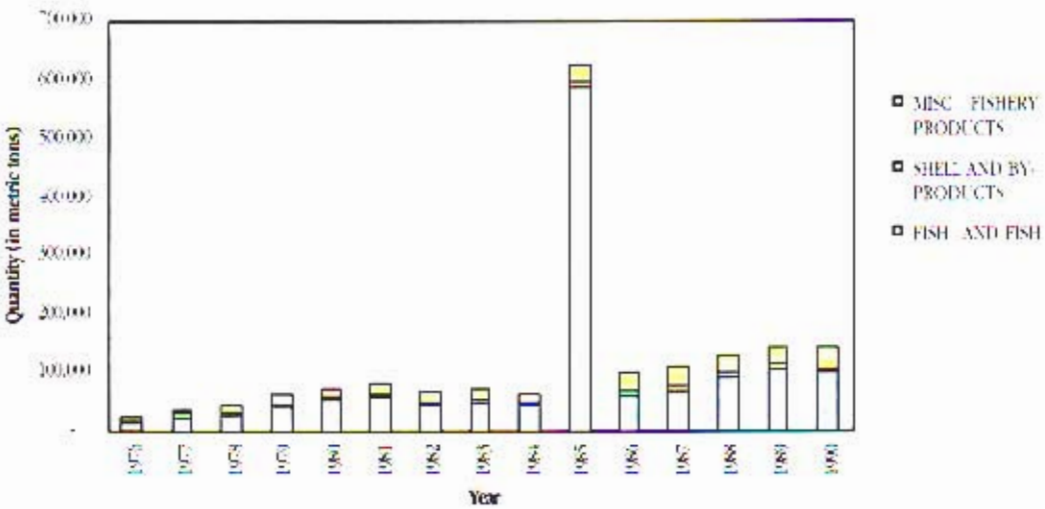

Figure 13 Exports of fishery products by kind (1976 to 1990)

Table 52 *Value of exported fishery products by kind (in thousand pesos) 1976-1990*

YEAR	TOTAL EXPORTS	FISH AND FISH PREPARATION	SHELL AND BY-PRODUCTS	MISC. FISHERY PRODUCTS AND BY-PRODUCTS
1976	330,293	169,052	138,162	23,079
1977	395,365	261,013	106,294	28,058
1978	532,223	351,069	112,348	68,806
1979	781,736	587,515	108,268	85,953
1980	939,294	750,039	97,741	91,514
1981	83,736	1,044,323	102,530	104,289
1982	1,119,735	920,176	92,797	106,762
1983	1,592,882	1,283,289	133,728	175,865
1984	2,179,380	1,723,331	303,674	152,375
1985	3,496,096	2,752,053	284,984	459,059
1986	4,863,056	3,985,285	327,923	549,848
1987	6,441,805	5,452,510	433,062	556,233
1988	9,599,453	8,543,892	463,385	592,158
1989	10,248,362	8,857,523	493,840	897,000
1990	11,528,727	9,658,538	551,153	1,319,036

Source: National Statistics Office

Note: A possible data error is the 1981 entry for total exports

Table 53 *Imports of fishery products by kind (in metric tons), 1976-1990*

YEAR	TOTAL IMPORTS	CANNED	FRESH, FROZEN CHILLED	FISH MEAL	SALTED, SMOKED DRIED, ETC.
1976	64,111	45,360	13	18,727	11
1977	38,557	26,401	23	12,118	15
1978	47,955	29,768	22	18,134	31
1979	45,874	22,446	39	23,360	29
1980	53,401	28,755	17	24,621	8
1981	46,851	30,323	20	16,499	9
1982	83,445	36,203	6,180	41,052	10
1983	23,038	5,397	3,524	14,096	21
1984	6,097	12	1,269	4,816	9
1985	28,755	207	5,283	23,252	13
1986	89,085	601	52,270	36,175	39
1987	104,936	892	66,535	37,474	35
1988	164,575	2,901	113,860	47,784	29
1989	197,905	3,815	136,860	57,227	762
1990	196,155	4,907	130,995	60,165	48

Source: National Statistics Office

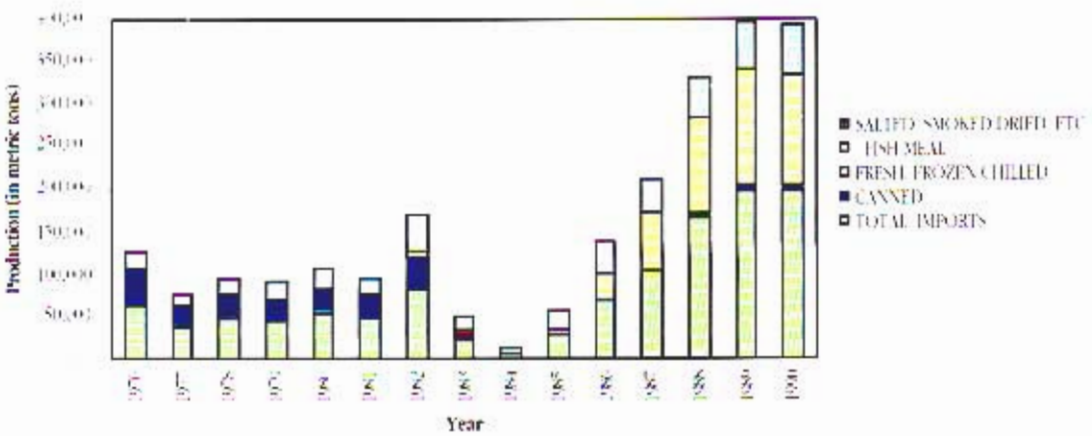

Figure 14 Imports of fishery products by kind (1976-1990)

Table 54 *Value of imported fishery products by kind (in thousand pesos), 1976-1990*

YEAR	TOTAL IMPORTS	CANNED	FRESH, FROZEN CHILLED	FISH MEAL	SALTED, SMOKED DRIED, ETC.
1976	266,021	225,696	335	39,543	447
1977	205,082	164,920	518	38,804	840
1978	229,529	174,061	439	54,177	852
1979	207,039	142,585	1,549	61,554	1,351
1980	274,078	197,344	960	75,232	542
1981	288,434	232,111	1,297	54,525	503
1982	443,678	310,726	12,997	119,296	659
1983	110,909	54,817	11,150	43,507	1,435
1984	50,269	356	17,368	30,712	1,833
1985	118,181	5,131	20,399	91,335	1,316
1986	385,658	14,509	161,786	206,419	2,944
1987	817,382	199,632	300,221	315,121	2,408
1988	1,512,468	54,295	680,511	574,271	3,391
1989	1,424,133	69,339	717,137	629,883	7,774
1990	1,853,743	91,679	1,090,506	666,585	4,973

Table 55 *Balance of trade: Fishery (in thousand pesos), 1976-1990*

YEAR	VALUE OF EXPORTS-VALUE OF IMPORTS
1976	64,272
1977	190,283
1978	302,694
1979	574,697
1980	665,216
1981	1204,6981
1982	676,057
1983	1,481,973
1984	2,129,111
1985	3,577,915
1986	4,477,398
1987	5,624,423
1988	8,286,965
1989	8,824,229
1990	9,674,984

Annual rate of change: (in percent)

1976-1990	43.069
1980-1990	30.698

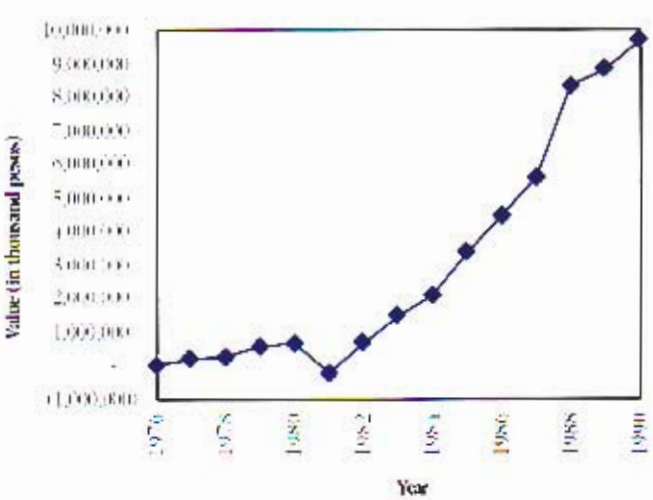

Figure 15 Balance of trade: Fishery (1976-1990)

Note: The 1981 figure can be due to data error in the export value which should be 1,251,142. In this case, the value of net exports is 962,708.

2.4 Diversity in Agricultural Ecosystems

2.4.1 Introduction

Agrobiodiversity is a managed ecosystem whose composition evolved with time and which varies according to area location. It fits specific sets of environmental conditions to attain acceptable levels of productivity. This evolutionary process, which involves changes in overall composition both in the life forms (genes and species) and their habitat (ecological setting), eventually reached a stage of stability fully adapted to the site that it has become a part of the overall useful biodiversity required for human support systems.

Agricultural biodiversity is largely influenced by:

a) past and continuing institutional efforts related at expanding the breeding, selection, multiplication and distribution of planting materials of high yielding varieties

b) market and socio-economic relevance of the crop

c) population growth and changing social, economic, and institutional requirements

The country has a total of about 10 million hectares that have been converted to agriculture and used for various crop production. The delineation of the agrobiogeographic zones within the pre-delineated biogeographic zones reveal the following:

a) Low Agrobiodiversity Areas represent about 24 percent of the total cultivated lands in the country. These areas refer to portions of the biogeographic zones which are generally devoted to monocropping systems such as irrigated rice system, pineapple, sugarcane, and banana plantations.

b) Medium Agrobiodiversity Areas represent 34 percent of the total cultivated lands in the country. These areas are those that are currently planted to coconuts with various magnitudes of understoreys.

c) High Agrobiodiversity Zones represent a total area of 4.2 million hectares or 42 percent of the total cultivated areas in the country. These areas are grown to corn, rain fed rice, cultivated/ managed pasture lands and other farm areas devoted to traditional farms which produce multiple crops in very small space.

The agrobiogeographic zones are the agricultural crop production areas within the 15 biogeographic zones of the Philippines. The agricultural areas range from 11 to as much as 54 percent of the biogeographic zones as in the case of Palawan including Calamian and Sulu biogeographic zones, respectively. A significant part of the 12 biogeographic zones is characterized by high agrobiodiversity or areas devoted to limited but varied crops usually done at subsistence level. Western Visayas biogeographic zone predominantly has low agrobiodiversity areas while Sulu and Zamboanga biogeographic zones primarily have medium agrobiodiversity areas.

The grasslands of the country which come to more than six million hectares represent close to 21 percent of the total area in the country. This resource is classified to have low biodiversity considering its being acidic and of low fertility. So far, the Northern and Southern Luzon biogeographic zones have the most extensive grasslands covering about 1.8 million hectares.

2.4.2 Biological Composition

Comprehensive inventories of the various plant species were provided by various authors at different time periods. This study consolidated a total of 1,663 species relevant to agriculture based on various listings. Of these, 477 angiosperms relevant to agriculture have food values, 353 have feed values, 632 have medicinal/ herbal values, and 201 have ornamental values. In addition, 35 species are considered as fiber crops. Still, a number of them have industrial importance. The breakdown below also shows the number of endemic and introduced species in the country, with the rest of them with unknown origin (Table 56).

The National Plant Germplasm and Resources Laboratory (NPGRL), as of December 1994, maintains a total of 32,446 accessions of 396 species (Table 57).

In addition, other institutions such as the Philippine Rice Research Institute (PHILRICE), Bureau of Plant Industry (BPI), National Tobacco Authority (NTA) have capacities for maintaining and conserving germplasm of important crops. In fact, PHILRICE reported in 1992 that, among others, it maintains 12 species of wild rice from the International Rice Research Institute (IRRI) germplasm center and from its collections in the different parts of the country. The NTA reported that its germplasm collection

Table 56 *Uses of endemic, introduced, and naturalized angiosperm species*

	FOOD	FEED	ORNAMENTAL	MEDICINAL
Endemic	28			15
Introduced	87	155	64	168
Naturalized	5	12	3	9
Of Unknown Origin	357	186	134	440
TOTAL	**477**	**353**	**201**	**632**

Table 57 *Number of species and accessions of various crops in the National Germplasm and Resources Laboratory*

CROPS	SPECIES	ACCESSIONS
Cereals	3	3,039
Fiber crops	3	235
Forage/pasture	57	228
Fruit trees	101	619
Legumes	11	11,300
Nut trees	12	66
Oil crops	12	374
Plantation crops	100	224
Rootcrops	7	1,029
Small fruits	39	172
Vegetables	71	15,160
TOTAL	**296**	**32,446**

has increased to 488 accessions in 1995. The plant population statistics for 1980 and 1991 covering 61 economically important crops reveal that coconut, coffee, fiber crops particularly abaca, kenaf, piña and ramie, and mulberry substantially decreased in their respective population during the 11 year period while banana, cacao, rubber, and ipil-ipil dramatically increased in population. During both periods, extensive cultivation was on-going for cacao and banana, which substantially increased in population as well as coconut, coffee, abaca, and ramie which, however, remarkably decreased in numbers.

On domesticated exotic species, the animal population in 1991 as reported by NSO totaled 2,766,000 carabaos, 1,991,000 cattle, 286,000 horses, 7,479,000 hogs, 2,403,000 goats and 56,000 other domesticated exotic species. Aggregate poultry population which includes chicken, ducks, quails, geese, turkeys, and pigeons total 101,235,000 heads. From among the 11 domesticated exotic species types (including poultry), only carabaos showed substantial decrease in numbers while the others increased their respective population during the 11 year period. There are no statistics on wildlife

Lory Tan

farming although some ranches are known to be engaged in it.

2.4.3 Rates of Change

Increase in crop and domesticated exotic species count does not necessarily mean domestic sufficiency in crop and domesticated exotic species products. The country still relies heavily on imports of milk products. Also, the increase in the population of grapes, orange, cacao, atsuete, blackpepper and rubber does not imply adequacy of local supply of these inasmuch as the country still imports these products.

Despite tremendous national and international efforts to improve productivity, the gap of the average national yield and the improved yield level for most crops remains high. This is partly explained by the fact that traditional farming methods still dominate.

2.4.4 Uses and Values of Biological Resources in Agriculture

Roque (1995) identified five values of biodiversity, namely: production, recreational, scientific, educational, and public utility values. The reported majority of the agricultural plants have multiple values. Generally, the values of biodiversity in the agriculture sector is focused on production and less on scientific and educational values. The said values necessarily are based on the current and potential uses. Additional information is needed to identify which among them are already considered as genetic resource.

For production purposes, the values of agricultural plants can be grouped into food, feed, medicinal/herbal, and ornamental. About 477 angiosperms relevant to agriculture have food value. 353 are used as feeds, 632 have medicinal/herbal value, 201 are ornamental, and 35 are fiber crops. In the case of domesticated exotic species, biodiversity values relate to production, aesthetic, scientific, educational and public utility or transportation. Production values relate to food, craft, and recreational uses. The valuation of the uses of biological resources in agriculture is limited to food crops and domesticated exotic species specifically those which go through the market system.

Crops

The yield data of the Bureau of Agricultural Statistics (BAS) for 22 economically important crops collectively represent the traditional and improved varieties. The national average yield for the 22 crops are presented in Table 58. The yield of various improved varieties are included in Tables 59 to 61 in the inventories of National Seed Industry Council (NSIC) released varieties while the yield of the traditional rice varieties is also included in Table 62. Comparatively, the national average yield of 3.3 mt/ha for irrigated rice is far below the attainable yield of about 6 mt/ha in the case of the recently released Magat hybrid. Under the DA's Grains Productivity Enhancement Program (GPEP), the target yield is 5 mt/ha. The recorded yield of traditional rice varieties like Raminad and Seraup is higher than the 1993 preliminary average yield level. In the case of the non-irrigated rice, the average yield of 2.14 mt/ha is much less than the yield obtained from improved varieties 3.5 (upland - IR43) to 4.0 (lowland - C168) mt/ha. One can harvest as much as 3.0 mt/ha with traditional upland rice varieties yield. On the other hand, the national average yield of white corn is 1.25 mt/ha and that of yellow corn 2.07 mt/ha. With the improved varieties released by the National Seed Industry Council (NSIC), harvests go no less than 4.0 mt/ha to as much as 7.0 mt/ha.

The existing yield levels for other crops like peanuts, mongo, tomato, eggplant, cabbage, sweet potato, and cassava are far less relative to those of improved varieties. In the case of tobacco, the national average yield is somehow at par with the yield of the improved varieties. The data on income by crop are listed in Table 63, which provides the range of income from the enumerated crops. Most of the 11 crops listed have modest positive growth rates except for yellow corn which registered a high 6.6 percent (Table 64). The remaining 10 economically important crops show negative growth rates namely: peanut, mongo, eggplant, banana, mango, citrus,

Lory Tan

Table 58 *Agricultural area, production, and value, by kind of crop (1984 to 1993)*

ITEM	1984			1985			1986			1987			1988		
	AREA '000 ha.	QUANTITY 000 m.t.	VALUE million pesos	AREA '000 ha.	QUANTITY '000 m.t.	VALUE million pesos	AREA '000 ha.	QUANTITY '000 m.t.	VALUE million pesos	AREA 000 ha.	QUANTITY '000 m.t.	VALUE million pesos	AREA '000 ha.	QUANTITY 000 m.t.	VALUE million pesos
Agricultural crops	12,589.1	61,865.8	90,275.5	13,032.1	58,831.6	103,489.1	13,300.4	59,010.1	103,798.5	12,986.9	56,685.3	107,472.8	13,127.6	59,700.4	125,313.1
A. CEREALS	5,389.3	11,079.2	27,384.7	6,817.4	12,668.4	39,513.4	7,059.2	13,337.5	36,648.6	6,938.5	12,818.0	38,298.9	7,137.8	13,399.0	43,186.0
Palay	3,162.3	7,828.9	19,668.1	3,306.5	8,805.6	28,718.7	3,464.2	9,246.8	26,389.7	3,255.9	8,539.9	26,122.3	3,392.7	8,971.0	30,612.6
Corn	3,227.0	3,250.3	7,716.6	3,510.9	3,862.8	10,794.7	3,595.0	4,090.7	10,258.9	3,682.6	4,278.1	12,176.6	3,745.1	4,428.0	12,573.4
B. MAJOR CROPS	4,963.9	43,322.9	51,247.4	4,973.5	38,300.3	46,723.8	4,947.6	37,528.4	43,916.1	4,897.1	35,964.3	47,561.4	4,792.5	38,027.4	57,907.0
Coconut	3,222.9	11,737.6	22,184.1	3,270.3	12,827.8	17,958.9	3,284.0	14,334.9	12,328.0	3,251.6	13,730.5	14,966.2	3,221.8	12,481.8	19,222.0
Sugarcane a/	409.5	23,944.2	6,704.4	368.5	17,542.1	5,788.9	300.1	14,831.1	5,042.6	269.3	13,797.0	6,208.7	215.7	17,275.0	9,202.4
Banana	285.7	3,058.3	4,709.8	289.8	3,127.1	5,191.0	292.7	3,192.6	5,140.1	298.9	3,157.4	4,830.8	294.6	3,067.3	4,754.3
Pineapple	59.0	1,035.6	1,698.4	58.0	1,030.0	1,792.2	60.9	1,273.2	2,253.6	63.1	1,303.4	2,893.5	60.5	1,181.2	3,768.0
Coffee	138.3	124.7	3,674.9	137.2	137.3	3,394.1	141.3	145.3	4,967.8	143.2	140.1	3,857.0	142.5	141.9	3,881.0
Mango	52.7	339.3	3,104.6	53.7	355.7	2,888.3	54.4	372.9	4,128.0	55.5	367.1	3,942.7	55.7	361.1	4,954.3
Tobacco	70.0	98.1	1,253.7	60.2	74.3	1,108.6	64.2	74.2	1,003.9	68.7	82.8	1,793.4	61.4	76.4	1,333.2
Abaca	124.6	86.2	766.3	120.4	81.3	507.3	116.8	83.6	403.0	114.8	82.0	525.6	108.3	84.1	736.7
Rubber	77.8	140.7	769.6	80.7	145.9	665.3	82.6	146.0	773.8	83.9	147.2	1,017.2	84.6	156.4	828.9
Cacao	13.9	6.0	157.4	15.5	7.0	188.4	16.8	8.0	218.8	17.5	8.8	266.0	17.7	9.1	218.5
Cassava	201.5	1,491.1	1,506.0	204.6	1,686.7	1,990.3	211.4	1,724.1	2,120.6	209.7	1,784.3	1,855.7	217.1	1,865.9	2,276.4
Camote	149.7	692.9	1,039.4	150.2	701.7	1,277.1	155.2	726.2	1,328.9	149.6	716.9	1,190.1	144.1	695.0	1,237.1
Peanut	46.5	40.0	327.6	50.4	41.3	354.4	50.9	42.2	405.5	55.3	43.0	352.6	51.0	39.9	345.9
Mongo	33.8	25.1	269.3	35.5	25.3	303.1	36.0	25.9	321.4	34.7	25.3	270.5	36.7	26.6	316.8
Onion	7.8	52.5	467.8	7.1	53.1	577.2	6.6	54.2	471.0	7.0	60.9	549.9	5.8	45.9	420.9
Garlic	5.5	13.3	620.2	6.3	15.0	698.9	6.8	15.5	596.3	6.3	15.4	330.8	5.6	14.1	905.8
Tomato	16.3	149.0	657.1	16.7	150.4	616.6	18.1	165.7	725.8	18.0	166.9	642.6	18.4	167.9	851.3
Eggplant	14.7	110.4	407.4	14.4	102.7	438.5	14.5	104.5	491.2	14.8	107.7	535.3	15.3	109.8	563.3
Cabbage	5.9	62.1	328.5	6.2	66.1	342.4	6.4	69.0	428.5	6.5	71.3	307.3	6.4	70.3	357.1
Citrus b/	27.8	115.8	600.9	27.8	129.5	642.3	27.9	139.3	767.3	28.7	156.3	1,225.5	29.3	157.7	1,733.1
C. OTHER CROPS	1,235.9	7,463.7	11,643.4	1,241.2	7,862.9	17,251.9	1,293.6	8,144.2	23,233.8	1,151.3	7,903.0	21,612.5	1,197.3	8,274.0	24,220.1
Other fiber crops	81.9	198.5	474.8	92.2	204.8	987.3	89.2	195.1	682.8	35.0	68.0	651.0	40.0	76.0	727.1
Other root crops	125.5	197.8	319.3	106.8	121.1	309.8	109.7	126.4	379.2	112.9	126.8	443.7	113.5	127.5	463.6
Tubers	96.5	140.2	114.8	101.0	146.8	179.0	111.0	162.0	225.6	109.4	159.6	223.4	122.0	198.0	309.5
Spices	44.9	22.9	54.5	42.6	25.6	88.4	42.6	26.1	91.4	39.6	24.9	99.6	35.3	25.5	210.7
Fruit bearing vegetables	326.2	2,503.4	3,295.1	333.1	2,633.3	5,303.8	368.1	2,740.8	9,172.4	306.9	2,691.4	6,420.3	304.1	2,680.6	7,494.2
Leafy/Stem vegetables	147.0	1,092.0	1,475.7	151.7	1,122.4	2,356.7	159.4	1,141.7	2,730.2	147.4	910.5	2,277.6	157.1	1,058.0	2,484.5
Other legumes	21.6	29.7	78.2	25.6	30.1	132.3	26.0	31.8	159.0	27.4	31.3	187.4	28.5	32.0	189.3
Other fruits	291.3	2,852.3	4,912.6	299.2	3,104.7	6,258.3	304.5	3,239.6	7,943.7	299.6	3,451.0	9,402.4	316.8	3,595.2	10,271.9
Others	101.0	426.9	918.4	89.0	474.1	1,636.3	83.1	480.7	1,849.5	73.1	439.5	1,907.1	80.0	481.2	2,069.3

Cont'n. **Table 58**

ITEM	1989 AREA '000 ha.	1989 QUANTITY 000 m.t.	1989 VALUE million pesos	1990 AREA '000 ha.	1990 QUANTITY '000 m.t.	1990 VALUE million pesos	1991 AREA '000 ha.	1991 QUANTITY '000 m.t.	1991 VALUE million pesos	1992 AREA 000 ha.	1992 QUANTITY '000 m.t.	1992 VALUE million pesos	1993 AREA '000 ha.	1993 QUANTITY 000 m.t.	1993 VALUE million pesos
Agricultural Crop	13,147.1	64,207.1	144,407.1	13,096.3	61,566.5	153,925.1	12,983.7	64,109.3	164,311.5	12,520.4	63,837.4	172,710.3	12,610.2	65,756.3	177,698.7
A. CEREALS	7,186.5	13,981.0	57,463.2	7,138.3	14,173.3	63,500.3	7,014.5	14,328.3	60,993.3	6,529.5	13,747.8	64,704.6	6,431.7	14,232.3	71,353.5
Palay	3,497.3	9,458.8	39,359.6	3,318.7	9,319.4	43,987.6	3,425.0	9,673.3	43,723.1	3,198.1	9,128.9	42,996.4	3,282.4	9,434.3	49,906.9
Corn	3,689.2	4,522.2	18,103.6	3,819.6	4,853.9	19,512.7	3,589.5	4,655.0	17,270.2	3,331.4	4,618.9	21,708.2	3,149.3	4,798.0	21,446.6
B. MAJOR CROPS	4,725.0	41,648.1	66,703.4	4,698.2	38,684.5	64,759.6	4,716.2	41,091.1	72,524.7	4,730.6	41,329.5	76,543.6	4,928.3	42,954.5	76,064.2
Coconut	3,110.4	11,810.4	22,439.8	3,112.0	11,940.4	18,746.4	3,093.3	11,290.9	18,968.7	3,076.7	11,404.9	23,038.1	3,075.2	11,317.0	21,049.6
Sugarcane a/	261.7	21,424.8	12,854.9	235.3	18,666.9	11,386.8	271.5	21,824.5	14,622.4	267.0	21,801.9	13,552.1	374.0	23,366.1	13,786.0
Banana	295.5	3,190.3	5,008.8	300.2	2,913.3	7,254.1	311.3	2,951.1	9,738.6	321.4	3,059.2	10,523.7	325.8	3,110.2	11,010.0
Pineapple	61.0	1,178.8	5,328.2	59.7	1,155.8	4,773.5	57.7	1,117.1	4,691.8	60.6	1,135.2	4,801.9	66.9	1,189.7	5,603.3
Coffee	143.2	155.9	3,325.3	143.2	134.1	2,983.7	143.1	133.4	3,157.6	142.0	127.6	2,615.8	212.7	123.2	2,607.5
Mango	56.4	370.1	3,797.2	56.7	337.6	4,324.7	56.9	307.0	4,405.5	57.2	330.0	4,456.4	57.7	334.4	4,795.4
Tobacco	63.3	79.9	2,044.6	63.2	81.7	2,131.6	67.9	85.2	2,626.7	95.0	117.9	3,304.7	91.0	101.8	2,120.5
Abaca	107.7	88.4	901.7	106.7	80.5	891.9	107.4	85.2	1,226.9	107.0	84.3	1,465.1	106.5	81.4	1,588.1
Rubber	86.1	171.9	825.1	86.3	185.4	1,062.3	88.0	180.7	1,201.7	84.2	172.5	1,145.4	84.2	174.3	1,148.4
Cacao	18.2	9.4	181.0	18.4	9.8	263.5	17.3	9.6	265.8	16.8	7.5	274.2	16.8	7.7	281.5
Cassava	213.1	1,846.9	2,696.5	213.8	1,854.0	3,467.0	211.0	1,815.7	3,921.9	204.3	1,784.9	3,195.0	211.4	1,844.2	3,762.1
Camote	138.3	660.3	1,439.5	136.7	668.9	1,792.7	136.5	662.3	2,125.9	140.8	677.2	2,465.0	147.1	691.9	2,338.6
Peanut	50.4	37.6	376.4	44.5	34.8	388.7	39.1	31.4	413.5	44.6	34.0	412.8	44.9	34.0	441.0
Mongo	35.7	25.1	376.8	36.7	26.7	454.2	34.3	25.1	399.3	32.7	23.2	392.8	33.1	23.4	383.2
Onion	6.5	65.3	592.3	6.4	61.5	497.5	6.4	60.3	604.8	5.8	56.7	530.2	6.5	61.5	628.7
Garlic	6.1	17.2	1,159.5	6.4	17.9	764.9	4.5	12.4	494.5	4.2	11.8	875.6	4.3	12.3	778.7
Tomato	19.7	178.7	750.5	20.0	184.0	833.5	19.5	177.2	928.5	18.2	165.4	793.9	15.8	141.9	791.8
Eggplant	15.4	111.6	698.6	16.4	112.7	688.6	14.5	104.0	638.6	15.5	110.4	663.5	17.5	111.1	808.9
Cabbage	6.9	75.9	496.4	6.4	68.3	538.2	6.9	75.8	557.1	7.5	83.2	638.1	7.8	86.0	579.9
Citrus b/	29.4	149.6	1,410.3	29.2	150.2	1,515.8	29.1	142.2	1,534.9	29.1	141.7	1,399.3	29.1	142.4	1,561.0
C. OTHER CROPS	1,235.6	8,578.0	20,240.5	1,259.8	8,708.6	25,665.2	1,253.0	8,689.9	30,793.5	1,260.3	8,760.1	31,462.1	1,250.2	8,569.5	30,281.0
Other fiber crops	37.0	64.6	696.4	33.4	58.4	1,153.4	31.5	77.6	1,098.9	37.7	92.9	1,062.8	33.8	65.5	634.4
Other root crops	108.0	121.3	346.0	109.6	132.3	430.2	107.6	128.7	519.0	109.2	128.5	533.6	108.7	126.1	519.2
Tubers	125.7	214.0	261.1	135.7	201.4	330.0	134.9	198.4	384.9	132.8	206.4	402.2	132.1	202.6	395.2
Spices	35.9	26.3	967.5	38.6	27.0	1,202.7	36.1	26.5	1,454.9	36.9	26.8	1,494.3	36.8	26.4	1,452.7
Fruit bearing vegetables	313.2	2,887.6	6,346.9	328.0	2,910.2	6,788.2	314.5	2,812.7	8,801.3	313.9	2,895.4	9,042.2	312.3	2,840.7	8,830.7
Leafy/Stem vegetables	166.7	1,097.2	2,067.1	171.2	1,080.2	2,506.3	172.8	1,124.6	3,062.3	174.5	1,110.4	3,147.3	173.6	1,089.4	3,061.6
Other legumes	30.2	34.0	160.1	30.5	34.3	198.2	31.1	35.0	240.2	31.2	34.7	246.5	31.0	34.1	240.1
Other fruits	331.7	3,639.3	7,687.0	327.7	3,764.9	10,880.9	338.1	3,784.4	12,637.8	339.2	3,762.2	12,863.0	337.5	3,691.3	12,551.0
Others	87.2	493.7	1,708.4	85.1	499.9	2,175.3	86.4	502.0	2,594.2	84.9	502.8	2,670.2	84.4	493.4	2,596.1

p/ Preliminary
a/ Revised based on data from the Sugar Regulatory Administration
b/ Includes calamansi, pomelo, mandarin, and orange.

Source: Bureau of Agricultural Statistics, Department of Agriculture

Table 59 National Seed Industry Council-released rice varieties and major characteristics, 1955-1994

VARIETY	YEAR RELEASED	YIELD (kg/ha)	GROWTH DURATION (days)
IRRIGATED LOWLAND			
BE-3	1955		166
Peat	1955		141
Remind Strain 3	1955		184
Tjeremas	1955		138
Seraup Ketchil 36 Str. 482	1956		185
Tjanara	1957		169
Intan	1957		160
BPI 76	1960		
FB 121	1961		
Milflor 6-2	1962		
AC 440	1962		
Nangthay	1963		
Norelon Strain 340	1963		
Fk 178 A	1963		
C-18	1964		
C-74	1964		
BPI 121	1966		
IR 8- 288-3	1967		
IR 5	1968	3,920	140
IR 8	1968	3,337	130
C4-63 G	1968	3,800	130
BPI-76	1968	4,170	130
IR 20	1969	4,139	125
C4-137	1969	4,370	139
IR 22	1970	4,380	125
C12	1971		
BPI 121-407	1971	4,110	130
IR 24	1971	3,771	120
IR 26	1973	4,892	130
BPI 3-2	1973	3,869	130
IR 28	1975	4,326	105
IR 30	1975	3,916	110
IR 32	1975	4,400	140
BPI Ri-2	1975	4,004	115
IR 34	1976	3,939	130
IR 36	1976	4,856	110
IR 38	1976	4,382	125
RP Kl 2	1976		
BPI 21-4	1977		
IR 40	1977	3,600	120
IR 42	1977	5,044	135
IR 44	1978	4,950	130
BPI Ri-4	1978	5,600	112
IR 203-242-1	1978		
IR 48	1979	4,420	140
IR 50	1980	4,558	105
IR 54	1980	4,319	120
IR 56	1982	4,568	110
UPLRi-4	1982	4,762	111
IR 58	1983	4,155	100
IR 60	1983	4,750	107
BPI Ri-10	1983	4,657	108
IR 62	1984	4,770	115
IR64	1985	5,307	113
IR 66	1987	5,194	108
BPI Ri-12	1987	4,892	119
IR 68	1988	4,479	121
IR 70	1988	4,816	129
IR 72	1988	5,004	112
IR 74	1988	4,710	131
IR 13149 (Trece Katorse)	1988	4,600	125
PSB Rc 2 (Nahalin)	1991	4,943	123
PSB Rc 4 (Molawin)	1991	4,585	104
PSB Rc 6 (Caranglan)	1992	5,739	112
PSB Rc 8 (Talavera)	1992	5,391	108
PSB Rc 10 (Pagsanjan)	1992	5,074	106
Rc 18 (ALA)	1994	5,111	123
Rc 20 (Chico)	1994	4,567	110
Rc 22 (Liliw)	1994	4,842	129
Rc 26H (Magat hybrid)	1994	6,039	112
LOWLAND IRRIGATED (GLUTINOUS)			
IR 29	1975	3,717	115
UPLRi-1	1977	3,988	130
C166-133	1978		
BPIRi-1	1979	4,311	120
BPIRi-3	1981	4,701	121
IR 65	1985	4,719	115
RAINFED LOWLAND			
C168	1973	4,063	128
IR 46	1978	3,977	123
UPLRi-2	1978	2,752	123
IR 52	1980	3,167	119
PSB Rc 12 (Caliraya)	1992	3,835	109
PSB Rc 14 (Rio Grande)	1992	3,786	110
PSB Rc 16 (Ennano)	1993	2,708	125
PSB Rc 24 (Cagayan)	1994	3,101	117
UPLAND			
Kinandang Puti	1955		116

Cont'n. ***Table 59***

VARIETY	YEAR RELEASED	YIELD (kg/ha)	GROWTH DURATION (days)
Magsayana	1955	2,200	124
Palawan	1955		130
Pinulot	1955	1,936	130
Azucena	1956	2,508	125
Fortuna	1956	2,200	135
Nagdami	1956	2,200	135
Mangarez	1959		
Milpal	1959		
Dinalaga	1960		
Bengawan	1960		
Azomil 85	1963		
HBDA -2	1963		
Texas 317	1965		
Azomil 26	1967		
M9-33B	1968		
BPI -76 NS	1972		
C 22	1972	2,182	128
BPI 3-2	1973		
PARC 2-2	1973		
IR 43	1978	3,525	129
IR 45	1978	2,511	131
UPLRi-3	1979	2,405	125
BPIRi-6	1979	2,539	125
UPLRi-5	1980	2,578	120
UPLRi-7	1981	3,044	116
PSB Rc 1 (Makiling)	1990	2,392	121

Sources: PhilRice. 1993. Rice Production Technaguide.
Philippine Seedboard Released Varieties, 1955-92 (unpublished)

Table 60 *National Seed Industry Council-released corn varieties and major characteristics, 1955-1993*

VARIETY	YEAR RELEASED	YIELD (mt/ha)	GROWTH DURATION (days)
YELLOW CORN HYBRID			
Phil Hybrid 1d	1966		
Cargill 100	1983	5.29	100-109
Cargill 200	1983	5.27	102-107
Hycorn 9	1983	4.92	99-103
Pioneer 6181	1983	5.36	103
P 3228	1985	6.45	98-102
SMC 309	1985	6.32	103
P 3274	1986	6.17	106
SMC 317	1986	6.96	107
CX757	1987	5.85	103
SMARC 1283 (SMARC 1283)	1987	4.97	104-107
SMC 319 (SMC E-9)	1988	5.73	100
SMC 321 (SMC E-17)	1988	6.19	96-100
SMC 323 (SMC E-19)	1988	6.17	95-99
CX767 (CPX-621)	1988	5.98	96
PSB Cn 90-2 (P3262)	1990	6.11	86-94
PSB Cn 90-4 (SX-767)	1990	6.89	89-93
PSB Cn 90-5 (P 3278)	1990	7.32	89-92
PSB Cn 90-6 (E-25)	1990	6.21	90-94
PSB Cn 90-7 (CPX 912)	1990	6.08	89-93
PSB Cn 90-9 (P 3234)	1990	6.25	89-93
PSB Cn 91-11 (CPX 921)	1991	6.3	89-95
PSB Cn 91-14 (CPX 1011)	1991	6.35	90-95
PSB Cn 91-15 (CPX 1012)	1991	6.89	89-95
PSB Cn 91-16 (CPX 1014)	1991	6.85	87-93
PSB Cn 91-17 (9PG238)	1991	7.12	91-96
PSB Cn 91-18 (YOF 62)	1991	7.3	89-94
PSB Cn 92-22 (19 PG 248)	1992	6.64	96-100
PSB Cn 92-23 (CPX 113)	1992	6.31	96-104
PSB Cn 92-24 (IPB x H913)	1992	6.58	104-108
PSB Cn 93-33 (P3246)	1993	6.96	96-97
PSB Cn 93-34 (X1402U)	1993	7.17	97-98
PSB Cn 93-36 (IPB 919)	1993	6.35	101-104
PSB Cn 93-37 (IPB 921)	1993	6.89	97-98

Cont'n. **Table 60**

VARIETY	YEAR RELEASED	YIELD (mt/ha)	GROWTH DURATION (days)
PSB Cn 93-38 (IPB 929)	1993	7.01	97-100
PSB Cn 93-39 (XCW 11)	1993	6.59	96-97
PSB Cn 93-40 (XCW 15)	1993	6.29	96-115
PSB Cn 93-41 (MX 8336)	1993	7.34	95-96
PSB Cn 93-42 (CPX 3122)	1993	5.95	92-94
PSB Cn 93-43 (MX8190)	1993	6.33	95-96
PSB Cn 93-44 (X1352G)	1993	6.65	97-98
PSB Cn 93-45 (CTH501)	1993	6.20	92-97
PSB Cn 93-46 (CW16)	1993	5.94	99-100
PSB Cn 93-47 (CW18)	1993	6.78	^97-99
WHITE CORN HYBRID			
Phil Hybrid =2	1966		
Phil Hybrid =3b	1966		
Phil Hybrid =4	1966		
Phil Hybrid =6	1966		
Phil Hybrid =9	1966		
Phil Hybrid =11	1966		
SMC 102	1983	5.27	101
XCG 33 (Pioneer)	1984	6.09	97
SMC HY 152	1984	5.8	96
P 3228	1985	6.45	102
P 3208	1986	7.03	109
P 3224	1986	6.04	107
SMC 308	1987	5.3	198
SMC 310	1989		
PSB Cn 90-03	1990		
SMC 310 (SMC E-6)	1990	6.57	91-94
PSB Cn 92-25 (YOF 61)	1992	6.19	96-104
YELLOW CORN OPEN POLLINATED			
IES Cn1 (Isabela Yellow)	1988	4.69	97-99
PSB Cn 90-1 (IPB Var1)	1990	5.39	90
PSB Cn 91-21	1991	5.36	95
PSB Cn 93-35 (Daprosa)	1993	5.57	93-96
WHITE CORN OPEN POLLINATED			
UPL Cn-2 "Tanco White" (IPB Var 2)	1985	5.06	97-107
PSB Cn 90-01	1990		
IES Cn2 (IES Var2)	1990	5.24	87-89
PSB Cn 3 (VISCA 8550)	1990	4.91	90-92
PSB Cn 90-8 "USM Var6" (USMARC 2088)	1990	4.43	90-94
PSB Cn 91-10	1991	4.89	94
PSB Cn 91-19 (USMARC 1887)	1991	4.68	89-96
PSB Cn 91-20 (USMARC 1888)	1991	4.85	89-94
SWEET CORN			
Phil. Hybrid 801	1966	5.5	75
UPCA Sweet 1			
Super Sweet Comp. 1	1976		
PSB Cn 93-48 (SC111)	1993	8.55	92
GLUTINOUS CORN			
Glutinous Compositae 2	1976		
PSB Cn 91-12	1991	6.24	65
PSB Cn 91-13 (IPB Improved Macapuno)	1991	6.26	65
PSB Cn 93-46 or DLU Pearl	1993	6.10	92-97
WHITE CORN *			
Cagayan White Flint	1955		
Isabela White Flint	1955		
Cebu White Flint	1955		
Phil DMR Comp. 2	1975	4.46	100
Improved Tiniguib	1980	7.2	69
UPL IPB 218	1980		
XCG 33	1984	6.09	97
SMC HY 152	1984	5.84	100
PSB Cn 93-26 (IES E02)	1993	5.30	93-96
PSB Cn 93-27 (USM Var 10)	1993	4.74	97-102
PSB Cn 93-28 (IES Cn 6)	1993	5.75	92-97
PSB Cn 93-29 (CMU Var 2)	1993	5.66	95-98
YELLOW CORN*			
Cuban Yellow Flint	1955		
Cebu Yellow Flint	1955		
Caribbean	1966		
Phil DMR Comp 1	1975	5.35	
Phil DMR Opaque Comp 1	1976		
Glutinous Comp 11D	1976		
UPCA Var 1	1978	5.3	105-110
BPI Var 2	1978	4.32	105-110
Phil DMR Com 1	1978	4.44	95-105
BPI Var 1	1980	4.73	100
IPB Var 1	1981	4.08-4.55	50-54
Cargill SX 711	1984	5.48	100
Cargill SX 747	1984	5.53	100
SMC HY 301	1984	6.07	98
SMC HY 305	1984	5.52	100
PSB Cn 91-10 (AP 4)	1991	4.89	90-94
PSB Cn 93-30 (USM Var 3)	1993	5.30	98-102
PSB Cn 93-31 (USM Var 5)	1993	6.43	97
PSB Cn 93-32 (IES Cn 3)	1993	5.09	91-94

*Include flint and composite corn varieties—hybrid or open pollinated

Sources: *Bureau of Plant Industry. 1993. Philippine Board Seed Catalogue*
Philippine Seed Board Released Varieties, 1955-92 (unpublished)

Table 61 National Seed Industry Council-released varieties of various crops and major characteristics, 1970-1994

VARIETY	YEAR RELEASED	YIELD (mt/ha)	GROWTH DURATION (days)
WHEAT			
UPL W1 (Trigo 1)	1980	1.6	91
UPL W2 (Trigo 2)	1980	1.8	90
UPL W-3 (Trigo 3)	1985	1.69	76
SORGHUM			
Cosor 2	1970	4.13	65
Cosor 1s	1971	3.25	66
Cosor 3	1972	3.74	62
BPI Sor 1	1973	4.02	64
UPL Sg 5 (Cosor 5)	1976	3.8	100
CS 100	1976	4.13	65
Tropic	1983	4.6	90-95
PSB Sg 93-01 (USMARC 109)	1993	4.4	118
SOYBEAN			
L114	1971	1.5-2.3	105-120
Clark 63	1972	1.5-2.0	80-95
TR	1972	1.5-2.0	78-85
UPL Sy-2 (Tiwala 2)	1975	1.5-2.0	86-96
CL Soy-1	1981	1.5-2.0	
BPI Sy-2	1981	0.82-2.2	94
BPI Sy-4 (Tanco Soy)	1985	1.93	80-100
UPL Sy-4 (Tiwala 4)	1986	2.07-2.63	90-97
SJ-2 or CL Soy-1	1989	2.18	93
PSB Sy-1 (LGSy 01-24)	1990	1.94-2.85	89-95
PSB Sy-2 (IPB Sy 85-49-05)	1992	2.45-3.07	85-99
PSB Sy-3 (La Carlota Soy 2)	1993	2.04-2.42	86-100
VEGETABLE SOYBEAN			
Vesoy #1	1977	6 pod	70-95
BPI Vesoy #2	1977	7 pod	70-90
MUNGBEAN			
MG 50-10A	1969	1.0-1.3	60-65
MP 15-2A	1969	1.0-1.3	60-65
BPI Glabrous	1971	1.0-1.3	60-65
CES-87	1975	1.0-1.5	65-68
UPL Mg 1 (Pagasa 1)	1977	1.19	56-64
UPL Mg 2 (Pagasa 2)	1980	1.3	56-69
UPL Mg-3 (Pagasa 3)	1983	1.1	58-61
BPI Mg 1	1984	1.13-1.32	58-61
BPI Mg 5	1986	1.45	60
UPL Mg 5 (Pagasa 5)	1986	1.1-1.48	60
BPI Mg7 (VC 1973-3-B-3-B)	1988	1.53	62-63
BPI Mg 9 (EG 2768B) Ilocos Gree	1989	1.05-1.38	59-60
UPL Mg7 (IPB M-79-9-82 or Pagasa 7)	1989	1.68	66
PEANUT			
Eg Bunch	1965	1.8-2.1	105-110
Eg Red	1965	1.8-2.1	105-110
CES 101	1973	1.8-2.1	104-110
BPI Pn 9	1973	1.8-2.1	104-110
UPL Pn-2 "Biyaya 2"	1976	1.8-2.0	104-111
UPL Pn-4 "Biyaya 4"	1978	2.25	105-110
UPL Pn-6 "Biyaya 6"	1986	1.76-2.32	101
UPL Pn-8 (IPB Pn-1-174) "Biyaya 8"	1989	1.88-2.17	100-110
BPI Pn2 (EG Pn 48) "Mithi"	1989	1.69-1.89	97-101
UPL Pn-10 "Biyaya 10"	1992	1.6-1.7	98-100
UPL Pn-12 "Biyaya 10"	1994	1.6-1.7	98-100
POLE SITAO			
BPI Ps-1 (DES Pole Sitao)	1976	15-18	80-85
BPI Ps-2 (EG Pole Sitao)	1976		
UPL Ps-1 (Sandigan)	1982	13.3	99-103
BPI Ps-3 (Maagap)	1982	12.77	95
UPL Ps-2 (CSL-19) "Ana"	1989	7.09-12.65	43
PSB Ps-1 (CSL-15) "UPL Ps-3"	1990	7.55-12.39	48
EG PS 5 (BPI-PS 4)	1992	7.79-9.29	47
CSL-14 (UPL PS 3) "Maagap 1)	1992	7.83-9.03	45-49
COWPEA			
UPL Cp-1 (Pulahan)	1976	10-15	60
UPL Cp-2 (Putian)	1976	O.7 seeds	60
BPI Cp-1 (BPI Imp Green #2)	1976	1.2 seeds	56
BPI Cp-2 (Mecan Pea)	1976	10-15	70
UPL Cp-3	1976		
UPL Cp-5 (Mabunyi)	1982	7.08	77
UPL Cp-7 (CES 18-6)	1987	10.43-11.05	48-50
UPL Cp-9 (CES 26-1 or Juliet)	1989	8.5-9.6	45
EG 3-2 (BPI-Cp 4)	1992	7.97-9.22	47
EG 22 (BOI-Cp 3)	1992	7.15-7.47	45
BUSH SITAO			
EG Bush Sitao # 2	1972	8.0-10	40-55
UPL Bs-2	1976	8.0-10	47
UPL Bs-3 (Sumilang)	1981	10.67-15.68	73-80
PSB Bs-1 (CBD-2) "UPL Bs4"	1990	10.36-11.82	45
PSB Bs-2 (CBL-3) "UPL Bs 5"	1990	11.89-12.19	48
LIMA BEANS			
UPL Lb 1 (Jackson Wonder)	1979	9.43	73
UPL Lb 2	1979	8.4	75
UPL Lb 3 (Hitik)	1979	12.7	77
EGGPLANT			
Dumaguete Long Purple	1972		90-100
Dingras Long Purple	1972		90-100
UPL EG 11	1980	10.22-20.82	79-86
CA Cluster or Tagumpay	1986	23.7	55-75
TOMATO			
VC-11-1 UG	1972		
UPL Tm-1 (Marikit)	1976		
BPI Tm-1 (BPI Improved Pope)	1976		
BPI Tm-2 (BPI Apple Share)	1976		
TM-2 (Marilag)	1980	3.82-4.46	80.5-82.5
BPI Tm P-1 (Bukudtangi)	1987	36	60-65
UPL Tm-6 (Maigaya)	1987	20.89-34.05	75-95
CUCUMBER			
UPL Cu-1 (UPL Cu 73-19 or Pinagpala)	1976		

Source: Bureau of Plant Industry. 1993. Philippine Seed Catalogue
BPI. 1986. Philippine Seed Board Seed Catalogue
Philippine Seedboard Released Varieties, 1955-92 (unpublished)
Philippine Plant Breeding. 1995. Vol. 7 No. 1