PHILIPPINES:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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CHAPTER 1
Introduction to the Philippines and its Agricultural and Forestry Sector

The Philippines forms part of the Southeast Asian region. With its total land area of 115,830 square miles (300,000 square kilometers), it constitutes two percent of the total land area of the world and is classified as a medium sized country.

Geographically, the Philippines is about 1,000 kilometers from the southeast coast of the mainland of Asia lying on the western margin of the Pacific Ocean. It lies between 21°20' north and 4°30' north latitude and 116°55' east and 126°36' east longitude. Its boundaries are formed by three large bodies of water: on the west and north by the South China Sea, on the east by the Pacific Ocean; and on the South by the Celebes Sea and the coastal waters of Borneo. The country's location makes it strategically important not only as the meeting ground of various cultures but also as the distribution center of goods within the region.

The country's 7,107 islands and islets are clustered into three major groups: Luzon, Visayas and Mindanao. Of these, Luzon and Mindanao comprise the two largest islands with land areas of 105,000 and 95,000 square kilometers, respectively, which together represent two-thirds of the total land area of the country. Forty-five of the islands have an area of 100 square kilometers or more and their aggregate areas comprise 98 percent of the total area of the Archipelago. The archipelagic character has given the country extensive territorial waters and the longest discontinuous coastline in the world, bigger than that of Great Britain, twice the size of Greece and more than twice that of continental United States of America. Because of its extensive territorial water, the Philippines adopted the Archipelago Doctrine as a basis in determining the inland and territorial waters of the country.

Ancestral domains cover a total area of at least two million hectares. The area covered could be larger since most indigenous communities inhabit the forest zones, which account for about 15 M hectares or half of the country's total land area.

1.1 CLIMATE

The climate of the Philippines is tropical and maritime. It is characterized by relatively high temperature, high humidity and abundant rainfall. The country has two marked seasons, dry and wet on the western shores facing the South China Sea, where the dry season generally begins in December and ends in May, with the wet season covering the rest of the year. The dry season shortens progressively eastward, and the rain is heaviest along the eastern shores facing the Pacific Ocean. From June to December, typhoons frequently strike the archipelago at an average of 19 typhoons per year.

The average monthly relative humidity varies between 71% in March and 85% in September. The mean temperature is between 25 to 27°C with a range of 21°C to 34°C. Monthly average rainfall ranges from as low as 120 cm to as high as 270 cm.

The Philippine climate is classified into four types using the Corona system (Appendix 1). This is based on the prevalence of southwest and northwest monsoons and the monthly distribution of rainfall.

1.2 CULTURE

Historical and geographic circumstances account for the curious character of Filipino culture compared to its Southeast Asian neighbors. The culture reveals a wide range of elements derived from four main sources, namely: the indigenous island world, the Asian continent, the Western world, and the contemporary international scene. Although less precise than the comparable terms such as “English”, “French” or “Chinese”, “Filipino” suggests a unified people with a common history, a unitary racial composition and a relatively homogeneous culture.

Both unity and diversity are in the mainstream of Philippine culture. Before the coming of the Westerners, the early communities were multiple and self-contained and often battled against one another for land. Spanish and American influence stressed the unification of various sectors of culture and combined to achieve a certain kind of unity for the islands. Yet the divisive character of an archipelagic environment and the essential duality of East and West have continually been there.

1.3 PEOPLE AND ETHNIC CONSTITUTION

The Filipinos are derived from diverse stocks, but majority share uniformly the Indonesian-Malayan ethnic element.

The early Filipino ethnic mixture is classified into three racial stocks, namely: Negrito, proto-Malay and Malay. Other culture groups such as the Chinese, Japanese, Indian, Spanish and American somehow contributed to the cultural blend.

A member of the Negroid racial group, the Negritos are generally less than 155 cm (5 ft) in height, broad-headed, with kinky hair and blackish pigmentation. They are now a vanishing people due to modern pressures. In the 1960s, there were less than 15,000 relatively pureblooded Negritos remaining. The Negrito gene complex has entered as a stream into the island population as ethnic mixture with other groups occurred. However, in the modern period, little mixture is taking place and the Negrito share in the dominant Filipino bloodstream is declining. The Negritos continue to reside in Zambales and Bataan provinces in Luzon, in the uplands of Panay and Negros islands, in northeast Mindanao and in the uplands of Palawan island.

The second racial type to settle in the Philippines were the proto-Malays. They are considered less Mongoloid than the Malay and are said to be derived from various admixtures in Southeast Asia. Ethnic mixture between and the Negritos has been fairly continuous but on a small scale. The proto-Malay element in the modern Filipino bloodstream is significant. Several groups were sufficiently cohesive and have maintained their identity by speaking their own languages and dialects, and by living life according to tradition. The dominant groups considered to be of proto-Malay stock are the following: the Bontoc, Ifugao, Kalinga and Apayao in northern Luzon; the Manobo, Bagobo and Tinuray in Mindanao; the Mangyan of Mindoro; and the Tagbanua of Palawan.

The Malay stock entered the Philippines about 300 AD from southern Asia and the Western half of the Indies. The Malays are more Mongoloid than the proto-Malays. Their main differences are in language, habits of dressing, architecture and dietary systems. The Malays are also more adaptive to alien cultures than the proto-Malays. Almost all of the Malay group north of Mindanao and Palawan became Christians, while those in Mindanao, Palawan and Sulu became Muslims.

Other ethnic sources contributed to the Filipino bloodstream but these are difficult to estimate. late Indonesian migration brought in Indian components among others. Chinese contact has been on-going for a thousand years

and intermarriages with Malays have been significant. Western colonizers added to the ethnic mixture and compounded the culture complex. Christianity altered the basic structure of culture in many parts of the archipelago, just as Islam changed the culture of the southern islands.

1.4 LANGUAGE

The language situation in the country is complex. No language is common to the whole country. A foreign language (English) is the primary language of instruction of the educational system. Filipino, a language derived from Tagalog, was adopted as the national language in 1937.

The Philippine languages belong to the Malayo-Polynesian family of languages. Separate islands and different histories of population growth differentiated the tongues of the population. Based on the 1980 Census of Population and Housing, there are more than 87 languages and dialects in the country. The ten leading dialects spoken by private households are: Tagalog, Cebuano, Ilocano, Hiligaynon (Ilonggo), Bicol, Waray, Pampango and Pangasinan.

1.5 RELIGION

The influence of varied Asiatic ethnic group settlers, combined with 300 years of Spanish rule and a half century of American occupation, have made the Philippines a unique meeting place for the great religions of the world.

Islam entered the southern islands much earlier than the Roman Catholic Church and remained a militant force against Spanish missionary work in Mindanao and Sulu.

As the Constitution guarantees freedom of religion and worship, the Government maintains a policy of religious tolerance, hence the religious diversity in the country. Christianity has remained the most predominant, with Roman Catholics making up the bulk of the Christian population. Other religious groups are the Muslims (Islam), Protestants of various denominations (Baptist, Evangelical, Lutheran etc.), Aglipayans (Philippine Independent Church), Iglesia ni Kristo (Church of Christ) and Buddhists (predominantly belonging to the Chinese community).

1.6 POPULATION

The population of the Philippines is unevenly distributed throughout the islands. This is due to geographical, social and historical forces, and to the uneven development in the various regions of the country.

From 1987 to 1992, seven regions registered average population growth rates below the national average of 2.3%, and seven above the national average. In 1995, the total population was about 68 M.

Although the Philippines is predominantly rural, majority of the population live in urban areas. Much of the population growth in these areas may be attributed to the influx of rural migrants to the more urbanized areas to gain access to relatively better employment opportunities.

1.7 POLITICAL STRUCTURE AND GOVERNMENT

With the ratification of the 1986 Constitution, the Philippines returned from parliamentary to the presidential form of government headed by a President. In this set-up, three departments undertake government affairs, namely the legislative, executive and judiciary departments.

The country has four types of local government units: the 'barangay', the city, the municipality and the province. In addition, distinct political subdivisions were created which are considered as local government units since they possess all the elements or requisites of a municipal corporation. These are the Metropolitan Manila or the National Capital Region, the Cordillera Autonomous Region, and the Autonomous Region of Muslim Mindanao.

The 'barangay' is the basic unit of the Philippine political system. It consists of not less than 1,000 inhabitants residing within the territorial limit of a city or a municipality and administered by a set of elective officials. The 'barangay' performs both political and development functions.

The municipality is a political corporate body which consists of a number of 'barangays' within its territorial boundaries.

Cities are of two classes: the highly urbanized cities which are independent of the province, and the component cities subject to the administrative supervision of the provinces. Highly urbanized cities are large centers of population. They generally have a high degree of economic and cultural development. A highly urbanized city has a population of at least 150,000. Component cities

have smaller populations (about 100,000) but are capable of governing themselves independently of their provinces.

The province is the largest unit in the political structure of the Philippines. It consists of municipalities and in some cases, of component cities. Its functions and duties are generally coordinative and supervisory. A province has a territory of at least 3,500 km^2, either contiguous or comprising two or more islands, and a population of at least 500,000 persons.

1.8 VEGETATION

As in most of the tropics, the natural vegetation of the Philippines is highly diverse. It supports one of the world's richest floral communities. In many ways, the vegetation constitutes one of the country's greatest resources. The major vegetational formations in the Philippines can be grouped into two recognizable forest formations - lowland rain forests, and lower montane forests. Lowland rainforest, of which there are several different types, is found from sea level to 1,000 m or more. Most widespread is the dipterocarp forest accounting for some three-quarters of lowland rain forest. Seasonal 'molave' forest, swamp forest, mangrove forest and strand woodland are also found in this area. At about 1,000 m above sea level, the humid lowlands give way to a mid-mountain region where the lower montane forests are found. The various types of Philippine forests are the sources of a wide variety of woods with different colors, textures, grains, weights and strength properties.

Another dominant vegetational cover of the Philippines is the grasslands found on the plains and hills where two species of grass, 'kogon' (Imperata cylindrica) and 'talahib' (*Saccharum spontaneum*) predominate.

A big portion of the total area of the Philippines is now occupied by regrowth. Together with 'kogon' grasslands, secondary vegetation or 'parang' forms one of the country's most characteristic and extensive vegetation types. This type of vegetation resulted from a combination of man's activities such as logging and shifting cultivation.

1.9 ANIMAL LIFE

The fauna of the Philippines is almost as diversified as its flora. The total biotic assemblage is a moderate one compared to the centers of the Oriental Life Region, to which its animal and bird populations belong. The life forms are numerous and are of considerable economic value, but they do not provide the same rich resources as the mainland regions of Southeast Asia.

There are said to be 500 species of birds in the country. One-fourth of these are seasonal migrants to the islands. The jungle fowl, pheasants, parrots, pigeons, doves, quails and cuckoos are among the common resident birds. Some rarities such as the monkey-eating eagle or Philippine eagle (*Pithecophaga jefferyi*) are to be found in the mountain fastnesses of the islands.

The land animals of the Philippines are said to form a distinct subdivision of the Malayan Subregion of the Oriental Life Region. There is a restricted variety and number of ordinary land animals. Many of the animals which once roamed the entire archipelago such as the sambe deer, squirrels, lemurs and monkeys are now confined to specific sectors of the country. A wild buffalo called the 'tamaraw' (*Anoa mindorensis*) is restricted to Mindoro. The wild pig, however, has adapted better to the changes in ecological environments. Today, the wild pigs are well distributed throughout the country.

The climate is ideal for many kinds of reptiles and amphibians. There are some 100 species of lizards, of which the iguana resembles a small cayman. Numerous crocodiles inhabit rivers, swamps and brackish pools. Of these, the Estuarine is the most dangerous and one of the largest. But like several species of animal life, it faces extinction.

1.10 AGRICULTURE

The Philippines is chiefly an agricultural country. Its soil is rich and fertile, and its products grow abundantly throughout the year. The principal farm products are rice (*Oryza sativa*), maize *(Zea mays*), coconut (*Cocos nucifera*), sugar (*Saccharum officinarum*), abaca or Manila hemp (*Musa textilis*), tobacco (*Nicotiana tabacum*), maguey (*Agave sisalina*) and pineapple (*Ananas comosus*). Many tropical fruits are also raised, the most important being banana (*Musa* spp.), mango (*Mangifera indica*), *lanzones (Lansium domesticum*), citrus (*Citrus* spp.), papaya (*Carica papaya*), avocado (*Persea americana*), star apple (*Chrysophyllum cainito*), atis (*Annona squamosa*), jackfruit (*Artocarpus heterophyllus*), guava (*Psidium guajava*), santol (*Sandoricum koetjape*), and durian (*Durio zibethinus*). Vegetables and root crops such as mungbean (*Vigna radiata*), yardlong bean (*Vigna unguiculata* ssp. *sesquipedalis*), cowpea (*Vigna unguiculata* ssp. *unguiculata*), tomatoes (*Lycopersicon esculentum*), eggplant (*Solanum melongena*), Chinese cabbage (*Brassica pekinensis*), cabbage (*Brassica oleracea* ssp. *capitata*), mustard (*Brassica juncea*), lettuce (*Lactuca sativa*), sweet pepper (*Capsicum annuum*), pea (*Pisum sativum*), sweet potatoes *(Ipomoea batatas*), sugar beets (*Beta vulgaris*), cassava (*Manihot esculenta*), and squash (*Cucurbita moschata*) are raised for domestic consumption.

Rice, the principal staple crop, is grown everywhere but especially in the provinces of Nueva Ecija, Pampanga, Pangasinan, Batangas, Laguna and Tarlac in Luzon; in North and South Cotabato in Mindanao; and in Negros Occidental, Capiz, and Iloilo in the Visayas. A total of 3.2 M hectares of crop lands is planted to rice, and the livelihood of about 24% of the population depends on it. Next to rice, maize is the most important crop in the Philippines. It is estimated that about 20% of the population depends on corn as food. Corn is also a major ingredient of feed formulation for the growing livestock industry. Major corn areas are in Mindanao and Cagayan Valley.

The Philippines is one of the world's largest producers of coconut and a major exporter of coconut products. The area devoted to coconut production is more than 3 million. The Philippines also produces about half of the world's copra.

Sugar is one of the country's major export and earns for the country a substantial amount of foreign exchange. Sugarcane is grown extensively in the Batangas, Laguna, Pampanga, and Tarlac provinces of Luzon; in Negros Occidental; in Iloilo province of Panay; and in Bukidnon province of Mindanao. Most of the sugar crop is exported to the United States.

Abaca or Manila hemp, the best hemp fiber available, ranks high among the country's exports. It is grown extensively in Davao provinces of Mindanao, southeastern Luzon, Leyte and Samar.

High-quality timber and veneer products were among the leading exports prior to the logging ban. Other forest products include dyewoods, rattan, tanbarks, gutta-percha, beeswax, rubber, and edible birds' nests.

Fishing is also one of the most important Filipino industries. Canned tuna is the principal fish exported, and fish provides an important proportion of the protein in the Filipino diet. Commercial fishing is carried on primarily off Palawan, Negros, Mindanao, and Panay.

The hectarage and volume of production of the leading agricultural crops are presented in Appendix 2.

1.11 AGRICULTURAL EXPORTS AND IMPORTS

Agricultural exports contributed 16.1% of the total value of Philippine exports in 1993. Out of the 20 principal exports of the country, seven agricultural commodities ranked as follows: 6th - shrimps and prawns; 7th - coconut oil;

9th - fresh banana; 10th - tuna; 13th - pineapple and pineapple products; 15th - sugar; and 19th - desiccated coconut (Appendix 3).
The total expenditure for the top ten agricultural imports (Appendix 4) amounted to US$ 133.19 million in 1993. This accounted for 82.8% of the aggregate disbursements for agriculture and 8.4% of the overall Philippine imports.

1.12 CROPPING SYSTEMS

In the late 60s, multiple cropping in the Philippines was considered as a response to the urgent need for increasing production. In 1971, the country embarked on a multiple cropping program with emphasis on rainfed rice areas. Thus, cropping systems then were primarily rice-based, later on expanding to large areas grown to corn, coconut and sugarcane. Farming systems for upland and hilly areas were also developed in recent years.

For rice, generally the cropping sequence is rice-rice in irrigated areas. In recent years, fish or duck has been raised with rice, as well as legumes such as mungbean (*Vigna radiata*), peanut (*Arachis hypogaea*) and soybean (*Glycine max*) after two rice cropping. On the other hand, in rainfed lowland areas, garlic (*Allium sativum*), onion (*Allium cepa*), and tomato are grown after rice using zero or minimum tillage.

In coconut areas, especially in flat lands, the soil is cultivated and grown to various crops, depending on the age of the coconut and distance of planting. Some of these crops are rice, corn, sweet potato, pineapple, banana, lanzones, rambutan, papaya, peanut, mungbean, abaca, taro (*Colocasia esculenta*), arrowroot (*Maranta arundinacea*), daisy (*Gerbera sp.*), sorghum (*Sorghum bicolor*), coffee (*Coffea spp.*), cacao (*Theobroma cacao*), black pepper (*Piper nigrum*), vanilla (*Vanilla planifolia*) and many others. In large coconut areas, cattle and small ruminants are also raised but they require the growing of appropriate pasture grass and legumes.

Upland areas constitute 60% of the Philippines' land area and are predominantly sloping and hilly. Since upland areas are also home to resource-poor farmers and their families, the sloping agricultural land technology (SALT) enables them to strip-crop annual crops and grow perennial crops for domestic consumption and some income, without resulting to soil erosion and decreased soil productivity.

In sugarcane areas, legumes such as mungbean and cowpea intercropped during the first three months provide an opportunity for harvesting one crop in

addition to sugarcane. Farmers in some areas also raise livestock. However, planters would resort to monoculture whenever the price of sugar goes up.

From the 1970s onward, the progress towards the development of sustainable farming systems occurred rapidly, not only to enhance food production, but also to increase income; maximize the use of all available resources such as land, capital, labor and irrigation facilities; develop the countryside; and to minimize environmental degradation.

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 FOREST GENETIC RESOURCES

Out of 4.5 million living species in the world, l.4 million species of flora and fauna were given descriptive names by scientists and 39,l0l species have been identified in the Philippines. There are approximately l5,000 species of plants in the country composed of 8,120 species of flowering plants (of which 2,500 are trees and 800 are orchids); 33 species are gymnosperms (of which 4 are cycads, 24 are conifers and 4 are gnetums); 1,030 species of ferns and fern-allies, 1 is horsetail, 76 are clubmosses, 3 are psilopsids; and 1,271 species of bryophytes (of which 518 are liverworts and hornworts and 753 are mosses). The estimated number of species in the various groups of plants is shown in Appendix 5.

The Philippines is famous for its hardwoods, such as 'apitong' (*Diptocarpus grandiflorus*); 'tanguile' (*Shorea polysperma*), red 'lauan' (*Shorea negrosensis*), white 'lauan' (*Shorea contorta*), 'mayapis' (*Shorea palosapis*), 'guijo' (*Shorea guiso*), 'yakal' (*Shorea astylosa*), 'kalunti' (*Shorea hopeifolia*), 'bagtikan' (*Parashorea malaanonan*), 'palosapis' (*Anisoptera thurifera*) and 'manggachapui' (*Hopea acuminata*). In the lowland evergreen rainforest, there are many other species that have not been fully identified and catalogued.

There are 36 endemic genera and about 3,500 endemic species of flowering plants (Madulid, 1982). Among the lower plant forms, there are about 111 species which are endemic. Some scientists believe that a great percentage of our endemic plants may have been extinct by now. The virgin forests, which harbor a lot of the Philippine endemic species, are now down to only 900,000 hectares from a high 12M hectares in 1969. There are about 86 species of vascular plants occurring in the Philippine mangrove areas, 48 of which are small-to-medium sized trees (Zamora, 1985). This forest type occurs along tidal flats at the mouth of streams and along the shores of sheltered bays. The stand is composed of 8 species of the 'bakauan' (*Rhizoporaceae*) family, which is a source of tanbark, cutch, dyebark and charcoal.

To ensure the perpetuation of forests and the protection of the environment, reforestation and biodiversity conservation programs are implemented. A strategy for reforestation termed as Assisted Natural Regeneration (ANR) makes use of advance stages of secondary plant succession characterized by the presence of sufficient number of tree seedlings, mother trees, favorable soil and

micro-climatic conditions and as a starting point by which enhancement activities of seedling liberation, protection and enrichment are conducted. A bio-ecological, social and economic assessment of this method of forest cover restoration is presently nearing completion.

2.2 MARINE PLANT GENETIC RESOURCES

The country has a coastline of 17,460 km. Its water resources are approximately seven times larger than its land resources. The country's marine waters cover a total area of 220M ha including its 200 mile Exclusive Economic Zone (EEZ). Of this 220M ha, 26.6 are coastal areas which are mostly covered with corals, seaweeds and seagrasses.

Plant genetic resources in the marine environment can be generally divided into seaweed (or algae) and seagrasses. A relatively large number of marine plants are known sources of important natural products for industries and biotechnology.

2.2.1 Seaweeds

Seaweeds have limited distribution ranging from the lower intertidal to the shallow subtidal zones in the marine environment. Many species are found in sheltered bays and cays while others may be limited to the rocky, exposed areas along the shores or margins of the reefs. In the Philippines, there are 141 *algae* species subdivided into 3 divisions: *Chlorophyta* (green algae), 58 species; *Phaeophyta* (brown algae), 23 species; and *Rhodophyta* (red algae), 60 species (Trono, 1988).

Ecological research on seaweeds has been focused on the description of vegetation while statistical methods have been used to describe seaweed communities. Until recently, large-scale phytogeographical patterns specific to the Asian region have not been thoroughly analyzed due to the great number of species involved and the paucity of taxonomic studies on seaweeds.

Fortes (1992) separated the Philippines into two biogeographic zones (BZ) based on the distribution of macrobenthic seaweed flora. This flora comprises 190 genera (*Chlorophyta* or green seaweeds, 37; *Phaeophyta* or brown seaweeds, 23; and *Rhodophyta* or red seaweeds, 130). The zones are BZ-West, the western zone which is bounded by the South China Sea and the Sulu sea and BZ-East, the eastern zone which faces the southwestern portion of the Pacific Ocean (Fig. 1). This classification is partly explained in terms of

the prevailing tidal regimes, dominant airstreams and their effects on the current systems and on rainfall distribution.

Red and brown seaweeds are commercially important to the colloid-using industry (Renn, 1986); red and green seaweeds are important as food. Seaweeds may be collected from wild stocks or grown in seaweed farms.

Seaweeds have several uses but the major industrial importance is that they contain a group of chemicals called hydrocolloids, which include agars, alginates and carrageenans. Carrageenans are used by the food (78%) and cosmetic (225%) industry (Polysaccharides, 1991). Alginates are used by the textile (50%), food (30%), paper (6%) and pharmaceutical (6%) industry. Agars are used by the food (58%) scientific laboratories (28%) and pharmaceutical (14%) industry (Mabeau et al., 1990 as cited by Zinkskas and Lundin, 1993). Agars are particularly important to the conduct of biotechnology research and to bioindustry processes.

In the Philippines, seaweeds are still relatively unexplored. Aside from *Eucheuma* which is generating dollars for the country, there are other commercially important species with export potentials like *Gracilaria, Gelidiella, Caulerpa* and *Sargassum*.

Major producing areas of seaweeds are the coastal waters of Tawi-Tawi, the reef areas of Sulu, Zamboanga del Norte, Sacol and Cuyo Islands of Palawan and Danajon Reef of Central Visayas.

Seaweed farming covers an estimated 151,200 hectares in coastal areas of Western Mindanao. Besides this, all small islands of the country are production/growing areas of seaweeds.

Approximately 80,000 families or 350,000 people are engaged in seaweed farming. More than 10,000 workers are employed in the processing sector in Cebu, Zamboanga, Metro Manila and Laguna.

The seaweed industry is one of the fast expanding industries of the Philippines with an annual growth rate of 15.5%. Our country is the leading world supplier of *Eucheuma* contributing about 80% of the world supply. Among the fishery products exported in 1993, seaweeds rank second in terms of volume (23,574 mt) and fourth in terms of value (US$ 18,504M).

Under the Medium-Term Export Development Plan, the seaweed (carrageenan) industry aims to increase imports by an annual average growth rate of 20%, provided marker access issues are resolved. The target markets are Europe, the United States of America, South America and Japan.

The Board of Investments (BOI) includes carrageenan and seaweeds in its Priority Investment Areas. The seaweed processing industry enjoys various incentives such as 3-4 years income tax holiday granted to new and expanding firms; 100% tax and duty-free importation of capital equipment; tax credit on domestic capital equipment and exemption from contractor tax.

Major losses in seaweeds production have been attributed to lack of quality seedstocks, lack of refining plants to meet world demand of refined carrageenan and unfavorable international marketing practices.

The *Eucheuma* industry has experienced lack of quality seedstocks in the past years because of the deteriorating genetic condition of the existing seedstocks due to the monoculture practice of seaweed farmers. Occurrence of ice-ice disease in *Euchema* from time to time also contributes to the degeneration of seedstocks.

Marine biotechnology may benefit seaweed culture. Its research techniques can produce quality seedstocks, enhance seaweed growth rate, disease resistance and ability to endure adverse environmental conditions.

High cost prohibits seaweed processors from putting up additional plants that can produce refined carrageenan to satisfy European markets.

2.2.2 Seagrasses

In the Philippines, the study of seagrasses receives very little attention from marine botanists. It was only in the last three decades that seagrass studies started to gain popularity with the realization that seagrasses together with plankton and benthic algae contribute to the basis source of primary production in the shallow coastal areas. The multifunction of seagrasses including their role as spawning and nursery grounds for a wide variety of marine organisms is not so well-documented in the Philippines. Although seagrass resources have not been quantified, a conservative estimate would be between 10,000 and 50,000 sq km of coastal lands and seagrass coverage. In the Philippines, 7 genera comprising 16 species of seagrasses have been reported.

From the viewpoint of productivity, coastal production and their varied roles, conservation of the natural genetic stocks of our local seagrasses are most desirable. Aside from pentosans, other natural products maybe discovered from the many species of seagrasses which so far have not been screened for useful chemical substances. In addition, seagrasses may also be used for bioremediation (Zinkskas and Lundin, 1993).

2.3 LANDRACES (FARMERS' VARIETIES) AND OLD CULTIVARS

A model of on-farm PGR conservation project implemented by an NGO is CONSERVE (Community-Based Native Seeds Research) by the Southeast Asia Regional Institute for Community Education (SEARICE). The project works with around 1,800 farmer families that cultivate around 1,800 hectares of irrigated lands and with some upland farmers whose landholding ranges from 1 to 3 hectares.

CONSERVE's collection of rice cultivars around North Cotabato and in six villages in adjoining provinces yielded 298 accessions. Eighty percent of the accessions are upland varieties.

On the other hand, the total rice accessions at the IRRI gene bank from the whole of Mindanao is only 135. Comparing the CONSERVE accessions which were obtained from less than 1/25th of the land area of Mindanao, it is safe to assume that the country does not have a clear data on how much diversity is left and how much were actually lost.

Of the 298 traditional rice varieties collected by CONSERVE, two are wild rices. Very limited knowledge is available on existing plants and varieties in the wild. Wild species are endangered due to continuous urbanization and human intervention that destroy their natural habitat.

2.4 OTHER WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

Based on the most recent (December 1994) inventory of the National Plant Genetic Resources Laboratory (NPGRL), the laboratory holds a collection of 396 species of various plants that include cereals, fibers, forage and pasture crops, fruit trees, legumes, nut trees, oil crops, plantation crops, root crops, small fruits and vegetables. A large proportion (about 75%) of this collection is of local origin.

The local collection comprises largely of indigenous accessions of different species including the wild relatives. The *Abelmoschus* (also *Hibiscus*) collection consists of *A. esculentus, A. manihot, A. moschatus* and *A. tetraphyllus*. The immature fruits of *A. esculentus* are cooked as vegetables while the young leaves of *A. manihot* are boiled and eaten as vegetables. The other species of *Abelmoschus* were collected as weeds in the northern and southern parts of Luzon. A wide collection of *Solanum spp.* is also being maintained in the genebank. We have the *Solanum melongena, S. nigrum, S. aethiopicum, S. surattense, S. torvum* and *S. macrocarpon. S. melongena* is commonly grown as vegetable while *S. nigrum* and *S. aethiopicum* are grown or cultivated as vege-

table or for medicinal purposes. They can also be found growing naturally in different regions of the country. *S. torvum* grows naturally in the wild and is considered as a weed in some areas.

Aside from the common tomato (*Lycopersicon esculentum*), the only wild species in the local collection is the *L. pimpinellifolium* which is also being consumed as vegetable in some regions because of its sour taste. From the Cucurbitaceae, the genebank has in the collection two species of *Momordica*, namely *M. charantia* and *M. balsamina.* The young fruits are eaten as vegetables. Wild forms of *Luffa* and *Lagenaria* were also observed and collected during collecting trips of the genebank. The wild forms of *Luffa* (L. *acutangula* and *L. cylindrica*) have small, bitter immature fruits. Local farmers believe that these have medicinal values. They can also be tapped by the plant breeders for sources of disease and insect pest resistance. Unlike loofah, the wild forms of bottlegourd (*Lagenaria siceraria*) have various shapes and sizes but they also have a very bitter taste. The natives in the northern part of the country dry the mature fruits and use them as storage vessels for meats and other food products. Other cucurbits that were collected in the wild and with potential as vegetable or for medicines are *Cucumis melo* ssp. *dudaim* (small fruits, very aromatic and sweet), *Trichosanthes ovina* (young leaves and fruits eaten as vegetable) and *Coccinia grandis* (young shoots and fruits eaten as vegetable).

The Philippines also has a wide collection of different species of yams (*Dioscorea spp.*). The cultivated species is *D. alata* ('ubi') and the wild relatives are *D. bulbifera* ('utong-utongan'), *D. esculenta* ('tugi') and *D. hispida* ('nami'). The wild relatives have medicinal potential.

Other commercial crops like sugarcane, cotton, abaca coconut, sweet potato and banana are considered major industrial crops. The Sugar Regulatory Administration (SRA) maintains 3 species of sugarcane namely, *Saccharum officinarum*, *S. spontaneum* and *S. sinense*, as well as wild species in related genera. The last two species of *Saccharum* can be found in the wild locally and they are now being tapped in the crop improvement program of SRA.

There are three species of cotton namely, *Gossypium hirsutum*, *G. barbadense* and *G. arboreum* which can be found growing naturally in most regions of the country. An active germplasm collection is being maintained at the Cotton Research and Development Institute with a duplicate collection at NPGRL. Their collection is directly being utilized for breeding purposes.

2.5 MISCELLANEOUS FRUITS AND NUTS

The Philippines is a country richly endowed with edible fruit-bearing species. Added to the wealth of indigenous species which thrive in the primary forests are fruits which were introduced from other countries during the prehistoric times, the Spanish and American era and during the present time. As a result of these plant introductions, the indigenous fruit and nut species were relegated to the background as the fruit industry of the country was slowly built on exotic plants. This can easily be gleaned from the list of major fruits of the country.

2.5.1 Fruit and nut species for fresh consumption

'Alupag' (*Litchi chinensis ssp. philippinensis*)

Indigenous to the Philippines and is known under various names such as 'alupag', 'alpay', 'alupag-amo', 'bakalao', 'matamata', 'usau' and a lot of other names. The tree is small and attractive, 10-15 m high, and distributed at low elevations both in dry and moist regions. The fruit is similar to the lychee, juicy, sweet and with translucent pulp of good flavor, except that it is green, less meaty and contains a large, oblong and black seed while the lychee seed is brownish in color. According to Galang (1955), a meaty variety called 'Alpay carabao' is found occasionally and it should be cultivated instead of the ordinary type.

A breeding program between 'alupag' and lychee is being done in Thailand to come up with a hybrid fruit which incorporates the superior eating quality of the lychee and the adaptability to warm tropical climate of the alupag.

'Anonas' (*Annona reticulata*)

Native of tropical America and widely cultivated in the Philippines. It is also known locally as 'salikaya' and 'sarikaya'. The fruit is heart-shaped and reddish or yellow when ripe; pulp is white, sweet, slightly granular toward the skin and contains many large, dark-brown seeds that adhere closely to the pulp.

'Bitungol' (*Flacourtia indica*)

A native of India and Madagascar it was introduced into the Philippines from Singapore in 1915. Also called 'serali' or governor's plum. Tree is medium-sized and very spiny. The cherry-like round fruit is globose, purple or reddish-

purple when ripe with a dry, sweet flesh which encloses 6-10 small, flattened seeds.

'Marang' (*Artocarpus odoratissimus*)

'Marang' is tagged by Galang (1955) as the best of all native fruits of the Philippines, being superior to its relative, the jackfruit. Tree is medium to large-sized. The brownish fruit is almost the same size as the 'rimas' (breadfruit), about 16 cm long, roundish oblong and thickly studded with short, brittle greenish-yellow spines. Flesh is creamy white, very sweet and juicy. Seeds are edible when boiled or roasted.

'Tabu' (*Willughbeia edulis*)

Indigenous to the Philippines. It is a vine found growing wild in the primary forests of Palawan bearing a very delicious fruit about the size of a small pummelo, smooth and thick-skinned like the mangosteen. The flesh is composed of white, subacid, juicy segments separable from each other, of refreshing flavor and excellent quality like the mangosteen, containing several rather large seeds.

2.5.2 Fruit and nut species for processing

'Alingaro' (*Elaeagnus philippinensis*)

Indigenous to the Philippines. A climbing shrub, of wide distribution at low and medium elevations, up to at least 900 m. Fruits are oblong, 2 to 3 cm long, pale red or pinkish, with subacid flesh of good flavor containing a small seed. This can be made into preserve, jelly and jam.

'Bago' (*Gnetum gnemon*)

Indigenous to the Philippines. A tree about 10-15 m high, of wide distribution at low to medium elevations (600-1,200 m). Fruit is produced in small clusters, oblong and pointed, 2.5 cm long, red and smooth containing one large seed. The seed, referred to as the nut, is white and may be eaten boiled or roasted or made into chips. Young shoots can also be cooked as a vegetable.

'Barobo' (*Diplodiscus paniculatus*)

Indigenous to the Philippines, of wide distribution at low elevations. A medium-sized tree bearing fruits in clusters at the tips of branches. Each fruit contains starchy seeds which when boiled or roasted has the flavor of a nut.

'Bignay' (*Antidesma bunius*)

Indigenous to Southeast Asia. A small, attractive dark green, dioecious tree attaining a height of 10 m. Fruits are small, 8-10 mm long, dark red or purple when ripe, juicy and subacid containing a single flat seed. The fruits make an excellent wine and can also be made into jam and jelly.

'Binucao' (*Garcinia binucao*)

Indigenous to the Philippines. Of wide distribution at low elevations. An evergreen tree, up to 15 or more m high. Fruits are flattened, lemon yellow, 4 or more cm in diameter, with acid flesh. It is used in souring dishes and is usually eaten with fish. It makes a good preserve, jelly and jam. This is called 'batuan' in the Visayas especially in Iloilo.

'Galo' (*Anacolosa frutescens*)

The 'galo' or 'aluloy' is indigenous to the Philippines. It is a tree of medium size about 15 m high, of rare occurrence at low and medium elevations. Fruit is ellipsoid, green and about 2 cm long. Kernel has a delicious nutty flavor when raw or cooked and taste like avocado. There's a farmer's myth that if galo is planted beside a coconut, the coconut will die. Could this be a case of allelopathy? That's why 'galo' is a highly endangered species because it is being cut down by farmers in favor of coconut.

'Iba' (*Phyllanthus acidus*)

Also known as 'karmay', 'poras' and 'bangkiling'. It is indigenous to southern Asia and Polynesia. A small, deciduous tree up to 9 m high. The fruit size approximates that of a small grape, ribbed, pale green or yellow. Flesh is firm, very acidic and encloses a single, hard, bony, grooved seed. Fruit may be used for souring dishes and is excellent for jelly, jam and marmalade. It also makes a good "ade". Two crops of fruit are produced annually.

'Kalumpit' (*Terminalia microcarpa*)

Kalumpit is believed to be indigenous to the Philippines and is of wide distribution throughout the country at low elevations in dry and moist regions but is not cultivated. The tree reaches up to a height of about 25 m. Fruits are ovoid, about 2 cm wide, smooth, dark red when ripe, fleshy and sour. The fruits make a good preserve, can also be dehydrated or made into wine. The

bark contains 34-42 % tannin and can be used for the manufacture of tannin extract or for direct use in tannery.

'Kamansi' (*Artocarpus camansi*)

Native of tropical Asia and Polynesia. A large tree up to 25 m high. Fruit ovoid or subglobose with fleshy spines, 10-15 cm long and with numerous seeds. Immature fruits can be used as a vegetable. Boiled or roasted seeds are also edible.

'Kamias' (*Averrhoa bilimbi*)

Native of tropical Asia. A small tree, 5-10 m high. Fruits are greenish yellow to yellow when ripe, about 6-9 cm long, juicy, sour and contain few flat, brown seeds. Used for flavoring dishes, making preserve and removing stains on clothes and brasswares.

'Kaong' or Sugar palm (*Arenga pinnata*)

Native of India to Malaysia. It is a palm up to 12 m. high, with thicker trunk but shorter than the coconut. Strong fiber which can be made into the so-called cabo-negro ropes can be extracted from the leaf base; starch can be extracted from the trunk, yielding as much as 2 cavans of starch per tree; wine and palm sugar can be obtained from the young inflorescence and an excellent preserve can be made from the immature seeds when boiled in sugar. It can be grown on the poorest land and on rocky hillsides. It prefers to grow along banks of mountain streams, edges of forests and partially open hillsides. Considering its value as fiber, starch and sugar producing plant it should be given due consideration.

'Kubili' (*Cubilia cubili*)

Indigenous to the Philippines. A medium-sized tree attaining a height of 15 m. Fruit is round or oblong, 5-6 cm long , bright green, spiny and contains a roundish oblong nut, 3-4 cm long, dark red and of excellent flavor when either boiled or roasted. Some authors claim that it is one of the best flavored nuts. Found wild in many parts of the Philippines especially in Laguna and Cavite.

'Lipote' (*Syzygium curranii*)

Also called bahag, baligang or igot. This fruit species is indigenous to the Philippines. The tree is medium-sized, 9 m or more high. The fruits are borne in compact clusters, small up to 20 mm in diameter, round, dark red to black,

rather dry but of pleasant, acid flavor. The fruit is used in the making of preserves, wine, pickle, beverages and jelly. It is a good source of pectin.

'Mansanitas' (*Ziziphus mauritiana*)

A small, thorny tree, 6-8 m high; a native of tropical Asia. The fruit is ovoid or subglobose, 1.5-2 cm in diameter, light green to yellowish and contains one large and hard seed enclosed by whitish flesh of crisp texture. Fruit is usually eaten fresh and also made into preserve and jam or dehydrated.

'Roselle' (*Hibiscus sabdariffa*)

Native of India and Malaysia and was introduced into the Philippines in 1911. 'An herbaceous annual bearing fruits characterized as round, hairy, dry capsule about 2.5 cm long and enclosed by enlarged, red, fleshy calyces. This is probably the only plant whose calyces are used in making tart, sauce, beverage, jam, jelly, syrup and wine.

'Sampalok' (*Tamarindus indica*)

Native of tropical Asia and Africa. Introduced to the Philippines during prehistoric times. Tree is 12-25 m high, bearing brown, curved pods, 6-5 cm long with thin brittle skin with ripe. Pulp is soft, brownish, sticky sour to subacid or sweet and aromatic. Green fruits and flowers are used to flavor dishes while the ripe fruit is eaten fresh or made into jam, syrup, candy and ade.

'Tiesa' (*Pouteria campechiana*)

Native of the West Indies introduced into the Philippines from Cuba in 1914. Tree about 7-12 m high Fruits are roundish to egg-shaped, frequently pointed, orange, yellow, smooth and thin-skinned. Flesh is yellow to orange, dry, mealy and sweet. Fruit is usually eaten fresh and can also be made into sherbet, ice cream or processed into baby food.

CHAPTER 3
National Conservation Activities

3.1 AGRICULTURE SECTOR

Plant genetic resources activities in the Philippines became institutionalized with the creation of the Institute of Plant Breeding (IPB) in November 1976 as national centers of plant breeding and genetic resources, respectively in the University of the Philippines Los Baños (UPLB). In 1984, the National Committee on Plant Genetic Resources (NCPGR) was organized by the National Science and Technology Authority (now Department of Science and Technology) to provide direction and implementation of guidelines on PGR activities in the country. In relation to the national agricultural research and development system, the roles of the NPGRL are to serve as secretariat of NCPGR and to coordinate and monitor PGR activities of the national program, in addition to its being the seat of the national repository of agricultural crops germplasm.

The establishment of crop germplasm networks was initiated in 1989 as a strategy to attain the major objectives of the national program. To date, networking of germplasm activities has been on-going for root crops, abaca and cotton. The fruit and plantation crop networks are accepted in principle but the committee suggested reviewing crop priorities and a "leaner" network.

Lately, environmental concerns have highlighted the importance of plant germplasm conservation. In March 1992, the Philippine Legislative body passed Republic Act No. 7308 known as the Seed Industry Development Act of 1992 which further affirms the vital role of plant genetic resources in seed industry and agricultural development.

3.1.1 *In situ* conservation activities

The *in situ* conservation activities in the country are being conducted by government agencies supported by the non-government organizations (NGO). Conservation activities done by the forestry sector will be discussed in the latter part of this chapter.

SEARICE's CONSERVE conducted a collection expedition in 1993 which yielded 298 traditional rice and 14 corn varieties. Ten rice varieties, amounting to 100 grams each, were given to farmer curators for conservation and

adaptability test. Prior to distribution farmer-curators were carefully selected and series of meetings and focused group discussion on the urgency and importance of PGR conservation and development were conducted with farmers. The task of the farmer-curators was not limited to growing samplesnamic relationship and flow of materials exist between CONSERVE and the farmer-curators and within the farmer-curators themselves. No condition is imposed on the farmers for the PGR project. The technology promoted is anchored on sustainable agriculture.

At present, CONSERVE has a total of 140 farmer-curators. The ten traditional varieties were added to those that are already maintained by the farmers.

3.1.2 *Ex situ* conservation activities

The NPGRL maintains and conserves a collection of 32,446 accessions of 396 plant species (except rice). Majority are seeds maintained in the cold storage facilities while the asexually propagated species are maintained in the field genebank and by *in vitro* conservation. The national germplasm collection based on the contribution of each network member is presented in Table 1 and the complete listing of the species collection is presented in Appendix 6.

Table 1 The National Germplasm Collection

Agency/institution	Number of species or crop maintained	Number of accessions
BPI	69 species (vegetables and fruit trees)	2,113
CLSU	4 species	88
CMU	8 species	2,304
CRDI	Cotton - 2 species	465
FIDA	Abaca	112
IBS- UPLB	62 species	62
ISU	5 species	77
NARC, VISCA	Abaca	517
NPGRL	396 species	32,446
NTA	Tobacco and related species	468
PCA	Coconut	97
PHILRICE	Rice and related species	3,123
PRCRTC,VISCA	11 root crop species	2,333
SRA	Sugarcane 3 species	1,231
UPLB Horticulture	9 species	462
TOTAL		**45,898**

The NPGRL is also designated the world base collection center for germplasm of winged bean (*Psophocarpus tetragonolobus*), snake gourd (*Trichosanthes spp.*), bittergourd (*Momordica charantia*), and waxgourd (*Benincasa hispida*). It also holds the duplicate world collection of mungbean (*Vigna radiata*) and the Asian collection of tomato (*Lycopesicon esculentum*). Collection of Southeast Asian indigenous crop germplasm are likewise conserved.

The germplasm collection of the NPGRL is mostly of indigenous origin. These are being utilized directly by the plant breeders of the Institute of Plant Breeding. In 1991, a project, funded by the Asian Vegetable Research and Development Center (AVRDC) in Taiwan, helped greatly in increasing the native vegetable germplasm collection of NPGRL. Priority areas were identified wherein collecting expeditions were conducted. Many wild species of vegetables (*Solanum sp.*, *Abelmoschus sp.*, *Cucumis sp.*, *Trichosanthes sp.*) were collected and identified. A duplicate collection of these germplasm accessions is being maintained at AVRDC. The fruit germplasm collection is also given special attention by the government as these crops are considered export winners. Collecting of fruit species with potential for processing and fresh consumption are given priorities. In fact, NPRGL has identified these fruit species with export potential (Chapter 2; complete listing of species collection of NPGRL is in Appendix 6).

Aside from the NPGRL collection of herbs and spices, the Department of Horticulture, College of Agriculture at UPLB is also maintaining a field genebank of different herbs and spices namely, sweet basil (*Ocimum basilicum*), holy basil (*O. sanctum*), peppermint (*Mentha piperita*), spearmint (*M. spicata*), corsican mint (*Mentha sp.*), clove (*Eugenia caryophyllata*), cinnamon (*Cinnamomum sp.*), nutmeg (*Myristica fragrans*), coriander (*Coriandrum sativum*), leeks (*Allium ampeloprasum* var. *porrum*), chives (*A. schoenoprasum*), dill (*Anethum graveolens*), annatto (*Bixa orellana*), citronella (*Cymbopogon citratus*), pandan (*Pandanus odororatissimus*), turmeric (*Curcuma longa*), vanilla (*Vanilla sp.*). Based on the export/import priorities, ginger (*Zingiber officinale*), bay leaves (*Laurus nobilis*), saffron (*Carthamus tinctorius*), vanilla, cinnamon, cloves, nutmeg, cardamoms, and spice seeds are given priority by the genebank for collection.

For medicinal plants, there is a program launched to maintain a collection of different species of such plants giving priority to those that have been tested already by the Department of Health (DOH). The National Integrated Research Program on Medicinal Plants (NIRPROMP) in UPLB collects and maintains the medicinal plants species at the Institute of Biological Sciences.

The program conducted survey on various parts of the country and was able to identify 1,687 plant species being used by traditional healers or "herbolarios". A gene bank at the Department of Horticulture, UPLB was

established to house medicinal plants collected in the conduct of the survey. A duplicate collection was established by the National Plant Genetic Resources Laboratory (NPGRL). At present, 87 species of medicinal plants are being maintained by the national gene bank. Most are maintained as field collections and others as seed collections. Appendix 7 provides a list of the medicinal crop germplasm holding together with the corresponding purported uses. Fourteen species which have passed scientific validation conducted by the NIRPROMP can be found in the collection and these are: *Vitex negundo* and *Coleus amboinicus* (leaves) for cough; *Blumea balsamifera* (leaves) and *Zea mays* (silk) as a diuretic; *Carmona retusa*, *Psidum guajava* (leaves) and *Garcinia mangostana* (fruit peel) as an anti-diarrheal, *C. retusa* as a mouthwash too due to its high fluoride content; *Cassia alata* (leaves) for skin diseases of fungal origin; *Mentha cordifolia* (leaves) as an analgesic; *Quisqualis indica* and *Leucaena leucocephala* (seeds) as an anthelmintic; *Momordica charantia* (tops) as an anti-diabetes; *Peperomia pellucida* (whole plant) for arthritis and *Allium sativum* (cloves) for lowering high blood pressure. The mode of preparation and the recommended dosage for the proper use of these plants are indicated in Appendix 8. Analysis of the essential oil yield and active components of indigenous plants are in Appendices 9 and 10, respectively.

The Environmental Research and Development Bureau (ERDB) is also maintaining 100 species of medicinal plants at the Mudspring Experimental Area, College of Forestry, UPLB, also as part of the program of the DOH.

Adding to national germplasm collection are the conservation activities being done by the NGOs notably those of SEARICE and MASIPAG.

Some of the traditional varieties distributed by CONSERVE were lost due to social and economic limitations that prompted farmers to discard them. Among the limitations are varieties that did not thrive in some areas and the presence of environmental factors which are not within the farmers' control. In such cases, CONSERVE ensures that the varieties lost and discarded are redistributed to other farmers and are maintained as back-up collection. To support the on-farm conservation done by farmers, CONSERVE maintains a back-up base and active collection in its center farm located within the community.

The base collections are back-up of farmers `discards' and depository of those accessions which are not yet distributed. On the other hand, the active collection contain the seeds for distribution to farmers and seed materials and for on-farm and center-base experimentation.

It should be noted that the collection of CONSERVE covers only portion of the 18 provinces of Mindanao. The total collection amounts to 485 rice varieties and 14 corn varieties. Of the rice accessions, 208 were actually collected

by CONSERVE while the rest were shared by other NGOs. The duplicates of these varieties have not yet been checked. Considering the wide variation of the ecosystem and tribes in Mindanao, the present collection does fully cover the existing diversity in the island.

The contribution of the MASIPAG Project in the conservation and use of the Philippine genetic resources, particularly rice, lies in its CIMME (Collection, Identification, Maintenance, Multiplication and Evaluation) and Rice Breeding programs.

Started 8 years ago, MASIPAG's collection of traditional rice varieties (TRVs), improved varieties (IVs) and some high yielding varieties (HYVs - as control) has resulted in a small collection of about 400 accessions. The collection was made possible through the initiatives of farmers, NGO partners, researchers and friends who are members and supporters of MASIPAG's geographic area clusters, Trial Farms (Farmers' research stations) and communal seedbanks. About half of this collection is being sown out continuously throughout the network of MASIPAG's implementors nationwide.

3.1.3 Storage facilities

Facilities for safeguarding the country's genetic resources include cold storage facilities, field genebanks, and *in vitro* collections.

Cold Storage Facilities

Seed collections (orthodox seeds) are conserved in cold storage facilities. The national gene bank stores seed collection of approximately 128 crop species. There are four (4) existing cold storage units, three (3) are designated for medium term storage and a single unit for long term storage. Each unit has a volume of 43 cubic meters and is capable of storing 30,000 accessions packed in aluminum polyethylene bags. The long term unit is maintained at -20ºC and holds the national gene bank's base collection of peanut, winged bean, soybean, corn, sorghum, mungbean, snap bean and tomato. The mungbean collection is a duplicate of the AVRDC's holdings. All materials kept for long term storage were dried to a moisture content of 6% or lower and packed in aluminum polyethylene pouches and tin cans. The medium term units are maintained at 0º to 5ºC and hold the active collections dried to 6% MC or lower and kept in bottles and aluminum polyethylene pouches.

Aside from the national gene bank, three (3) other government agencies maintain seed collections in medium term cold storage units. PHILRICE, CRDI and NTA maintain seed collections of *Oryza spp.*, *Gossypium spp.* and *Nicotiana spp.*, respectively. These collections are provided with long term

back up collection, parts of which are stored for them by the national gene bank.

The Bureau of Plant Industry has a medium-term cold storage (20°C) facility in the Department of Agriculture Building in Diliman, Quezon City. SEARICE, at the meantime maintain their *ex situ* base collection in glass jars with silica gel at room temperature. The active collections are stored in bags and cans. The amount of each variety in the base collection is 4,000 to 12,000 seeds while the active collection is 1 kg at the minimum.

MASIPAG It has two living seedbanks which serve also as back-up research stations. The Trial Farms also functions as local seedbanks. In all these stations, the farmers are putting in their valuable contributions in conserving and protecting the rice genes of the country.

The national gene bank stores materials for other agencies and at present, the storage facilities are reaching full capacity. It is viewed that a shift to *aluminum* foil packs from bottles and tin cans will increase the capacity of the cold storage facilities maximizing the space available for new germplasm acquisitions.

Repair and maintenance of cold storage facilities require considerable financial support. Presence of leak in the refrigeration system of the units which are often very hard to detect leads to the problem of maintaining the required conditions.

Field Genebank

Field gene banking is employed for collections with recalcitrant seeds and vegetatively propagated accessions. Several field gene banks holding specific crop commodity have already been established and these are: banana and plantains (*Musa spp.*); root crops such as sweet potato (*Ipomoea*), taro (*Colocasia esculenta*), *Xanthosoma, a*rrowroot (*Maranta arundinacea*), and yam (*Dioscorea spp.*); fiber crops like abaca (*Musa textilis*) and cotton (*Gossypium spp.); s*ugarcane and related species (*Saccharum spp.); p*lantation crops like coffee (*Coffea spp.*), cacao (*Theobroma cacao*), coconut (*Cocos nucifera*), black pepper (*Piper nigrum*), mulberry (*Morus alba*) and rubber (*Hevea spp.*) and gene bank for tropical fruits and nut tree species.

***In vitro* Genebank**

Constant and regular rejuvenation leads to loss of accessions through improper handling of materials. *In vitro* conservation minimizes this problem.

Materials are maintained *in vitro* by four gene banks. The NARTC maintains *in vitro* collection of abaca; BPI-Davao has accessions of banana maintained *in vitro* for rescue (virus indexing) and conservation. BPI-Baguio is working on *in vitro* conservation of potato while BSU on *in vitro* storage of selected highland crops like *Chrysanthemun*, lilies, asparagus, strawberry and *Calla*. The national gene bank through the Institute's Cellular and Molecular Plant Biotechnology (IPB CMPB) laboratory maintains *in vitro* back up of the following crops: abaca (73 accessions), banana (135 accessions), potato (587 accessions), sweet potato (67 accessions), taro (19 accessions), yam (13 accessions), garlic (16 accessions) and shallot (25 accessions) totaling to 925 accessions.

3.1.4 Documentation

Institutions working on their priority crops maintain their own documentation systems. The status of documentation of each institution working in PGRs is shown on Appendix 11. Documentation of germplasm data is toward computerization of manually encoded data. This will enable faster retrieval and queries regarding the stored materials. Similarly, computerization of germplasm data is a move prior to the onset of germplasm on line networking in the country.

It can be noted that most of the institutions maintain computerized databases as a method of storing germplasm data. Computerization of characterization and evaluation data in the national genebank, FIDA and PRCRTC are ongoing. BPI still maintains a manually documented passport and characterization/evaluation data.

SEARICE's CONSERVE which allows farmers to characterize chosen varieties enable farmers to maintain their own record of observations. Access to the database in each center can be done with assistance of their staff. At the conserve center, the documentation of all the collected materials are stored in a computer database. The information stored are based on the characterization, preliminary evaluation done by the project staff in the center , routine work (germination test, etc.), seed distribution, etc. Accessions donated to CONSERVE by other sources are not yet characterized. All data are appropriately duplicated and copies are stored within the community.

3.1.5 Evaluation and characterization

The terms characterization and evaluation refer to observations regarding qualitative and quantitative characters, respectively. The national gene bank uses descriptors published by IBPGR-IPGRI on crops when they are available, and descriptors that it has devised for other crop species when descriptor lists are not available from IPGRI. Similarly, other institutions in the country rely on IBPGR-IPGRI published descriptors in characterization and evaluation works.

Government agencies rely on their staff to conduct germplasm characterization and evaluation. The percentage of germplasm characterized and evaluated in an institutions holdings are also indicated in Appendix 11.

For SEARICE-CONSERVE, the morpho-agronomic characters of the seeds collected are characterized in the center using the descriptors' list of IPGRI. In the succeeding season, the descriptor was modified to fit the needs of the project. Initial characterization were also done during collecting expeditions.

There is also an on-farm characterization done by the farmers on varieties which the farmers consider of great importance. The objective is to come up with a system of germplasm characterization applicable to farmers' identification system and conditions. The evaluation and characterization is closely supervised and monitored by CONSERVE staff. To disseminate information to farmers from the center-base, farmers' assemblies are regularly conducted.

MASIPAG on the other hand, undergoes an adaptability trial for a minimum of two (2) crop seasons in different stations. The entries are then screened and evaluated by the partner farmers to select the locally adapted varieties (LAVs). Out of the LAVs, participating farmers can choose their own selection(s) (Farmer Selections or FS), which they base on certain outstanding characters of the rice plants and their own perception of what their local conditions need. They can now use these for multiplication and commercial propagation.

Outstanding traditional varieties are recommended for rice breeding work. This component program is not only directed towards improving some weaknesses inherent in native cultivars. In the longer term, this creates new cultivars that will augment cultivar diversity in the farmers' fields. In its modified rice breeding program, MASIPAG has used more than 26 native varieties and 26 improved varieties as parent materials. From more than 145 crosses, more than 300 selections were isolated and screened. To date, the number of MASIPAG selections consisting of advanced lines and promising lines has gone up to 109. These are shared with the network members in more than 33 provinces in Luzon and Mindanao.

3.1.6 Regeneration

Regeneration of germplasm is done whenever the amount stored falls below the required level, or if the germination becomes lower than 85%. More than one generation of the same accession is maintained in the national genebank. Fresh and old materials of the same accession are stored in separate containers and labeled. The national genebank, in collaboration with IPGRI, is currently determining the acceptable size of regeneration samples needed to avoid genetic drift.

Regeneration at SEARICE-CONSERVE is done at the center-base. The active collections are regenerated only when demanded by farmers and used by the center. Simple germination is conducted for each variety and results are properly documented.

3.2 FORESTRY SECTOR

3.2.1 In situ conservation

In the Philippines, protected areas (PA) play a significant role in the conservation of biological diversity. They are among the most valuable tools of *in situ* conservation and cost effective means for preserving biological resources.

One of the support programs of the Philippine government, through the Department of Environment and Natural Resources (DENR) is the establishment and management of protected areas under the National Integrated Protected Areas System (NIPAS) Act of 1992 (RA 7586). The NIPAS law espouses the twin objectives of bio-diversity management and sustainable development. It gives cognizance to the need to sustainably manage the resources of protected areas for by doing so, the development of the socio-economic and political fibers of the community will be achieved. In the end, these two levels of sustainable development will result in the appreciation by the public of the importance of participating in PA management. It is anticipated that their appreciation on the other hand will lead to the attainment of the primary goal of NIPAS, i.e. biodiversity conservation and sustainable development.

Based on the NIPAS Act, protected areas maybe classified under one of the following categories:

- Strict Nature Reserve
- Natural Park
- Natural Monument
- Protected Landscape/Seascape
- Wildlife Sanctuary
- Resource Reserve
- Natural Biotic Area
- Other categories established by law, conventions or international agreements to which the Philippine Government is a signatory.

All areas or islands in the Philippines proclaimed, designated or set aside, pursuant to a law, presidential decree, presidential proclamation or executive order as national park, game refuge, bird and wildlife sanctuary, wilderness area, strict nature reserve, watershed, mangrove reserve, fish sanctuary, natural and historical landmark, protected and managed landscape/seascape as well as identified virgin forest before the effectiveness of the Act were designated as initial components of the system.

Appendix 12 gives a list of all the National Parks in the country.

There is also an *in situ* conservation effort from the NGOs. The Haribon Foundation is doing *in situ* forest conservation at St. Paul Reservation in Palawan.

3.2.2 *Ex situ* Conservation

A two (2) hectare Rattan Genebank was established in 1985 composed of thirty-eight (38) taxa collected from different provinces throughout the Philippines. Commercial and non-commercial endemic and introduced species are found in the genebank, which is maintained at the ERDB Mudspring Experimental Station using regular funds from ERDB. Growth measurements of all samples are taken periodically.

Four (4) Bambuseta are being maintained through the UNDP/FAO/ERDB Bamboo Research and Development Project. The Philippine Bambusetum located in Loakan, Baguio City has a total of 60 species, 40 of which are exotic and 2 are endemic. The Los Baños Bambusetum located at the Mudspring Experiment Station, Los Baños, Laguna has 38 species, 28 of which are exotic

and 10 are endemic, while the Davao Bambusetum located in Nabunturan, Davao del Norte, has 33 species, 27 of which are exotic and 6 endemic. Another one is located in Malaybalay, Bukidnon with 32 species, 26 of which are exotic and 6 endemic. A bamboo plant exchange was carried out with Australia, United States, Colombia and Chile.

Six (6) pilot plantations covering an area of 57 hectares are also being maintained in selected regions, namely Rosario, La Union; Magalang, Pampanga; Dumarao, Iloilo; Minglanilla, Cebu; Malaybalay, Bukidnon; and Bislig, Surigao del Sur.

Establishment of a Mangrovetum is currently being put in place, to conserve the mangrove ecosystems. Plans to conduct taxonomic identification of unknown mangroves aside from the 38 known species are also being programmed. Best performing provenances shall also be assessed.

An *ex situ* conservation area of *Pinus caribaea* (2 ten-hectare parcels) was established in 1981 at the FORI Experimental Forest in Pakyas Oriental Mindoro. The provenances are Limones, Honduras (parcel l); and Alamicamba, Nicaragua (parcel 2). The area is now being maintained by the Mindoro Community Environment and Natural Resources Office, as well as researchers from ERDB who are currently observing the phenological behavior of the species.

Neem (*Azadirachta indica*) International Network Trials are presently conducted at the ERDB Mudspring Experiment Station. So far, 6 provenances from India and Thailand have arrived and the plantations are now being established. A lot more provenances are expected to be sent to ERDB, through the DANIDA Forest Tree Seed Center. This is through the international network of the UNDP/FAO/RAS 91/004 Forest Tree Improvement and Propagation Project, based in ERDB.

Mountain 'agoho' (*Casuarina equisetifolia*) and beach 'agoho' (*Casuarina rumphiana*) plantations are currently being maintained at the Jawili Reforestation Project in Region 7. The plantations had been designated as one of the seed production areas of the region for these species.

A ten (10) hectare thirty-seven (37) year old mahogany (*Swietenia macrophylla*) plantation established in Region 7, Visayas, Philippines serve as a seed production area in the region.

Provenance/progeny trials and seedling seed orchards for *Eucalyptus urophylla*, *Acacia crassicarpa* and *A. auriculiformis* will be established in Bansud, Oriental Mindoro with funding from the Australian Tree Seed Center (ATSC) and the government of the Philippines. *Paulownia tomentosa*, *P. fortuneii, P. catalpifolia* and *P. elongata* provenance trials are also being conducted in the country specifically in the Cordillera Autonomous Region, Regions 4 and 10 also in collaboration with FORTIP.

A *Gmelina arborea* Species International Network will also be spearheaded by the Philippines in close coordination with the Regional Forest Tree Improvement & Propagation Project of the UNDP/FAO.

Also at the Mudspring area is a Palmetum with nine (9) species.

A small Grassetum with seven (7) species is also being maintained in the Mudspring area.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

Genetic resources serve as a gene pool wherein desirable traits of various crop species are being utilized in the breeding works and attempts to incorporate these traits to a new crop variety are being developed. In many instances researchers/plant breeders introduce/import foreign materials for breeding purposes.

4.1 USE OF PGR COLLECTIONS

Genetic resources are for research/breeding purposes and the number of DA/BPI scientist/professionals involved are the following:

Table 2 Number of DA/BPI scientist assigned per crop

Crop	No. of Scientist	In country Uses
Corn	2	seed growers, seed farms/stations
Chinese Cabbage	1	vegetable growers
Peanut	3	seed growers/farmers
White potato	2	potato growers
Soybean	3	seed growers, seed farms/station
Mungbean	3	-do-
Pole sitao	1	vegetable growers
Bush sitao	1	-do-
Squash	2	vegetable growers
Tomato	4	-do-
Cowpea	2	-do-

The genetic resources maintained in the NPGRL, Institute of Plant Breeding are generally used by the plant breeders of the Institute and other researchers in their crop improvement programs. The accessions acquired from the laboratory are evaluated, selected and either directly recommended as a variety to the farmers or used in the hybridization works. Generally, high yielding ability, good eating quality, high nutritional value, resistance to pest and diseases and adaptability to a wide range of climatic conditions as well as adverse conditions. The possible sources of such desirable characters are landraces, farmers' varieties and wild related species which are either introduced from other countries or locally collected.

The following is a list of crop species where genetic resources collections have been very useful to the Institute's plant breeders and researchers.

1.	Corn / Maize	eight open pollinated varieties that are high yielding, with high lysine content and relative resistance to stem borer and downy mildew were developed from the existing collection; at least seven hybrids were developed, selected and recommended by the National Seed Industry Council (NSIC); forty interspecific hybrids between maize and its wild relatives (mexicana and diplopermis) were found to possess resistance (either single or combined resistances) to stem borer and downy mildew; several accessions were found to possess tolerance to saline conditions as well as to drought
2.	Root Crops	Sweet potato - one accession (a farmer's variety) was selected and released as a variety and at least 4 recommended varieties were products of hybridization using the selected promising accessions Cassava - 4 recommended varieties were selected from the introduced collections
3.	Fiber Crops	Cotton - recommended varieties were selected from the crosses made between selected promising introduced accessions Abaca - 5 genetic stocks possessing resistance to bunchy top were identified from the crosses between 2 promising accessions
4.	Grain Legumes	Mungbean -5 recommended varieties were products of crossing selected promising accessions Peanut -6 varieties were developed and recommended Cowpea -6 varieties were developed and recommended Soybean -3 varieties were developed and recommended

5.	Fruits and Plantation Crops	Pineapple -6 crosses between Smooth Cayenne and Queen were selected and are currently propagated for further evaluation Papaya - 2 hybrids between promising accessions were released. Interspecific hybridization between the cultivated papaya (Carica papaya).and a wild relative (C. cauliflora) is being conducted with the aim of transferring resistance to papaya ring spot virus from the wild species Mango - 5 accessions are being evaluated for rootstock selection and one farmer's variety was selected and released as a variety Banana - 3 varieties were selected and released by the Institute's GRRO Durian - one introduced variety was selected and released by the Institute's GRRO
6.	Ornamentals	Mussaenda - hybrids with improved bract color and growth habit have been developed Anthurium -promising hybrids were developed
7.	Vegetables	Squash -2 recommended varieties (`Rizalina' and `Sampuso') were selected from the collection Bittergourd - a farmer's variety found to possess good characters (high yielding, relative resistance to fruit fly) was recommended for release as a variety Spongegourd - developed one variety ideal for high quality sponge Potato -selected 2 clones that are high yielding during the dry season and one clone highly resistant to leaf blight. Identified a clone which is very good combiner in developing true potato seed hybrids. Garden peas - selected and recommended 2 high yielding accessions

Farmers have very limited access to seeds stored at national genebanks. In most cases, approved varieties are the seeds directly utilized by the farmers. Utilization of traditional varieties by farmers can be done only if these are within their reach such as in community seed banks. Trial participation in the decision-making aspects of selecting and evaluating varieties that they will use. The CONSERVE experience is one example that shows farmers' participation in conservation since this directly done in the community.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

4.2.1 Crop Improvement Programmes

There are other commodity based government institutions or research centers other than the IPB that conduct crop improvement programmes. These are attached to State Colleges and Universities (SCUs) or agencies of the Department of Agriculture (DA). Examples of the agencies of the DA are the PHILRICE, Philippine Coconut Authority, the Cotton Research and Development Institute and the National Tobacco Administration. The Bureau of Plant Industry (BPI) under the DA, is also doing plant breeding work aside from its regulatory role for the seed industry. On the other hand, other SCU-based research agencies are the Philippine Root Crop Research and Training Center, ViSCA; the National Abaca Research Center, ViSCA; the Philippine Industrial Crops Research Institute, University of Southern Mindanao; and the University of Southern Mindanao Agricultural Research Center.

In addition, there are also private groups engaged in crop improvement. These usually started from the distribution of local and imported seeds but gradually start conducting serious breeding work on selected crops such as vegetables (East-West Seed Company, Kaneko Seed Co., etc.), ornamental crops, and cereals (Pioneer, Cargill, etc.). Lately, big foreign seed companies entered the local scene whose main product is the hybrid corn. It is safe to say that the bulk of the plant breeding research money spent by all the private seed companies is devoted to hybrid corn research. Non-government organizations also conduct their own breeding work like MASIPAG AND SEARICE-CONSERVE on rice. In both organizations, the farmers have direct participation in their crop improvement programmes wherein they make their own evaluation and selections of the traditional rice varieties in their germplasm collection. Even modern varieties released by the NSIC (formerly the Philippine Seed Board) have undergone further selection in the farmers' fields.

Government institutions follow certain standards before they can recommend varieties for release. The technical secretariat of the NSIC established by the Seed Industry Development Act of 1992 assumes the functions of the Philippine Seed Board Technical Working Groups (TWG). It is expected to establish seed standards and formulate systems and procedures for varietal evaluation, identification, nomination, registration, release etc. of crop varieties in the National Agricultural Crop Production and Development Programme. Thus, after a certain variety has undergone a series of varietal trials, (including on-farm trials) and found to have the desired characteristics, it can now be recommended or nominated to the NSIC.

4.2.2 Seed Distribution

Due to lack of commercial seeds not all farmers have access to improved varieties of economically important crops. Other reasons for this are:

- limited number of seed producers and production area,
- lack of knowledge/awareness of the farmers of available improved varieties,
- high cost of seeds resulting in the farmers' practice of using home saved seeds,
- lack of availability of production/post harvest facilities in seed centers.

The constraints identified to better seeds production and distribution are the following:

- Seed yield per unit area.
- High cost of production inputs.
- Transfer of seed technology information.
- Lack of infrastructure and facilities.
- Lack of monitoring facilities.
- Participation of private sector in the seed industry.

Improvement of the government seed production and distribution system is continuously undertaken. Policies, program and implementing guidelines are being formulated pursuant to the Implementing Rules and Regulations of the Seed Act. Administrative Order No. 10 Series of 1994 is now being implemented for the regulation and monitoring of seed multiplication, production and distribution of the recommended varieties of food crops.

4.3 USE OF FOREST GENETIC RESOURCES

The Dipterocarpaceae comprise the most important tree family in the Philippines in terms of its economic distribution and vegetative soil cover. The Dipterocarp forest, despite its dwindling area, is still the mainstay of the forest industry and also remains a vital component of watershed areas of the country.

There is an urgent need to improve the local source of forest tree seeds in the Philippines. The simplest, easiest and cheapest way of improving the local seed sources is through the conversion of existing forest plantations and natural forest stands into seed production areas. Forest plantations and natural stands

which have long been the sources of seeds used in the country's reforestation program, are evaluated to determine the potential for conversion into permanent SPAs (seed production areas). The best natural stands and forest plantation with minimum size of five (5) hectares which have reached fruiting maturity were already selected.

The Department of Environment and Natural Resources, in its effort to regenerate the country's forest cover, has continuously been collecting seeds from stands of these indigenous and non-indigenous materials, through the National Forest Tree Seed Committee which has regional counterparts in all Environment and Natural Resources Offices throughout the country. A national list of proposed seed production areas are herewith attached. It is not clear, however, whether the non-indigenous materials are shared with the countries of origin.

4.4 BENEFITS DERIVED FROM USE OF PLANT GENETIC RESOURCES

Since the establishment of the Institute of Plant Breeding in 1976, there has been a conscious effort and active participation of the government to conserve plant genetic resources. With the help of the NGOs, farmers have learned to use and preserve traditional varieties for their own purposes. Plant breeders from the institute as well as those from the Department of Agriculture have benefited a lot from the use of PGR for their crop improvement programmes. The approval of different varieties of rice, corn, root crops, vegetables and other major fruits by the NSIC (formerly the PSB) has contributed to increased productivity and development of varieties with resistances to various pests and diseases and wide adaptability to adverse conditions. For example, in maize, forty (40) interspecific hybrids with its wild relatives (*mexicana* and *diploperennis*) were found to possess resistance (either single or combined resistances) to stem borer and downy mildew. Many useful traits in wild species of vegetables are found to be related to resistances to major pests and diseases.

Many introduced/foreign genetic resources used for crop improvement activities are also a steady source of different desirable characteristics. Four varieties of cassava recommended to the NSIC were selected from introduced collections. This is only one of the many examples that can be cited from the use of PGR. Other nations benefited also from the free exchange of PGR worldwide.

4.5 IMPROVING PGR UTILIZATION

At the national level, utilization of PGR can be improved if the system of information exchange can be upgraded by improving the network information system in the country. The data gathered, which have long been stored in databases, can be of better use if these can be utilized by other scientists and plant breeders. The characterization data and other information needed by plant breeders, if easily accessed, will facilitate their research on crop improvement programs for specific crops.

Farmers should have access to the different germplasm collections in the national genebanks. Likewise, if the information dissemination network will be improved and established, other users (farmers, producers, etc.) can avail of the germplasm collection.

CHAPTER 5
National Goals, Policies, Programs and Legislation

5.1 NATIONAL PROGRAMS

A comprehensive national program on plant genetic resources has yet to be formally developed. However, in general, plant genetic resources conservation, evaluation and utilization as well as other related activities form part of the varietal improvement programs for specific crops in major R and D institutions. There are also commodity-based national PGR networks, such as root crops, abaca, fruit and plantation crops. These networks serve to standardize collection, maintenance, evaluation and documentation of germplasm. For coconut, linkage has been forged and strengthened with countries in Asia and the Pacific through the International Coconut Genetic Resources Network (COGENT). COGENT coordinates and promotes research activities in coconut germplasm collection, conservation and utilization at the national, regional and global levels. Presently, COGENT is chaired by the Philippines.

At the national level, plant genetic resources activities for various crops are being coordinated by an interagency group, the National Committee on Plant Genetic Resources under the Department of Science and Technology. The Committee's functions include recommending policies, rules and regulations and establishing direction for all plant genetic resources activities; determining and recommending for adoption a system of priorities among germplasm activities; and recommending measures to generate financial support for the national plant genetic resources program.

Recently, the private sector and non-government organizations are being tapped, arising from the growing need to upgrade facilities, disseminate information, formulate policies, and provide more funds for PGR projects and activities. They are also represented in fora and seminars which tackle specific issues on plant genetic resources.

5.2 NATIONAL PROJECTS ON BIODIVERSITY

There are a total of 21 ongoing biodiversity projects (some recently completed) coordinated and/or monitored by PCARRD (Appendix 13). Implementing agencies include the National Museum (MM), Central Mindanao University (CMU), Visayas State University (VISCA), Ecosystems Research and

Development Bureau (ERDB) of the University of the Philippines at Los Baños (UPLB), the United States agency for International Development (USAID), and some DENR Regional Offices. Private sectors involved as collaborators include the Ateneo de Davao, Notre Dame University and Xavier University.

Gleaning through the listing of the projects, the areas addressed are as follows: a) survey and inventory, b) reproductive studies, c) ethnobotany, d) utilization studies, e) conservation and restoration, f) economics and trading and g) educational and awareness campaign. The descriptions of these are listed in Table 3.

Table 3 Areas covered by current biodiversity projects

Area Addressed	Description
1. Survey / Inventory	Investigation into the distribution (location) and extent (on population) of the species
2. Reproduction studies	Understanding the nature and process of the species multiplication or regeneration
3. Ethnobotany	Local community regard, interaction, conservation, and utilization of the existing species
4. Utilization Studies	Documentation of current uses and prospects for commercialization
5. Conservation and restoration	A look into what both insiders and outsiders can do to save a rare, threatened or endangered species
6. Economics and trading	Valuation of biodiversity and assurance of its protection and conservation if traded
7. Ecological awareness and educational campaign	Increasing popular appreciation of biodiversity and rounding up support for conservation and wise use

Of the above areas, concentration of many projects are on survey and inventory. Situated in the tropics, the Philippines can boast to be among the countries endowed with the widest array of plant and animal species. The country has about 12,000 species of which 3,800 are endemic and are mostly found in primary forests. These include dipterocarps, palms, ferns, about 4,000 species of pteridophytes, bryophytes, fungi, algae and lichens. The animal species, which include insects, terrestrial vertebrates, birds, mammal's reptiles and amphibians, total about 170,000 species roughly half of which are endemic, most of them still unidentified, unnamed and undescribed.

There is a great need to pursue more action to arrest the dwindling of commercialized species while speeding up efforts to replenish them through plantation establishments, captive breeding or *in situ* conservation. Currently, the Philippines is listed as among those countries with historically neglected biodiversity. In 1991 the Department of Environment and Natural Resources (DENR) through the Protected Areas and Wildlife Bureau (PAWB) has released a national list of 163 rare, threatened and endangered species.

In addition to the above, the following areas shall be addressed by PCARRD and the NARRDN (Table 4.) with the right and welfare of the local community as a primary concern.

Table 4 Additional areas of concern in biodiversity to be addressed by research and development

Area of concern	Description
1. Bioprospecting	Exploring economic/commercial use of diverse, unutilized indigenous species
2. Intellectual property rights	Recognizing and respecting traditional rights of indigenous communities to their biological resources that is subject for exploitation
3. Indigenous knowledge system	Tapping and applying local knowledge and indigenous leadership patterns in biodiversity conservation and management
4. Ecological tourism	Increasing appreciation of the bioresource, while gaining support towards conservation
5. Policy studies	Arriving at policy setting or arrangement most conducive to biodiversity conservation and management

5.3 TRAININGS

5.3.1 Technical Level

The importance of training in plant genetic resources in the Philippines and other developing countries is now recognized by both the formal and informal sectors throughout the world,. It is an urgent requirement to provide scientists with the skills required to collect, classify, conserve, manage and utilize plant genetic resources.

To cater to the particular needs of the developing countries with regard to plant genetic resources, a Master of Science in Plant Genetic Resources (M.Sc. in PGR) is proposed to be instituted in the University of the Philippines at Los Baños (UPLB). The proposed master's program in UPLB will offer an

equally strong theoretical basis as the University of Birmingham program in the United Kingdom (UK). The program will have the added advantage of direct application of the theories to a tropical setting. IPGRI (formerly IBPGR) has strongly supported students for training in the UK. At present, however, IPGRI can no longer afford to send students to Birmingham. A regional training, being more cost-effective, will train more students from the region, perhaps with IPGRI support.

The academic curriculum of the proposed M.Sc. in PGR will be similar to the existing master's degree program in Birmingham, but will be designed within the context of a tropical environment. The formulation and design of the program will also be based on the particular realities, needs and requirements of the developing countries, particularly in Asia. It will be a master's program that will hone the knowledge and skills of professionals, technicians and scientists who are directly involved or who want to be involved in the conservation, management and utilization of plant genetic resources in the Third World.

The UPLB has gained considerable experience and reputation in the relevant sciences such as plant breeding, plant physiology, biosystematics, genetics, statistics, sociology, information management, forestry, and environmental science which underpin the study of the different aspects of plant genetic resources. The proposed M.Sc. in PGR course should capitalize on the complementary strengths and capabilities of the various departments and institutes within the University.

In the meantime during which there is no M.Sc. in PGR program, the University has already taken positive steps towards the institutionalization of a formal training on plant genetic resources. In the new curriculum of the Department of Agronomy, a basic course on plant genetic resources - Agronomy 152 - has been integrated in the undergraduate and graduate programs. The course aims to provide the students with the basic knowledge, skill, perspectives and issues in plant genetic resources, particularly in the context of the Third World.

To answer the question of sustainability of the M.Sc. in PGR program in the region, IPGRI has indicated interest in conducting surveys to assess the demand and impact of the program throughout Asia.

The presence of an international agricultural research center within the University campus in Los Baños - the International Rice Research Institute (IRRI) - and the existence of the national gene bank (National Plant Genetic Resources Laboratory, NPGRL) will provide excellent laboratories and teaching expertise on gene banking activities for the students of the master course. These institutions will provide the necessary support infrastructures and expertise

particularly on *ex situ* conservation and management of plant genetic resources, especially as a complementary strategy to the *in situ* approach.

Also situated within the UPLB campus is the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), which has established an operational consortium among universities in four countries in Southeast Asia and affiliates in Australia and Canada. This could provide options for students in the region to conduct their thesis projects within the aegis of the consortium.

IPGRI has, in the past, extended concrete support for the development of the M.Sc. in PGR program by providing teaching expertise in the PGR course offered by UPLB, books and references, and a study tour to strengthen the capability of a UPLB staff teaching the PGR course.

The growing movement among non-government organizations (NGOs) in the Philippines and other Asian countries towards the recognition of and support for the community-based plant genetic resources conservation and research systems, which is gradually gaining recognition from the formal sector, could also provide a complementary strategy in PGR conservation for the program. The existence of community-based plant genetic resource systems or the informal system in the Philippines, for example Community-Based Native Seed Research Center (CONSERVE) in Cotabato, Philippines, and (MASIPAG), based primarily in Nueva Ecija, Philippines, could provide students with hands-on experience on the important role played by farming communities in plant genetic resources conservation and management. These actual experiences integrated within the proposed master program will provide the students with the appropriate and distinct Third World context on the study of plant genetic resources.

5.3.2 Farmers level

Farmers are also provided training by local NGO's on the aspects of PGR conservation, utilization and management. Selected farmers participate in local and international workshops and symposia on PGR utilization and sustainable agriculture. Similarly, there are cross visits of farmers among some countries in Southeast Asia.

5.4 NATIONAL LEGISLATION

5.4.1 Quarantine

Quarantine laws regulate the import and export of plant genetic resources to and from the Philippines. Quarantine procedures are enforced by virtue of Presidential Decree No. 1431, otherwise known as the Philippine Quarantine Law of 1978. Importations are prohibited if the genetic material has known quarantine pests and there is no known treatment available. Similarly exports are prohibited if the genetic material contain or harbor a known quarantine pest. The list of regulated plant, plant parts and plant products are listed in Appendix 14.

Entry of *in vitro* plant materials are allowed provided that the materials were indexed for viruses known to infect the particular plant. Certification by virologists or proper authorities from the source country, in addition to the required Phytosanitary Certification should accompany the importation.

At present, a stringent quarantine control is necessary because of the increased threats to plants. This is due to the fast movement and introduction of PGRs that may carry pests from one place to another due to faster modes of transportation and the current trend in genetic manipulations. In addition with the onset of WTO/GATT Agreement, exports must be subjected to a more stringent quarantine control to maintain them free from pests and meet the requirements of the importing countries.

5.4.2 Plant Varieties Registration and Protection

Legislation

Presently, there is no specific law in the Philippines that offers Intellectual Property Rights (IPR) protection for innovations concerning plant genetic resources. Also, the country is not a signatory to the Union for the Protection for Plant Varieties (UPOV). There are, however, a number of bills filed in Congress proposing for approaches in plant variety protection. One such pending bill is the Plant Variety Protection and Registration Act which was drafted in consultation with farmers, NGOs and academicians involved in the conservation and development of traditional seed varieties. Government officials have also expressed their interest to join the UPOV or at least adopt a UPOV-style protection of plant varieties. This move is strongly opposed by farmers' organizations and NGOs which are opposing IPRs on seeds.

In the absence of a policy on plant variety protection, some legal experts interpret that relevant provisions of the Philippine Patent Law could be applied. The Law does not expressly prohibit the patenting of inventions involving genetic resources. On the other hand, it allows the patenting of manufactured products or substance, and processed under which innovations involving genetic resources could be interpreted to fall. This patent law was enacted as early as 1947 through Republic Act 165. The Law is basically patterned after the patent law of the United States while later amendments were based on the German patent law. Other IPR laws pertaining to copyright were adopted until the '70s. With regards to patent, the law was not substantially amended since after the World War II.

Proposed revisions in the Patent Law in view of the GATT

Upon the adoption of the GATT and even before its ratification by the Philippine Congress, the Bureau of Patents, Trademarks and Technology Transfer (BPTTT) submitted to Congress a proposal for the revision of the Patent Law. The proposed revisions are meant to make the country's patent legislation consistent with the Trade-Related Intellectual Property Systems (TRIPS) agreement in the GATT.

Specifically, the proposed revisions to the patent law concern the duration of the patent coverage, adoption of the "first-to-file" principle (the Philippines and the US are the only remaining countries that still adopt the "first-to-invent" principle in their patent laws), removal of provisions on licensing agreements, allowing patents on microorganisms, among others.

The above proposal for revision is still pending in Congress. However, the revised patent law is among the "priority legislations" identified for the 10th Congress that will assume in July.

Implications of IPR Legislations on Genetic Resources Programs

The ensuing decisions and debates that accompanied the approval and ratification of the GATT in 1994, somewhat ironically, contributed to the wider understanding of the implications of IPR legislations on the country's (and the world's) genetic resources programs. The provisions of the TRIPS which basically allow the patenting of life forms have drawn criticisms from various sectors ranging from NGOs and POs involved in agricultural concerns, to civic organizations and church groups.

Public debates and opinions on the application of IPR on genetic resources center mostly on the following implications:

- moral questions in the patenting of life forms;
- prohibition on farmers' unlimited access to plant genetic resources which they have nurtures and conserved through millennia;
- prohibition on free exchange of germplasm which has been responsible for the continued development of these resources;
- increase in the commercial price of seeds and produce due to royalties that will be passed on to the producers and consumers;
- monopoly ownership of plant genetic resources by trans-national corporations and the North who have the resources to utilize IPR as a form of protection;
- further narrowing of the country's plant genetic resources because of the government's active promotion of patented seeds;
- non-recognition of the contribution of the farming communities and indigenous peoples in the conservation and development of genetic resources;
- further erosion of indigenous knowledge on PGR due to the non-promotion and neglect of traditional varieties and farmers' seeds.

Judging from the issues raised in public debates and the discussions related to the GATT-TRIPS and the subsequent proposal to revise the Philippine Patent Law, the effects of IPR on genetic resources programs were quite well anticipated. The only effect which was not well discussed and fully understood is the probability of the farming communities' share in the benefits resulting from the commercialization of genetic resources. This is so because the general public opinion on the issue was primarily against the patenting of genetic resources. There are countries in the South, however, which are beginning to explore the potential of such sharing. The idea is yet to be tested if acceptable or not to the farming communities.

It should be noted that these reactions do not guarantee the full understanding of the implications of IPR legislation on genetic resources program. The discussions on the implications of IPR to the country's genetic resources program revolved around policy makers, the civil society, and to some extent, church groups and the urban populace. The people in the farming communities, who are the major stakeholder in this issue, are not well informed on these issues. Initiative on information dissemination and advocacy on these concerns primarily come from NGOs and POs that work in the rural areas.

Need for Assistance on Legal Matters in PGR

In view of the trends in IPR countries, particularly in the North, the Philippines needs assistance on legal matters concerning plant genetic resources. Particularly, such assistance could help explore legal mechanisms, such as but not limited to intellectual property systems, that fully recognize the contribution of farming communities and indigenous peoples in the conservation and development of PGRs. Such mechanism could likewise reward the innovations of the local communities to improve and enhance these resources. Any mechanism that will be recommended should agree with the culture, practices, values, aspirations and sensitivities of the people who will be mostly affected. The concept of "Farmer's Rights" need to be interpreted and explained based on the realities and perception of Filipino farmers.

Incentives to Farmers' Conservation of Traditional Varieties

Existing Philippine laws do not provide for incentive to farmers for conserving traditional seed varieties. On the contrary, the government provides incentives to farmers who use the modern high-yielding varieties. The government's agricultural programs is "coupled" with the promotion of the use of modern varieties and chemical inputs.

There are, however, a number of pending bills in Congress that provide for incentives to farmers for conserving traditional varieties. Likewise, there is a pending bill in the Senate which aims to provide for a system of community intellectual rights protection that acknowledges the innovative contribution of local and indigenous cultural communities with respect to the development of genetic resources and the conservation of the country's biological diversity.

5.4.3 Multiplication, Production, and Distribution of Seeds

Administrative Order No. 10 Series of 1994 (Appendix 15) is now being implemented as far as seed multiplication, production and distribution of the recommended food crop. To provide high quality seeds of superior crop cultivars to farmers and sustain adequate supply of seeds, improvement of the government seed production and distribution system is continuously undertaken. Policies, program and implementing guidelines are being formulated pursuant to Implementing Rules and Regulations (IRR) of the Seed Industry Development Act 7308 of 1992.

The following are the policies and guidelines of the Department of Agriculture on seed multiplication, production and distribution:

Seed multiplication and production

Production of breeder seeds and maintenance of buffer stock of officially approved and released cultivars for commercial planting are the responsibilities of government and private breeding institutions. The production of certified seed requirements, on the other hand, is left to accredited individual farmers, members of cooperatives/associations, cooperatives or private seed companies, programming of which is the responsibility of DA Regional Directors. Registered seed production are left to qualified seed growers also with the decision of the DA Regional Directors.

Crop cultivars/varieties to be produced are those that are approved and officially released by the National Seed Industry Council Breeding institution representatives monitor standing seed crop fields variety. In case of cultivar/hybrid developed by private sector, they are responsible in production and multiplication of their seeds. The Regional Directors and BPI Director are provided with data on seed availability for monitoring purposes;

All seed producers file application for inspection and certification for all seed crops with the nearest Seed Quality Control Services Office (SQCS).

Seed processing and storage

Seed inspectors check seeds for certification, the processing and storage procedures and tag those that pass.

Seed distribution

Only accredited seed growers are allowed to buy registered seeds. Breeding institutions shall strictly limit distribution of breeder and foundation seeds to seed networks and accredited seed growers;

Monitoring

Regional and Provincial Seed Coordinators are responsible for monitoring the progress of seed production and distribution and maintain stock inventory for all crops of seed network.

With the implementation of the program, still there is a lack of commercial seeds thus, not all farmers has access to improved varieties of economically important crops. The limited access of farmers to improved varieties are due to the following reasons:

- limited number of seed producers and production area,
- lack of knowledge/awareness of the farmers in improved varieties,
- high cost of seeds resulting for the farmers practice to use home saved seeds,
- lack of production/post harvest facilities available in seed centers.

The constraints identified to better seeds production and distribution are the following:

- Seed yield per unit area.
- High cost of production inputs.
- Transfer of seed technology information.
- Lack of infrastructure and facilities.
- Lack of monitoring facilities.
- Participation of private sector in the seed industry.

As stipulated in the Philippine Seed Act, only certified seeds can be sold and distributed legally to farmers in a commercial scale. Farmers' seeds and traditional seeds have to comply with the criteria set by the National Seed Board before they can be certified.

Non-government organizations (NGOs) and peoples' organizations engaged in the conservation of traditional varieties and development of farmers' seeds express that their seeds do not satisfy the requirements for certification by the government. This does not mean, however, that traditional varieties and farmers' seeds are of inferior quality. The reason is that the government's seed certification criteria are different from the standards set by the farmers in seed selection and improvement. Furthermore, farmers have no participation in setting the government's criteria for seed certification.

5.4.4 PGR Exchange

The Philippines does not have any clear policy on the exchange of plant genetic resources particularly with other countries or across political boundaries. Plant genetic resources brought in from another country are not governed by laws, except by quarantine regulations and procedures.

5.4.5 Foreign Collection of PGR

The Philippines has enacted a policy on the regulation of biodiversity prospecting on 18 May 1995 through the signing of Executive Order 247. The collection of plant genetic resources, as part of biological diversity, within Philippine territory is covered by the mandate of this EO.

The new law classifies foreign and local collectors into academic and commercial collectors. All prospective collectors are required to submit an application to the Inter-Agency Committee on Biological and Genetic Resources before they venture into any collection mission. The Committee will then review, discuss and decide on such application after thorough consultation with the source communities of the target resources. A system of direct consultation and prior informed consent of communities are adopted by the EO in regulating the access of bioprospectors to the country's biodiversity.

Since the EO has just been enacted and its implementing rules and regulations are yet to be formulated by the Committee, any judgment on its implementation and direction will be too premature at this stage. Various sectors, however, have expressed their optimism on the promises offered.

5.5 OTHER POLICIES

Recognizing the value of biodiversity and the need for wise utilization and conservation, a number of related policies and legislations have been and continue to be promulgated. This is also spurred by the need to protect the right of communities and nations to their own biological resources, presented and briefly discussed below are some policy related initiatives for biodiversity at the national level.

5.5.1 Executive Order No. 247 or EO on Biodiversity

The EO prescribes guidelines and establishes a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives for scientific, commercial and other purposes. It empowers the State to regulate the prospecting of biological and genetic resources so that they are protected and conserved, are developed and put to sustainable uses and benefit of the national interest. It provides for the prior informed consent of indigenous cultural and local communities in any bioprospecting by any party.

5.5.2 National Integrated Protected Areas System (NIPAS) Act

The Act provides for an *in situ* approach to biodiversity conservation involving the partnership of the government, local communities and NGOs. Protected areas provide the safety mechanism to cushion the country from ecological imbalances even as it pursues economic development.

5.5.3 Old Growth Forest Logging Ban

Imposed logging ban in all remaining virgin forests of the country and shifted timber harvesting in residual or secondary forests. It transformed virgin forests into protection forests to conserve the remaining biodiversity therein. There are roughly 500,00 remaining virgin forests in the Philippines.

5.5.4 Philippine strategy for Biological Diversity Conservation (PSBDC)

The PSBDC is focused on 18 broad objectives intended to address the issues/concerns on biodiversity policy, sustainable use, sustainable agriculture, biotechnology and property rights, community based resource management, participation of local and private sectors, *in situ* and *ex situ* conservation measures, biodiversity inventory and research, recognition of ancestral domain and traditional knowledge/practices, public education and awareness and institutional capacity building. It is the Philippine contribution to the implementation of Agenda 21 and International Convention on Biological Diversity.

CHAPTER 6
International Collaboration

6.1 UNITED NATIONS INITIATIVE

6.1.1 Convention on Biological Diversity

This Convention has its primary aim, the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

The Philippines became party to the Biodiversity Convention on 31 October 1993. The Philippine Strategy for Biodiversity Conservation has been approved in principle by the President.

The Biodiversity Country Study to assess the status of biodiversity and formulate strategies and action plan relative to biodiversity conservation in the country is also on-going for a period of 9 months. Executive Order 247, prescribing guidelines and establishing a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives for scientific and commercial purposes and for other purposes has been enacted on 18 May 1995.

The Philippines is also a signatory to the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), along with the other 120 nations (as of June 1995). CITES aims to protect endangered species against over-exploitation resulting from unregulated trade and to promote their aesthetic, scientific, cultural, recreational and economic values. The Philippines acceded to the Convention in 1981 and became an active member of the CITES in 1983.

6.1.2 International Union for the Conservation of Nature and Natural Resources (IUCN)

The International Union for the Conservation of Nature and Natural Resources (IUCN), is a union of sovereign states, government agencies and NGO's with the initiation and promotion of scientifically-based action that will ensure the perpetuation of man's natural environment. It has consultative status with ECOSOC and several specialized agencies of the United Nations. It maintains close working relations with many inter-governmental organiza-

tions especially UNESCO, FAO, ENEP with which it forms the "Ecosystem Conservation Group". It also maintain closed working relations with the World Wide Fund for Nature (WWF). Its mission is to provide international leadership for the conservation and management of living resources.

Even before the Philippines became a member of the IUCN, consultancy assistance was extended by the IUCN to the country in the survey of national parks and other equivalent reserves of the then Parks and Wildlife Office (1965). The Philippines became a member of the IUCN in 1968.

The country's membership to IUCN is voluntary in nature - Philippine commitment to the International Conservation Movement. IUCN member countries submit data on the status of endangered species and on traffic in wildlife through IUCN specialized monitoring centres based in the United Kingdom.

Being a member of the IUCN, we get involved in the religious execution of its objective in the global conservation campaign. Through this participation, we have established areas of concern in protection, management and conservation of parks and protected areas, some contribution tantamount to the needs of the national programme can be identified which is simply fashioned by providing information, issues and simple publications on what is happening on the country's natural resources today. Hence, the government has recognized the need for project establishment, planning and management of wildlife and protected areas under conservation measures.

Likewise, the country is benefited by international linkages which provide opportunities for contact with other member countries in carrying out conservation activities.

6.1.3 Ramsar Convention

The Convention on Wetland of International Importance especially as Waterfowl Habitat, also known as the Convention on Wetlands or Ramsar Convention is an intergovernmental treaty which provides the framework for international co-operation for the conservation of wetland habitats.

Wetlands are essential not only for hydrological and ecological processes, but also for the rich fauna and flora they support. The Convention's objectives are to stem the loss of wetlands and ensure their conservation. The Philippines is the 82nd member-country of the Convention.

6.2 BILATERAL INTERGOVERNMENTAL INITIATIVES

- Twinning arrangements between Indonesia and the Philippines. In support of the effort to re-activate the Dipterocarp Research and Development Center in Bislig, Surigao del Sur, Mindanao, Philippines, the UNDP/FAO/RAS/91/004 Forest Tree Improvement and Propagation Project (FORTIP) arranged the twinning by establishing channels of communication and transfer of technologies between these two countries. Two scientists from the Philippines were able to visit Indonesia, through the financial assistance of FORTIP. They visited forest agencies involved in dipterocarp propagation and plantation management for one month. A technical expert is also coming, through a one month consultancy with FORTIP, to assist in the improvement of the DFRC in Bislig.

- Financial assistance of the Australian AID, through the Australian Tree Seed Center (ATSC) of the CSIRO through FORTIP will be given in 1995 to support the establishment of a 12-hectare seed production area and seed orchards of Acacias and Eucalyptus in Bansud, Oriental Mindoro, Luzon, Philippines.

- Acquisition of genetically superior seeds of different plantation species through the ASEAN Forest Tree Seed Center (AFTSC) in Thailand, DANIDA, ATSC-CSIRO, and other member countries of the FORTIP project, like India, Sri Lanka, etc.

- CIRAD-Foret is interested in the establishment of a Biotechnology Laboratory for Forestry. Negotiations were started as early as 1991, specifically to involve the Industrial Forest Management agencies like PICOP Resources, Inc. and Provident Tree Farms, Inc. in Mindanao. FORTIP is also being tapped as a possible cooperator.

- The INBAR, through the assistance of IDRC and FORTIP, has recently held an international meeting held in ERDB Philippines for the conservation of bamboo and rattan. Continuous contacts with Filipino experts are on-going for their future activities.

- The UNDP/FAO/RAS/91/004 Regional Project on Improved Productivity of Man-Made Forests Through the Application of Technological Advances in Tree Breeding and Propagation is based in the Ecosystems Res. & Dev.'t Bureau. It has been instrumental in a lot of ERDB's international linkages. It has linkages with CIFOR, IDRC, JICA, IPGRI, AIDAB, INBAR, ASEAN FTSC, DANIDA FSC, FORSPA, APAN, etc.. FORTIP has made possible that all ten (10) member countries do develop/establish international linkages with these Regional/International Networks, Centers, and donor agencies.

CHAPTER 7
National Needs and Opportunities

- Development and integration of all policies, rules and regulations on PGR conservation and utilization.
- Establishment of a coordinated networking system.
- Institutionalization of a budget in GR.
- Strengthening of PGR characterization, evaluation and conservation activities.
- Enhancement of germplasm utilization through biotechnology.
- Intensify research on genetic diversity and conservation technology.
- Identification and utilization of potential of wild and endangered species.
- Support *in situ* conservation.
- Training and extension activities on PGR.
- Enhance farmers participatory research on GR.
- Development of integrated informational database on PGR.
- Develop strategies for crop diversification and implement an action plan for the development and introduction of new alternate crops for food and industrial purposes.

7.1 FOR FORESTRY

- Funds for *in situ* conservation of species which do not belong in Integrated Protected Areas System (IPAS) sites. Different regions of the country have unique indigenous tree species which are very useful to indigenous people. This is an urgent concern which need international support. To cite an example, Philippine Teak, which is found only in Lobo, Batangas and Iling Island also at the vicinity of Batangas are now being considered endangered. To wait for a few more years could result in the extinction of the species.
- Training on micro-propagation of forest tree species.

- The need for site/species adaptability researches, species selection, manpower training on tree breeding and improvement to include isozyme studies.
- Information exchange between agriculture and natural resources regarding plant genetic resources.
- Trainings in plant genetic resources.

CHAPTER 8
Proposal for a Global Plan of Action

8.1 GENERAL

- Information exchange.
- Material exchange -ASEAN.
- Research / Global technology.
- International *in situ* reserves/parks.
- Development of status reports, protection -not free access.
- Support to international conventions.

8.2 FOR FORESTRY

- Biodiversity Conservation.
- Tree Improvement.
- Micro and Macro-Propagation of Endangered Tree Species.
- Integrated approach to environmental management and protection.
- Conservation, rehabilitation and protection of degraded coastal areas with emphasis on mangroves.
- Revival and rehabilitation of important rivers and waterways.
- Alleviate poverty in the uplands and continuous influx of migrants from the lowlands.

ANNEX 1
Seed Production Networks 1994-1996 Cropping Season Seed Class to be Produced

CROP	BREEDER	FOUNDATION	REGISTERED
A. Rice	Phil. Rice Res.Institute, Nueva Ecija University of the Philippines at Los Baños, College of Agriculture International Rice Research Institute	PhilRice N. Ecija PhilRice Cotabato PhilRice Agusan PhilRice Cagayan BIARC, Pili Camarines Sur WVIARC, Iloilo Institute of Plant Breeding International Rice Research Institute SCU's/Agricultural College CVIARC, Ilagan Gandara WMIARC, Ipil BPI-Davao BPI-La Granja	Phil Rice Cotabato Phil RIce Cagayan ROS - Abulog ILIARC, Dingras STIARC, RPS - Victoria, Mindoro BIARC, Pili, Camarines Sur WVIARC, Iloilo ROS - Gandara ROS - Babatngon WVIARC, Ipil, Zambo. ROS-Tupi, South Cot. Private Seed Producers, SCU's /Agricultural College
B. Corn (Open Pollinated or Hybrids)	Institute of Plant Breeding CVIARC, Ilagan BPI -La Granja University of Southern Mindanao, Cotabato Hybrid Seed Companies	Institute of Plant Breeding CVIARC, Ilagan BPI- La Granja University of Southern Mindanao, Cotabato Hybrid Seed Companies	Private Seed Growers Private Hybrid Seed Company (F1)
C. Field Legumes (Peanut, Mungbean Soybeans)	BPI-Los Baños Institute of Plant Breeding BPI-La Granja	Institute of Plant Breeding CVIARC, Ilagan BPI-La Granja ROS - Tupi, Cotabato BPI - Davao SCUs	ROS-Sta. Barbara, Pangasinan CVIARC, Ilagan & Iguig BPI-La Granja ILIARC, Bacnotan ROS-Aroman, Coatabato ROS - Dingras, Ilocos Norte ROS - Palawan, Prt. Princesa ROS - Kibawe, Bukidnon BPI-Davao SCUs Private Seed Growers/Seed Producer CENVIARC, Ubay ROS-Romualdez-Babatgnon WMIARC-Ipil

CROP	BREEDER	FOUNDATION	REGISTERED
D. Vegetables			
D.1 Solanaceous (eggplant, pepper, tomato)		BPI-Los Baños BPI - Dingras Institute of Plant Breeding NMIARC, Bukidnon Private Seed Companies	GOOD SEEDS BPI-La Garnja Ilagan Dingras BPI-Los Baños Institute of Plant Breeding Private Seed Growers/Seed Producers NMIARC, Bukidnon
D.2 Cucurbits (squash, bittergourd, bottle gourd, etc.)		Institute of Plant Breeding BPI-Los Baños Aroman (squash) Private Seed Companies	BPI-Los Baños Institute of Plant Breeding BPI- La Granja Babatgnon Sta. Barabara Aroman Ilagan Private Seed Growers/Seed Producers Palawan
D.3 Crucifers and others		Institute of Plant Breeding BPI-Baguio BPI-Los Baños Private Seed Companies	Institute of Plant Breeding BPI- Baguio NMIARC, Bukidnon ROS- Tanay BPI- La Granja ROS-Aroman ROS- Agusan, Talacogon Private Seed Growers/Seed Producers

Note:

No Certification program for all vegetables but breeding institutions/centers should maintain and produce breeder seeds and subject all production to seed testing prior to distribution.

The Regional Directors will identify the private seed growers for provision of foundation seeds.

APPENDIX 1
Corona Classification of the Philippine Climate

Type	Description	Regions/Provinces	Remarks
1	Two pronounced wet and dry seasons; wet during the months of June to November and dry from December to May	Western part of Luzon, Mindanao, 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. They are open only to the southwest monsoon and the cyclonic storms.
2	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.	These regions are along or very near the eastern coast and are not sheltered either from the northeastern monsoon and tradewinds nor from the cyclonic storms.
3	Intermediate type with no pronounced maximum rain period and short dry season lasting from one to three months only.	Western parts of the Cagayan valley, eastern parts of the Mountain 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 northeastern monsoon and tradewinds and are open to the southwest monsoon or at least to frequent cyclonic storms.
4	Uniformly distributed rainfall	Batanes, northeastern Luzon, southwestern Camarines Norte, western Camarines Sur and Albay, Bondoc peninsula, eastern Mindanao, Marinduque, Western Leyte, northern Cebu, Bohol and most of central, western and southern Mindanao.	These regions are so situated that they receive the moderate effects of the northeast monsoon and tradewinds as well as the southeast monsoon and cyclonic storms.

APPENDIX 2
Hectarage and Volume of Production for Selected Crops (1993)

Crop	Area Planted (Ha)	Production Volume (mt)
Rice	3,282,350	9,434,206
Maize	3,149,340	4,102,106
Coconut	3,077,206	11,328,408
Sugarcane	374,009	23,366,081
Banana	325,509	3,069,045
Cassava	211,420	1,844,322
Sweet potato	147,064	693,488
Coffee	140,699	123,933
Abaca	106,443	81,480
Tobacco	90,936	104,779
Rubber	88,133	174,691
Pineapple	66,925	1,254,372
Mango	57,669	334,462
Peanut	44,909	34,028
Mungbean	33,094	23,421
Cacao	16,833	7,892
Soybean	8,218	4,055,520

APPENDIX 3
Value of Export of Major Traditional Philippine Products (1993)

Product	Value (million US$)	Product	Value (million US$)
Total exports	11,375	Plywood	17
Traditional exports	1,395	Veneer sheets / corestocks	2
Coconut products	494	Fruits and vegetables	186
Copra	7	Canned pineapple	94
CNO	358	Pineapple juice	8
DCN	84	Pineapple concentrate	22
Copra meal or cake	45	Others	63
Sugar and sugar products	129	Abaca fibers	19
Centrifugal and refined sugar	102	Tobacco, unmanufactured	26
Molasses	26		
Others	1		
Forest products	45		
Logs	0		
Lumber	26		

APPENDIX 4
Top Ten Philippine Agricultural Imports (1993)

Commodity	FOB Value (million US$)
Feeding stuff for animals (excluding unmilled cereals)	31.63
Cereal and cereal preparation	29.30
Dairy products and birds' eggs	19.78
Fertilizers, manufactured	14.40
Tobacco and tobacco manufactures	12.17
Vegetables and fruits	11.34
Fish and fish preparation	5.04
Miscellaneous edible preparation	4.29
Coffee and cocoa	2.67
Live animals	2.57

APPENDIX 5
Estimated Number of Species in the Various Groups of Plants in the Philippines (January, 1992)

Group	Estimated Number of Species	Source of Information
All Plant Groups	15,108	
Algae	865	Trono (l988)
Fungi (sensu lato)	3,000	Madulid in Sohmer (l989)
Lichens	789	Gruezo (l979)
Liverworts and Hornworts	518	Tan (l98l), Tan & Engel (1986)
Mosses	753	Iwatsuki & Tan (l979), Tan & Iwatsuki (1983)
Psilopsids (Whiskferns)	3	Zamora & Zamora (l970), Zamora (1976)
Clubmosses	77	Zamora (l97l, l988)
Horsetails	1	Zamora (l970)
Ferns	950	Copeland (l958-l960), Price (1972), Zamora et al (1986)
Cycads	4	Zamora & Co. (l986)
Conifers	24	de Laubenfels (l978), Zamora & Co. (l986)
Gnetum	4	Markgraf (l954, l972), Zamora & Co. (l986)
Flowering Plants	8,120	Merrill (l923-l926)

APPENDIX 6
List of Species in the National Germplasm Collection

From the National Plant Genetic Resources Laboratory, Institute of Plant Breeding, University of the Philippines Los Baños

List of Species in the National Germplasm Collection

Scientific Name	Common name (English, Filipino)	No. of accessions
Cereals		
Sorghum bicolor	*Sorghum* (E)	1,184
Zea mays	Corn (E), Mais (F)	1,855
Zea mexicana	Teosinte (E)	2
Sub-total	***3 species***	***3,039***
Field Legumes		
Arachis hypogaea	Peanut, Groundnut (E), Mani (F)	1,263
Glycine max	Soybean (E), Utaw (F)	1,457
Prosopis vidaliana	Aroma bean (E), Aroma (F)	1
Vigna angularis	Adzuki bean (E)	20
Vigna latifolia	-	1
Vigna mungo	Black gram (E)	292
Vigna radiata	Mungbean (E), Munggo (F)	6,728
Vigna sublobata	-	1
Vigna umbellata	Ricebean (E), Tapilan (F)	143
Vigna unguiculata	Cowpea (E), Paayap (F)	1,393
Vigna vexillata	-	1
Sub-total	***11 species***	***11,300***

Vegetables

Scientific Name	Common name (English, Filipino)	No. of accessions
Solanaceous Crops		
Capsicum spp. (4 species)	Pepper (E), Sili (F)	1,507
Lycopersicon esculentum	Tomato (E), Kamatis (F)	6,116
Solanaceous Crops		
Lycopersicon pimpinellifolium	Wild tomato (E)	18
Solanum aethiopicum	Wild eggplant (E)	3
S. macrocarpon	Wild eggplant (E)	1
S. melongena	Eggplant (E), Talong (F)	492
S. nigrum	Wild eggplant (E)	7
S. surattense	Wild eggplant (E)	1
S. tapiro	Wild eggplant (E)	5
S. torvum	Wild eggplant (E)	5
Sub-total	***12 species***	***8,155***

Cucurbitaceae		
Benincasa hispida	Waxgourd (E), Kondol (F)	57
Citrullus lanatus	Watermelon (E), Pakwan (F)	64
Coccinia grandis	Tamling (F)	1
C. melo	Muskmelon (E), Melon (F)	123
C. melo ssp. *dudaim*	Wild melon (E), Melon daga (F)	1
C. sativus	Cucumber (E), Pipino (F)	107
Cucumis sp.	Wild cucumis (E)	2
Cucurbita moschata	Squash (E), Kalabasa (F)	237
Lagenaria siceraria	Bottlegourd (E), Upo (F)	145
Luffa spp. (2 species)	Spongegourd (E), Patola (F)	357
Momordica charantia	Bittergourd (E), Ampalaya (F)	127
M. balsamina	Wild bittergourd (E)	10
Trichosanthes cucumerina	Snakegourd (E), Sikwa (F)	19
T. ovina	Wild cucurbit (E)	1
Sub-total	***14 species***	***1,252***

Scientific Name	Common name (English, Filipino)	No. of accessions
Vegetable Legumes		
Cajanus cajan	Pigeon pea (E), Kadios (F)	562
Canavalia ensiformis	Jackbean (E)	25
C. gladiata	Swordbean (E)	3
Cicer arietinum	Chickpea (E), Gisantes (F)	407
Clitoria ternatea	Butterfly pea (E), Samsamping (F)	19
Lablab purpureus	Hyacinth bean (E), Batao (F)	173
Mucuna curranii	Velvet bean (E), Sabawel (F)	20
Pachyrrhizus erosus	Yambean (E), Singkamas (F)	31
Phaseolus lunatus	Lima bean (E), Patani (E)	494
P. vulgaris	Common bean (E), Habitsuelas (F)	612
Pisum sativum	Sweet pea (E), Sitsaro (F)	837
Psophocarpus tetragonolobus	Winged bean (E), Sigarillas (F)	379
Vigna unguiculata ssp. sesquipedalis	Yardlong bean (E), Sitao (F)	438
V. unguiculata ssp. unguiculata x V. unguiculata ssp. sesquipedalis	Yardlong bean (E), Bush Sitao (F)	13
Sub-total	***14 species***	***4,013***
Crucifers		
Brassica oleracea var. botrytis	Cauliflower (E)	27
B. oleracea var. italica	Broccoli (E)	8
B. rugosa	Mustard (E), Mustasa (F)	98
Brassica spp. (3 species)	Pechay, cabbage, Chinese cabbage	332
Lactuca sativa	Lettuce (E), Letsugas (F)	10
Raphanus sativus	Radish (E), Labanos (F)	33
Sub-total	***8 species***	***508***
Okra and relatives		
Abelmoschus esculentus	Lady's Finger (E), Okra (F)	672
A. manihot	Aibika (E), Likway (F)	1
A. moschatus	Wild okra (E)	3
A. tetraphyllus	Wild okra (E)	3
Sub-total	***4 species***	***679***

Scientific Name	Common name (English, Filipino)	No. of accessions
Perennial vegetables		
Moringa oleifera	Horse radish (E), Malunggay (F)	34
Sesbania grandiflora	Katuray (F)	8
Sub-total	***2 species***	***42***
Minor and other leafy vegetables		
Amaranthus tricolor	Leaf amaranth (E), Uray babae (F)	25
Basella rubra	Ceylon spinach (E), Alugbati (F)	35
Corchorus olitorius	Jute mallow (E), Saluyot (F)	24
Corchorus capsularis	White jute (E), Saluyot (F)	1
Hibiscus sabdariffa	Roselle (E)	3
Talinum triangulare	Talinum (F)	14
	Edible fern (E)	2
	Unknown (2 species)	2
Daucus carota	Carrot	29
Sub-total	***10 species***	***135***
Bulb Crops		
Allium cepa	Onion (E), Sibuyas (F)	330
Allium porrum	Leek (E)	7
Allium sativum	Garlic (E), Bawang (F)	36
Allium tuberosum	Chinese Leek (E), Kutsay (F)	1
Bulb Crops		
Apium graveolens	Celery (E)	2
Sub-total	***5 species***	***376***
GRAND TOTAL	***71 species***	***15,160***

Feed and industrial crops

Scientific Name	Common name (English, Filipino)	No. of accessions
1. Root Crops		
Ipomoea batatas	Sweet potato (E), Kamote (F)	631
Dioscorea alata	Yam (E), Ubi (F)	104
Dioscorea esculenta	Tugui (F)	109
Dioscorea hispida	Nami (F)	6
Manihot esculenta	Cassava (E), Kamoteng kahoy (F)	67
Colocasia esculenta	Taro (E), Gabi (F)	106
Maranta arundinacea	Arrow root (E), Uraro (F)	6
Sub-total	***7 species***	***1,029***
2. Forage and Pasture Plants		
Leucaena leucocephala	Ipil-ipil (F)	139
L. macrophylla	-	10
L. diversifolia	-	8
L. collinsii	-	1
L. shannoni	-	2
Stylosanthes guyanensis	-	19
S. furicosa	-	1
S. subserecia	-	1
S. humilis	-	5
S. scabra	-	3
S. viscosa	-	2
S. hamata	-	4
S. sundaica	-	1
S. erecta	-	1
S. sympodiales	-	1
S. macrophala	-	1
S. capitata	-	7
S. macrophala	-	1
S. leiocarpa	-	1
Stylosanthes sp.	-	1
Desmodium sp.	-	1
Crotalaria sp.	-	3
Macroptilium sp.	-	1
Brachiaria humidicola	-	1
B. decumbens	-	1
B. ruziziensis	-	1
B. mutica	-	1
Paspalum notatum	-	1
P. dilatatum	-	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Forage and Pasture Plants (continued)		
Setaria anceps	-	3
Digitaria decumbens	-	1
Pennisetum decumbens	-	1
Cynodon plectostachyus	-	1
Panicum maximum	-	2
Sub-total	***37 species***	***228***
3. Fiber Crops		
Gossypium arboreum	Tree cotton (E)	105
Ceiba pentandra	Kapok (F)	78
Musa textilis	Manila hemp (E), Abaca (F)	52
Sub-total	***3 species***	***235***
4. Oil Plants		
Carthamus tinctorius	Safflower (E), casubha (F)	2
Cymbopogon citratus	Lemon grass (E), tanglad (F)	6
C. nardus	Citronella (E)	1
Eucalyptus sp.	Blue gum (E), yukaliptus (F)	1
Helianthus annuus	Sunflower (E)	206
Mentha arvensis	Japanese mint (E)	1
M. cordifolia	Philippine mint (E)	1
M. spicata	Spearmint (E)	1
Pogostemon cablin	Patchouli (E), kabling (F)	1
Ricinus communis	Castor bean (E), tangan tangan (F)	27
Sesamum indicum	Sesame (E), linga (F)	126
Vetiveria zizanioides	Vetiver (E), Moras (F)	1
Sub-total	***12 species***	***374***

Plantation crops

1. Medicinal and Pesticidal Plants		
Abrus precatorius	Prayer bean (E)	1
Acorus calamus	Sweet flag (E), lubigan (F)	1
Allium odorum	Leek (E), Kutsay (F)	6
Aloe vera	Sabila (F)	1
Andrographis paniculatus	-	1
Arcangelisia flava	Albutra (F)	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Medicinal and Pesticidal Plants (continued)		
Artemisia vulgaris	Mugwort (E), damong maria (F)	1
Azadirachta indica	Neem (E)	1
Belamcanda chinensis	Black berry lily (E), abaniko (F)	1
Blumea balsamifera	Naai camphor (E), sambong (F)	1
Caesalpinia sappan	Sappan wood (E), sibucao (F)	1
Carmona retusa	Tsaang gubat (F)	1
Cassia acutifolia	-	1
C. alata	Ringworm bush (E), akapulko (F)	1
C. fistula	Golden shower (E)	1
Catharanthus roseus	Periwinkle (E), chichirica (F)	1
Centella asiatica	Indian hydrocotyle (E), takip kohol (F)	1
Chenopodium ambrosioides	Apozotl (E), aposotis (F)	1
Chrysanthemum indicum	Chrysanthemum (E), manzanilla	1
Cinnamomum zeylanicum	Cinnamon (E)	1
C. blumei	Mayana (F)	1
Crossostephius artemisioides	Anjejo (F)	1
C. zedoaria	Zedoary root (E), barat (F)	1
Datura metel	Thorn apple (E), talampunay (F)	1
Derris cebuensis	-	1
D. cumingii	-	1
D. elliptica	-	2
D. philippinensis	-	8
D. polyantha	-	2
D. scandens	-	10
D. tubli	-	1
Dioscorea hispida	Nami (F)	6
Euphoria hirta	Snake week (E), golandrina (F)	1
E. neriifolia	Common milk hedge (E), sorosoro	1
Ervatamia pandacaqui	Crepe-jasmine (E), pandakaki (F)	1
Foeniculum vulgare	Fennel (E), anis (F)	1
Hedychium coronarium	Garland flower (E), camia (F)	1
Hibiscus rosa-sinensis	Rose of China (E), gumamela (F)	1
Impatiens balsamina	Garden balsam (E), camantigue (F)	1
Isotoma longiflora	Estrella (F)	1
Jasminum sambac	Arabian jasmine (E), sampaguita (F)	1
Jatropha curcas	Physic nut (E), tubang bakod (F)	1
Kaempferia galanga	Dusol (F)	1
Kalanchoe bidens	Air plant (E), kataka-taka (F)	
Languas speciosa		1
Lantana camara	Kantutay	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Medicinal and Pesticidal Plants (continued)		
Lawsonia sp.	Patchal (F)	1
Murraya paniculata	Kamuning (F)	1
Nopalea cochinelifera	Chochineal cactus (E), dilang baka (F)	1
Ortosiphon aristatus	-	1
Pandanus odoratissimus	Screw pine (E), pandan (F)	1
Pelargonium graveolens	Rose pelargonium (E), malvarosa (F)	1
Peperomia pellucida	Pansit-pansitan (F)	1
Phyllanthus reticulatus	Tinta-tintahan (F)	1
Portulaca oleracea	Purslane (E), golasiman (F)	1
Premna odorata	Alagao (F)	1
P. integrifolia	Alagao (F)	1
Pseudocallyma alliaceum	Garlic vine (E)	1
Quisqualis indica	Niyog-niyugan (F)	1
Rhoeo spathacea	Bangka-bangkahan (F)	1
Ricinus communis	Castor oil plant (E), tangan-tangan (F)	27
Solanum surattense	Kama-kamatisan (F)	1
Tagetes erecta	Marigold (E), amarillo (F)	1
Tinospora crispa	Makabuhay (F)	1
Triphasia trifolia	Lime berry (E), lemonsito (F)	1
Vitex negundo	Five leaved chaste tree (E)	1
V. trifolia	Lagundi (F)	1
Sub-total	55 genera, 68 species	95
2. Spices/Condiments		
Allium cepa	Onion (E), sibuyas (F)	36
A. sativum	Garlic (E), bawang (F)	37
A. schoenoprasum	Chives (E)	1
Anethum graveolens	Dill (E)	1
Anthriscus cerefolium	Chervil, curled (E)	1
Bixa orellana	Anatto (E), achuete (F)	9
Carthamus tinctorius	Safflower (E), casubha (F)	2
Carum earvi	Caraway (E)	1
Chicorium intybus	Chicory (E)	3
C. endivia	Endive (E)	2
Coleus amboinicus	Indian borage (E), oregano (F)	1
Coriandrum sativum	Coriander (E), kulantro (F)	2
Curcuma longa	Turmeric (E), dilao (F)	1
Elettaria cardamomum	Cardamom (E)	1
Foeniculum vulgare	Fennel (E), anis (F)	4
Hyssopus officinalis	Hyssop (E)	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Spices/Condiments (continued)		
Lavandula spica	Lavender (E)	1
L. vera	Lavender (E)	1
Levisticum officinale	Lovage (E)	1
Majorana hortensis	Marjoram, sweet (E)	1
Melissa officinalis	Balm (E)	1
Ocimum basilicum	Basil, sweet (E), solasi (F)	1
Ocimum sp.	Basil, bush (E), solasi (F)	1
Rosmarinus officinale	Rosemary (E), romero (F)	1
Salvia officinalis	Sage (E)	1
Satureja hortensis	Savory, summer (E)	1
Thymus vulgaris	Thyme (E)	1
Zingiber officinale	Ginger (E), luya (F)	14
Sub-total	***17 genera, 32 species***	***129***

Fruit Crops

1. Fruit Trees		
Adansonia digitata	Baobab (E)	1
Aglaia clarkii	Batukanag (F)	1
A. everettii	Bobonao (F)	1
Annona cherimola	Cherimoya (E)	4
A. cherimola x squamosa	Custard apple (E), atemoya (E, F)	5
A. glabra	Pondapple, mamon (E)	1
A. montana	Mountain apple, maron (E)	1
A. muricata	Soursop (E), guayabano (F)	3
A. purpurea	Soncoya (E)	1
A. reticulata	Custard apple (E), anonas(F)	4
A. squamosa	Sugar apple (E), atis (F)	7
Annona sp.	Graviola (E)	1
Antidesma bunius	Salamander tree (E), bignay (F)	2
A. ghaesembilla	Inyam (F)	1
A. pentandrum	Bignay-pugo (F)	1
Artocarpus altilis	Kamansi (F)	1
A. elasticus	Gumihan (F)	1
A. heterophyllus	Jackfruit (E), langka (F)	13
A. odoratissimus	Marang (E, F)	1
A. rigidus	Monkey jackfruit (E), mandalika (F)	1
Averrhoa bilimbi	Bilimbi (E), kamias (F)	1
A. carambola	Carambola, starapple (E), balimbing (F)	10
Blighia sapida	Akee (E)	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Fruit Trees (continued)		
Burckella obovata	Sawo berang (I)	1
Chrysophyllum cainito	Caimito (E, F), starapple (E)	7
C. oliviforme	Caimitillo (F)	2
Citrofortunella microcarpa	Calamondin (E, F), calamansi (F)	2
Citrus maxima	Pummelo (E), suha, lukban (F)	3
Coccoloba uvifera	Seagrape (E)	1
Cynometra cauliflora	Namnam (I)	1
Dillenia philippinensis	Katmon (F)	1
Dimocarpus longan	Longan (E, F)	2
Diospyros blancoi	Velvetfruit (E), mabolo (F)	5
D. cauliflora	-	1
D. digyna	Black sapote (E), sapote (F)	2
D. pyrrhocarpa	Anang (F)	1
Durio zibethinus	Durian (E, F)	4
Euphoria didyma	Alupag, alpay (F)	1
Flacourtia rukam	Rukam (E), bitungol (F)	10
Garcinia binucao	Binukaw (F)	1
G. dulcis	Taklang-anak (F)	1
G. kydia	Kydia (F)	1
G. lateriflora	Kariis (F)	1
G. mangostana	Mangosteen (E, F)	1
G. xanthochymus	Gamboge tree, tinctoria (E)	1
Glenniea philippinensis	Malachico (F)	1
Hydnocarpus sp.	-	1
Inga sp.	-	1
Lansium domesticum	Langsat (E), lanzones (F)	3
Limonia acidissima	Woodapple (E)	2
Litchi chinensis	Lychee (E), letsias (F)	4
Malpighia glabra	Acerola, Barbados cherry (E)	1
Mammea africana	-	1
Mangifera altissima	Paho (F)	1
M. caesia	Binjai (E), bauno (F)	1
M. indica	Mango (E), mangga (F)	265
M. odorata	Kuwini (E), huani (F)	2
Mangifera sp.	Apali (F)	1
Manilkara kauki	Sawo kecik (I)	3
M. zapota	Sapodilla (E), chico (F)	70
Muntingia calabura	Capulin (E), datiles (F)	1
Nephelium lappaceum	Rambutan (E, F)	15
N. ramboutan-ake	Pulasan (E), kapulasan (F)	1
Pangium edule	Pangi (F)	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Fruit Trees (continued)		
Parmentiera edulis	Cuachilote (E)	1
Persea americana	Avocado (E, F)	10
Phyllantus acidus	Otaheiti gooseberry (E), karmay (F)	1
Pithecellobium dulce	Guayamochil (E), kamachile (F)	1
Pouteria caimito	Abiu (E)	6
P. campechiana	Canistel (E, F), tiesa (F)	23
P. sapota	Mamey sapota (E), chico-mamey (F)	1
Psidium friedrichsthalianum	-	1
P. guajava	Guava (E), bayabas (F)	23
P. littorale	Strawberry guava (E)	23
P. lucidium	-	1
Psidium sp.	Miniature guava (E)	1
Psidium sp.	Sour guava (E)	1
Punica granatum	Pomegranate (E), granada (F)	1
Rheedia edulis	Berba (F)	1
Rollinia mucosa	Biriba (E, F)	1
Sandoricum koetjape	Santol (E, F)	5
Semecarpus cuneiformis	Ligas (F)	2
Spondias purpurea	Spanish plum (E), siniguelas (F)	2
Spondias sp.	Tepereba (E)	1
Sterculia foetida	Bangar, kalumpang (F)	1
Syzygium cumini	Jambolan (E), duhat (F)	13
S. curranii	Lipote (F)	1
S. dombeyi	Hagis (F)	2
S. jambos	Roseapple (E), tampoy (F)	1
S. malaccense	Malay apple (E), yambu (F)	1
S. polycephaloides	Baligang (F)	2
S. samarangense	Java apple (E), makopa (F)	4
S. sumatranum	-	1
Syzygium sp.	-	2
Tamarindus indica	Tamarind (E), sampalok (F)	12
Terminalia catappa	Indian almond (E), talisay (F)	1
T. microcarpa	Kalumpit (F)	1
Theobroma grandiflora	Cupucu (E)	1
Ziziphus mauritiana	Indian jujube (E), mansanitas (F)	1
Z. spina-christi	Crown of thorns (E)	1
Sub-total	101 species	619

Scientific Name	Common name (English, Filipino)	No. of accessions
2. Nut Trees		
Anacardium occidentale	Cashew (F), kasoy (F)	32
Anacolosa frutescens	Galo (F)	9
Canarium indicum	Kanari (E)	1
C. ovatum	Pili nut (E), pili (F)	11
Cubilia cubili	Kubili (F)	1
Diplodiscus paniculatus	Barobo (F)	1
Gnetum gnemon	Bago (F)	3
G. latifolium	Koliat (F)	1
Inocarpus fagiferus	Polynesian chestnut (E), kayam (F)	1
Macadamia integrifolia	Macadamia (E)	3
M. tetraphylla	Macadamia (E)	1
Pachira aquatica	Malabar chestnut (E)	2
Sub-total	***12 species***	***66***
3. Small Fruits (Herbs, Shrubs, Vines, Palms)		
Ananas comosus	Pineapple (E), pinya (F)	14
Ardisia squamolosa	Tagpo (F)	1
Ardisia sp.	-	1
Bactris gasipaes	Pejibaye, peach palm (E)	1
Borassus flabellifer	Palmyra palm (E)	1
Byrsonima crassifolia	-	1
B. coriacea var. spicata	Locust berry (E)	1
Calamus sp.	Rattan (E), uay (F)	1
Capparis micracantha	Halubagat-kahoy (F)	1
Carica papaya	Papaya (E, F)	35
Carissa carandas	Karanda, Bengal currant (E)	1
Chrysobalanus icaco	Cocoplum (E)	1
Elaeagnus triflora	Alingaro (F)	1
Eugenia dombeyi	Grumichama (E)	1
E. uniflora	Pitanga (E)	1
Eugenia sp.	Cedar Bay Cherry (E)	1
Glycosmis pentaphylla	Linauin (F)	1
Hibiscus sabdariffa	Roselle (E)	2
Lepisanthes alata	-	1
L. amoena	-	1
L. fruticosa	Pipiyasuton (F)	1
Morus alba	Mulberry (E)	1
Murraya paniculata	Kamuning (F)	1
Musa acuminata	Saging-matsing (F)	2

Scientific Name	Common name (English, Filipino)	No. of accessions
Small Fruits (Herbs, Shrubs, Vines, Palms) (continued)		
M. balbisiana	Butuhan (F)	1
M. ornata	-	1
M. x paradisiaca	Banana, plantain (E), saging (F)	83
Myrciaria cauliflora	Jaboticaba (E, F)	1
Passiflora coccinea	-	1
P. edulis	Passionfruit (E)	1
P. malformis	-	1
P. quadrangularis	Giant passionfruit (E)	1
Phoenix aculeata	Date palm (E)	3
Salacca zalacca	Salak (E, F)	1
Solanum quitoense	Naranjilla (E)	1
Synsepalum dulcificum	Miracle fruit (E)	1
Triphasia trifolia	Lime berry (E), limonsito (F)	1
Sub total	***39 species***	***172***
GRAND TOTAL	***152 species***	***857***

Medicinal Plants in the UPLB Herbal Garden, Institute of Biological Sciences, University of the Philippines Los Baños

Scientific Name	Common name (English, Filipino)	No. of accessions
Aloe barbadensis	Sabila (F)	1
Amaranthus spinosus	Uray (F)	1
Andrographis paniculata	Sinta (F)	1
Annona muricata	Guayabano (F)	1
A. squamosa	Atis (F)	1
Areca catechu	Bunga (F)	1
Artemisia vulgaris	Damong maria (F)	1
Artocarpus heterophyllus	Langka (F)	1
Azadirachta indica	Neem (F)	1
Bixa orellana	Atswete (F)	1
Blumea balsamifera	Sambong (F)	1
Calotropis gigantea	Kapal-kapal (F)	1
Capsicum frutescens	Siling labuyo (F)	1
Carmona retusa	Tsaang-gubat (F)	1
Cassia alata	Acapulco (F)	1
Catharanthus roseus	Chichirica (F)	1
Centella asiatica	Takip-kuhol (F)	1
Chrysanthemum indicum	Manzanilla (F)	1
Chrysophyllum cainito	Kaimito (F)	1
Cocos nucifera	Niyog (F)	1
Coleus amboinicus	Oregano (F)	1
C. scutellarioides	Mayana (F)	1
Curcuma longa	Luyang-dilaw (F)	1
Datura metel	Talampunay (F)	1
Durio zibethinus	Durian (F)	1
Ervatamia pandacaqui	Pandakaki (F)	1
Euphorbia hirta	Gatasgatas (F)	1
E. neriifolia	Soro-soro (F)	1
Gardenia jasminoides	Rosal (F)	1
Gendarussa vulgaris	Kapanitulot (F)	1
Gliricidia sepium	Kakawati (F)	1
Hedychium coronarium	Kamya (F)	1
Hibiscus rosa-sinensis	Gumamela (F)	1
Impatiens balsamina	Kamantigi (F)	1
Ixora coccinea	Santan (F)	1
Jasminum sambac	Sampaguita (F)	1
Jatropha multifida	Mana (F)	1

Scientific Name	Common name (English, Filipino)	No. of accessions
Kalanchoe pinnata	Katakataka (F)	1
Mangifera indica	Mangga (F)	1
Mentha cordifolia	Yerba buena (F)	1
Mimosa pudica	Makahiya (F)	1
Mirabilis jalapa	Alas cuatro (F)	1
Moringa oleifera	Malunggay (F)	1
Ocimum basilicum	Balanoy (F)	1
O. sanctum	Solasi (F)	1
Orthosiphon aristatus	Balbas-pusa (F)	1
Pandanus odoratissimus	Pandan (F)	1
Peperomia pellucida	Pansit-pansitan (F)	1
Persea americana	Avocado (F)	1
Pogostemon cablin	Kabling (F)	1
Premna odorata	Alagaw (F)	1
Psidium guajava	Bayabas (F)	1
Quisqualis indica	Niyog-niyogan (F)	1
Rhoeo spathacea	Bangka-bangkaan (F)	1
Ricinus communis	Tangan-tangan (F)	1
Samanea saman	Acacia (F)	1
Stachytarpheta jamaicensis	Kandi-kandilaan (F)	1
Syzygium cuminii	Duhat (F)	1
Tagetes erecta	Amarillo (F)	1
Tinospora rumphii	Makabuhay (F)	1
Vetiveria zizanioides	Moras (F)	1
Vitex negundo	Lagundi (F)	1
Sub-total	***62 species***	***62***

From the Cotton Research and Development Institute (CRDI), Batac, Ilocos Norte

Cotton - 2 species		465

From the Bureau of Plant Industry (BPI), San Andres, Manila

69 species	(vegetables and fruit trees)	2,113

From FIDA, Makati

Musa textilis	112

From NARC, VISCA, Baybay, Leyte

Musa textilis	517

Scientific Name	Common name (English, Filipino)	No. of accessions
From the National Tobacco Administration (NTA), Batac, Ilocos Norte		
Nicotiana tabaccum		445
Nicotiana spp.		23
Sub total		***468***
From SRA, Diliman, Quezon City		
Saccharum officinarum		11
S. spontaneum		18
S. sinense		4
Saccharum spp.		1,198
Sub total		***1,231***
From Philippine Root Crops Research and Training Center (PRCRTC), VISCA, Baybay, Leyte		
Colocasia esculenta		243
Ipomoea batatas		1,377
Dioscorea alata		234
D. esculenta		76
D. hispida		22
D. rotundata		26
D. bulbifera		8
D. pentaphylla		1
Manihot esculenta		288
Maranta arundinacea		29
Pachyrrhizus erosus		29
Xanthosoma sagittifolia		10
Sub total		***2,333***

Scientific Name	Common name (English, Filipino)	No. of accessions
From the Philippine Rice Research Institute (PhilRice), Maligaya, Muñoz, Nueva Ecija		
Oryza sativa,O. minuta, O. perennis, O. granulata, O. meyeriana, O. officinalis, O. rufipogon		3,123
From the Philippine Coconut Authority (PCA), Diliman, Quezon City		
Cocos nucifera		97
NATIONAL TOTAL		***45,898***

APPENDIX 7
Medicinal Plants Maintained by the National Plant Genetic Resources Laboratory, Institute of Plant Breeding, and their Traditional or Purported Uses

Scientific Name	Family	Traditional/Purported Uses
Abrus precatorius	*Leguminosae*	Leaves - for the treatment of conjunctivitis; for colic, flu, fever and colds
Acorus calamus	*Araceae*	Leaves- when chewed is good for colic
Allium cepa	*Liliaceae*	Bulbs when eaten raw - diuretic, emmenagogue
Allium odorum	*Liliaceae*	Pounded leaves - for wounds and bruises
Allium sativum	*Liliaceae*	Cloves - for lowering high blood pressure
Aloe vera	*Liliaceae*	Juice of the fleshy part of leaves mixed with "gogo"- prevents falling hair, arrest baldness
Andrographis paniculata	*Acanthaceae*	Leaves - prescribed as a tonic in cases of diarrhea; abortifacient
Arcangelisia flava	*Menispermaceae*	Decoction or infusion of wood- stomachic, febrifuge, cure for itches, wounds and ulcers
Artemisia vulgaris	*Compositae*	Leaves in decoction - expectorant, anti-spasmodic, carminative, emmenagogue and for gaseous distention
Averrhoa bilimbi	*Oxalidaceae*	Decoction of leaves- for skin itching and inflammations. Fruit - astringent, stomachic, refrigerant
Belamcanda chinensis	*Amaryllidaceae*	Rhizome- expectorant, carminative
Bixa orellana	*Bixaceae*	Pounded leaves-applied as poultice on sprains and abdominal pains
Blumea balsamifera	*Compositae*	Leaf decoction-anti-spasmodic, astringent, expectorant

Scientific Name	Family	Traditional/Purported Uses
Caesalpinia sappan	*Leguminosae*	Decoction of bark-febrifuge
Carmona retusa	*Boraginaceae*	Decoction of leaves-for colic, anti-diarrhea
Carthamus tinctorius	*Compositae*	Infusion of dried flowers-carminative

Scientific Name	Family	Traditional/Purported Uses
Cassia acutifolia	*Leguminosae*	Seeds - laxative
Cassia alata	*Leguminosae*	Juice of pounded leaves -for skin diseases of fungal origin like ringworm, athlete's foot and Tinea
Cassia fistula	*Leguminosae*	Seeds - laxative
Catharanthus roseus	*Apocynaceae*	Leaf decoction - anti-diabetes. Roots- vermifuge and purgative
Centella asiatica	*Umbelliferae*	Decoction of leaves - diuretic; useful in gonorrhea. Fresh juice of leaves - for wounds
Chenopodium ambrosioides	*Chenopodiaceae*	Leaves - antihelmintic
Chrysanthemum indicum	*Compositae*	stomach pains and colic. Emulsion of flowers - for infection of the cervix.
Cinnamomum zeylanicum	*Lauraceae*	Flower decoction - for urinary or kidney trouble and for other stomach trouble
Citrus aurantifolia	*Rutaceae*	Leaves - used as aromatic bath to remedy skin itching
Clausena anisum olens	*Rutaceae*	Leaves - for headache and dizziness
Coleus amboinicus	*Labiatae*	Macerated fresh leaves - for burns, centipede bites, headache. Juice extracted from the leaves - for cough, asthma and bronchitis
Coleus blumei	*Labiatae*	Pounded leaves - poultice for bruises and contusions
Coriandrum sativum	*Umbelliferae*	Decoction of seeds - used as bath to hasten healing of chicken pox marks
Crossostephium artemisioides	*Compositae*	Leaves- carminative, for dizziness and stomach pains
Curcuma longa	*Zingiberaceae*	Juice of fresh rhizomes - for wounds, bruises, leech bites and scabies. Rhizome with coconut oil - stomachic and vulnerary
Curcuma zedoaria	*Zingiberaceae*	Dried rhizome in decoction - for abdominal cramps, pains, and amenorrhea
Cymbopogon citratus	*Graminae*	Root decoction - diuretic. Decoction of leaves - diaphoretic in fevers
Cymbopogon nardus	*Graminae*	Decoction of leaves - aromatic bath to lower fever

Scientific Name	Family	Traditional/Purported Uses
Datura metel	*Solanaceae*	Dried leaves and flowers -used as cigarettes to relieve asthma. Plant - narcotic, anodyne, anti-spasmodic
Dioscorea hispida	*Dioscoreaceae*	Tubers - as an anodyne; maturative in cases of tumors and boils; also for arthritic and rheumatic pains
Eucalyptus sp.	*Myrtaceae*	Decoction of leaves - for cough and colds. A stimulant internally and possess mildly anesthetic and anti-septic properties
Euphorbia hirta	*Euphorbiaceae*	Juice of the heated leaves-for cataract of the eye. Plant decoction - as eternal wash for skin diseases like dermatitis
Euphorbia neriifolia	*Euphorbiaceae*	Juice extracted from the leaves for otitis media, paroxysms, asthma, piles and warts. Milky juice of the leaves - drastic cathartic, purgative, rubefacient
Ervatamia pandacaqui	*Apocynaceae*	Latex applied directly on wounds facilitates healing and alleviates swelling. Leaves as cataplasm on the abdomen induces menstruation
Foeniculum vulgare	*Umbelliferae*	Infusion of the seeds -for gaseous distention
Garcinia mangostana	*Guttiferae*	Decoction of fruit peel-anti-diarrheal
Hedychium coronarium	*Zingiberaceae*	Decoction of rhizomes -antirheumatic, tonic and excitant
Hibiscus rosa- sinensis	*Malvaceae*	Flower buds beaten into paste - poultice for boils to hasten pointing, cancerous swellings, mumps, abscesses and carbuncles
Impatiens balsamina	*Balsaminaceae*	Crushed plant - as poultice to bruises or any painful area. Decoction of seeds and dried flowers - for inflammations and carbuncles-, lumbago and snake bites
Isotoma longiflora	*Campanulaceae*	Decoction of leaves - as wound wash
Jasminum sambac	*Olacaceae*	Leaves and flowers - anti-pyretic and decongestant; for gaseous distention and diarrhea

Scientific Name	Family	Traditional/Purported Uses
Jatropha curcas	*Euphorbiaceae*	Bark with coconut oil - poultice for sprains and dislocation
Kaempferia galanga	*Zingiberaceae*	Leaves - topical application for sore throat, swellings and rheumatism. Decoction of rhizomes - tonic for dyspepsia
Kalanchoe pinnata	*Crassulaceae*	Pounded fresh leaves - applied to burns and as poultice to boils; leaves - poultice to relieve headache
Languas pyramidata	*Zingiberaceae*	Decoction of seeds - as bath to lower fever
Lantana camara	*Verbenaceae*	Leaf infusion - antidote for snake bites. Pounded fresh leaves - poultice for sprains
Lawsonia sp.	*Lythraceae*	Roots and leaves emmenagogue, antihelmintic. Roots -for fertility control
Leucaena leucocephala	*Leguminosae*	Powdered seeds - for expelling intestinal worms
Mangifera indica	*Anacardiaceae*	Root decoction - diuretic. Leaf decoction - for sore throat, cough and colds
Mentha arvensis	*Labiatae*	Leaf infusion - antispasmodic, carminative and sudorific
Mentha cordifolia	*Labiatae*	Leaf decoction - for headache, toothache and stomachache
Mentha spicata	*Labiatae*	Leaf decoction - for gaseous distention, colds
Momordica charantia	*Cucurbitaceae*	Juice extracted from the green fruits - for chronic colitis, bacillary dysentery; astringent. Juice from the leaves - for cough, colic. Tops - for diabetes
Murraya paniculata	*Rutaceae*	Crushed leaves - vulnerary. Leaf infusion - antidiarrhea; also used as mouthwash
Nopalea cochinellifera	*Cactaceae*	Fleshy stem is used as poultice for articular rheumatism. Plant juice is a cure for earache, toothache and erysipelas
Ocimum basilicum	*Labiatae*	Decoction of leaves - for cough and colds

Scientific Name	Family	Traditional/Purported Uses
Ocimum sanctum	*Labiatae*	Decoction of leaves - for aromatic baths, cough and colds, stimulant; used in baths to cure rheumatic pains and paralysis
Ortosiphon aristatus	*Labiatae*	Plant decoction - diuretic, for catarrh of the bladder
Pandanus odoratissimus	*Pandanaceae*	Floral oil - purgative, cardio-tonic, for small pox
Pelargonium graveolens	*Geraniaceae*	Crushed leaves with coconut oil - for stomachache
Peperomia pellucida	*Piperaceae*	The whole plant is used as poultice for abscesses and boils; to cure arthritis
Phyllanthus reticulatus	*Euphorbiaceae*	Plant decoction - for snake, dog and insect bites
Pogostemon cablin	*Labiatae*	Plant infusion - carminative, diuretic and stimulant. Fresh leaf infusion - emmenagogue, anti-rheumatism
Portulaca oleracea	*Portulacaceae*	Leaves - used for poulticing tumors, wounds and ulcers. Roots - for cough and colds
Premna odorata	*Verbenaceae*	Decoction of leaves - expectorant mucolytic
Premna integrifolia	*Verbenaceae*	Decoction of leaves - for fever and colds, abdominal pains
Pseudocallyma alliaceum	*Bignoniaceae*	Leaves - for hypertension
Psidium guajava	*Myrtaceae*	Decoction of the leaves- astringent, vulnerary, anti-diarrhea, mouthwash for swollen gums, antiseptic for wounds
Quisqualis indica	*Combretaceae*	Roasted ripe nuts - antihelmintic.
Rhoeo spathacea	*Commelinaceae*	Flowers and leaves - lung decongestant, expectorant, blood refrigerant and antidysentery.
Ricinus communis	*Euphorbiaceae*	Seeds - purgative, anti-rheumatic, for arthritis, paralysis, epilepsy
Solanum surattense	*Solanaceae*	Pounded leaves - for boils
Tagetes erecta	*Compositae*	Flowers - blood tonic, emmenagogue and disperses contusions; for irregular menstruation, dysmenorrhea

Scientific Name	Family	Traditional/Purported Uses
Tinospora crispa	*Menispermaceae*	Bark decoction - for washing areas afflicted with eczema. Bark and leaves with coconut oil is anti-rheumatic
Triphasia trifolia	*Rutaceae*	Leaf decoction - for colic, diarrhea and as a wash for skin diseases
Vetiveria zizanioides	*Graminae*	Infusion of roots - diuretic
Vitex negundo	*Verbenaceae*	Infusion and decoction of leaves - for colds, cough, fever and muscular pain
Vitex trifolia	*Verbenaceae*	Leaves - analgesic, diuretic, emmenagogue, febrifuge
Zingiber officinale	*Zingiberaceae*	Pounded rhizome as poultice - for rheumatism; Juice from rhizome - for sore throat and cough. Decoction of rhizome - stimulant, stomachic, carminative

APPENDIX 8
Mode of Preparation and Recommended Dosage for Some Clinically Tested Plants (After Maramba *et al.*,1982, Guidebook on the Proper Use of Medicinal Plants)

a ANTIDIARRHEAL

Plant Material		Amount of chopped leaves needed		Preparation	Direction for use
		if dried	if fresh		
Carmona retusa leaves	Adult	10 tbsp	12 tbsp	Boil the needed amount of leaves in 2 glasses of water for 15 minutes or until one glass of the liquid is left. Cool and strain.	Divide the decoction into 4 parts . Drink 1 part every 2 or 3 hours
	7-12 years	5 tbsp	6 tbsp		
	2-6 years	2 ½ tbsp	3 tbsp		
Psidium guajava leaves	Adult	6 tbsp	8 tbsp	Boil the needed amount of leaves in 2 glasses of water for 15 minutes or until one glass of the liquid is left. Cool and strain.	Divide the decoction into 4 parts and drink 1 part every 2 or 3 hours
	7-12 years	3 tbsp	4 tbsp		
	2-6 years	1 1/2 tbsp	2 tbsp		
Garcinia mangostana fruit peel				Boil the needed amount of peel in 2 glasses of water for 15 minutes or until half of the liquid is left. Cool and strain	Divide the decoction into 4 parts. Drink 1 part every 2 or 3 hours

b FOR COUGH

Plant Material		Amount of chopped leaves needed		Preparation	Direction for use
		if dried	if fresh		
Vitex negundo leaves	Adult	4 tbsp	6 tbsp	Boil the needed amount of leaves in 2 glasses of water for 15 minutes or until 1 glass of liquid is left. Cool and strain	Divide the decoction into 3 parts and take 1 part 3 times a day
	7-12 years	2 tbsp	3 tbsp		
	2-6 years	1 tbsp	1 1/2 tbsp		
Coleus amboinicus leaves	Adult	2 tbsp	4 tbsp	Boil the needed amount of leaves in 2 glasses of water or until 1 glass of liquid is left. Cool and strain	Divide the decoction into 3 parts and take 1 part 3 times a day
	7-12 years	1 tbsp	2 tbsp		

c FOR HYPERTENSION

Plant Material	Preparation	Direction for use
Allium sativum cloves	Cook, roast or blanch 2 medium-sized cloves of garlic	Eat the cloves with meals, 3 times daily

d AS DIURETIC

Plant Material		Amount of chopped leaves needed		Preparation	Direction for use
		if dried	if fresh		
Blumea balsamifera leaves	Adult	4 tbsp	6 tbsp	Boil the needed amount of leaves in 2 glasses of water for 15 minutes or until one glass of liquid is left.	Divide the decoction into 3 parts and drink 1 part 3 times a day
	7-12 years	2 tbsp	3 tbsp		
Zea mays silk				AS IN Blumea balsamifera	AS IN Blumea balsamifera

e AS ANALGESIC

Plant Material		Amount of chopped leaves needed		Preparation	Direction for use
		if dried	if fresh		
Mentha cordifolia leaves	Adult	4 tbsp	6 tbsp	Boil the needed amount of leaves in 2 glasses of water for 15 minutes or until 1 glass of liquid is left.	Divide the decotion into 2 parts and take 1 part
	7-12 years	2 tbsp	3 tbsp		

f AS ANTIHELMINTIC

Plant Material	Preparation	Direction for use
Quisqualis indica seeds	Get mature and freshly opened fruits	Eat the kernels 2 hours after supper . If there is no passage of worms, repeat the same dose only after 1 week has passed. Do not eat more than the specified number of seeds. Do not eat immature seeds. Some side effects that may be observed are hiccough and abdominal pain.
Leucaena leucocephala seeds	Powder mature Leucaena leucocephala seeds	Eat the powdered seeds two hours after supper. Children may take the powdered seeds with condensed milk.

g FOR SKIN DISEASES OF FUNGAL ORIGIN

Plant Material	Preparation	Direction for use
Cassia alata leaves	Pound enough fresh material and express the juice.	Apply the juice on the affected skin 2 times daily for 2 to 3 weeks.

APPENDIX 9
Local Data on Essential Oil Yield of Some Spices and Aromatics

SCIENTIFIC NAME	PLANT PART	COMMON NAME	ESSENTIAL OIL YIELD (%)	
I. Spices/culinary herbs			Fresh	Air dried
Curcuma domestica Val.	rhizomes	dilaw	1.3-5.5	
Piper nigrum L.	seeds	paminta	1.0-3.0	
Zingiber officinale Rosc.	rhizomes	ginger	0.8-1.0	
Ocimum basilicum L.	leaves	balanoy	0.4	1.2
O. sanctum L.	leaves	solasi	1.8	
Rosmarinus officinalis L.	leaves	romero	0.5	
Bixa orellana L.	leaves seeds	achuete	0.5 0.2-0.8	
Ocimum adscendens L.	leaves	Vietnamese basil	1.3-1.45	
Melissa officinalis	leaves	lemon balm	0.2-0.3	
Clausena anisum-olens (Bico) Merr	leaves	kayumanis	2.2-2.5	2.8-3.0
Anethum graveolens L.	seeds	dill	2.9-3.9	
Coriandrum sativum L.	seeds	unsoy	0.2	
Cymbopogon flexuosus (Stevd.) Wats	leaves	salay	0.4-0.5	
Cinnamomum mercadoi L.	bark	kalingag	0.5-1.0	
II. Aromatics				
Mentha arvensis	leaves	Japanese mint	1.4	
Cymbopogon winterianus Jowitt	leaves	citronella	1.2	
C. martinii (Roxburgh) W.	leaves	palmarosa	0.6-1.1	
Vetiveria zizanioides Hack	roots	moras	1.1	
Pogostemon cablin (Bico) Benth	leaves	kabling	2.5-3.5	
Michelia champaca	flowers	yellow champaca	0.04	
M. longifolia	flowers	white champaca	0.01	

APPENDIX 10
Major Chemical Components of Selected Herbs and Spices (Geunther, 1950; Purseglove *et al*, 1981)

PLANT	MAJOR CHEMICAL COMPONENTS
Cardamom	Terpin hydrate, Terpineol
Nutmeg and Mace	d and l-α-Pinene, Camphene, B-Pinene, Genraniol, Safole, Dipentene, p-Cymene, d-Linalool
Cinnamon	Cinnamic Aldehyde (bark oil), Eugenol (leaf oil)
Cassia	Cinnamic Aldehyde
Sweet bay	Pinene, α-Phelandrene, Cineois, Linalool, l- α-Terpineol, Geraniol Eugeniol, Eugeniol Acetate
Clove	Free Eugenol, Eugenol Acetate, Caryophylene
Anise	Anethone, Methyl Chavicol
Caraway	Carvol, Carvene, Carvone, d-Limonene
Coriander	Coriandrol, d-Linalool
Cumin	Cuminaldehyde
Dill	Carvone
Fennel	d-α-Pinellandrene (Herb), d-α-Pinene (Seed)
Sweet Basil	l-Linalool, Methyl Chavicol, Eugenol
Lavender	Linalyl Acetate, Linalool
Sweet Marjoram	Terpinene
Oregano	Amyl Alcohol
Peppermint	menthol, Menthone, Methyl Acetate
Rosemary	α-Pinene, Camphene, Cineole, Camphor, Bomeol
Sage	Salvene, d-α-Pinene, Cineole, d-B-Thujone, Borneol, d-Camphor
Spearmint	Carvone, Linalool, Cineole
Thyme	Thymol
Tarragon	Methyl Chavicol, -Methoxyolnnamaldehyde
Vanilla	Vanillin
Annatto	Bixin
Black Pepper	Piperine

Appendix 11

Member institutions of the National Committee of Plant Genetic Resources (NCPGR) maintaining gene banks, crops and number of accessions, type of information stored, characterization and evaluation data gathered and percentage characterized and evaluated

INSTITUTION	CROP	NO ACCS	INFORMATION STORAGE		DATA GATHERED		Percent Characterized
			Passport	Characterization and Evaluation	Characterization	Evaluation	
BPI	*Anthurium*	3	Manual	Manual	Yield potentials	Disease and pest resistance	
	Blackberry	2	Manual	Manual	Yield potentials	Disease and pest resistance	
	Cabbage	24	Manual	Manual	Yield potentials	Disease and pest resistance	
	Cauliflower	14	Manual	Manual	Yield potentials	Disease and pest resistance	
	Chinese Cabbage	19	Manual	Manual	Yield potentials	Disease and pest resistance	
	Chrysanthemum	4	Manual	Manual	Yield potentials	Disease and pest resistance	
	Cowpea	15	Manual	Manual	Yield potentials	Disease and pest resistance	
	Cucumber	27	Manual	Manual	Yield potentials	Disease and pest resistance	
	Eggplant	25	Manual	Manual	Yield potentials	Disease and pest resistance	
	Gerbera	15	Manual	Manual	Yield potentials	Disease and pest resistance	
	Kiwi	4	Manual	Manual	Yield potentials	Disease and pest resistance	
	Loquat	6	Manual	Manual	Yield potentials	Disease and pest resistance	
	Lemon	1	Manual	Manual	Yield potentials	Disease and pest resistance	
	Gladioli	13	Manual	Manual	Yield potentials	Disease and pest resistance	
	Mandarin	1	Manual	Manual	Yield potentials	Disease and pest resistance	
	Mungbean	71	Manual	Manual	Yield potentials	Disease and pest resistance	
	Oranges	7	Manual	Manual	Yield potentials	Disease and pest resistance	
	Peanut	158	Manual	Manual	Yield potentials	Disease and pest resistance	
	Pepper	44	Manual	Manual	Yield potentials	Disease and pest resistance	
	Radish	5	Manual	Manual	Yield potentials	Disease and pest resistance	

INSTITUTION	CROP	NO ACCS	INFORMATION STORAGE			DATA GATHERED	Percent Characterized
			Passport	Characterization and Evaluation	Characterization	Evaluation	
BPI	Raspberry	2	Manual	Manual	Yield potentials	Disease and pest resistance	
	Roses	5	Manual	Manual	Yield potentials	Disease and pest resistance	
	Soybean	148	Manual	Manual	Yield potentials	Disease and pest resistance	
	Squash	42	Manual	Manual	Yield potentials	Disease and pest resistance	
	Sweet potato		Manual	Manual	Yield potentials	Disease and pest resistance	
	Tomato	73	Manual	Manual	Yield potentials	Disease and pest resistance	
	White Zapote	4	Manual	Manual	Yield potentials	Disease and pest resistance	
CRDI	Cotton	465	Computerized	Computerized	Plant morphology; agronomic characters	Disease resistance; drought and salt tolerance	
FIDA	Abaca	517	Computerized	Computerized	Fiber morphology	Pest and disease ID; screening for resistance to bacterial wilt, marasmius, mosaic and insect pests	
NARC	Abaca	519	Computerized	Computerized	Plant Morphology; fiber morphology, chemical and physical properties	Pest and disease ID; screening for resistance to bacterial wilt, marasmius, mosaic and insect pests	50% for plant morphology 25% for fiber characters
NPGRL	Corn	1886	Computerized	Computerized	Agronomic characters		100% characterization
	Sorghum	1181	Manual	Manual	Agronomic characters		100% characterization
	Mungbean	7264	Computerized	Computerized	Agronomic characters		100% characterization
	Cowpea	1393	Computerized	Computerized	Agronomic characters		
	Peanut	1263	Computerized	Computerized	Agronomic characters		
	Soybean	1487	Computerized	Manual	Agronomic characters		
	Minor Legumes	292	Computerized	Computerized	Agronomic characters		
	Root crops	989	Computerized	Manual	Agronomic characters		
	Forage/ pasture	266	Computerized	Manual	Agronomic characters		
	Oil crops	373	Manual	Manual	Agronomic characters		
	Vegetable legumes	3996	Computerized	Computerized	Horti-morphological chaarcters		
	Solanaceous	2574	Computerized	Computerized	Horti-morphological chaarcters		

INSTITUTION	CROP	NO ACCS	INFORMATION STORAGE			DATA GATHERED	Percent Characterized
			Passport	Characterization and Evaluation	Characterization	Evaluation	
NPGRL	Cucurbits	1200	Computerized	Computerized	Horti-morphological chaarcters		
	Crucifers	410	Computerized	Computerized	Horti-morphological chaarcters		
	Okra	672	Computerized	Computerized	Horti-morphological chaarcters		
	Bulb crops	367	Computerized	Manual	Horti-morphological chaarcters		
	Perennial vegetables	42	Manual	Manual	Horti-morphological chaarcters		
	Leaf vegetables	91	Computerized	Computerized	Horti-morphological chaarcters		
	Minor vegetables	46	Computerized	Manual	Horti-morphological chaarcters		
	Fruit crops	857	Computerized	Computerized	Horti-morphological chaarcters		
NTA	Tobacco	468	Computerized	Computerized	Agronomic characters	Selection for resistance to Cucumber mosaic virus, *Phythopthora*, Potato virus Y, and TMV	
PHILRICE	Rice	2123	Computerized	Computerized			
PCA	Coconut	83	Computerized	Computerized			
PRCTRC	Arrowroot	29	Manual	Manual			90% characterization 50% evaluation
	Cassava	788	Manual	Manual			
	Sweet potato	1402	Computerized	Computerized			90% characterization 50% evaluation
	Taro	243	Computerized	Manual			100% characterization 50% evaluation
	Yam bean	29	Manual	Manual			90% characterization 50% evaluation
	Yam *(Dioscorea)*	367	Computerized	Computerized			100% characterization 50% evaluation
	Xanthosoma	10	Manual	Manual			
SRA	Sugarcane	1231			Yield components	Resistance to sugarcane smut, downy mildew, leaf scorch and yellow spot	30% characterization 50% evaluation

APPENDIX 12
National Parks of the Philippines - 1992. Department of Environment and Natural Resources. Protected Areas and Wildlife Bureau

A. Terrestrial Areas

Name	Location	Area (Ha)	Special Features/Remarks
CAR		18,457	
1. Cassamata Hill	Bangued, Abra	57.00	Panoramic view of Bangued and its surrounding area
2. Mt. Data	Along the Baguio-Bontoc National Road, Benguet, Ifugao and Mt. Province	(2,398)	Pine forests; natural scenery; deep ravines; zigzag road; andtemperate climate
3. Mt. Pulog (a)	Buguias & Kabayan	11,550	Pine forests; habitat of unique
	Benguet, Kiangan,		species of cloud rats; mountain
	Ifugao and Kayapa		lake; dwarf bamboos; deep
	Nueva Ecija		ravines; and temperate climate
4. Balbalasang-Balbalan	Balbalan, Kalinga Apayao	1,338	Pine forests; sparkling streams and temperate climate
Region I		**12,998.65**	
5. Paoay Lake	Paoay, Ilocos Norte	(1,744) 340	Freshwater lake
6. Bessang Pass*	Cervantes, Ilocos Sur	304	Formerly part of Tirad Pass; hostirical and superb natural scenery; mountainous terrain, cool climate; with landmark of World War II.

Name	Location	Area (Ha)	Special Features/Remarks
7. Northern Luzon Heroes Hill	Santa & Narvacan, Ilocos Sur	1,316	Historical; Panoramic; remnant of Spanish tower
8. Agoo-Damortis	Agoo & Rosario, La Union	20,946.95	Extensive shoreline with sandy beaches ideal for swimming; colorful fishes; recreational resort.
9. Manleluag Spring	Mangatarem,	91.7	Medicinal hotsprings and health resort.
Region II		**1,011**	
10. Callao Cave	Peñablanca, Cagayan	192	Multi-chambered caves; deep canyons rock formations; beautiful stream; and recrea-tional resort.
11. Fuyot Springs	Ilagan, Isabela	819	Springs; caves; and rock formations.
Region III		**37,101.25**	
12. Minalungao	Gapan & Gen.Tinio Nueva Ecija	2,018	Cathedral like caves; exquisite rock formations; and natural swimming pool.
13. Capas Death March Monument	Capas, Tarlac	1.54	Erected in honor of the World War II death march participants.
14. Mt. Arayat	Arayat & Magalang Pampanga	(3,714.03) 3,715.23	Remnant of natural forest; natural waterhole; scenic spots; and recreational resort
15. Olongapo Naval Base Perimeter	Olongapo City, Zambales	9.04	Open space with stream within the heart of Olongapo City.
16. Roosevelt	Hermosa and Dinalupihan, Bataan	(1,485) 1,334.59	Remnants of dipterocarp forest; natural spring; and recreational resort
17. Bataan	Hermosa, Orani, Samal, Abucay, Pilar, Balanga, Bagac and Morong Bataan	(31,000) (29,853) (23,853)	Historical; tropical moist forest; waterfalls; and with sandy beaches along coastal zone

Name	Location	Area (Ha)	Special Features/Remarks
18. Aurora Memorial	Bongabon, Nueva Ecija and Baler, Quezon	(2,356) (5,676)	Dipterocarp forest; streams rivers; springs for swimming area and invigorating climate
19. Biak-na-Bato	San Miguel and Doña Remedios, Trinidad, Bulacan	(2.117) (330.62) (2117) 659.85	Where Pack of Biak-na-Bato signed; limestone formations; caves; remnants of dipterocarp forests. Proc. 401 excludes 2,078.22 ha.
National Capital Region		**24**	
20. Quezon Memorial (Ninoy Aquino Parks and Wildlife Nature Center)	Diliman, Quezon City	(197.8) (58.85)	Man-made lagoon; forested; mini-zoo, playgrounds; and picnic areas
Region V		**146082.18**	
21. Taal Volcano Island	Province of Batangas	4,537	
22. Mts. Palaypalay-Mataas-na-Gulod	Ternate and Maragondon, Cavite and Nasugbu, Batangas	4,000	
23. Mts. Banahaw-San Cristobal	Majayjay, Laguna& Lucban Tayabas Quezon	11,133.30 11,133.30 3,539.25	Twin-mountain; natural scenery; waterfalls dipterocarp forest;
24. Quezon	Atimonan, Padre Burgos, and Pagbilao, Quezon	(535.08) (983.09)	Virgin dipterocarp forests; winding road; deep ravines
25. Naujan Lake	Naujan Pola and Victoria, Oriental Mindoro	(21,655) 21,655	Freshwater lake; breeding for birds; dipterocarp
26. Mts. Iglit-Baco	Sablayan Occidental Mindoro and Bongabon	75,445	Habitat of tamaraw (*Anoa mindorensis*); natural
27. St. Paul Subterranean River	Puerto Princesa, Palawan	3,901	

Name	Location	Area (Ha)	Special Features/Remarks
28. National Parks, (c) Provinces of Wildlife Sanctuary and Game Preserve	Laguna, Quezon, Rizal & Bulacan	(46,310) (34,681) (34,681)	Dipterocarp forest,
29. Hinulugang Taktak	Antipolo, Rizal	0.85	
Region V		**24,811.69**	
30. Bicol	Basud and Daet, & Sipocot & Lupi, Camarines Norte	(4,225) 5201	Dipterocarp forest; natural
31. Libmanan	Libmanan, Camarines Sur	19.40	
Region VI		**25,411.93**	
36. Bulabog-Putian	Dingle & San Enrique, Iloilo	854.33	
37. Mt. Canlaon	Bage, La Carlota, La Castallana, Murcia, Canlaon, San Carlos, Negros Occidental and Vallehermosa, Negros Oriental	24,557.6	
Region VII		**21,670.08**	
38. Sudlon	Cebu,Cebu	696	Caverns; waterhole; wonderful scenery; temperate climate; historical
39. Central Cebu	Balamban, Toledo, City of Cebu, Cebu	15,393.58 11,893.58	Where President Magsaysay met his fiery death
40. Guadalupe Mabugnao-Mainit Hot Springs	Carcar, Cebu	Undetermined 57.5	Cold and hotsprings; recreational resort; caves interconnected and charac terized by stalagmites and stalactites.
41. Rajah Sikatuna	Carmen, Sierra Bullones, Valencia Garcia Hernandez, Dimiao, Bilar, Batuan, Bohol	9,023	Game preserve especially for flying lemur and Philippine Tarsier; water- shed and last remaining forested portion of Bohol Island; recreational

Name	Location	Area (Ha)	Special Features/Remarks
Region VIII		**4,038.78**	
42. Sohoton Natural Bridge	Basey, Samar	840	Natural stone bridge; other rock formations; winding Sohoton River; Catedral-like cave; dipterocarp forest; and teemed with wildlife.
43. Kuapnit-Balinsasayao	Baybay & Abuyog Layte	340	Home of bats and swifts; caves with guano deposits
44. McArthus Landing (Imelda Park)	Palo, Leyte	6.78	Historical; extensive shoreline, recreational
45. Mahagnao	Burauen & La Paz, Leyte	635	Rock formations; beautiful lake; panoramic views; dipterocarp forests; teemed with wildlife
46. Imelda Lake (Lake Danao)	Ormoc City, Leyte	2,193	Beautiful lake; verdant surrounding; dipterocarp forest; mild climate
Region IX		**3,323.35**	
47. Rizal (Dapitan)	Dapitan, Zamboanga	10	Where Dr. Jose Rizal was exiled; scenic seascape
48. Basilan	Lamitan, Basilan	(6,451) 3,100	Waterfallls; natural swimming pools; virgin dipterocarp forest.
49. Mt.Dajo	Patikul & Talipau, Sulu	213.35	Historical; only mountain in Jolo, Sulu
Region X		**84,616**	
50. Mt. Malindang	Misamis Occidental	53,262	Waterfalls; mountain lake; tropical moist forest; and abundant wildlife; invigorating climate.
51. Initao	Initao, Misamis Oriental	57	Virgin dipterocarp forests; scenic spot sandy beach; caves & recreational areas

Name	Location	Area (Ha)	Special Features/Remarks
52. Mt. Kitanglad Range	Manolo Fortich, Sumilao, Impasugong Malaybalay, Lantapan Talakag, Baungon & Libona, Bukidnon	31,297	Habitat of Philippine Eagle; virgin dipterocarp and forest; composed of range of mountains with features such as: waterfalls, small mountain lake, caves and rock formations
Region XI		**74,194.59**	
53. Mainit Hotsprings	Compostela, Davao	1,381	Medicinal hotsprings and natural scenery; dipterocarp forest; rock formation and cold spring
54. Mt. Apo (e)	Kidapawan, North Cotabato & Guianga& Sta. Cruz, Davao	(76,900) 72,813.59	Volcanic mountain; rock formations; waterfalls mountain lakes; medicinal hotsprings; home of the Philippine Eagle; dipterocarp forest; the highest peak in Philippines
Region XII		**1,730**	
55. Sacred Mountain	Marawi City, Lanao del Sur	94	Panoramic mountain; forest rich with interesting wildlife.
56. Rungkunan	Ramain, Lanao del Sur	Undetermined	Beautiful sparkling stream, virgin forest; and invigorating climate
57. Lake Dapao	Pualas, Lanao del Sur	1,500	Scenic lake; recreational
58. Lake Butig	Butig, Lanao del Sur	68	Recreational area; swimming resort; invigorating climate
59. Salikata	Lumba Bayambao, Lanao del Sur	Undetermined	Basin of Gata River; peculiar rock formations; scenic landscape
60. Pantuwaraya	Saguiran, Lanao	20	Recreational resort
61. Mado Hotspring	Awang, Cotabato	48	Medicinal hotspring; natural swimming pool; and health resort.
	TOTAL	**464496.81**	

(a) Partly within Region II (Nueva Vizcaya)
(b) Partly within Region IV (Quezon)
(c) Partly within Region III (Bulacan)
(d) Partly within Region VII (Negros Oriental)
(e) Partly within Region XII (North Cotabato)
*** National Shrine**

B. MARINE AREA

Name	Location	Area (Ha)	Special Features/Remarks
Region IV		**33,200**	
1. Tubbataha Reef National Marine Park	Central Sulu Sea, Palawan	33,200	The marine park has two atolls the north and south reef. A diverse coral assemblage with about 46 coral genera have been recorded in the area. Coral cover reaches to 70% - 80% on many parts of the reef edge and slope. A very high diversity of reef fish fauna has been recorded through visual day census and shows at least 40 families with 379 species. The sandy beach in both reefs are nesting and roosting site of marine turtles (*Chelonia mydas*) and five (5) species of water birds.
Region VI		**1,143.45**	
2. Taklong Island National Marine Reserve	Guimaras,Iloilo	1,143.45	Composed of two major islands named Taklong and Tandog surrounded with 46 smallislets; possesses interesting coves and coral reefs which support abundant and varied marine flora and fauna; White sandy beaches and extensive subtidal zones with potential for tourism and recreational activities
	TOTAL	**34,343.45**	**.**
	GRAND TOTAL	**498,840.26**	

NATIONAL PARKS OF THE PHILIPPINES UNDER OTHER AGENCIES

Establishment Area Name of National Park	Location	Hectares	Special Features
Region I		**7,996.3**	
1. Hundred Islands	Alaminos, Pangasinan	(1,844) 1,676.3	Placed under the Philippine Tourism Authority
2. Tirad Pass	Cervantes, Ilocos Sur	6,320	Transferred jurisdication to National Shrine Commission
Region IV		**3,962.19**	
3. Luneta	Ermita, Manila	16.24	Reserved the area as Rizal Park under the jurisdiction of National Parks Development Committees.
4. Manila Bay Beach Resort	Cities of Manila, Pasay & Parañaque Metro Manila	464.66	Transferred jurisdiction to Public Estates Authority
5. Mt. Makiling	Los Baños & Calamba, Laguna & Sto. Tomas, Batangas		Transferred jurisdiction to U.P. at Los Baños
6. Pagsanjan Gorge	Cavinti & Lumban, Laguna	152.64	Transferred to jurisdiction Philippine Tourism Authority
Region VI		**Undetermined**	
7. Tiwi	Tiwi, Albay	-do-	Part of Tiwi Geothermal Reservation under the jurisdiction of Department of Energy - NPC
Region VIII		**272**	
8. Tongonan Hotspring	Ormoc City, Leyte	272	Part of Tongonan Geothermal Reservation under the jurisdiction of Department of Energy - NPC

Establishment Area Name of National Park	Location	Hectares	Special Features
Region IX		**Undetermined**	
9. Sta. Cruz Island	Zamboanga City	-do-	Transferred jurisdiction to Philippine Tourism Authority
	TOTAL	**12,230.49**	

GAME REFUGE AND BIRD SANCTUARY

Game Refuge and Bird Sanctuary	Location	Area	Size (Ha)
1) R-2	Magapit Game Refuge & Bird Sanctuary	Lallo & Gattaran	4,554
2) R-3	Lake Malimanga	Candelaria	12.35
3) R-4	Calauit	Busuanga, Palawan	3,400
4) R-4	F. B. Harrison	Sablayan and Mamburao, Occidental Mindoro	140,000
5) R-4	Minasawa Island	Patnanongan, Quezon	4
6) R-4	Palawan CRBS	Portion of Palawan	763,399
7) R-4	Ursula Island	Bataraza, Palawan	20
8) R-6	Sampunong Bolo	Juaneza, Sara, Iloilo	52
9) R-7	Lake Danao	San Francisco, Pacijan Island Camotes Group, Cebu Province	480
10) R-12	Liguasan Marsh	Dulawan, Liguasan	30,000
11) R-12	Lake Buluan	Koronadal,Buluan, Kidapawan, North Cotabato	6,300

LIST OF PROCLAIMED WATERSHED FOREST RESERVE (WFR) (as of December 31, 1992)

Name of Protected Area	Municipality	Province	No.	Area(ha)
Grand Total			**95**	**1,250,123**
CAR Sub-total			**5**	**113,011**
1. Ambuklao-Binga WFE	Atok, Bokod	Mt. Province		63,650
2. Ambuklao WFR	Atok, Bokod	Mt. Province		9,700
3. Lower-Agno WFR	San Manuel, San Nicolas	Baguio City		39,304
4. Busol WFR	Baguio City, La Trinidad	Benguet		337
5. Buyog WFR	Baguio City	Benguet		20
6. Luchab WFR	Luchab	Benguet		
Region I				
Sub-total			**9**	**4 ,26**
1. Ilocos Norte Metro WFR	Pasuquin	Ilocos Norte		2,934
2. Magnuang WFR	Batac	Ilocos Norte		152
3. Libunao Spring WFR	Sinait	Ilocos Sur		47
4. Bigbiga Spring WFR	Narvacan	Ilocos Sur		135
5. Santa WFR	Santa	Ilocos Sur		25
6. Lidlidda WFR	Lidlidda	Ilocos Sur		1,228
7. Sta. Lucia WFR	Sta. Lucia	Ilocos Sur		174
8. Naguilian Watershed Reservation	Naguilian	La Union		90
9. Tanap WFR	Burgos	Ilocos Norte		41
Region II				
Sub-total			**4**	**101,591**
1. Casecnan River Watershed	Dupax del Norte & del Sur	Nueva Vizcaya		82,219
2. Dupax Watershed Reservation	Dupax	Nueva Vizcaya		425
3. Bawa WFR	Gonzaga and Lallo	Cagayan		8,955
4. Wangag WFR	Gonzaga and Lallo	Cagayan		6,992
5. Tumauini WFR	Cabagan, San Pablo	Isabela		17,670
6. _____ River	Maconacom, Divilacan Ma. Aurora	Aurora & Nueva Vizcaya		3,219.14

Name of Protected Area	Municipality	Province	No.	Area(ha)
Region III				
Sub-total			**8**	**221,611**
1. Watershed Purposes of Mariveles (Palanas)	Mariveles	Bataan		325
2. Olongapo WFR	Olongapo	Zambales		6,424
3. Subic WFR		Bataan		10,000
4. Angat Watershed Metro Water District	Montalban, Norzagaray, Angat, San Rafael, Infanta	Rizal, Bulacan, N. Ecija, Quezon		55,707
5. Pantabangan-Carranglan Watershed Reservation	Pantabangan, Carranglan	Nueva Ecija		84,500
6. Angat Watershed and Forest Range (Pilot)	Norzagaray, San Jose, Montalban	Bulacan, Rizal		6,600
7. Talavera Watershed Reservation	Sta. Fe, Carranglan, Lupao, San Jose	N. Ecija, Nueva Vizcaya		37,295
8. Doña Remedios/General Tinio Watershed	Doña Remedios, Gen.Tinio	Bulacan, Nueva Ecija		20,760
Region IV				
Sub-total			**28**	**81,204**
1. Marikina Watershed Reservation (Amended)	Antipolo Montalban	Rizal		18,966
2. Mulanay Watershed Forest Reserve	Mulanay	Quezon		26
3. Infanta Watershed Forest Reserve	Infanta	Quezon		384
4. Polillo Watershed Forest Reserve	Polillo	Quezon		130
5. Mulawin Spring Watershed Forest Reserve	Guinyangan	Quezon		204
6. Buenavista Watershed Forest Reserve	Mulanay	Quezon		356
7. Lopez Watershed Forest Reserve	Lopez	Quezon		418
8. Torrijos Watershed Forest Reserve	Torrijos	Marinduque		105
9. Palawan Flora, Fauna and Watershed Forest Reserve	Puerto Princesa	Palawan		4,776
10. Calabangan Watershed and Forest Reserve	Casiguran	Aurora		4,803

Name of Protected Area	Municipality	Province	No.	Area(ha)
11. Dipaculao Watershed Forest Reserve	Dipaculao	Aurora		1,786
12. Dinadlawan River Watershed Forest Reserve	Dipaculao	Aurora		3,387
13. Calatrava, San Andres, San Agustin Watershed	Calatrava, San Andres, San Agustin	Romblon		2,670
14. Calauag Watershed	Calauag	Quezon		328
15. Alabat Watershed Forest Reserve	Alabat	Quezon		688
16. Aurora Watershed Forest Reserve	Baler	Quezon		430
17. Bacuit Watershed Forest Reserve	Bacuit	Palawan		94
18. Tibiang-Dumagandong Watershed	Quezon	Quezon		280
19. Amro River Watershed Forest Reserve	Casiguran and Disalag	Aurora		6,470
20. Talaytay River Watershed Forest Reserve	Dinalungan	Aurora		3,626
21. Palawan Flora-Fauna (parcel 2)	Puerto Princesa	Palawan		3,224
22. Binahan River Watershed Forest Reserve	Pagbilao & Manban	Quezon		465
23. Simbahan-Talagas River Watershed Forest Reserve	Dingalan	Aurora		2,266
24. Dibalo-Pingit-Zibali-Malayat Watershed Forest Reserve	Baler & San Luis	Aurora		4,528
25. Diteki River Watershed Forest Reserve	Baler & San Luis	Aurora		12,970
26. Dingalan River Watershed Forest Reserve	Dingalan	Aurora		1,788
27. Parugao River Watershed Forest Reserve	Maria Aurora & Dupax del Norte	Aurora, N. Vizcaya		3,247
28. San Luis Watershed Forest Reserve	San Luis	Aurora		2,789
29. Umiray Watershed Reserve	Gen. Nakar Norzagaray	Rizal,Quezon Bulacan		16,723
30. Panulukan Watershed FR	Panulukan	Quezon		178.68
31. Divat River	Ma. Aurora & S. Dupax Vizcaya	Aurora & Nueva		3,219.14

Name of Protected Area	Municipality	Province	No.	Area(ha)
Region V				
Subtotal			**7**	**34,663**
1. Catanduanes Watershed and Forest Reserve	Virac, Bato,San Miguel, Pandan, Calolbon, Baras	Catanduanes		26,010
2. Lagonoy WFR	Lagonoy	Camarines Sur		470
3. Dahican WFR	Mambulao	Camarines Norte		44
4. Capalonga WFR	Capalonga	Camarines Norte		752
5. Abasig-Matogdon-Manang (Amendment)	Labo, San Lorenzo Ruiz and San Vicente	Camarines Norte		5,545
6. Mt. Masaraga WFR	Polangui, Oas, Ligao, Tabaco	Albay		810
7. Magallanes and Juban WFR	Magallanes, Juban	Sorsogon		1,032
Region VI				
Subtotal			**8**	**125,627**
1. Pan-ay River WFR	Tapaz	Capiz		4,350
2. Aklan River WFR	Madalag & Libucao	Aklan		23,185
3. Jalaur River WFR	Calinog	Iloilo		9,228
4. Ilog-Hilabangan WFR	Himamaylan & Kabankalan	Negros Occ.		10,211
5. Dalanas River WFR	Barbaza	Antique		8,558
6. Bago River WFR	Murcia, Don Salvador, Benedicto, Calatrava	Negros Occidental		61,926
7. Tipulu-an Mau-it River Watershed	Sibalom	Antique		7,737
8. Kabankalan Watershed	Kabankalan	Negros Occ.		432
Region VII				
Subtotal			**4**	**44,397**
1. Loboc WFR	Bilar,Butuan, Carmen, G. Hernandez			19,410
2. Mananga River (Amendment)	Minglanilla, Cebu City	Cebu		6,823

Name of Protected Area	Municipality	Province	No.	Area(ha)
3. Kotkot and Lusaran River WFR	Cebu City, Danao City, Balamban, Campostela, Consolacion & Liloan	Cebu		14,534
4. Alijawan-Cansuhay-Anibongan River WFR	Duero,Jagna	Bohol		3,630
Region VIII				
Sub-total			**5**	**26,205**
1. Pan-as Falls Hay-ban WFR	Catarman & Calbayog City	Samar		7,832
2. Palompon WFR	Palompon, Villaba	Leyte		2,392
3. Jicontal WFR	Dolores & Canovid	Eastern Samar		7,390
4. Hinablan-Lawigan Watershed	Libagon, Hinunangan, St. Bernard & Silago	Southern		4,536
5. Bulosao WFR	Laua-an, Marabut	Eastern &		4,055
Region IX				
Sub-total				
1. Pasonanca Watershed Forest Reserve	Zamboanga	Zamboanga del Norte		10,560
2. Buug WFR	Buug	Zamboanga del Sur		108
3. Siocon WFR	Siocon	Zamboanga del Norte		612
Region X			**7**	**147,059**
1. Muleta-Manupali WFR	Latapan & Pangantuan	Bukidnon		61,500
2. Mt. Malindang NP & Watershed	Oroquieta, Ozamis City, Calamba, Bonifacio Jimenez			53,262
3. Malisbilisan Falls WFR	Talisayan	Misamis Oriental		72
4. Mahoganao WFR	Caoayan	Misamis Oriental		136
5. Surigao WFR	Surigao City	Surigao del Norte		967
6. Andanan River WFR	Sibagat & Bayugan	Agusan del Sur		15,097
7. Cabadbarab Watershed	Cabadbaran	Agusan del Norte		16,025

Name of Protected Area	Municipality	Province	No.	Area(ha)
Region XI				
Sub-total			**4**	**103,475**
1. Malagos Watershed	Guingana	Davao		235
2. Allah WFR	Isulan, Banga,	S. Cotabato		92,450
3. Sebu WFR	Banga,Kiamba	S. Cotabato		9,900
4. Mati WFR	Mati	Davao		890
Region XII				
Sub-total			**2**	**54,714**
1. South Upi WFR	South Upi	N. Cotabato		1,894
2. Libungan WFR	Libungan & Alamada	Cotabato		52,820
ARMM			**1**	**180,460**
1. Lake Lanao Watershed Reservation		Lanao del Sur		180,460

APPENDIX 13
Programs/Projects on Biodiversity

Name of Project/Activity (Research or Developmental)	Duration	Funding Agency
1. Field survey and study of conservation status of rare, endemic and endangered plants of Mt.Pinatubo and adjoining mountains	Dec. 1992 to Nov. 1994	DOST
2. Diversity status and ecology of pteridophytes in three forest in Mindanao	Jan. 1991 to Dec. 1995	CMU
3. Aroid and epiphytes of Mt. Pangasugan/Maisel Diputado	Jan. 1992 to Dec. 1994	
4. Ethobotanical study of Phil. indigenous forest plants	1993 to 1995	DOST
5. High diversity forest farming system for ecosystem rehabilitation and protection of Ormoc Watershed	Nov. 1992 to Oct. 1997	DOST
6. Captive breeding of Philippine tarsier	3 years	PCARRD
7. Reproductive biology of flying lemur	4 years	ERDB
8. Development of a wildlife breeding center in the Philippines	6 years	ERDB
9. Wildlife faunal inventory studies in Mt. Makiling	2 years	UPLB
10. Assessment of the wildlife trading industry at the National Capital Region	4 years	DENR-NCR
11. Economic evaluation of usage of reaction areas	3 years	ERDB
12. Avifaunal analysis of Fuyot Spring National Park	2 years	DENR-R2
13. Wildlife and faunal survey	2 years	SENR-R4
14. Avifaunal inventory at Davao, Plaridel, Misamis Occidental	2 years	CEP
15. Upper-Manubali watershed biodiversity research conservation program	4 years	USAID
16. Potential non-traditional forest products in the Manupali watershed	3 years	USAID
17. Enhancing biodiversity conservation and family security through homegardening and sustainable field production of vegetables	4 years	USAID

Name of Project/Activity (Research or Developmental)	Duration	Funding Agency
18. Ethnoecology of the Manupali watershed: seeing sustainability through the eyes of the farmer	3 years	USAID
19 Integrated biodiversity and productivity improvement of VISCA waters	2 years	VISCA
20. Biodiversity studies in Central Sierra Madre	3 years	
21. Natural resources management program	8 years	USAID

Programs/projects on biodiversity

Name of Project/Activity (Research or Developmental)	Duration
Field survey and study of conservation status of rare, endemic and endangered plants of Mt.Pinatubo and adjoining mountains	Dec. 1992 to Nov. 1994
Diversity status and ecology of pteridophytes in three forest in Mindanao	Jan. 1991 to Dec. 1995
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Ethnobotanical study of Phil. indigenous forest plants	1993 to 1995
High diversity forest farming system for ecosystem rehabilitation and protection of Ormoc Watershed	Nov. 1992 to Oct. 1997
Captive breeding of Philippine tarsier	3 years
Reproductive biology of flying lemur	4 years
Development of a wildlife breeding center in the Philippines	6 years
Wildlife faunal inventory studies in Mt. Makiling	2 years
Assessment of the wildlife trading industry at the National Capital Region	4 years
Economic evaluation of usage of reaction areas	3 years
Avifaunal analysis of Fuyot Spring National Park	2 years
Wildlife and faunal survey	2 years
Avifaunal inventory at Davao, Plaridel, Misamis Occidental	2 years
Upper-Manubali watershed biodiversity research conservation program	4 years
Potential non-traditional forest products in the Manupali watershed	3 years
Enhancing biodiversity conservation and family security through home gardening and sustainable field production of vegetables	4 years

Name of Project/Activity (Research or Developmental)	Duration
Ethnoecology of the Manupali watershed: seeing sustainability through the eyes of the farmer	3 years
Integrated biodiversity and productivity improvement of VISCA waters	2 years
Biodiversity studies in Central Sierra Madre	3 years
Natural resources management program	8 years

APPENDIX 14
List of Prohibited/Restricted Imports of Plants and Plant Products

A. PLANTS AND PARTS THEREOF INCLUDING SEEDS, CUTTINGS, RHIZOMES, BULBS AND CORMS, GRAFTS, LEAVES, ROOTS, SCIONS AND OTHERS CAPABLE OF PROPAGATION

Plants/plant products	Reasons for prohibition/ restriction	Places of origin
Bamboo (*Bambusa spp.)*	Smut(*Ustilago spp.*)	All countries
Cacao (*Theobroma spp.*)	Swollen shoot (*virus complex*) Witches broom (*Marasmius peniciosus*)	West africa Sri Lanka Indonesia Colombia Venezuela West Indies South America
Citrus (*Citrus spp.)*	Nematode and virus diseases	All countries
Coconut (*Cocos nucifera*)	Lethal yellowing disease (mycoplasma)	Caribbean region Florida, USA West Africa
Kenaf (*Hibiscus cannabinus*)	Virus diseases	South America Florida, USA
Mango (*Mangifera indica*)	Malformation or Bunchy top disease (unknown)	India Bangladesh Pakistan
	Scaly bark or Woody gall disease (unknown)	Colombia Hawaii
Musaceae (*Banana, Abaca* and all plants belonging to the *Genus Musa*)	Virus and nematode diseases	All countries
Maguey (*Agave cantala*)	Virus diseases and pests	All countries
Rice (*Oryza sativa*)	Virus diseases	All countries
	Water weevil (*Lissoroptus oryzophilus*)	Burma India Japan USA
Rubber (*Hevea brasiliensis*)	South American leaf blight (*Microcyclus ulci*)	Mexico, Central & South America West Indies
Sisal (*Agave sisalina*)	Pests and diseases	All countries
Sugarcane (*Saccharum officinarum*)	Virus diseases	All countries

Plants/plant products	Reasons for prohibition/ restriction	Places of origin
	Stalk borer (*Diatreae spp.*)	Southern USA West Indies Mexico Central & Southern America
Tobacco (*Nicotiana tabacum*)	Blue mold (*Peronospora tabacina*)	Autralia Europe North & South America
Vegetable and other fruits	Host of many pests and/or diseases	All countries

B. PLANT PRODUCTS - PRODUCTS DERIVED FROM PLANTS, EITHER IN THEIR NATURAL STATE, IN MANUFACTURED OR PROCESSED FORM AND CAPABLE OF HARBORING PLANT PESTS

Plants/plant products	Reasons for prohibition/ restriction	Places of origin
Fresh fruits and vegetables	Mediterranean fruitfly (*Ceratitits capitata*) Queensland fruitfly (*Dacus tryoni*)	All countries where the insect exists Australia
Fresh fruits of chicos, limes, guavas, mangoes, oranges, peaches and plums	Maxican fruitfly (*Anastrepha ludens*)	Mexico Texas Central America
Dried or processed bamboo	carrier of many pests and/or diseases	All countries
Packing materials such as rice straw, rice chaffs, coconut leaves, sugarcane, wheat straw, grasses or weeds	Carrier of many pests and/or diseases	All countries

C. PLANT AND PLANT PRODUCTS REQUIRING COMMODITY CLEARANCE

Plant and plant products	Clearance issuing office
1. Abaca seeds, seedlings, suckers and rootstocks	Department of Agriculture
2. Bakawan	Office of the President
3.Buri seeds and seedlings	Bureau of Plant Industry
4. Grains and grain by products	National Food Authority
5. Log, poles and piles including log core and flitchers/railroad ties	Bureau of Plant Industry
6. Matured coconuts and coconut seedlings	Philippine Coconut Authority
7. Raw materials for cottage industries of a. bamboo b. buntal or buri fibers c. monkey pods (acacia) d. rattan (including poles)	National Cottage Industries Development Authority
8. Orchids, cycads, fern tree and pitcherplant	Bureau of Forest Development (Parks and Wildlife)

APPENDIX 15
Administrative Order No. 10, Series 1994

compiled by

Secretary
Sgd. Roberto S. Sebastian

29 August 1994

Subject : Implementing Guidelines on Seed Multiplication, Production and Distribution of Recommended Superior Food Crop Cultivars

Pursuant to the Implementing Rules and Regulations of the Seed Industry Development Act 7308 of 1992, and the need to provide and sustain adequate supply of high quality seeds of superior crop cultivars to farmers, the following shall be the policies and guidelines of the Department of Agriculture on seed multiplication, production and distribution:

1 SEED MULTIPLICATION AND PRODUCTION

1.1 Government and private breeding institutions shall be responsible for the production of breeder seeds and maintenance of buffer stock of officially approved and released cultivars for commercial planting;

1.2 The multiplication of breeder, foundation and registered seeds shall be done at different seed network identified as per attachment A;

1.3 Regional Directors shall identify among accredited seed growers those qualified to produce registered seeds and list should be submitted to the Bureau of Plant Industry (BPI);

1.4 Crop cultivars/varieties to be produced are those that are approved and officially released by the National Seed Industry Council;

1.5 Certified seed requirements of the Government Program shall be produced only by accredited individual farmers, members of cooperatives/associations, cooperatives or private seed companies;

1.6 Regional Directors are responsible in planning/programming certified seed production targets including 10% buffer stock in cooperation with seed growers and the local government units. The program should be based on demand of end users as to the variety, varietal reaction to pests and diseases and to agro-climatic adaptability;

1.7 In case of cultivar/hybrid developed by private sector, they are responsible in production and multiplication of their seeds, however, DA Regional Directors and BPI Director should be provided with data on seed availability for monitoring purposes;

1.8 Breeding institution representatives shall be allowed to monitor and visit standing seed crop fields of their variety at any stage;

1.9 Seed producers must file application for inspection and certification for all seed crops with the nearest Seed Quality Control Services Office (SQCS)

2 SEED PROCESSING AND SEED STORAGE

2.1 All facilities for seed processing and seed storage must be cleaned and disinfected prior to operations;

2.2 Processed seeds must be bagged in new containers at officially prescribed weight as per attachment B;

2.3 Seed inspectors shall be informed by Seed Growers of the schedule of planting, harvesting, processing and storage for seed sampling and seed certification;

2.4 The seeds for certification keep in proper storage shall only be tagged and sealed by the Seed Inspectors;

2.5 Seed producers shall maintain inventory records of seed stock for monitoring purposes.

3 SEED DISTRIBUTION

3.1 BPI shall coordinate with seed production networks the distribution of breeder, foundation and registered seeds;

3.2 Only certified and tagged seeds shall be distributed;

3.3 Only accredited seed growers shall be allowed to buy registered seeds;

3.4 Breeding institutions shall strictly limit distribution of breeder and foundation seeds to seed networks and accredited seed growers;

3.5 Regional and Provincial Seed Coordinators shall submit to Regional Directors and BPI list of recipients of foundation and registered seeds indicating names, location of farm, quantity, variety and class of seeds.

4 MONITORING

4.1 Regional Seed Coordinators shall maintain appropriate monitoring system as to production areas, expected date of harvest, actual production and stock inventory using prescribed forms as per Attachment C;

4.2 Regional and Provincial Seed Coordinators shall maintain information board showing summary of seed production, distribution and stock inventory for all crops of seed network;

4.3 Regional and Provincial Seed Coordinators in coordination with research institutions shall monitor varietal performance of distributed crop varieties/cultivars for future planning;

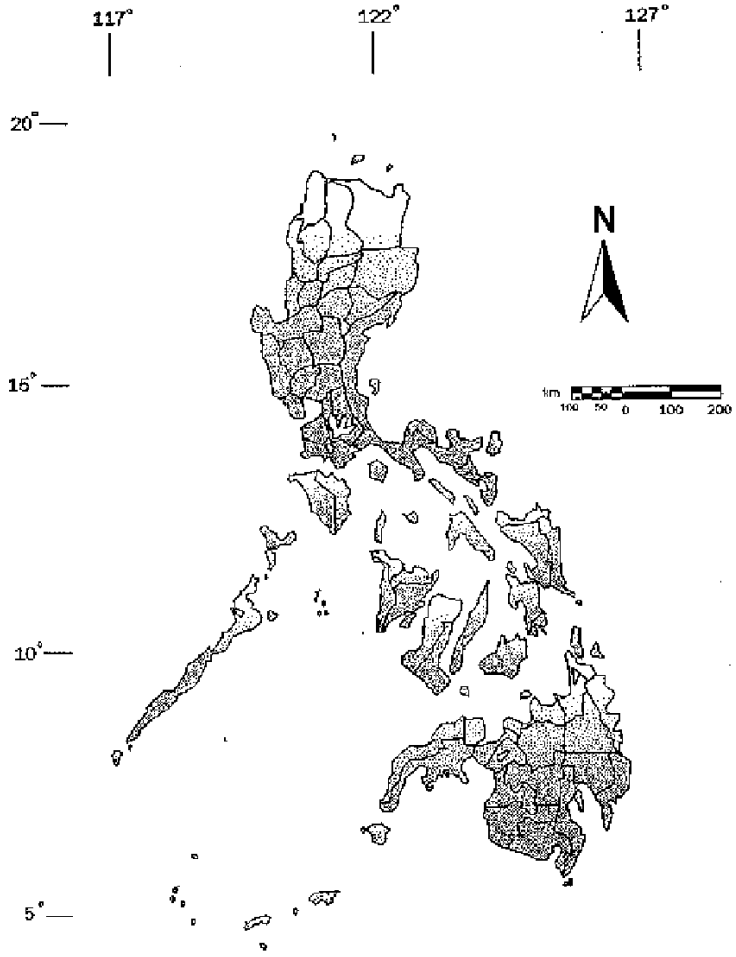
4.4 Regional Seed Coordinators, and ROs/Center Managers shall submit quarterly reports of seed production and distribution;

4.5 The Bureau of Plant Industry in coordination with all those in the seed network shall monitor the implementation of these guidelines.

This shall take effect takes effect immediately and supersedes all other orders inconsistent herewith.

APPENDIX 16

THE REPUBLIC OF PHILIPPINES



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