COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

PHILIPPINES

THE STATE OF THE PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE OF THE PHILIPPINES

(1997 - 2006)

A COUNTRY REPORT

Department of Agriculture
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Written by
Nestor C. Altoveros and Teresita H.Borromeo

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Note by FAO

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LIST OF ACRONYMS

AFMA	Agriculture and Fisheries Modernization Act
ANSWER	Asian Network for Sweetpotato Genetic Resources
AO	Administrative Order
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
AVRDC	Asian Vegetable Research and Development Center
BAPNET	Banana Asia Pacific Network
BAS	Bureau of Agricultural Statistics
BPI	Bureau of Plant Industry
BPI-BNCRDC	BPI-Baguio National Crop Research and Development Center
BPI-DNCRDC	BPI -Davao National Crop Research and Development Center
BPI-LGNCRDC	BPI-La Granja National Crop Research and Development Center
BSU	Benguet State University
CBD	Convention on Biological Diversity
CGRD	Coconut Genetic Resources Database
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLSU	Central Luzon State University
COGENT	International Coconut Genetic Resources Network
CVSCAFT	Central Visayas State College of Agriculture and Forestry Technology
DA	Department of Agriculture
DA-BAR	Department of Agriculture - Bureau of Agricultural Research
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
EO	Executive Order
ERDB	Ecosystems Research and Development Bureau
FAITH	Food Always In The Home
FAO	Food and Agriculture Organization of the United Nations
FIDA	Fiber Industry Development Authority
FPIC	Free and Prior Informed Consent
GDP	Gross Domestic Product
GPA	Global Plan of Action
IACBGR	Inter-Agency Committee on Biological Resources
IARC	International Agricultural Research Center
ICC	Indigenous Cultural Community
IEC	Information, Education and Communication
INGER	International Network for Genetic Evaluation of Rice
INIBAP	International Network for the Improvement of Banana and Plantain
IPs	Indigenous Peoples
IPB	Institute of Plant Breeding
IPGRI	International Plant Genetic Resources Institute
IPPC	International Plant Protection Convention
IPR	Intellectual property rights
ITPGR	International Treaty on Plant Genetic Resources
IUCN	International Union for the Conservation of Nature
LGU	Local Government Unit
MGIS	Musa Germplasm Information System

MTA	Material Transfer Agreement
NARC	National Abaca Research Center
NARES	National Agricultural Research and Extension Systems
NARRDN	National Agriculture and Resources Research and Development Network
NBSAP	National Biodiversity Strategy and Action Plan
NCIP	National Commission on Indigenous People
NCPGR	National Committee on Plant Genetic Resources
NGO	Non-Government Organization
NIPAS	National Integrated Protected Areas System
NPRCTRC	Northern Philippine Root Crop Training and Research Center
NPGRL	National Plant Genetic Resources Laboratory
NSIC	National Seed Industry Council
NSQCS	National Seed Quality Control Services
PAWB	Protected Areas and Wildlife Bureau
PCA	Philippine Coconut Authority
PCARRD	Philippine Council for Agriculture and Forestry Resources Research and Development
PCSD	Palawan Council for Sustainable Development
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PhilRice	Philippine Rice Research Institute
PhilRootcrops	Philippine Root Crop Research and Training Center
PHILSURIN	Philippine Sugar Research Institute Foundation, Inc.
PIC	Prior Informed Consent
PNNPGRFA	Philippine National Network on Plant Genetic Resources for Food and Agriculture
PPB	Participatory Plant Breeding
PSB	Philippine Seed Board
PVS	Participatory Varietal Selection
R.A.	Republic Act
RECSEA-PGR	Regional Cooperation in Southeast Asia on Plant Genetic Resources
RIARCs	Regional Integrated Agricultural Research Centers
ROS	Research Outreach Stations
SABGRC	Southeast Asia Banana Germplasm Resources Center
SALT	Sloping Agricultural Land Technology
SMTA	Standard Material Transfer Agreement
SRA-LGAREC	Sugar Regulatory Administration-La Granja Agricultural Research Center
SEARICE	Southeast Asian Regional Institute for Community Empowerment
UPWARD	Users' Perspectives With Agricultural Research and Development
UPLB	University of the Philippines Los Baños
VMC	Victorias Milling Corporation
WTO-TRIPS	World Trade Organization-Trade Related Intellectual Property Rights

SECTION I

EXECUTIVE SUMMARY

The Philippines lies between 21°20′ north and 4°30′ north latitude and 116°55′ east and 126°36′ east longitude, in the southeast coast of the mainland of Asia lying on the western margin of the Pacific Ocean. The Philippines is one of the world's 25 recognized biodiversity hotspots and one of the world's 17 megadiversity countries. It also ranks seventh in the world in terms of species diversity and endemism. A total of 52 177 species of flora and fauna have been identified in the country, of which 67% are endemic. There are approximately 15 000 plant species so far identified within its borders. Of the 8 120 species of flowering plants 40% are endemic to the country. There are more than 3 000 plant species in the country that are used for food, medicine, fiber, essential oil, commercial timber or ornamentals.

The share of the agriculture sector in the GDP is around 19 percent. Employment in agriculture represents 36 percent of the country's total employment. The leading crops are rice, maize, sugarcane, coconut, banana, mango, pineapple, cassava, coffee, sweetpotato and eggplant. In terms of harvest area, the most extensively grown crops are rice, coconut, maize, sugarcane, banana, cassava, coffee, mango, sweetpotato and Manila hemp.

Agrobiodiversity in the country also forms an integral part of the living culture in the country. Some indigenous species serve as staple food of ethnic tribes. Other endemic species are utilized by ethnic tribes for their food, clothing, shelter, or raw materials of handicrafts. Direct threats to biodiversity in the Philippines include habitat loss and destruction, biological, chemical and environmental pollution, displacement of indigenous crop species and varieties by modern varieties, and natural disasters.

National institutions and networks were established in the country to conserve and manage plant genetic resources. Laws for the conservation and protection of biological genetic resources and their habitats were enacted, and regional and international initiatives were promulgated.

PGRFA are conserved *in situ* in areas declared as national reservations and as a component of traditional farming systems. Since the Philippines is either a primary or a secondary center of diversity of some important crop species, there is a necessity to conduct a survey of the diversity existing in the said species in the country.

Ex situ collections of important germplasm have been assembled and maintained since the early 1900s. There are 45 government and non-government organizations that hold *ex situ* germplasm collections in the Philippines totaling 173 205 accessions. A total of 40% of the total collection has been characterized morphologically, 7% biochemical properties, 3% on molecular properties, and 60% had been evaluated for insect pest and pathogen reaction, physiological and abiotic stress reaction and product quality. Major *ex situ* needs include funding, staff, equipment and facilities.

There is adequate to strong capacity in plant breeding in the public and private sectors.

Seed production and distribution are functions of both public and private sectors. There are two seed supply systems operating in the country, the formal seed supply system which accounts for 10 to 15% of the total seed requirement, and the informal seed system, which . provides a mechanism to reproduce the seeds of traditional varieties and under-utilized crops.

Access to PGRFA of the country is regulated by legal instruments which adhere to the country's international commitments.

Implementation of farmers' rights is limited to certain provisions in existing legislations.

SECTION II

INTRODUCTION TO THE PHILIPPINES AND ITS AGRICULTURAL 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. It is part of the East Indies, a vast island group lying southeast of mainland Asia, with Taiwan at its northwest coast and Borneo on the south. 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 (Figure 1). 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. 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.

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

FIGURE 1
Relief map of the Philippines

Figure 1. Relief map of the Philippines.

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.

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: Aeta, 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 Aetas 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 Aetas remaining. The Aeta 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 Aeta share in the dominant Filipino bloodstream is declining. The Aetas 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 Aetas 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. The 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.

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. The 1980 Census of Population and Housing listed 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.

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).

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.

Based on the national census of 2000, the total population was 76.5 million. The annual population growth rate from 1995 to 2000 was nearly 2.4 percent but was projected to decrease to less than 1.9 percent during the 2000–2005 period.

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.

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.

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.

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.

10. Agriculture

10.1 The agriculture sector

In 2005, the share of the agriculture sector in the GDP was about 19 percent. The crops subsector which accounted for half of the agricultural output posted a growth rate of 0.69 percent while the fisheries sub-sector which shared 23 percent expanded by 6.01 percent. The livestock sub-sector, on the other hand, improved by 2.37 percent.

Employed persons in agriculture reached 11.63 million in 2005 representing 36 percent of the country's total employment. From 1985 to 1997, agriculture has contributed at least 40 percent of the country's employment. The 13-year period generally showed a declining share of agriculture to employment on a low pace. The Bureau of Agricultural Statistics (BAS) noted about 50 percent of the employed females in the rural areas were in agriculture.

In value terms, the leading crops are rice, maize, sugarcane, coconut, banana, mango, pineapple, cassava, coffee, sweetpotato and eggplant. In terms of harvest area, the most extensively grown crops are rice, coconut, maize, sugarcane, banana, cassava, coffee, mango, sweetpotato and Manila hemp.

10.2 Cropping systems

Several crop-based farming systems can be found in the Philippines. Among these are systems based on rice, maize, coconut and sugarcane.

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. Several types of farming systems are practiced, as follows:

Agroforest/homestead gardens

This is a system where forest trees and agricultural crops are grown together, along with the raising of livestock in homelots. This is often a multistorey agroforestry system where the canopies of the component species occupy different strata on the vertical view. This started as an unplanned traditional system of planting the component crops and it evolved into a systematic land management practice.

The traditional practice in Cordillera region in northern Philippines involves a multi-layered agroforestry garden with the upper layer dominated by trees such as pine trees, alnus, mango, rimas, acacia, santol, and caimito. Smaller tree crops like coffee, jackfruit, guava, citrus, banana and papaya serve as the middle layer, while the ground layer is planted with a variety of vegetables, spices and medicinal plants. Livestock components include pigs, chicken, dogs, turkey, geese, ducks, etc. More recently developed systems, which are more systematic, are the combinations of Benguet pine – coffee, Akleng parang – several agricultural crops, alnus-coffee, and alnus-chayote, among many others.

Multi-storey farming system

This farming system involves more than two layers of crops in a given area. Most typical of this is the coconut based farming system in Cavite and other areas in Southern Tagalog. In this system, coconut serves as the first storey crop, followed by the second storey crops like lanzones or coffee or cacao or other medium-sized trees or their combinations depending on the preference of the farmers. The third layer of crops may be banana or papaya. The lower layer of crops may be the annual crops like taro, ginger, yam, sweet potato, and vines like chayote, among others. Pineapple is also a common crop planted at the lower layer of the cropping system. It is very evident from these examples of crops that there is great diversity of crop species in this kind of farming system.

Integrated farming system

This is a farming system whereby the outputs or by-products of one component are used as inputs to the production of another components. Thus, there is an integration or close relationships among the components of the system and a greater utilization of available resources in the farm is achieved.

Diversified conservation farming in sloping lands

This is an upland farming technology combining soil and water conservation through contour farming /cropping, soil fertility improvement, crop diversity and productivity. This system has evolved through time from a simple alley cropping with food and cash crops along with leguminous hedgerows (SALT 1) into a system combining food crops, fruits, and marketable forest trees (SALT 3). Under the SALT 3, more diverse crop species are observed together with a variety of short-, medium-, and long-term tree species. This diversity of plant species provides a long-term stability to the production system.

Multicropped home gardens

This is a model for a home garden that could supply sufficient vegetables for the family's needs. An example of this is the FAITH (Food Always in the Home) gardens. In a 100 m^2 lot, three sections should be made and each section would be planted with different crops of varying maturities. One section should be planted with vegetables that are maturing in two to four months, like soybean, mustard, pechay, carrots, cowpeas, bush sitao, sweet corn and tomatoes. The other section can be planted with okra, cucumber, eggplant, winged bean, and ginger, which are maturing in six to nine months. The last section can be planted with crops that are maturing in 11 to 12 months such as pigeon peas, taro, and swamp cabbage.

SECTION III

CHAPTER 1

THE STATE OF DIVERSITY

1.1 Significance of agricultural biodiversity in the Philippines

The Philippines is one of the countries that comprise the Association of Southeast Asian Nations (ASEAN) region. The lands and seas of ASEAN are naturally blessed with amazing richness of life forms whether these be plants, insects, fish, corals, birds or mammals. Seven of the world's 25 recognized biodiversity hotspots and 3 of the world's 17 megadiversity countries (Indonesia, Malaysia and the Philippines) are found in this region. The Philippines is also one of the five distinct major biogeographic sub-units in the region. The other sub-units are: Indochina (Myanmar, Lao P.D.R, Cambodia, Vietnam and most of Thailand), Sundaic (Thailand, Peninsular Malaysia and the Great Sunda Islands of Borneo, Palawan, Sumatra, Java and Bali), Wallacea (Sulawesi, Maluku and the Lesser Sundas) and Papua (New Guinea and Aru). The country's complex geological history and long period of isolation from the rest of the world have produced varied landforms, water bodies, and climatic conditions. These, in turn have contributed to the wide array of soil, temperature, moisture, and weather regimes and combined with its former extensive areas of rainforest and its tropical location, have given rise to high species diversity. According to the International Union for the Conservation of Nature (IUCN), the Philippines also ranks seventh in the world in terms of species diversity and endemism. A total of 52 177 species of flora and fauna have been identified in the country, of which a high 67% are endemic. There are approximately 15 000 plant species so far identified within its borders. Of the 8 120 species of flowering plants 40% are endemic to the country.

There are more than 3 000 diverse plant species in the country that have played important roles in the lives of the Filipinos. So many species can be used for food, medicine, fiber, essential oil, commercial timber or ornamental.

1.2 The state of diversity and relative importance of all major crops for food security and the diversity within them

Rice (*Oryza sativa*)

Rice is the staple food of over 89% of the Philippine population. It is planted to 4 704 million hectares producing 14 603 million metric tons in the year 2005 valued at P155.6681 million Philippine pesos. Rice farming is the source of income and employment to 12 million farmers and family members. The diversity of ecosystems, cultural management practices, preferences and use contribute to the diversity of Philippine rices.

The Philippines is part of the center of diversity of rice. Extensive traditional varieties exist, consisting of farmers' varieties adapted to varied agroecological zones (e.g. lowland irrigated paddy, lowland rainfed, upland, saline, and cool elevated areas). There is at present a total of over 5 500 collected and documented traditional varieties of rice in the country. Rice germplasm is conserved in the genebanks of PhilRice, Crop Science Cluster of UPLBCA, IRRI, MASIPAG and SEARICE. On-going survey of the diversity continues to uncover more unique traditional varieties in many parts of the archipelago.

There are four wild relatives of *Oryza* found in the Philippines, namely *O. minuta*, *O. meyeriana*, *O. officinalis* and *O. rufipogon*. *O. minuta* can only be found in the Philippines and Papua New Guinea. Current breeding programs are tapping *O. minuta* not only to broaden the rice genetic base but also to incorporate resistance genes for bacterial blight and blast. *O. meyeriana* is a potential source of shade and drought tolerance and photoperiod insensitivity. *O. officinalis* is a source of resistance to brown plant hopper, while *O. rufipogon* is a source of resistance to the rice tungro virus.

The continued existence of the natural populations of wild rices is threatened by the destruction of their natural habitat, especially those populations which are extant in areas near urban centers.

Maize (*Zea mays*)

Maize is the second most important agricultural crop in the Philippines. A total of 2.49 million hectares are planted to the crop, the third most extensive after rice and coconut. With a production of 5.2532 million metric tons. In terms of value of production, the P 40.2917 million value of maize produced in 2005 ranks third after rice and coconut, and ahead of sugarcane, banana and pineapple (Bureau of Agricultural Statistics, 2006).

In the Philippines, maize chiefly supplements and substitutes for rice in areas and periods of rice scarcity (Logroño *et al*., 1996). About one-fifth of the population depends on `white maize' as a staple grain. Over 60% of the seed planted for grain maize in the Philippines is supplied by traditional varieties (FFTC, 2000).

In 2005, white maize was planted to 1.49 million hectares and its production of 2.25 million metric tons accounted for 43% of the total production for the year; whereas yellow maize was planted to 0.95 million hectares, with production of 3.00 million metric tons accounting for 57% of total production (Bureau of Agricultural Statistics, 2005).

White maize has undergone intense use- and region-specific selection during the course of over four centuries of cultivation in the Philippines. Because of its use as human staple, there has been selection for palatability and cooking qualities such that a diversity of forms has developed. In addition, the cultivation of traditional white and yellow maize varieties over a broad range of edaphic, geographic, climatic and cultural factors have produced unique adaptations in different regions of the country.

Farmers' varieties of traditional, or "native", white and yellow maize of both the flint and glutinous types which show unique characteristics can be found throughout the maize growing areas of the country. Notable examples are tiniguib, cebu, mimis, kalimpos, kabagtik, amnikat, lagkitan, pilit, dikkit, bayag, munaw, sida-sida and kiling. In addition, cultural minorities in Mindoro, Ifugao, Abra, Kalinga, and Mindanao also grow heirloom varieties of white and yellow maize.

From the 1950s onward, there has been a gradual but inexorable and rapidly accelerating change in the type of maize being cultivated in farmers' fields all over the country. Beginning with the UPCA Var series of varieties, followed by the College Composites, Phil DMR and EG Synthetic series, to the IPB Vars and lately the commercial hybrids, the traditional or "native" maize varieties are being replaced in the farmers' fields.

Among Southeast Asian countries, the Philippines is unique in that it possesses a considerable number of traditional or "native" farmers' varieties of white and yellow maize that have evolved over four centuries of continuous cultivation, and thus may possess many desirable characteristics and adaptations. Maize is one of the first crops to be introduced to the Philippines from the New World during the beginnings of the Spanish colonization. Due to its over 400 years of continuous cultivation in the country, the crop has adapted to conditions somewhat different from those of its origins. Natural selection for resistance to the downy mildew organism is one prominent example of such adaptation.

The National Plant Genetic Resources Laboratory (NPGRL) of the Institute of Plant Breeding, University of the Philippines Los Baños has assembled a germplasm collection of maize with a total of 2 099 accessions. Of these, a total of 389 accessions are farmers' varieties collected from 32 maize growing provinces all over the Philippines. The most frequently collected is a white maize variety, tiniguib, with 131 populations collected from six provinces in Mindanao. It is expected that a lot more of the diversity of traditional white maize available in farmers' fields all over the country is still not represented in this collection.

Analysis of diversity of 200 accessions of Philippine local maize collection using the Standardized Shannon-Weaver diversity index showed that traditional corn varieties in the Philippines have medium variation for qualitative characters and high variation for quantitative characters (Siopongco *et al*., 1999), indicating the potential of traditional maize for selection, especially for quantitative characters.

Coconut (*Cocos nucifera*)

Another important export crop of the Philippines is coconut which is planted to 3.258 million hectares by 2.7 million farmers, with total domestic production in 2005 of 14.8246 million metric tons from 3.2433 million hectares valued at 52 775.5 million Philippine pesos. During the same year, the country exported coconut oil and desiccated coconut valued at US$ 784.26 million.

The Philippines belongs to the primary center of diversity of coconut. A total of 224 accessions are documented, of which a great majority are traditional varieties.

Populations of the 'wild' coconut types resembling Niu Kafa are found in Homonhon, Sulu-an Islands, Quinapondan in Eastern Samar and Palawan in the middle and southern parts of the Philippines. They have large fruits (55% greater husk content compared to cultivated types).

Present stands of the wild type coconuts are in imminent danger as massive planting of the more popular recommended varieties of Niu Vai types is encouraged. As well, extensive felling of mature and productive trees for lumber poses additional threat to the continued existence of this unique germplasm.

Coconut is monotypic, i.e. there is only one species in the genus. Because of this unique situation, it is but prudent that all wild genotypes are conserved and eventually utilized in improvement programs.

Sugarcane (*Saccharum officinarum*)

Sugarcane is an historically important export crop commodity of the Philippines. In 2005, a total of 388.9 thousand hectares were planted to the crop, the fourth most extensive after rice, coconut and maize, and producing 22.9177 million metric tons of sugar valued at 22 688.5 million Philippine pesos. During the period from 1997 to 2001, sugar export declined from 197.8 million pesos (1997) to 56.7 million pesos (2001).

The following species and genera are extant in the country: *S. officinarum*, *S. spontaneum*, *S. sinense*, *Miscanthus*, *Erianthus* and *Ripidium*. Sugarcane genetic resources collections in the Philippines are maintained at the Sugar Regulatory Administration-La Granja Agricultural Research Center (SRA-LGAREC), the Philippine Sugar Research Institute Foundation, Inc. (PHILSURIN) and the Institute of Plant Breeding (IPB), College of Agriculture, University of the Philippines Los Baños (UPLB) with over 898 accessions. The SRA-LGAREC collection is represented by over 263 accessions of *S. officinarum*, *S. spontaneum*, *S. sinense* and other unidentified *Saccharum* species. The Philsurin and IPB collections are duplicates of each other and consist mainly of traditional varieties, introductions and improved varieties developed by SRA, the then-Victorias Milling Corporation (VMC) and the present Philsurin. Recommended varieties, including introductions, are generally cultivated in large scale production areas, while traditional varieties can be found in small holder farms. Some varieties, especially the chewing type, can be found as components of home gardens.

Banana (*Musa acuminata, M. balbisiana* and *M. x paradisiaca*)

Banana is the most important fruit crop of the Philippines in terms of area and volume of production. In 2005, it is planted to 417 800 hectares producing 6.2982 million metric tons, of which a total of 2 024 million tons were exported with a value of US$ 362.58 million. It contributes 2.3% of the total Philippine export revenue. The industry also provides employment to more than 40 000 people.

The Philippines is considered as part of the center of origin and diversity of bananas in Southeast Asia. At present, more than 90 varieties of cultivated bananas have been identified. The diversity in the bananas has not been fully explored by the industry. Development of new products based on indigenous varieties and special purpose types can expand market potentials and provide source of livelihood for women members of households.

The wild progenitors of the cultivated banana, namely: *Musa acuminata* (4 subspecies) and *Musa balbisiana* are indigenous to the country. In addition, three ornamental species occur in the country, namely *M. coccinea*, *M. ornata* and *M. velutina*. *M. acuminata* and *M. balbisiana* occur naturally all over the country. Documentation during germplasm collecting expeditions and other field exploration activities show that these valuable germplasm are continuously being threatened and efforts to conserve and manage them are very limited. Farmers prefer to replace areas occupied by the wild species with the cultivated species in order to increase their income.

The unabated destruction of populations of wild bananas during clearing of areas in shifting cultivation, road constructions, and rouging by banana farmers affects the food supply of the wild bats and birds which are natural pollinators and predators of harmful insects. Therefore the threats affecting wild bananas can have adverse effect on the ecosystem as a whole.

The cultivated banana carries the A and the B genome contributed by the wild *M. acuminata* and *M. balbisiana* respectively. The wild progenitors are completely untapped in the improvement of cultivated banana although they are known to possess desirable traits such as resistance to major banana diseases like bunchy top, banana mosaic viruses and Sigatoka.

The occurrence of destructive pests and diseases, e.g. corm weevil and banana bunchy top and other viruses, occurrence of natural calamities and the use of a few genotypes contribute to the rapid loss of banana germplasm. Appropriate strategies and control measures will need to be identified to address the problem.

Manila Hemp (*Musa textilis*)

Manila hemp, also known locally as abaca, is endemic to the Philippines. In 2005, the crop was planted in an area of 136 000 hectares. It is a major export commodity, accounting for 80 % of traded abaca in the world export market worth US$ 11.91 million in 2005. In the 25-year period from 1981 to 2005, the production trend of abaca consistently declined from 132 000 metric tons to 74 000 metric tons due to reduced economic benefits derived from the abaca, as influenced by the price of Manila hemp in the world market. This decline can also be attributed to the replacement of Manila hemp with synthetic fibers. Reduction in the production of abaca fiber will threaten the weaving and handicraft industries which are the major source of livelihood for women in some communities.

An overwhelming majority of cultivars planted in the country are traditional varieties. There are 773 accessions of Manila hemp in one *ex situ* collection in the country, consisting of traditional cultivars or landraces, wild types, breeding lines, and improved cultivars. The diversity in Manila hemp is found only in the country.

The occurrence of destructive pests and diseases, occurrence of natural calamities and the use of a few genotypes contribute to the rapid loss of banana and abaca germplasm. Furthermore, threats to the continued existence of the wild types of abaca in their original habitat come from overexploitation due to over harvesting of natural stands. Another more insidious threat is posed by change in land use in the areas where wild abaca is extant, brought about by development and population pressure. A third likely cause of decline is the occurrence of destructive diseases of Manila hemp namely banana bunchy top and mosaic viruses.

Mango (*Mangifera indica*)

In 2005, the country has an estimated share of 3.7% of the global total production of 908 440 metric tons. The area devoted to mango production increased from 124 900 hectares in 1997 to 164 100 hectares in 2005. In addition, production amounted to 984 300 metric tons in 2005. During the same year, volume of mango export was 31 270 metric tons with a value of US$ 26.63 million.

The Philippines has distinct cultivars of *Mangifera indica*, including many strains of the 'Carabao' or Manila mango, 'Pico', 'Kinabayo', 'Pahutan' and 'Mampalam'. It also has two endemic mango species, namely *M. monandra* and *M. altissima*. They are found mostly in the northern and central part of the country. *M. altissima* is apparently a rare species but is reported to be found throughout the archipelago. In addition, two other wild species, namely *M. caesia* and *M. odorata* are also found in the country. There are 264 accessions of *Mangifera* spp. in two *ex situ* collections in the country.

As a species, *Mangifera indica* is not in any way threatened but the predominance of only one variety, the "Carabao", known in the international market as the Manila Super Mango, is threatening the existence of other minor varieties. Morever, both endemic and introduced wild relatives are continuously threatened by replacement and felling of trees, change in land use and habitat destruction.

Pineapple (*Ananas comosus*)

Pineapple is the third most important fruit crop in the Philippines (after banana and mango) in terms of agricultural crop area and value of production. In 2005, a total of 49 200 hectares were planted to the crop, producing 1 788.2 million metric tons of fruit valued at 9 334 million Philippine pesos (US$186.68 million). A total of 536 720 metric tons of fruit were exported in 2005 valued at US$ 204.28 million.

Pineapple is an introduced species in the country. The varieties traditionally cultivated include Smooth Cayenne, Formosa or Queen and Red Spanish. The last variety, Red Spanish, is also used as a fiber source for the manufacture of native cloth. The varieties grown for export and processing are derived from Smooth Cayenne, mostly through mutation breeding and somaclonal variation through tissue culture.

Coffee (*Coffea* spp.)

Coffee is an important crop commodity in the country, and most of the local production is consumed domestically. In 2005, coffee was cultivated in total area of 128 000 hectares with a production of 105 900 metric tons valued at 4 666.5 million Philippine pesos (US$93.33 million).

Coffee was introduced to the Philippines during the period of Spanish colonization. The species cultivated most extensively are *Coffea excelsa*, *C. canephora* (= *C. robusta*), *C. liberica* and *C. dewevrei* (= *C. arabica*). Outbreaks of disease, specifically coffee rust, have decimated coffee populations all over the country, although there are still pockets of the traditional coffee populations remaining. Most of the varieties currently grown are introductions.

Tobacco (*Nicotiana tabacum*)

Tobacco is an important crop commodity in the country. Historically, tobacco was an important export commodity. However, in recent years, all of the local production is consumed domestically. In 2005, tobacco was cultivated in total area of 29 600 hectares with a production of 45 100 metric tons valued at 2 097.6 million Philippine pesos (US$41.95 million).

Just like coffee, tobacco was introduced to the Philippines during the period of Spanish colonization.

Rubber (*Hevea brasiliensis*)

Rubber is an important industrial crop in the southern part of the country. In 2005, it was cultivated in an area totalling 81 900 hectares, mostly in plantations, with a production of 315 600 metric tons valued at 8 591.7 million Philippine pesos (US$ 171.8 million). Rubber is a recent introduction in the country. The varieties currently cultivated are clones from a few elite genotypes.

Cassava (*Manihot esculenta*)

Cassava is most important root crop in the Philippines in terms of agricultural crop area and value of production. In 2005, a total of 204 800 hectares were planted to the crop, producing 1 677.6 million metric tons valued at 6 374.7 million Philippine pesos (US$127.49 million).

Cassava is an introduced species in the country. The varieties traditionally cultivated include local and improved varieties. Most of the varieties commonly grown in plantation are improved varieties with high starch although some traditional varieties still remain in scattered and component of homegardens.

Sweetpotato (*Ipomoea batatas*)

Sweetpotato is an important root crop in the Philippines. In 2005, a total of 120 600 hectares were planted to the crop, producing 574 600 metric tons valued at 4 102.9 million Philippine pesos (US$82.06 million).

Sweetpotato is native to South America and was introduced in the Philippines in the 16th century. Reports indicate that there are 1 586 sweetpotato varieties in the country. Also, there are 30 sweetpotato varieties released by the National Seed Industry Council. The diversity in sweetpotato has been generated through artificial and natural selection in the different growing areas in the country including Central Luzon. Other sources of diversity include somatic mutations and introductions.Moreover, sweetpotato is a self-incompatible crop enforcing cross pollination. Hybridization can likely occur when different varieties are planted near each other and the seeds generate plants of different genotypes. This provides additional source of variation in sweetpotato.

Farmers continue to grow sweet potato due to its diverse uses. All plant parts are utilized for food, beverage, alcohol production and animal feeds. The roots and leaves of sweetpotato are utilized as vegetables in the households and restaurants. It is processed as bakery products, candies and pastries and chips for animal feeds. The vines are also used as silage for livestocks.

Peanut (*Arachis hypogaea*)

Peanut is the second most important food legume in the Philippines. In 2005, a total of 27 500 hectares were planted to the crop, producing 28 400 metric tons valued at 663 million Philippine pesos (US$13.26 million).

Peanut was introduced in the country during the Spanish period through Mexico. Peanut introduced in the country was of the Spanish type. It is mainly used in confectionary, as snacks and food ingredients. Most of the varieties under cultivation are recommended or introduced, although some traditional varieties still remain in scattered and remote landholdings.

Mungbean (*Vigna radiata*)

Mungbean is the most important food legume in the Philippines in terms of agricultural area and value of production. In 2001, a total of 36 100 hectares were planted to the crop, producing 26 800 metric tons valued at 680.8 million Philippine pesos (US$13.62 million).

The Philippines is part of the center of diversity of mungbean. However, most of the varieties currently grown are recommended varieties developed by UPLB, Bureau of Plant Industry (BPI) and Asian Vegetable Research and Development Center (AVRDC). There is still pockets of diversity that can be found in traditional areas of cultivation.

Onion (*Allium cepa*)

Onion is an important bulb vegetable in the Philippines. In 2005, a total of 8 900 hectares were planted to the crop, producing 82 000 metric tons valued at 1 701.1 million Philippine pesos (US$34.02 million).

Onion is a traditional vegetable of the country and its use as condiment is part of the traditional cuisine. The onion being cultivated in the country is represented by three types: the shallot or multiplier onion (*A. cepa* cv.gr. *ascalonicum*), the big yellow-skinned type represented by 'Yellow Granex', and the medium-sized purple-skinned type represented by 'Red Creole'. The genetic diversity in the last two types is very limited, since the varieties grown are the commercial cultivars. Shallot is traditionally extensively grown all over the country, and there are genotypes that flower and produce seeds.

Garlic (*Allium sativa*)

Like onion, garlic is an important bulb vegetable in the Philippines. In 2005, a total of 4 700 hectares were planted to the crop, producing 13 200 metric tons valued at 674.3 million Philippine pesos (US$13.49 million).

Also like onion, garlic is a traditional vegetable of the country and its use as condiment is part of the traditional cuisine. It is cultivated in the certain provinces of northern and southern Luzon. The genetic diversity of the crop is uncertain, although variation in size and pungency are observed. Recently, there is an influx of exotic varieties from China, although farmers still prefer to plant the traditional varieties.

Eggplant (*Solanum melongena*)

Eggplant is the most important fruit vegetable in the Philippines in terms of hectarage and volume of production. In 2005, a total of 21 200 hectares were planted to the crop, producing 187 800 metric tons valued at 2 118.4 million Philippine pesos (US$42.37 million).

Diversity in eggplant exists in the country, in terms of shape, size and color of fruit. In addition, there traditional varieties that exhibit pest resistance. In addition to S. melongena, other species can be found in the country, e.g. *S. torvum*, *S. indicum*, *S. nigrum, S. surattense* and *S. macrocarpon*.

Tomato (*Lycopersicon esculentum*)

Tomato is the second most important fruit vegetable in the country in terms of area and volume of production. In 2001, a total of 17 700 hectares were planted to the crop, producing 173 700 metric tons valued at 1 808.7 million Philippine pesos (US$36.17 million).

Tomato was introduced to the country during the Spanish era of colonization (from the 16th century). It has become an essential part of the cuisine of all cultural groups of the country. There is significant diversity of forms generated due to the different uses to which the vegetable is put, and to the varying preferences. Two species are extant, namely L. *esculentum* (the more prevalent) and L. *pimpinellifolium*.

Cabbage (*Brassica oleracea*)

Cabbage is the most important leaf vegetable in the country. In 2005, a total of 7 400 hectares were planted to the crop, producing 91 400 metric tons valued at 924.5 million Philippine pesos (US$18.5 million).

Cabbage is an introduced crop in the Philippines. The only existing varieties are the commercial cultivars, mainly hybrids, sold by private seed companies.

Calamansi (*Citrofortunella microcarpa*)

Calamansi is an important fruit crop used for condiment in the country. In 2005, a total of 20 200 hectares were planted to the crop, producing 200 800 metric tons valued at 2 042.2 million Philippine pesos (US$40.84 million).

There is a claim that calamansi was introduced into the country from Cochinchinensis (approximately Vietnam of the modern period) at the end of the 19th century and the beginning of the 20th century, as supported by the fact that one of its progenitors, *Fortunella* sp., is not found in the Philippines. There is also a claim that calamansi is apomictic, hence there is very limited diversity to be found in the crop.

1.3 State of diversity of minor crops and underutilized species

Taro and Yam (*Dioscorea* and *Colocasia*) and other root and tuber crops

Taro and yam (*Dioscorea* spp., *Colocasia* spp.) are important subsistence and staple crops of the poor and rural populations of South and Southeast Asia, the Pacific and Africa. In many parts of the tropics, root crops have played vital roles in traditional culture, rituals and religion and in local commerce as well. Some *Dioscorea* species contain large amounts of the saponins, dioscorins, which are important in the pharmaceutical industry and some types are preferred by the ice cream industry. The production of snack foods and the use of taro and yams in family meal food preparations as well the use of special flour products derived from them has not been fully explored.

In 2004, a total of 29 333 hectares were planted to yam, taro and potato, producing 200 256 metric tons.

The common species of root and tuber crops grown in the country include taro, yam and potato. Taro and yam are indigenous while potato is introduced root crops to the country. Root crops are a staple food of Filipinos in the central and southern Philippines.

The country is part of the center of diversity for *Colocasia* and *Dioscorea*. There are five species of *Dioscorea* found in the country, namely *D. alata*, *D. bulbifera*, *D. esculenta*, *D. hispida* and *D. pentaphylla*. There are 143 accessions of *D. alata* and 172 accessions of *Dioscorea* spp. found in three *ex situ* collections in the country. Except for *D. alata*, these species are generally not widely cultivated and utilized and are threatened with genetic erosion. This threat has been attributed to acculturation, industrialization and deforestation. Among the many uses of root crops that offer potential for exploitation are traditional snack foods.

Other underutilized ariods include *Xanthosoma sagittifolia*, *Cyrtosperma chamissonis*, *Alocasia* sp., *Amorphophallus pinnata*, *Maranta arundinacea* and *Pachyrrhizus erosus*. These species are either grown in home gardens or exist as natural stands. Some of them have commercial uses, e.g. native cookies (*Maranta*) and delicacies (*Xanthosoma, Alocasia*).

Other vegetables and food legumes

Statistics on agriculture in the Philippines released by the Bureau of Agricultural Statistics (BAS) lists the following vegetables and legumes classified as minor: asparagus, broccoli, carrots, cauliflower, ginger, gourd, common (field) bean, lettuce, okra, Chinese cabbage and pakchoi. In 2004, a total of 36 354 hectares were devoted to these crops, with a volume of production amounting to 351 304 metric tons.

Minor vegetables in the Philippines grow or are grown in the following types of production systems:

Vegetables gathered as weeds or wild plants

The practice of gathering vegetables from the natural vegetation is still important in the rural areas. With increasing urbanization, these vegetables will forever be lost in the Filipino food basket. Some examples are *Marsilea, Amaranthus, Broussonetia, Ficus pseudopalma, Portulaca oleracea* and the edible ferns.

Vegetables grown in home gardens

A large proportion of production of the home-consumed vegetables is through this production system. Such a system guarantees its conservation. Notable examples are *Lablab purpureus, Phaseolus lunatus, Clitoria ternatea, Mucuna curranii, Allium tuberosum, Hibiscus sabdariffa, Moringa oleifera* and *Psophocarpus tetragonolobus*.

Vegetables grown in comparatively large areas, generally in monoculture

The production of major traditional vegetables aimed at markets is through this system, usually after rice or corn or in coconut-based farming systems. *Momordica charantia, Lagenaria siceraria, Cucurbita moschata, Luffa* spp., *Vigna unguiculata* ssp. *sesquipedalis*, *Brassica juncea*, Brassica rapa (= *Brassica chinensis*), and *Ipomoea aquatica* are notable examples.

The Philippines is known to be rich in indigenous and locally adapted species utilized as vegetables. However, these species are being gradually replaced by new cultivated species, and newly introduced hybrid varieties.

In the Philippines, farmers plant vegetables as an important cash crop or for subsistence. In the rural areas, home gardens are usually planted to a diverse range of vegetables for home consumption including yardlong bean, okra, cowpea, ricebean, *Basella rubra*, hyacinth bean, lima bean, *Cajanus cajan*, *Cucurbita moschata*, *Luffa* spp., *Lagenaria siceraria*, *Benincasa hispida* and *Momordica charantia*. The germplasm collection is found in one *ex situ* collection in the country. Diversity is decreasing in yardlong bean, okra, cowpea, ricebean and bittergourd mainly due to the replacement of traditional varieties with modern cultivars. Diversity has remained the same for *Cucurbita* spp., *Lagenaria siceraria*, *Luffa* spp., hyacinth bean, lima bean, *Cajanus cajan* and *Benincasa hispida* as farmers still continue to grow traditional varieties even with the influx of modern cultivars.

Spices

Spices form part of the traditional Filipino home garden. The known uses of spices are for culinary and seasoning purposes. They are also known to possess medicinal properties and assist in food digestion. The most popular spices grown in the country are black pepper (*Piper nigrum*), ginger (*Zingiber officinale*) and hot pepper (*Capsicum frutescens*). In 2001, a total of 15 million hectares were planted to the crop, producing 72.3 million metric tons valued at 2 010 million Philippine pesos (US$ 40.2 million).

Black pepper is an introduced species in the Philippines. The traditional variety is exclusively asexually propagated by stem cuttings. Recently there have been foreign introductions coming from India and Indonesia. Ginger is also exclusively asexually propagated by rhizomes. The traditional variety is spread all over the country. There are several related species of *Zingiber* extant in the country. Hot pepper is an introduced species that has become naturalized in the country. It is widely distributed throughout the archipelago principally by birds. Therre is significant genetic diversity in the species in the country. Erosion of genetic diversity of spices is continuing due to urbanization, changes in land use and other biotic and abiotic factors.

Medicinal plants

The Philippines is a rich source of medicinal plants which provide traditional health care system mostly for the rural communities. These species are mostly found as a component of traditional homegardens, naturally in the wild, in garden plots in community health centers and schoolyards. To date, a total of 1 687 plant species have been identified to be of use to the traditional healers. Of these, ten (10) have been clinically tested and three (3) are available in commercial preparations. There is no available statistics on area, volume and value of production of medicinal plants.

1.4 The main factors affecting the state of diversity factors driving any change

Agricultural biodiversity provides economic, environmental and socio-cultural benefits.It enhances agricultural productivity and ensure food security. Diversity in genetic resources useful to food and agriculture provides sources of raw materials for genetic improvement of crops. Yield can be increased and vulnerability to attack of pests and diseases, and changes in weather and climate decreased. Productivity is increased leading to higher income and therefore alleviation of poverty and more available food for consumption. Increased diversity in food intake leads to better nutrition.

There are also biodiversity services such as water catchment, flood and climate mitigation, pollution fixing and climate regulation for the benefit of the local and global ecosystem. For example, the wild bananas in the Quezon area of Luzon in the Philippines provide food to wild bats and birds that are natural pollinators and predators of harmful insects. Several plant species also provide alternate hosts for both insect pests, pathogens and their biological control agents providing a delicately balanced situation which when disturbed can result in destructive epidemics.

The agrobiodiversity in the country also forms an integral part of the living culture in the country. Some indigenous species serve as staple food of ethnic tribes. For example, *Dioscorea alata* and *D. hispida* are the staple of the Aeta tribe of Mt. Pinatubo in Central Luzon and mountain tribes of Mindanao. The latter is also an important source of food during famine. Special varieties are presently becoming popular for use in ice creams and confectionary products. In Benguet, the native taro (*Colocasia esculenta*) variety is a delicacy and is served as special food during local feasts like the cañao. Other endemic species are utilized by ethnic tribes for their food, clothing, shelter, or raw materials of handicrafts. For example, certain landraces of *Musa textilis*, better known as abaca or Manila hemp are sources of fibers for the distinctive "tinalak" fabrics of the Tiboli tribe of Mindanao. Weaving and the production of handicrafts are two important economic activities that benefit many communities, especially women in Southern Philippines where these products are popularly made.

The Philippines is one of the most important countries in the world for conserving diversity of life on Earth. There are more than 52 177 described species of plants, animals and microorganisms, of which more than half are found nowhere else in the world. As such, Philippine biodiversity forms part of our global heritage.

History itself has pointed out the importance of Philippine agrobiodiversity. It should be noted that it was the Southeast Asian in spices that enticed Europeans to its shores, and along with the Chinese, pioneered trading in the region that lasted for several hundreds of years. This also paved the way for the colonization of the country, and most of the countries in the region, that subsequently left an ineffaceable mark in the social and cultural well-being of the Filipino people.

The market niche of the many precious Philippine plant species has proven significant economic value. Beyond commodity trading, however, many of the species indigenous and unique to the Philippines are important for broadening the genetic base of the globally important agricultural crops. For example, the Philippines is considered as part of the center of origin and diversity of bananas in Southeast Asia. The wild progenitors of the cultivated banana are indigenous to the country. In bananas resistances to viruses are known to exist in the wild diploid putative parental species of the cultivated species. Philippine taro has not been evaluated for disease resistances and their possible potential contribution as source of resistance genes have not been explored. However, despite the long history of use, the potential of a large number of Philippine indigenous crops and wild relatives has remained unexplored. Lack of appreciation of their potential is contributing to lack of interest by local communities in their genetic conservation in the face of threat of imminent loss.

Less than six percent of the country's original forest cover remains while 418 species are listed in the 2000 IUCN Red List of Threatened Species making it one of the 25 global biodiversity hotspots. Per hectare, the Philippines probably harbors more diversity of life than any other country on earth. This biodiversity also is under tremendous threat of total destruction. Therefore, every parcel of land that is converted, cultivated, or developed translates into the loss of unique life forms. The destruction of our original forests, freshwater, and marine ecosystems have led to an unmatched biodiversity crisis in this globally important country.

The threats and causes to agrobiodiversity loss are manifold and interrelated. In particular, the direct threats and root causes to agrobiodiversity in the Philippines can be categorized in three ways.

Direct threats

Direct threats to agricultural diversity can be considered human induced which include the following:

Habitat loss and destruction

Massive land conversion brought about by urbanization and industrialization continuously occurs throughout the country affecting the natural habitats of many plant species. Some development projects that rapidly change the land use of an area, particularly during the period 1960-1980 have consequently eliminated or destroyed populations/ genotypes of plant genetic resources. Agricultural expansion and shifting cultivation due to the survival needs of an ever-increasing population have also paved the way for the destruction of these natural habitats. Deforestation have contributed to erratic climate changes which in turn cause prolonged drought that change the vegetative composition of an area, losing many of the wild varieties.

Biological, chemical and environmental pollution

The agrobiodiversity in the Philippines is continuously threatened by the inadvertent introduction of exotic pests and diseases. The genetic diversity that has developed or evolved in the country in both indigenous and adapted crop species has severely diminished due to pest and disease infestations. Some notable examples are the collapse of the local papaya industry and loss of local papaya diversity due to the papaya ring spot virus; the wipe out of citrus genotypes due to the tristeza virus; the fruit and shoot borer in eggplant; the little leaf and mosaic viruses and the "namamarako" syndrome in local cucurbits like bittergourd, sponge gourd and bottle gourd; and the threat of erosion of local banana and abaca diversity from banana bunchy top virus, banana mosaic virus and the sigatoka disease. Industrial wastes likewise damage the various components of biodiversity.

Displacement of indigenous crop species and varieties by modern varieties

In most parts of the country, adoption of the products of modern plant breeding has led to the gradual replacement of farmers' varieties and landraces. This trend has accelerated dramatically with the advent of Green Revolution.

The other major category of direct threats to agricultural diversity is nature induced which include the following:

Natural disasters

Natural disasters like volcanic eruptions, typhoons, tsunamis, earthquakes can damage or totally destroy the habitat as well as the diversity of the crop species. The cataclysmic eruption of Mount Pinatubo, for example, has led to the total loss of the indigenous diversity of root crops and vegetables that was cultivated by the native populace around the area.

Abiotic stresses

Environmental disturbances also affect the diversity of crop species in the country. For instance, prolonged drought exacerbated by El Niño phenomenon in 1983 has caused the first large fire in the dipterocarp rainforest in the southern part of the country (Mindanao). The massive build-up of understory fuels, coupled with drought and the presence of a large number of ignition sources resulted in an unprecedented forest fire situation in the Philippines and Southeast Asia. This situation threatened the valuable mossy forest with its biodiversity-rich vegetation, which is high in medicinal, scientific and ecological values.

Three systemic and institutional problems were considered to be the root causes of agrobiodiversity loss in the Philippines.

Late recognition and development of in situ conservation knowledge system of indigenous crop species

In the Philippines, there is an apparent late recognition and development of *in situ* conservation knowledge system of indigenous crop species. This situation stems from the fact that for decades *ex situ* conservation methods had prevailed nationally and internationally. During the last three decades the understanding of agrobiodiversity has developed from the recognition of the importance of genetic diversity, particularly for crops and an emphasis on the *ex situ* conservation of genetic resources in the 1970s. As a result, plant genetic resources (PGR) institutions in the country do not focus on *in situ* conservation. There is no systematic effort to conserve the wild relatives of crops *in situ*. Formal and informal educational system, likewise, do not pay due attention on *in situ* conservation. Only few scientists and researchers are trained on *in situ* conservation. This situation trickles down to local government units (LGUs). LGUs should have been the primary agents of sustainability of PGR conservation at the local level, however, they too have limited physical, financial and technical capability to conduct agrobiodiversity conservation.

In particular for the target species under this project, there are no *in situ* conservation measures being implemented. Because of the limited extent of the conservation efforts for the target species, the existing genetic diversity cannot be adequately sampled and conserved.

Indigenous varieties are not a part of mainstream production systems

The constraint mentioned above is complemented by the presence of an economic development paradigm that requires the spread of modern, commercial agriculture and intensive high-input production systems using modern, genetically homogenous high yielding varieties, putting native varieties and breeds at low priority and high risk. In developing countries like the Philippines, this process has been reinforced by a donor/investment policy that has promoted the use of modern high yielding varieties in monoculture thus threatening the survival of locally adapted cultivars and landraces.

More specifically, indigenous vegetable species and their wild relatives are numerous and are often ranked low in the prioritization process of government institutions. Indigenous vegetables and root crops have long been neglected in agricultural research. They are in great danger of being replaced by a few improved cultivars including those introduced into the country. The indigenous knowledge associated with their cultivation, utilization and conservation is endangered as well.

Fragmented institutional activities on PGR conservation

In addition to the limitations mentioned above, the institutional activities on plant genetic resources conservation, especially on *in situ* conservation, in the country are operating independently of each other, mostly on project basis. This applies to both government and non-government led activities. This situation is partly due to the fact that most of the laws enacted to protect agrobiodiversity have insufficient corresponding funds for their implementation. Hence, activities and projects become opportunistic as available funds would allow paying little attention to complementation of all resources for agrobiodiversity conservation. This makes it difficult to coordinate, consolidate and sustain whatever little effort the country is doing to mitigate the loss of agrobiodiversity.

1.5 Improving the understanding of the state of diversity and ways to maintain diversity

To improve the understanding of the state of genetic diversity in the country and to identify and implement the means to maintain the diversity, it is necessary that the appropriate legal policy framework on sustainable conservation and use of agro-biodiversity should be put in place.

Policy

In response to the threats to biodiversity and in recognition of the value of plant biodiversity in the economy of the Philippines and the well-being of its people, government and non-government organizations have devoted efforts to conserve, safeguard and sustainably manage and utilize these valuable resources. The Philippines developed the National Biodiversity Strategy and Action Plan (NBSAP) in 1997 with the following goals: effective conservation of biodiversity components (genetic, species, ecosystem), sustainable use of biodiversity components and fair and equitable sharing of benefits from the sustainable use of biological resources.

To put these goals into operation, the country sets the following objectives: better management and collaborative decision-making on biodiversity, improving policies for biodiversity conservation, sustainable use and equitable sharing of its components, proper integration of biodiversity conservation strategies in development planning, including strategies based on indigenous knowledge system.

As early as 1976, the Philippines realized that to be effective in its plant genetic conservation efforts, institutionalization and coordination of some activities will have to be done. Thus, in 1976, the NPGRL of IPB was created by Presidential Decree 1046-A as the national repository of plant genetic resources. In 1985, the National Committee on Plant Genetic Resources (NCPGR) was created to consolidate the fragmented efforts on plant genetic resources for food and agriculture (PGRFA) conservation, management and utilization. It led to the establishment of the present Philippine National Network on PGRFA (PNNPGRFA) under the Department of Agriculture - Bureau of Agricultural Research (DA-BAR). The network aims to make operational a national system for the sustainable conservation and utilization of PGRFA in the country. The network is mandated to establish a national system for collecting, regeneration, multiplication, characterization, evaluation, documentation and utilization of PGR of importance to the economy of the Philippines and to support the country's efforts to sustainably conserve its biodiversity.

In addition, the Philippines has enacted several laws for the conservation and protection of biological genetic resources and their habitats, such as:

- Joint Department of Environment and Natural Resources (DENR)-DA-Palawan Council for Sustainable Development (PCSD)- National Commission on Indigenous People (NCIP) Administrative Order (AO) 1 (Guidelines for Bioprospecting Activities inn the Philippines)
- Republic Act (R.A.) 9147 (Conservation and Protection of Wildlife Resources and their Habitats)
- R.A. 7586 (An Act Providing for the Establishment and Management of National Integrated Protected Areas System)
- R.A. 7308 (Promotion and Development of the Seed Industry and the Creation of the National Seed Industry Council)
- R.A. 8371 (Recognition, Protection and Promotion of the Rights of Indigenous Cultural Communities/ Indigenous Peoples and Creating a National Commission on Indigenous Peoples)
- R.A. 9168 (Plant Variety Protection Act)

While there are many legal instruments, policy statements and government agencies that address the country's biodiversity concerns, a coherent national policy and program crafted by relevant sectors and stakeholders is necessary for the effective conservation and sustainable use of agro-biodiversity within the country.

Inventorying

One of the priority activities of the PNNPGRFA established in 2001, was to conduct a survey of *ex situ* collections in the country. Survey and verification was conducted in a total of 45 institutions; 31 of which are network members and 14 are additional institutions with germplasm holdings as well.

A total of 64 351 accessions are currently being conserved in the institutions surveyed. The collections were acquired through direct collecting of the researchers from different parts of the country (60% of all accessions), through exchange with local and foreign institutions (18%) and donations (22%). The high percentage of locally collected material highlights the efforts to collect and conserve local germplasm. The degree of duplication in the conserved germplasm at the different institutions cannot be gauged accurately, although the exchange of materials among local institutions indicate that there may be duplication.

The data on germplasm holdings obtained by the NISM is lower than those from the survey conducted the PNNPGRFA in 2001 (50 082 accessions vs. 64 351 accessions), since there were more respondent institutions in the latter survey.

There is a need to conduct survey of existing diversity *in situ* including on-farm especially for orphan crops.

In situ needs and priorities

In the Philippines, there is no systematic national effort in *in situ* conservation of PGRFA. PGRFA are however conserved *in situ* in areas declared as national reservations, e.g. protected areas in the National Integrated Protected Areas System (NIPAS). Also, maintenance of PGRFA in farmers' fields and buffer zones is still a common practice in some farming communities. PGRFA is maintained as a component of traditional farming systems, e.g. home gardens.

The priority activities for *in situ* conservation are the following:

- Development and testing of a model for *in situ* conservation
- Enhancing capacities of stakeholders to manage the sustainable conservation and utilization of the genetic resources
- Developing partnerships in conservation through strengthening of involvement of various sectors in the community (government institutions, non-government institutions, farmers, traders, and other stakeholders) through the development of a participatory *in situ* conservation strategy; and improving linkage and coordination among institutions involve in PGR activities.
- Sustainable operation of a community-based seed supply and product development system
- Establishment of a community-based seed supply system linked to product development and a marketing system and which enhance productivity and the capacity to sustain livelihoods by stimulating awareness of the benefits provided by a diverse genepool

- Development of public awareness of PGR conservation through the development of strategies in information, education and communication (IEC) to enhance awareness and public action on conservation and utilization of diversity; and advocacy for the passing of local ordinances on sustainable conservation and utilization of PGR.

Ex situ needs and priorities

Ex situ collections of important germplasm have been assembled and maintained by relevant agencies since the early 1900s. The first collections consisted of local materials and foreign introductions primarily of tropical fruits and plantation crops. Through the years, fruit germplasm collections have either flourished (banana, mango) or dwindled (citrus), the reasons ranging from sustained institutional commitment, funding, and pest and disease outbreaks.

The beginnings of *ex situ* collections of seed crops and asexually propagated species were assembled and maintained by plant breeders, predominantly from plant introductions although landraces and traditional varieties were also collected for some important crops like rice, maize, tomato and mungbean among others. Systematic conservation of germplasm as seed was centralized with the establishment of several genebanks.

Like in many genebanks, regeneration of stored germplasm accessions is often given the least priority mainly due to lack of funding. The window for funding for such activity is very limited for national programs. Hence, the genetic erosion in genebanks is common. It is strongly recommended that regeneration is considered to be a genebank responsibility and funding agencies should also give priority for carrying out regeneration activities.

The crop germplasm maintained as seed in cold storage rooms in the national repository require periodic regeneration and multiplication to insure that quality (seed viability) and quantity are maintained. This is due to the natural and irreversible loss of viability that occurs when seeds are kept in storage, no matter how good the storage conditions. This problem is compounded by the need to multiply the material to produce more seeds, especially in cases where requests for seeds to be used in research or plant breeding will have reduced the quantity of the collection being maintained.

Through the survey conducted in 2001, the following priority activities were identified:

- Specialized short-term training needs to be provided to staff of the institutions handling specific aspects of PGR conservation and management. In the case of staff with no training in PGR whatsoever, basic short-term training is indicated to fast-track the acquisition of basic knowledge in handling and conservation of PGR. On-the-job training in institutions with well-developed PGR programs is a viable option in both cases.
- There is a need to develop viable and practical seed conservation strategy to insure the continued maintenance of seed germplasm, in terms of equipment, facilities and technical support. The strategy could include sharing of resources, designation of seed conservation sites, and use of low-cost but effective storage facilities.
- There is an adequate number of fully functional tissue culture laboratories in the institutions from which to select *in vitro* conservation and cryopreservation laboratories. As the retrofitting of the selected laboratories will entail some expenditure in terms of equipment and specialized training of the staff, there is a need to assess the usefulness of *in vitro* conservation system as a complement to field genebanks, to decide the best number and configuration (in terms of location, crop of responsibility etc.) of the *in vitro* genebanks, and to make arrangements on sharing of resources among institutions within a geographical area.
- There is a need to assess the extent and proportion of genetic diversity existing in the collections among the institutions. This should be initiated in the crop species with appreciable number of accessions and with enough information (i.e. morphological characterization to begin with) for valid diversity assessment. The results of the assessment could be used to determine gaps, possible duplicates, and collecting needs.
- There is a need to determine obvious duplications (on the basis of variety name, pedigree and other similar passport information) to insure efficient use of resources for conservation and management of the germplasm collections.
- There exists a genuine interest to determine the characteristics of the collection, as shown by the relatively high proportion of the collection that has been characterized and evaluated. Primary interest appears to be focused on pest and pathogen reaction, physiological and abiotic stress reaction, and product quality. There would most likely be interest and benefit to be derived from describing the rest of the collections not yet characterized and evaluated.
- The usefulness and need for developing capability in biochemical and molecular characterization and evaluation among the different institutions should be assessed. Such an assessment should take into account the best number and location (within geographic groupings) of institutions that will be tasked with this activity.

1.6 Crop diversification, promoting development and commercialization of underutilized crops and species, developing new markets for diversity-rich products

To promote the development and utilization of under utilized crops, the following interventions are recommended:

Protocols for product development and marketing designed and applied to target sites with focus on the role of women members of the community

This will guarantee the continuous supply of raw materials for use of local and tribal communities in their livelihood and enhance the quality and quantity of food in local communities where the target species is a staple. Supply and demand of agricultural biodiversity will be enhanced through linkage between community-based seed supply systems, product development, marketing; and promoting the development of new products, markets and business opportunities with focus on the role of women.

Linkage between growers and product developers must be forged

Except for contract growing, there is practically no linkage between the growers and product developers. The lack of linkage results in lack of appreciation of the need of each other.

Research on the development of novel products from under utilized species must be conducted

New products using the target species developed and introduced to the community for adoption and marketing. Training on product development and marketing with focus on the role of women.

Need to formally establish linkage between the formal and informal seed supply systems

Most of the under utilized crops are in the informal seed supply system and are therefore not included in the mainstream of the country's production system. This also highlights the need to harmonize and standardize procedures for seed/ planting material quality and certification at the informal and formal seed supply systems.

1.7 Early warning system

There is no system for early warning on threats to agrobiodiversity in the country. There is therefore a need to establish a mechanism especially in reference to pest and disease epidemics. Examples in the past when an early warning system would have mitigated the destructive effects of pest and disease outbreaks are in the case of ringspot virus in papaya, mosaic and bunchy top viruses in abaca and banana, and the black bug infestation in rice. In the case of the effects of natural disasters, the system of repatriation/reintroduction of traditional/farmers' varieties will be an important element of the re-establishment of the ecosystem.

1.8 The main values of plant genetic resources

Important crops and products

Crops in the Philippines are ranked in importance according to their contribution to food security, livelihood and foreign trade. Rice and maize, the two main staple, are therefore considered the two most important crop commodities of the country. Coconut, sugarcane, banana, Manila hemp and mango, which are important both for domestic consumption and foreign trade, follow next in importance.

Rice

Rice is the most important crop in the country. Rice ranks first in importance for food security in all regions of the country. Rice is used in traditional food preparations, native delicacies and production of traditional wine. Rice has also social importance as it is used as offering in religious rituals and festivals.

Maize
In the Philippines, maize chiefly supplements and substitutes for rice in areas and periods of rice scarcity. Locally grown maize is used mainly for two purposes, as animal feed and as human staple. There is a strong association of kernel color with use, i.e. yellow maize is used predominantly as animal feed, while maize when used as human staple usually has white kernel. Other uses of maize include animal feeds, delicacies and snacks, and traditional food preparations.

Coconut
The importance of coconut is primarily for economic reasons. It is also important for food security in areas where it is chiefly grown (Southern Luzon, Bicol region, Leyte, Davao) as source of cooking oil, beverage, confectionery, delicacies, traditional food. As well, it has partially replaced traditional timber as construction materials. It also has social significance as material for ornaments and handicrafts. Coconut is also used for soil erosion control, planting media, and other industrial uses.

Sugarcane
The primary importance of sugarcane is mainly economic as one of the principal agricultural export of the country. It is also important in the food security in areas where it is chiefly grown (Ilocos region, Southern Luzon, Negros, Iloilo, Tarlac). Sugarcane is also used in traditional food preparations and its by-products (bagasse, molasses) are used in the paper production, particle board and some native food preparations.

Banana
Banana is the most important fruit in the Filipino diet. Banana is important primarily in food security in all regions of the country. Banana is also used in the preparations of snack foods, vinegar, catsup, bakery products, wine, delicacies, and other traditional foods.

Manila Hemp
Products from Manila hemp are important for different reasons depending on use. The primary importance of Manila hemp is economic, being the main source of livelihood in areas where it is cultivated. It has no importance for food security since it is a non-food commodity. It also has social importance in the southern part of the country, where the utilization of fibers of the wild forms of Manila hemp is part of the tradition, livelihood and artistic expression of several ethnic groups. In the Bicol region and the T'boli tibe of South Cotabato in Mindanao, it is an important raw material for traditional handicraft. including the "tinalak", a woven fabric from abaca fibers with unique ethnic designs, and "sinamay", another type of fabric woven from abaca produced in the southern part of Luzon.

Mango
Mango is an important fruit in the Philippines because of its high demand both in the local and foreign markets. Mango is used locally as fresh fruit, as beverage in the form of puree and mango juice, and in bakery products. It is therefore also important in the food security of the country, being a source of minerals, vitamins and carbohydrate.

Wild plants for food production
There are wild plant species essential to food production in the country. They are gathered from the forest and buffer zones. They have contributed significantly in the diversification of agricultural systems. The genetic diversity of *Dioscorea hispida*, *Ficus pseudopalma*, *Solanum nigrum* and the edible ferns remains the same. On the other hand, the genetic diversity of the following species is decreasing: *Arenga pinnata*, *Metroxylon sagu*, *Musa balbisiana*, Fishtail palm (Caryota sp.), *Willoughbeia edulis*, *Antidesma bunius*, *Garcinia dulcis*, *G. binucao*, *Mangifera caesia*, M. odorata, *M. altissima Nephelium ramboutan-akee*, *Artocarpus altilis*, *A. odoratissima* and edible bamboo.

There was no survey and inventory of wild plants for food production undertaken.

There are threats to diversity of crop species grown by farmers due to the following reasons.

- Land conversion
- Abandonment of traditional cultivars due to variety or crop replacement
- Disease and pests epidemics
- Abandonment of farming

The diversity of modern varieties being used is decreasing. In rice, for example, there is evidence that the varietal releases are becoming genetically uniform due to the narrowing of the genetic base.

1.9 Factors influencing the state of plant genetic diversity in the Philippines

Change in relative importance of crops

Over the past 10 years, changes in the relative importance in major crops in the Philippines can be attributed to the following factors:

- Land conversion
- Increase in volume of export due to increased global demand
- Pests and diseases
- Expanded use and new markets
- Importation and competition with locally-grown crops
- Rehabilitation programs

Rice and maize

There has been no change in the relative importance of rice and maize as the primary commodities both in terms of area and volume of production since they are the primary staple. In one case where there was a shortfall in production (1998), the deficit was made up with increased importation.

Coconut

There has been no change in relative importance of coconut since it is a major export commodity.

Sugarcane

The areas for sugarcane production fluctuate, reflective of the prevailing demand in the world market for sugar.

Banana, mango and pineapple

The production areas of banana, mango and pineapple have been increasing over the past 10 years due to increasing exportation of these crops.

Coffee

There is decreasing production areas in coffee due to diseases and crop replacement.

Calamansi

There is increasing importance of calamansi due to its expanded uses and new market in the processed food, cosmetics and household products industry.

Onions, garlic, and tobacco

There is a decrease in the relative importance of these crops due to increasing importation for the last ten years.

Manila hemp

There was a decrease in importance in Manila hemp during the first part of the last ten years due to outbreak of destructive diseases. There was however an increase in the latter part due the abaca rehabilitation program of the government.

Assessment of genetic erosion of plant genetic resources

There has been no systematic assessment of genetic erosion of plant genetic resources in the country. Although the methodology and the indicators for assessing genetic erosion is known, no activities along these lines were conducted due to lack of funds necessary to conduct the activity.

It is known that genetic erosion in many crops is occurring. The factors contributing to genetic erosion vary according to crops.

Variety replacement is an important factor contributing to the erosion of genetic diversity in rice, maize, mungbean, peanut, tomato, eggplant, cassava, yardlong bean, cowpea, durian and rambutan. The rate of variety replacement is accelerating with the increased marketing of commercial hybrids, especially in maize and vegetables. In mango, trees of traditional varieties are being felled and replaced with 'Carabao', the most popular variety for export and domestic consumption.

Existing policies on crop loans and subsidies also contribute to variety replacement. In rice and maize, for example, farmers can only avail themselves of crop loans if they will plant recommended varieties. In some crops, subsidies on fertilizers and other agricultural inputs are provided only if recommended varieties are planted.

The effect of land clearing and deforestation on genetic erosion is felt more strongly on wild relatives of crops, and wild plants used for food. Urbanization and human population growth, on the other hand, affect all crops. There has been an accelerating rate of conversion of agricultural lands, including irrigated rice land, into subdivisions and industrial estates. Felling of coconut trees for use as wood for house construction has also been increasing.

Pest and disease outbreaks have also led to genetic erosion in some crops. The genetic diversity of papaya in the country, which developed over centuries since the crop's introduction into the country during the Spanish period of colonization, was decimated by the outbreak of the papaya ringspot virus. Virus diseases including the banana bunchy top virus has led at one point to the decline of the Manila hemp industry, and has critically affected the genetic diversity of the species. The tristeza virus has contributed significantly to the abandonment of citrus growing in many parts of the country, resulting to the loss of genetic diversity in *Citrus reticulata*, *C. grandis* and *C. aurantifolia*. Coffee rust has also led to the decline in coffee cultivation and the abandonment of traditional varieties. In sweetpotato, the feathery mottle virus has affected all varieties thus leading to genetic erosion in the crop.

The environmental factors that have the most impact on genetic erosion are typhoons, drought and to a limited extent, volcanic eruptions. Typhoons occur regularly at a rate of 19 a year, and they can significantly affect survival and population structure of crop varieties, for example banana, Manila hemp, coconut and other perennial crops. Drought, although not a frequent occurrence, has affected the cultivation of rice, maize, vegetables and root crops in 1998.

Future needs and priorities

Improving understanding of the state of diversity of PGRFA

There is a need to increase awareness on the importance of PGRFA. This could be spearheaded by local government units. The crop diversity fairs initiated in some provinces in the country should be adopted by the rest of the provinces. As well, locally processed products of crops and wild plants in each province should be developed.

Capacity building needs to enhance assessments of the state of diversity of PGRFA

There is a need for training on the assessment of diversity and genetic erosion for both government and non government organizations. There is also a need to empower the peoples organizations and the local government units to assess genetic erosion through a science-based approach by providing technical training. There is also a need to provide training on modern approaches to genetic diversity assessment to all stakeholders.

Priorities to better understand the roles and values of the diversity of PGRFA

The documentation of indigenous/traditional knowledge on the uses of PGRFA should be prioritized. Studies on the valuation of PGRFA should be initiated as well.

Monitoring of genetic erosion and improve the response to observed erosion

The country should institutionalize the periodic monitoring of genetic erosion (eg every 10 years). The state of genetic erosion should be one of the criteria in prioritizing the activities in national PGR program.

Other strategic directions

Local ordinance promoting the conservation and use of plant diversity should be enacted. Research on the state and patterns of diversity in crops where the Philippines is at least the center of diversity should be conducted to better manage their conservation.

Assessment of diversity in crops at the morphological, biochemical and molecular levels and analysis using mathematical tools are being used.

There is a need to build capacity among stakeholders to analyze diversity of PGRFA. Funding constraints pose difficulty in carrying out the analyses for the assessment of diversity and erosion of PGRFA in the country.

CHAPTER 2

THE STATE OF *IN SITU* MANAGEMENT

2.1 Plant genetic resources inventories and surveys

Over the past 10 years, the only survey and inventory conducted in the country on PGRFA were limited to rice, sweetpotato, banana, cassava, maize, tropical fruits, indigenous vegetables, root crops and medicinal and herbal plants, and only on traditional cultivars and those grown in home gardens. The survey was conducted in the provinces of Bohol, Bukidnon, Cotabato, Ilocos Norte and Palawan. The greatest constraint on improving inventories and surveys remains the lack of funds. There exists a core of technical personnel who have the capability to conduct surveys and inventories.

Ecological functions played by the crops and crop-associated biodiversity

There are biodiversity services such as water catchment, flood and climate mitigation, pollution fixing and climate regulation for the benefit of the local and global ecosystem. For example, the wild bananas in the Quezon area of Luzon in the Philippines provide food to wild bats and birds that are natural pollinators and predators of harmful insects. Several plant species also provide alternate hosts for both insect pests, pathogens and their biological control agents providing a delicately balanced situation which when disturbed can result in destructive epidemics.

Priorities for future inventories and surveys of plant genetic resources, crop-associated biodiversity and wild plants for food production

Since the Philippines is either a primary or a secondary center of diversity of some important crop species, there is a necessity to conduct a survey of the diversity existing in the said species in the country. The inventory will elucidate the extent of diversity and provide information for periodic monitoring of genetic erosion. The crops on which inventory should be conducted will include coconut, banana, rice, maize, Manila hemp, sweetpotato, yam, taro, *Solanum* spp., mango, *Garcinia* spp., *Nephelium* spp. and *Artocarpus* spp.

Capacity building needs and priorities to support inventory and surveys for plant genetic resources, crop-associated biodiversity and wild plants for food production

Inventory and surveys of plant genetic resources *in situ* are a big undertaking that should involve many sectors and stakeholders. While technical capability exists, this is limited to the scientific community. This should therefore be made available to those who will participate in the collaborative undertaking, through training/mentoring.

Conservation of wild plant genetic resources for food and agriculture in protected areas

There are no *in situ* conservation programs per se on specific wild plant genetic resources for food and agriculture. However, many of these species are components of forest ecosystems. In the Philippines, there are 65 areas protected under the NIPAS (Table 1). Those wild species useful for food and agriculture, when they exist within these protected areas, are therefore likewise protected and conserved by fiat. Examples of these are wild species of *Mangifera*, *Citrus*, *Garcinia*, *Nephelium*, *Durio*, *Artocarpus* and *Dioscorea*.

TABLE 1

Protected areas and buffer zones under the National Integrated Protected Areas System (NIPAS)

Region	Name of Protected Area	Location	Area (Hectares)	
			Protected Area	Buffer Zone
Cordillera Administrative Region (CAR)	1. Upper Agno River Basin Resource Reserve	Atok, Buguias, Itogon, Kabayan, Tublay, Kibungan, La Trinidad, Benguet Province, Hungduan & Kiangan, Ifugao Province, Kayapa, Province of Nueva Vizcaya	77 561.0000	
			77 561.0000	
Region 1 (Ilocos Region)	2. Lidlidda Protected Landscape	Lidlidda, Banayoyo, Ilocos Sur	2 266.4900	
	3. Agoo-Damortis Protected Landscape and Seascape	Agoo, Sto. Tomas & Rosario, La Union	10 513.3000	135.6400
	4. Libunao Protected Landscape	Sinait, Ilocos Sur	46.7000	
	5. Bigbiga Protected Landscape	Narvacan, Ilocos Sur	135.7140	
	6. Sta. Lucia Protected Landscape	Balidbed, Salcedo, Ilocos Sur	174.1604	
	7. Manleluag Spring Protected Landscape	Brgy. Malabobo, Mun. of Mangatarem, Pangasinan	1 935.174	965.086
			15 071.5384	**1 100.7260**
Region 2 (Cagayan Valley	8. Peñablanca Protected Landscape/Seascape	Peñablanca, Cagayan	118 781.5820	
	9. Magapit Protected Landscape	Gattaran and Lal-lo, Cagayan	3 403.6200	
	10. Casecnan Protected Landscape	Dupax del Norte, Dupax del Sur, Nueva Vizcaya Madella and Dipaculao, Quirino and Aurora	88 846.8000	
	11. Northern Sierra Madre Natural Park	Palanan, Divilacan, Maconacon, Ilagan, Proc. 978 10-Mar-97 San Pablo, Cabagan, San Mariano, Dinapigue & Tumauini, Isabela	359 486.0000	
	12. Salinas Natural Monument	Bambang, Kayapa and Aritao, Nueva Vizcaya	6 675.5600	
			577 193.5620	
Region 3 (Central Luzon)	13. Roosevelt Protected Landscape	Dinalupihan and Hermosa, Bataan	786.0400	
	14. Simbahan-Talagas Protected Landscape	Dinalungan, Aurora Province	2 266.4900	
	15. Amro River Protected Landscape	Casiguran and Dilasag, Aurora Province	6 471.0800	
	16. Dinadiawan River ProtectedLandscape	Dipaculao, Aurora	3 371.3320	
	17. Talaytay Protected Landscape	Dinalungan, Aurora	3 526.2900	
			16 421.2320	

Region	Name of Protected Area	Location	Area (Hectares)	
			Protected Area	Buffer Zone
National Capital Region (NCR)	18. Ninoy Aquino Parks & Wildlife Center	Quezon City	22.7000	
			22.7000	
Region 4-A (Southern Tagalog)	19. Taal Volcano PL	Batangas	62 292.1369	
	22. Buenavista Protected Landscape	Mulanay, Quezon	284.2700	
	21. Maulawin Spring Protected Landscape	Guinayangan, Quezon	149.0100	
	22. Hinulugang Taktak Protected Landscape	Antipolo, Rizal	3 2000	
	23. Quezon Protected Landscape	Atimonan, Pagbilao and Padre Burgos, Quezon	938.0000	
	24. Mts. Banahaw- San Cristobal PL	Lucban, Tayabas, Sariaya, Candelaria & Dolores Quezon; Rizal, Nagcarlan Liliw, Majayjay and San Pablo City, Laguna	10 900.5900	
			74 567.2069	
Region 4-B (Southern Tagalog)	25. Puerto Princesa Subterranean River Natural Park	Puerto Princesa	22 202.0000	
	26. Mt. Calavite Wildlife Sanctuary	Palawan, Occidental Mindoro	18 016.1900	
	27. El Nido Managed Resource Protected Area	El Nido, Palawan	89 134.7600	
			129 352.9500	
Region 5 (Bicol Region)	28. Chico Island Wildlife Sanctuary	Cawayan, Masbate	7.7700	
	29. Naro Island Wildlife Sanctuary	Cawayan, Masbete	109.9800	
	30. Malabungot Protected Landscape & Seascape	Garchitorena, Camarines Sur	120.6200	
	31. Lagonoy Natural Biotic Area	Lagonoy, Camarines Sur	444.6000	
	32. Abasig-Matogdon Mananap Natural Biotic Area	San Vicente, San Lorenzo Ruiz, and Labo, Camarines Norte	5 420.1200	
	33. Mt. Isarog Natural Park	Naga, Calabanaga, Tinambac, Goa, Tigaon & Pili, Camarines Sur	10 112.3500	
	34. Bongsalay Natural Park	Batuan, Masbate	244.7210	
	35. Bicol Natural Park	Basud, Daet, Sipocot and Lupi, Camarines Norte and Camarines Sur	5 201.0000	
	36. Mayon Volcano Natural Park	Ligao, Guinobatan, Camalig, Damaga, Legazpi City, Sto. Domingo, Malilipot and Tobaco, Albay	5 775.7000	
	37. Bulusan Volcano Natural Park	Casiguran, Barcelona, Irosin & Juban Province of Sorsogon	3 672.0000	
			31 108.8610	

Region	Name of Protected Area	Location	Area (Hectares)	
			Protected Area	Buffer Zone
Region 6 (Western Visayas)	38. Canlaon Natural Park	Murcia and La Castellana, Bago, La Carlota, Canlaon and San Carlos	24 388.0000	169.0000
	39. Sibalom Natural Park	Sibalom, Antique	5 511.4700	
			29 899.4700	**169.0000**
Region 7 (Central Visayas)	40. Talibon Group of Islands Protected Landscape/Seascape	Municipality of Talibon, Bohol	6 456.8700	
	41. Rajah Sikatuna Protected Landscape	Carmen, SierraBullones, Garcia Hernandez, Valencia, Dimia, Bilar and Batuan, Bohol	10 452.6000	
	42. Alburquerque-Loay-Loboc Protected Landscape/Seascape	San Agustin, Bahi, Epo Sta. Fe & Tagvane, Alburquerque, Coastal Areas of Loay & Riverside of Loboc, Bohol	1 164.1600	
	43. Panglao Island Protected Seascape Province of Bohol	Island of Panglao	385.6659	
	44. Central Cebu Protected Landscape	Cities of Cebu, Talisay, Toledo and Danao & in Municipalities of Minglanilla Consolacion, Liloan Compstela & Balamban Province of Cebu	29 062.0000	
			47 521.2959	
Region 8 (Eastern Visayas)	45. Jicontol Natural Park	Maslog, Dolores, Can- Avid, Eastern Samar	(6 483.0000)	
	46. Mahagnao Volcano Natural Park Leyte	Burauen and La Paz,	635.0000	
	47. Calbayog-Pan-As Hayiban Protected Landscape	Calbayog, Samar	7 832.0000	
	48. Samar Island NP Eastern & Northern Samar	Provinces of Samar,	333 300.0000	125 400.0000
			335 284.0000	**125 400.0000**
Region 9 (Western Mindanao)	49. Buug Natural Biotic Park	Buug, Zamboanga del Sur	1 095.0000	470.0000
	50. Basilan Natural Biotic Area	Lamitan, Sumisip, Tipo-Tipo & Isabela, Basilan	4 497.0000	2 019.0000
	51. Siocon Resource Reserve del Norte	Siocon, Zamboanga	793.7410	186.6600
	52. Pasonanca Natural Park	Zamboanga City	12 107.0000	5 307.0000
	53. Jose Rizal Memorial Protected Landscape	Dapitan City, Zamboanga del Norte	439.0000	15.0000
	54. Great and Little Sta. Cruz Islands Protected Landscape & Seascape	Zamboanga City, Zamboanga del Sur	1 877.0000	1 548.0000
			20 808.7410	**9 545.6600**

Region	Name of Protected Area	Location	Area (Hectares)	
			Protected Area	Buffer Zone
Region 10 (Northern Mindanao)	55. Mt. Kitanglad Natural Park	Talakag, Baungon, Libona, Manolo Fortich, Sumilao, Impasug-ong, Malaybalay & Lantapan Province of Bukidnon	31 235.1900	16 034.8100
	56. Mt. Kalatungan Range Natural Park	Talakag, Valencia, Maramag & Pangantuan, Bukidnon	21 247.7300	13 891.5000
	57. Mimbilisan Protected Landscape	Talisayan and Balingoan, Misamis Oriental	66.0000	
	58. Mt. Malindang Natural Park	Misamis Occidental	34 694.0000	18 334.0000
	59. Initao-Libertad PLS	Initao and Libertad Misamis Oriental	1 300.7800	800.4500
Region 11 (Southern Mindanao)	60. Mt. Apo Natural Park	Kidapawan, Makilala, Magpet, Cotabato and Bansala, Digos, Sta. Cruz in Davao City, Davao del Sur	(72 113.0000) 54 974.4754	9 078.1200
			88 543.7000	**9 060.7600**
		Baganga, Davao Oriental	114.8780	
	62. Mabini Protected Landscape & Seascape	Mabini, Compostela Valley	6 106.0000	
	63. Mainit Hotspring Protected Landscape	Nabunturan, Compostela Valley	1 374.0000	401.0000
	64. Mati Protected Landscape	Mati, Davao Oriental	914.2600	135.7600
			63 483.6134	**9 614.8800**
Region 13 (CARAGA Region)	65. Siargao Protected Landscape/Seascape	Siargao, Surigao del Norte	278 914.1310	
			278 914.1310	
	Total		**1 785 754.0**	**194 891.0260**

There is no program for ecosystem management and *in situ* conservation of PGRFA and crop-associated biodiversity outside protected areas. For example, although several populations of wild *Oryza*, *Solanum* and *Abelmoschus* have been documented, there is continuing destruction of these populations since they are extant outside of protected areas.

2.2 On-farm management and improvement of plant genetic resources for food and agriculture

During the last 10 years, on-farm conservation is advocated and initiated to complement *ex situ* approaches in rice, sweetpotato, and yam. This has been conducted in three provinces. There is no incentive to promote on-farm management of PGRFA rather there is a disincentive due to bias for modern varieties in the provision of crop loans and subsidies. There is also no national/regional forum for stakeholders involved in on-farm conservation, recognized by the National Programme.

Country support of on-farm participatory plant breeding programmes

The participatory varietal selection and plant breeding have been institutionalized in crop improvement programs in research agencies. Similarly some non-government and peoples' organizations have collaborated on participatory plant breeding in rice.

Support to develop local or small scale seed production

There is no government support or encouragement for small-scale seed production of traditional or farmers' varieties. Existing support on local or small scale seed production is limited to seed production using recommended varieties. Some NGOs have implemented local or small scale seed production linked to marketing involving farmers and cooperatives.

Major needs for *in situ* management of plant genetic resources for food and agriculture

There is a need to identify crop species where *in situ* conservation is critical. One major criterion that should be considered is the presence of endemic or indigenous diversity. The potential crops for on-farm *in situ* conservation include rice, root crops, banana, Manila hemp, indigenous vegetables, medicinal plants, mango, Garcinia, coconut, and pili.

The additional actions needed to support on-farm management include:

- Facilitation of access to a wider range of planting material
- Development of products and markets for the products originating from traditional and underutilized varieties and crops
- Enhancement of capacity of stakeholders to manage the sustainable conservation and utilization of the genetic resources
- Establishment and strengthening of linkage among the partners and networking with agencies/ institutions involved in conservation
- Development of public awareness of PGR conservation

Restoring agricultural systems after disasters

In the Philippines, there is a system of disaster mitigation and relief from natural disasters, e.g. typhoons, drought and volcanic eruptions, that includes provision of basic necessities and services. The DA spearheads efforts to provide planting materials for the re-establishment of the agricultural system. Some non-government organizations also help re-introduce farmers' varieties devastated by natural disasters.

One major constraint to the establishment of an effective plant genetic resources response mechanism is the lack of formal seed supply system for traditional varieties, the non-inclusion of traditional varieties (which could come from the informal seed supply system) in the re-establishment of agricultural systems because this focuses on improved crop varieties only.

To insure that the agricultural system that is being re-established should contain the original crop diversity, the re-introduction program must include traditional or farmers' varieties that were originally grown in the area.

In situ conservation of wild crop relatives and wild plants for food production

The actions taken to encourage and support *in situ* conservation of plant genetic resources, crop-associated biodiversity and wild plants for food product include the following. Farmers get a premium price for traditional varieties, for example rice, taro, yam and maize because of consumer preference and market forces. However, there is no concerted effort to encourage/support *in situ* conservation of plant genetic resources, crop-associated biodiversity and wild plants for food products.

The main limitations to *in situ* conservation of plant genetic resources are that there is no program nor funding provided for *in situ* conservation of PGRFA. Farmers will only grow traditional varieties when economic benefits derived will be comparable to growing HYVs.

The research priorities to support improved plant genetic resources *in situ* management include distribution of diversity, and patterns of diversity to have a rational *in situ* conservation strategy and reintroduction methodologies and management.

Regarding policy development to support improved plant genetic resources *in situ* management, the PGRFA is currently not covered by NIPAS and therefore there is a need to develop policy on the conservation of PGRFA *in situ*.

Other strategic directions relevant to improving the state of *in situ* management of plant genetic resources include the following:

- Enhancement of capacity of stakeholders to manage the sustainable conservation and utilization of the genetic resources
- Establishment and strengthening of linkage among the partners and networking with agencies/ institutions involved in conservation
- Development of public awareness of PGR conservation

In situ management of PGRFA must be made a integral activity of the national PGR program. The participation of the different stakeholders in the *in situ* management must be sought. An *in situ* conservation model must be developed based on best practices. Linkage among the different sectors involved in the *in situ* conservation and management of PGRFA must be established. Public awareness of the importance of *in situ* conservation of PGRFA should be promoted.

The following obstacles to improving methods for *in situ* management of PGR were identified: on-farm management and improvement of PGRFA are not a national priority; the technical and scientific bases of an effective *in situ* management have not been established, e.g. effective population size, population biology, species interaction; inadequate incentives provided to farmers; insufficient seed or planting material; insufficient number of staff; Insufficient skills and staff training; and insufficient financial support.

One of the ways to overcome these obstacles is by making *in situ* management of PGRFA a component activity of the national program, with appropriate government support in terms of funding, training and research. It will also help if PGR in general are made part of the formal seed supply system to insure the availability of planting materials to farmers.

CHAPTER 3

THE STATE OF *EX SITU* MANAGEMENT

3.1 The state of collections

There are 45 government and non-government organizations that hold *ex situ* germplasm collections in the Philippines totaling 173 205 accessions. The collections are maintained either as seeds, living plants and *in vitro*. Germplasm holdings are available only for 40 institutions. given below.

TABLE 2
Agencies holding germplasm collections and number of accessions held

Agency/Institution	Number of Accessions
BPI-BNCRDC	389
BPI-CRD	275
BPI-DNCRDC	624
BPI-LBNCRDC	884
BPI-LGNCRDC	275
BPI-NMRDC	25
BSU	306
CLSU	355
CMU	707
CODA	661
CSU	5
CvSU	14
DA-ILOILO	84
DMMMSU	254
DOA	1 394
ERDB	197
EVIARC	76
IRRI	116 928
ISCAF	24
ISU	29
LAES	78
LSU	31
MMSU	6
NARC	773
NCRC	41
NPGRL	35 492
NPRCRTC	1 122
NTA	414
PAES	219

Agency/Institution	Number of Accessions
PCA	224
PHILRICE	5 861
PhilRootcrops	2 013
PHILSURIN	580
PICRI	176
QSC	94
RMTU	100
SEARICE	769
SRA-LGAREC	1 204
USM	227
WPU	275
NATIONAL TOTAL	**173 205**

The national *ex situ* collection (excluding the IRRI collection) increased by 22.7% from 1996 to 2005, with total of 10 399 accessions added.

To sustain *ex situ* plant genetic resources collections, 115 projects were conducted in the different aspects of germplasm collecting, conservation, characterization and documentation undertaken during the last 10 years. These projects dealt with germplasm collecting, characterization, evaluation, conservation (seed, field,*in vitro* and pollen), center and community-based seed banking, tree planting of indigenous species and germplasm conservation under screenhouse, crop improvement, screening for disease resistance, seed production and distribution, and dispersal/distribution of good seeds.

3.2 Collecting

Germplasm acquisitions of major crops were assembled through collecting from the existing local diversity, plant introductions, and products of research and crop improvement programs. From 1997 to 2005, major collecting expeditions were conducted for rice, maize, indigenous vegetables, tropical fruits, root crops and orchids.

3.3 Types of collections (major and minor crops)

The NPGRL was designated as the base collection for seed crops and those held in other institutions serve as the active collection. The base collection for coconut is maintained by the Philippine Coconut Authority (PCA), rice by Philippine Rice Research Institute (PhilRice), banana by Bureau of Plant Industry-Davao National Crop Research and Development Center (BPI-DNCRDC) sweetpotato by Philippine Root Crop Research and Training Center (PHILROOTCROPS) and Manila hemp by National Abaca Research Center (NARC).

3.4 Storage facilities

Only 4 of the institutions that conserve by seeds have cold storage rooms, namely BPI-Baguio National Crop Research and Development Center (BPI-BNCRDC), Central Luzon State University (CLSU), PhilRice and NPGRL.

In the absence of cold storage rooms, several institutions maintain their seeds in air-conditioned rooms, chest freezers and under ordinary room condition.

Of the 48 different institutions, 17 have tissue culture laboratories conducting normal growth conservation and micropropagation. Of the 17, only 5 are employing slow growth conservation (BPI-DNCRDC for banana, NARC for abaca, Northern Philippine Root Crop Training and Research Center (NPRCRTC) and PHILROOTCROPS for root crops and PCA for coconut).

Only one institution (PCA) conserve germplasm by pollen, and this is used primarily for its breeding program.

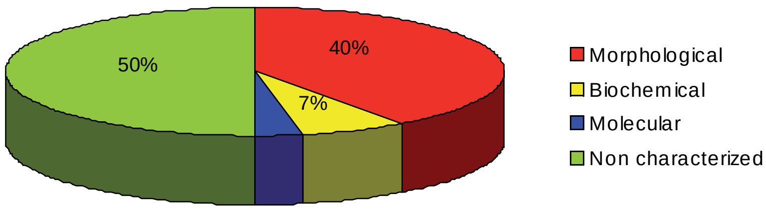
3.5 Security of stored material

For security of stored material is based on duplications in other genebanks. Examples of collections that are duplicated in other genebanks are rice, banana, mango, sweetpotato, Manila hemp and coconut. Except for rice, seed collections are poorly duplicated. Insufficient safety duplication is also the case in medicinal plants, some tropical fruits and nuts, and industrial crops. It is therefore necessary for the national programme to make safety duplication of the national germplasm collection a priority.

3.6 Characterization

A great majority of the 48 institutions are conducting characterization activities for their germplasm collections. A total of 40% of the total collection has been characterized morphologically. Some collections were characterized based on their biochemical (7% of the collection) and molecular properties (3% of the collection). Some institutions have germplasm collections but characterization of these collections is not being implemented as they focus on production. Thus, 50% of the total collection are still not characterized. The characterization in other institutions is hampered by the unavailability of certain equipment like as the refractometer, color charts and descriptor lists. Further, equipment and training of staff required for molecular and biochemical characterization of germplasm are not available in many institutions.

FIGURE 1
Germplasm characterized among the different institutions

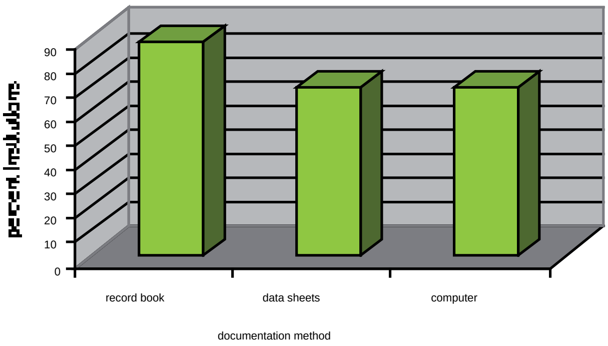


A total of 60% of the total crop collection in the institutions had been evaluated for insect pest and pathogen reaction, physiological and abiotic stress reaction and product quality). In many cases, the germplasm collections were evaluated through the crop protection researches of the institutions.

3.7 Documentation

The most common media used for documentation are record books, data sheets and computers in that order. Eighty–eight percent (88%) of the institutions use record books and 69% have computers that can be used for documentation, although not all of these computers are specifically for the institutions' PGR unit.

FIGURE 2
Documentation systems used in the institutions surveyed



In the institutions with computers, only 22 (54% of total) have their data encoded, and 19 (46%) have not yet encoded in the computer their germplasm data. This maybe due to the lack of computers to be used specifically for PGR purposes. The percent data encoded in each institution was not estimated.

Only 4 out of 44 institutions have their own database management systems, namely BPI-DNCRDC, PCA, PhilRice and PHILSURIN. The BPI-DNCRDC uses the Musa Germplasm Information System (MGIS) specifically for banana germplasm as it holds the Southeast Asian regional banana germplasm collection. PCA has CGRD/CDM specifically for coconut germplasm. PhilRice has an in-house devised database management system called GEMS and PHILSURIN uses Fox Pro to keep track of the parents and their crosses of sugarcane variety. The other institutions have their data recorded manually. Some do not have written data, with the information about their collections kept mentally by the researchers.

It is also observed in some institutions that information about the collections is lacking, specifically passport data such as the place of collection, acquisition date, local name and pedigree. Retrieval of information about their collection may be tedious and some information is lost.

3.8 Germplasm movement

Within the country, movement of germplasm of some crops is regulated to prevent spread of diseases. Examples are papaya, citrus, mango and coconut. Movement of germplasm out of the country follows a standard international quarantine rules.

3.9 Roles of botanical gardens

There is only one operational botanical garden in the country. It serves as awareness and appreciation of biodiversity. Except for some fruit species, the botanical garden does not focus on agricultural species.

3.10 Major *ex situ* needs

The constraints indicated by institutions maintaining *ex situ* collections include the following:

- Lack of funding
- Insufficient staff
- Lack of training
- Insufficient equipment
- Lack of facilities or irregular electrical supply
- Disaster prone environment
- Lack of focused approach
- Occurrence of pest and disease

The following needs for the different aspects of PGR conservation and management were identified:

Human resources development

There is a need for trained staff at the post graduate and technical levels in the different aspects of PGR conservation and management to take care of the many *ex situ* collections in the different genebanks.

Conservation

There is a need to develop viable and practical seed conservation strategy to insure the continued maintenance of seed germplasm, in terms of equipment, facilities and technical support. The strategy could include sharing of resources, designation of seed conservation sites, and use of low-cost but effective storage facilities.

There is a need to assess the extent and proportion of genetic diversity existing in the collections among the institutions. This should be initiated in the crop species with appreciable number of accessions and with enough information (i.e. morphological characterization to begin with) for valid diversity assessment. The results of the assessment could be used to determine gaps, possible duplicates, and collecting needs.

There is a need to determine obvious duplications (on the basis of variety name, pedigree and other similar passport information) to insure efficient use of resources for conservation and management of the germplasm collections.

The priorities for sustaining and expanding *ex situ* plant genetic resources collections should include continuing the national support for *ex situ* conservation. The activities for the conservation and management of germplasm collections should not be project-based. There is also a need to enhance capacity of staff in institutions maintaining *ex situ* collections.

Some germplasm collections like rice, sweetpotato, Manila hemp and banana are duplicated in at least two institutions in the Philippines for safety reasons. There is no mechanism for safety duplication in other crops. For seed crops, there are only four genebanks with seed cold storage rooms, and these are sometimes devoted to specific crops only. For vegetatively propagated species, problems of maintenance, funds, and staff prevent the adoption of duplication for safety of collections.

The priorities for research include the development of alternative conservation strategies that are cost effective, establishment of core collections in selected crops, seed storage behavior of under utilized crops and the development of protocols for cryopreservation of tropical fruit species.

Regeneration

To prevent genetic erosion in the collection during regeneration the management practices employed include conduct of periodic viability tests, making sure that representative samples of accessions are regenerated and prevention of pest damage to stored germplasm materials.

In the country, the top priority action to prevent genetic erosion is viability testing of stored germplasm materials and regeneration to improve seed quality and increase seed quantity of the materials. The continuing operation of the cold storage rooms is also a high priority to ensure the prolonged seed storage life.

The regeneration of threatened *ex situ* collections is identified as one of the top priorities of the Southeast Asian region, based on the agreements reached during the regional consultations held prior to the 1996 Leipzig meeting.

Characterization

There exists a genuine interest to determine the characteristics of the collection, as shown by the relatively high proportion of the collection that has been characterized and evaluated. Primary interest appears to be focused on pest and pathogen reaction, physiological and abiotic stress reaction, and product quality. There would most likely be interest and benefit to be derived from describing the rest of the collections not yet characterized and evaluated.

The need for developing capability in biochemical and molecular characterization and evaluation among the different institutions should be assessed. Such an assessment should take into account the best number and location (within geographic groupings) of institutions that will be tasked with this activity.

Documentation

In genebanks in the country, the most common media used for documentation are record books, data sheets and computers in that order. Eighty – eight percent (88%) of the institutions use record books and 69% have computers that can be used for documentation.

There is a need to institutionalize the adoption of electronic documentation systems. This will require designation of documentation units, investment on/designation of basic equipment specifically personal computers for use in PGR documentation, and specialized training of staff in documentation systems for PGR information.

There is a need to assess the desirability and cost of connectivity of documentation systems among institutions, perhaps through the Internet, for sharing and exchange of PGR information.

CHAPTER 4

THE STATE OF USE

4.1 Importance of utilization

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.

Utilization of the conserved plant genetic resources and major constraints to their use

Plant breeders from the crop research institutes and the IPB have benefited a lot from the use of PGR for their crop improvement programs. The approval of different varieties of rice, corn, root crops, vegetables and other major fruits by the National Seed Industry Council (NSIC) (formerly the Philippine Seed Board, PSB) has contributed to increased productivity and development of varieties with resistances to various pests and diseases and wide adaptability to adverse conditions.

Utilization activities and deployment of genetic diversity

The germplasm accessions acquired by plant breeders from the various genebanks 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 are the criteria in selection. On the other hand, other researchers and students utilize the germplasm to conduct characterization and evaluation to determine the extent of diversity in the collection or they are directly utilized for crop diversification studies.

Assessment of needs to improve utilization

There are various efforts among government and non government institutions to conduct researches on various aspects of PGR conservation and use. There is a need to consolidate and document the information on the characterization and evaluation of plant genetic resources from these institutions to determine their potentials. There is also a need to make them accessible and available to all users.

Distribution of plant genetic resources

The distribution of all conserved germplam is recorded manually or in electronic form. The intended use of the germplasm is indicated in the request form. The breeders have to keep tract of the source of parental materials used in hybridization as it has to be indicated together with the pedigree when a promising breeding line/selection is entered in the national varietal tests. In rice, an upland recommended variety, PSBRc 3 is a selection from a traditional variety 'Ginilingan Puti', NSIC 106 is a saline-prone irrigated lowland variety developed by IRRI is from a cross between an elite line and traditional variety, 'Wagwag'.

In cacao, 4 recommended varieties developed by the University of Southern Mindanao were from gemplasm obtained from UPLB. The NSIC Bs 05, a bush sitao variety developed by IPB was from a cross between recommended varieties from BPI and IPB. In corn, NSIC Cn 67 developed by BPI-La Granja National Crop Research and Development Center (BPI-LGNCRDC) is from an introduced line from IPB. All these information are documented by the NSIC.

Utilization and enhancing the use of plant genetic resources

There are recommended varieties (selected from the crosses made between traditional/local selections and elite/ introductions or from selections from traditional varieties and populations) that have improved crop production in recent years. Examples are in rice (PSB Rc 82), which is widely grown throughout the country; maize (IES-1, IES-2, IES-3, IES-4 and Makapuno) grown in maize growing areas all over the country; eggplant (Mestizo); coconut (highly inbred mutant endosperm variety); Manila hemp; rambutan, durian, pummelo and mango.

The constraints indicated by the research institutions in terms of improved use of plant genetic resources are the following:

- Lack of characterization and evaluation, especially for traits of agronomic or horticultural importance such as quality and reactions to environmental stresses
- Lack of core collections or access to samples from them
- Lack of documentation – useful information on the conserved germplasm
- Insufficient capacity for plant breeding
- The long-term nature of pre-breeding activities required to broaden the base of breeding materials
- Lack of capacity – qualified personnel, funds, training, facilities
- Weak policy development
- Lack of integration between conservation and utilization programmes
- Lack of coordination among researchers, breeders, genebank managers and farmers
- Policy or legal obstacles

The following activities have been undertaken by the Philippines to enhance the use of plant genetic resources:

- Strengthened capacities and improved training in plant breeding
  In general, there is an increasing capability and strengthened capacities in plant breeding among institutions involved in varietal development in the country. This is especially true for rice, maize, vegetables, legumes, root crops, coconut and sugarcane.
- Increased collaboration among researchers, breeders, genebank managers and farmers to better integrate conservation and use of plant genetic resources.
  Some of the breeding programs including that of non-governmental organizations involved all stakeholders from the setting of the breeding objectives to the selection of parental lines from local, national or international genebanks and in selection of segregating generations through the participatory approaches. Most crop breeding programs however only involved farmers in setting breeding priorities and selecting from fixed lines or finished varieties or in participatory varietal selection.
  There are several instances of close collaboration between breeders and genebank managers for a better integration of conservation and use of plant genetic resources in crop improvement. Examples are in coconut at PCA; Manila hemp at NARC; and sweetpotato, yam and taro at the PHILROOTCROPS and NPRCRTC.

There is a need for increased collaboration among researchers, breeders, genebank managers and farmers to better integrate conservation and use of plant genetic resources. Also this could facilitate release and adoption of improved and adapted varieties in various ecosystems.

There is also a need to enhance and link novel technologies to increase utilization.

Germplasm characterization and evaluation

In institutions holding germplasm collections, 40% of the total collection has been characterized morphologically. Some collections were characterized based on their biochemical (7% of the collection) and molecular properties (3% of the collection). Some institutions have germplasm collections but characterization of these collections is not being implemented as they focus on production.

Thus, 50% of the total collection is still not characterized. Sixty percent of the total crop collection in the institutions had been evaluated for insect pest and pathogen reaction, physiological and abiotic stress reaction and product quality. In many cases, the germplasm collections were evaluated through the crop protection researches of the institutions.

The characterization and evaluation in many institutions are hampered by lack of funding, unavailability of certain equipment and lack of trained staff required for characterization and evaluation especially using molecular and biochemical methods. There is therefore a need to prioritize characterization and evaluation of current holdings by institutions in the country. Training on characterization and evaluation is also a priority to increase utilization of plant genetic resources.

Core collections

The country has not established core collections. The obstacles in establishing core collections are the lack or incomplete passport and characterization and evaluation data and lack of systematic documentation system.

Capacity in plant breeding

There is adequate to strong capacity in plant breeding in the public and private sectors in the Philippines in terms of programmes and staff. Public sector breeding is concentrated in state universities and colleges, and crop-based research institutions attached to the Department of Agriculture. Private sector breeding is focused on the following crops: maize, vegetables and rice. A list of public and private sector organizations active in plant breeding in the Philippines is given below.

TABLE 3
Institutions in the Philippines engaged in plant breeding and their crops of interest

Institution	Crop
I. Public Sector	
A. State Universities and Colleges	
Benguet State University	Vegetables, root crops, fruits
Central Mindanao University	Maize
Leyte State University	Root crops, coconut, abaca
University of Southern Mindanao	Maize, fruits
University of the Philippines Los Baños	Cereals (rice, maize, sorghum), food legumes, vegetables, root crops, fiber crops, fruits, ornamentals
B. Agencies attached to the Department of Agriculture	
Bureau of Plant Industry-Baguio National Crop Research and Development Center	Vegetables, fruits
Bureau of Plant Industry-Davao National Crop Research and Development Center	Fruits
Bureau of Plant Industry-La Granja National Crop Research and Development Center	Food legumes
Bureau of Plant Industry-Los Baños National Crop Research and Development Center	Vegetables
Cotton Development Administration	Cotton
Fiber Industry Development Authority	Fiber crops (abaca, cotton, ramie etc.)
National Tobacco Authority	Tobacco
Philippine Coconut Authority	Coconut
Philippine Rice Research Institute	Rice
Sugar Regulatory Authority	Sugarcane
II. Private Sector	
Bayer Crop Science	Rice
BioSeed	Rice, maize, vegetables
CornWorld	Maize, rice, vegetables
East West	Vegetables
Monsanto	Rice, maize
Philippine Sugar Research Institute	Sugarcane
Pioneer	Maize
SL Agritech	Rice, maize
Syngenta	Rice, maize

The human resource capability for plant breeding varies according to crops of interest. It is strong in rice, maize, vegetables and root crops; adequate in food legumes, coconut, fruits, sugarcane and ornamentals; and inadequate in fiber crops and tobacco. The number and educational attainment of staff involved in plant breeding in both the public and private sectors in eight institutions that responded to the FAO's Assessment of National Plant Breeding and Biotechnology Capacity is given below.

TABLE 4
Number and educational attainment of staff in plant breeding

Educational Attainment	Number		
	1990	1995	2001
I. Public Sector			
A. State Universities and Colleges			
B.Sc.	4	5	2
M.Sc.	9	15	16
Ph.D.	1	9	16
B. Agencies attached to the Department of Agriculture			
B.Sc.	75	57	45
M.Sc.	43	58	54
Ph.D.	23	33	32
II. Private Sector			
B.Sc.	4	7	8
M.Sc.	2	3	3
Ph.D.	0	0	0

The goals of crop improvement in the country have remained the same for the major crops like rice, maize, food legumes, root crops, sugarcane, coconut and fiber crops. These goals according to importance are: yield, resistance to major pests and diseases, tolerance to adverse environments, and quality. The state of plant breeding programmes in these crops have progressed to the extent that the goals of yield increase and resistance to major pests and diseases have been addressed; in these cases, focus has widened to include tolerance to adverse conditions, and quality. In other crops, e.g. vegetables, fruits and ornamentals, the primary goals of crop improvement are quality, resistance to major pests and diseases, and yield.

Future research priorities to enhance use of PGRFA

There is a need to complete the characterization and evaluation of accessions conserved in genebanks to enhance utilization of plant genetic resources. The information on the characterization and evaluation of stored germplasm should be made accessible and available to users (farmers, 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. It is therefore necessary that the system of information exchange be upgraded by improving the network information system in the country.

Constraints to achieving diversification of crop production and broadening diversity in crops

Policy obstacles

The government provides incentives/ subsidies to farmers who use the modern high-yielding varieties. In rice, the government provides subsidies on seeds and agricultural inputs to farmers who use hybrid rice varieties. The government's agricultural programs are "coupled" with the promotion of the use of modern varieties and chemical inputs. The RA 7900 (High Value Crops Development Act) is a disincentive to farmers who use indigenous and local varieties of crops.

Marketing/commercial obstacles

There is no government support in the marketing of locally-produced crops.

Land tenure

Land tenure was identified by Southeast Asian Regional Institute for Community Empowerment (SEARICE) as the main constraint in crop diversification since the landlords dictate the kind of crops to be planted in his agricultural land.

Promotion and awareness on the utilization of lesser known PGRFA
There is a need to promote the local and indigenous crop species for food and agriculture especially to the younger generations of Filipinos to increase their use.

Release of heterogeneous materials as cultivars
The criteria for the release of crop varieties are distinctness, uniformity, stability and novelty. Heterogeneous materials cannot be released as a cultivar. Heterogeneous cultivar could contribute to diversity in areas where they will be grown.

Strategies to address genetic vulnerability in farming systems
Strategies to address genetic vulnerability in farming systems being employed in the country include crop diversification over time (relay and crop rotation) or space through mixed cropping/ intercropping. There should be a provision for research and development on value addition and diversification from lesser known PGRFA. The lesser known PGRFA are important components of the farming systems which could minimize genetic vulnerability.

4.2 Seed supply systems and the role of markets

Seed production and distribution are functions of both public and private sectors. 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, 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 is 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 National Seed Quality Control Services office (NSQCS).

The enactment of the R.A. 7308 (Seed Development Act) consolidated the policy and structure for variety testing and recommendation, seed quality control and certification, and seed production and distribution in the public sector. As well, R.A. 9168 (Plant Variety Protection Act) provides protection of new varieties thereby promoting the entry, production and marketing of new crop varieties in the market.

Current seed production and distribution are adequate in rice in irrigated lowland conditions. Seed planting material distribution is not as satisfactory in rainfed lowland, upland and fragile environments. In maize and vegetables, both the government and private sectors are involved in seed production and distribution, especially improved varieties including hybrids, and seed planting material availability is not a constraint. In coconut, planting material production and distribution is being looked after by PCA, although distribution in some areas is hampered. In root crops and legumes, seed production and distribution is left mainly to the government sector and often faces shortfall in supply.

There are two seed supply systems operating in the country, namely the formal and informal systems. The formal seed supply system accounts for only about 10 to 15% of the total seed requirement of the country. In general, it provides the requirement for the favorable environments of the crop. The rest of the seed requirement is supplied by the informal seed system. This is practiced for most farmers' varieties especially vegetables.

Over the last 10 years, the quality of seeds supplied by both systems had improved.

The informal seed system provides a mechanism to reproduce the seeds of traditional varieties and under utilized crops. Continued cultivation of local varieties/under-utilized crops is ensured since farmers derive incentives (higher price) for quality seed production of these crops. This ensures their continued use and conservation.

There is therefore a need to integrate the formal seed production system into the informal seed systems and vice versa to enhance seed production and improve the seed distribution system in the country.

Priorities to improve seed production and distribution
There is a need to broaden the concept of seed supply system. Also there is a need to enhance the integration of the formal seed production system into the informal seed systems and vice versa.

The government recognizes the contribution of the local seed supply system, the government therefore should provide support to it like establishing policy and guidelines in the certification of local cultivars. The certification guidelines of the formal and informal seed supply systems should therefore be harmonized.

The major constraints in making seeds of new cultivars available in the market place identified by stakeholders are the following:

- Availability and cost of required production inputs
- Insufficient availability of commercial seeds
- Insufficient availability of registered/certified seeds
- Poor seed storage facilities
- Distance to seed suppliers
- Insufficient availability of disease-free planting materials
- Inadequate seed distribution system
- Inadequate seed production system
- Poor seed germination
- Seed price too high compared to commodity price

4.3 Development of new markets for local varieties and diversity rich products

The local government units sponsor crop diversity fairs. The diversity features the diversity in local crops and processed products in the province. Each province becomes popular for a specific crop or product for example the province of Bohol is known for the local variety of yam, 'Kinampay'. Food fairs and rice festivals highlighting rice delicacies are held during Farmers' Week in Bohol. Central Visayas State State College of Agriculture and Forestry Technology (CVSCAFT) and SEARICE published and distributed cookbook on rice recipes to interested users.

Activities undertaken to support new markets for local varieties include implementation of researches on the improvement and development of new products in Manila hemp in Fiber Industry Development Authority (FIDA) and NARC. Coconut novelty products, coconut sugar, virgin coconut oil, coconut fiber and coir are some value-adding opportunities which are given serious consideration by the PCA and UPLB. Product development and market diversification of sweetpotato and yam are being undertaken by PHILROOTCROPS, Benguet State University (BSU) and concerned government and non-government stakeholders in Bohol. Evaluation trials on processing of different varieties of mango were also undertaken.

Organic farming is being implemented to promote market for local varieties and diversity-rich products. Likewise, strengthening cooperation of producers enhances the markets for local varieties.

The constraints identified to increase markets for local varieties and diversity-rich products are:

- Insufficient planting material
- Development/establishment of markets for local varieties is not a national priority
- Emphasis on modern varieties of staple crops
- Replacement of traditional foods and products
- Lack of financial support
- Lack of consumer demand
- Industrial processing limitations
- Disincentives in the country
- Uniformity standards in the country discourage diversity rich products
- Lack of trained personnel

Needs and priorities

The current focus of the national programs is on the development of improved crop varieties. Their adoption however displaces the local varieties. There is a need to develop new markets and popularize and main-stream the use of diversity-rich products, in both domestic and export markets for value-added products developed from local varieties. The government should also provide marketing support to organically-grown local varieties.

Strategies to better link small-scale producers with markets

Locally, there are initiatives to link small-scale producers with the local markets and in most cases they are linked to cooperatives which market the produce. There are also private-sector-driven initiatives along these lines, for example the operation of 'buying stations' who pool together products from small-scale farmers, to be sold in bulk. This system operates in the case of mango, vegetables and banana.

4.4 Crop improvement programmes and food security

The crop improvement programme in the Philippines is a well established formal-sector programme utilizing advanced methodologies and technologies. The following crops have benefited from improvement programmes:

- Cereals: rice, maize, sorghum
- Food legumes: mungbean, peanut, cowpea, soybean
- Vegetables: tomato, eggplant, pole and bush sitao, lima bean, bottle gourd, sweet pepper, hot pepper
- Root crops: cassava, sweetpotato, taro
- Fiber crops: cotton, Manila hemp
- Tobacco
- Sugarcane
- Plantation crops: coconut, cacao, coffee
- Fruit trees
- Ornamentals

Contribution of crop improvement to food security in the philippines

The products of crop improvement programs had boosted agricultural yields especially for the staples. The volume of production in rice and maize are mainly contributed by modern varieties. Modern varieties of staple crops are planted in more than 95% of the total area. Modern cultivars of sweetpotato, cassava, coconut, mungbean, peanut, eggplant, tomato, sweet pepper and sugarcane account for a significant proportion of varieties grown for food.

Breeding programmes to increase crop resistance to pests and diseases

The breeding programs have developed elite lines and varieties with increased resistance to pests and diseases. In rice, improved breeding lines named the Matatag series are widely grown in areas where the rice tungro virus is prevalent. Angelica is also an improved rice line with resistance to bacterial blight. Sweetpotato varieties, NSIC Sp 21 and NSIC Sp 23 are resistant to scab and weevil. Taro variety, NSIC Gb 08 is resistant to leaf blight. IPB Var 1, 2, 3 and 4, and Improved Tiniguib are resistant to downy mildew. Tomato varieties Marikit, Marilag, Rica, Rossana, Ara and Allesandra are resistant to bacterial wilt.

Participatory crop improvement programmes

PhilRice has undertaken participatory plant breeding (PPB) in the development of rice varieties adapted to fragile environments, saline, cool-elevated, upland and rainfed ecosystems. In maize, vegetables, legumes and root crops, participatory varietal selection (PVS) is employed with the participation of farmers. Both PPB and PVS are employed in the development of farmers' varieties and selections in rice and corn by farmer partners of SEARICE, and other NGOs.

Changes in the use of plant genetic resources in the philippines

It is expected that there will be changes in the use of plant genetic resources in response to changing needs, or as alternative to conventional sources of products. For example, the country expects to utilize renewable sources of energy through bio-fuels, e.g. sorghum, cassava, sugarcane and physic nut (*Jatropha curcas*); animal feeds, e.g. sweetpotato; medicinal plants.

It is also expected that the production hectarage devoted to specific crops, especially annuals, will vary in response to market demand, especially for international markets, e.g. sugarcane, strawberry and asparagus; and import substitution, e.g. soybean and cotton.

Methods being employed for plant breeding in the philippines

Conventional methods

In some crops, especially those where crop improvement program is fairly recent, selection of outstanding genotypes from existing variability (populations, varieties) is practiced. This is true for fruit and plantation crops, some root crops and indigenous vegetables.

In crops where crop improvement programs are more advanced, variability is generated through hybridization and various methods of handling of segregating generations are employed. In asexually propagated annual crops like sweetpotato, cassava and sugarcane and perennials like coconut, the variety maybe obtained from the propagation of the outstanding F1 lines.

In seed crops, pedigree, mass, bulk, modified bulk, population improvement methods, etc. are employed. Selected lines are entered in a preliminary yield trial. Selected elite lines are then entered in a coordinated advanced yield trials for 2 -3 growing seasons. The performance of each line in the trial is evaluated by the technical working group. Promising lines are recommended for seed increase and approval by the NSIC.

In some crops like rice, corn, papaya and some vegetables, inbred line extraction followed by hybridization are practiced to produce commercial F1 hybrid varieties.

Non conventional methods

This involve generating variation beyond the primary genepool using novel methods of manipulating variation like somaclonal variation, mutation breeding, transformation, marker-assisted breeding and others. This has been used to a limited extent in some crops like rice, maize, papaya, banana, Manila hemp, sweetpotato, tomato and eggplant.

Participatory plant breeding

Segregating lines starting in the F4 and advanced lines are shuttled to target environment for selection. The farmer-partners of SEARICE however are involved from the selection of the parentals used in the hybridization to the generation of advanced lines. Bulk and modified bulk methods are used.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING NEEDS AND LEGISLATION

5.1 National programme for plant genetic resources

Depending on the task, national PGR efforts and undertakings are coordinated through the Philippine Council for Agriculture Forestry and Natural Resources Research and Development (PCARRD) for the Department of Science and Technology (DOST), the Bureau of Agricultural Research (BAR) for the Department of Agriculture, and the Protected Areas and Wildlife Bureau (PAWB) and the Ecosystems Research and Development Bureau (ERDB) for the DENR.

In 1976, the NPGRL of the IPB was created by Presidential Decree 1046-A as the national repository of plant genetic resources. For national initiatives on PGR related to food and agriculture, the NPGRL is the national center for conservation and utilization of important and potentially useful agricultural crops. It has the mandate to conserve the endemic and introduced PGR, provide plant breeding projects and programs in the national research system with a broad genetic base for crop improvement, and monitor and coordinate national effort in the collection, conservation, utilization and exchange of PGR.

Different institutions in the Philippines that are members of the National Agriculture and Resources Research and Development Network (NARRDN), and some non-government organizations continue to make deliberate efforts to collect and maintain plant germplasm as part of their crop improvement programs. The agencies and their crops of interest are listed below.

TABLE 6
Institutions that hold gemplasm collections and their crops of interest

Institution	Crop
Baguio National Crops Research and Development Center, Bureau of Plant Industry	Root crops, fruits
Benguet State University	Fruits
Bureau of Plant Industry Central Office	Medicinal plants, ornamentals
Cavite State University	Coffee
Central Luzon State University	Tomato, sunflower
Central Mindanao University	Coffee, rubber
Cotton Development Administration	Cotton
Davao National Crops Research and Development Center, Bureau of Plant Industry	Fruits, ornamentals
Department of Agronomy, College of Agriculture, University of the Philippines Los Baños	Rice
Department of Horticulture, College of Agriculture, University of the Philippines Los Baños	Fruits, plantation crops, spices, medicinal plants, ornamentals
Don Mariano Marcos Memorial State University	Mulberry
Eastern Visayas Integrated Agricultural Research Center	Fruits
Ecosystems Research and Development Bureau	Bamboo, rattan, medicinal plants
Fiber Industry Development Administration	Fiber crops
La Granja National Crops Research and Development Center, Bureau of Plant Industry	Vegetables, field legumes
Los Baños National Crops Research and Development Center, Bureau of Plant Industry	Food legumes, fruits, vegetables, ornamentals

Institution	Crop
MASIPAG	Rice
National Abaca Research Center, Leyte State University	Abaca
National Coconut Research Center, Leyte State University	Coconut
National Mango Research and Development Center, Bureau of Plant Industry	Mango
National Plant Genetic Resources Laboratory, Institute of Plant Breeding, College of Agriculture, University of the Philippines Los Baños	Base collection of all crops
National Tobacco Administration	Tobacco
Northern Philippines Root Crops Research and Training Center, Benguet State University	Root crops
Palawan Agricultural Experiment Station	Fruits
Philippine Coconut Authority	Coconut
Philippine Industrial Crops Research Institute, University of Southern Mindanao	Industrial crops
Philippine Rice Research Institute	Rice
Philippine Root Crop Research and Training Center, Leyte State University	Root crops
Philippine Sugar Research Institute Foundation, Inc.	Sugracane
Ramon Magsaysay Technological University	Mango, cashew
SEARICE	Rice, root crops
Southern Tagalog Integrated Agricultural Research Center	Citrus
Sugar Regulatory Administration	Sugarcane
Western Philippines University	Mango, cashew

It was realized that to be effective in its plant genetic conservation efforts, the country has to institutionalize and coordinate activities on plant genetic resources conservation and management. In 1985, the NCPGR was created to consolidate the fragmented efforts on PGRFA conservation, management and utilization. The NCPGR was created by the DOST to oversee the National Plant Genetic Resources Program of the Philippines. The NCPGR operated from 1984 to 2000 with PCARRD as Chair, through its commodity R&D teams, and various crop technical committees, with the NPGRL of the IPB as secretariat.

Then the PNNPGRFA was established in 2001 to sustainably manage and safeguard the country's PGR, through the Department of Agriculture and the Bureau of Agricultural Research. The Network aimed to establish operationalize a national system for collecting, conservation, regeneration, multiplication, characterization, evaluation, documentation and utilization of PGR. The Network's role was to review existing programs and policies related to PGR conservation and utilization, develop and package national agenda for PGRFA and identify and substantiate the institutional capability of each member institution.

The BPI under DA is the base of the PGRFA Network. Presently, however, funding constraint has affected the scope, extent and prioritization of PGR activities of the PNNPGRFA.

At the DA, the Office of the Undersecretary for Policy and Planning coordinates activities related to policy. To accomplish the task at hand, this office taps PGR experts from various institutions on an on-call basis.

However, there is still a felt need for a coordinative body that could unify all institutional efforts and direct the focus of PGR conservation and utilization. Ideally, there should be an inter-departmental committee that coordinates all PGR policies, activities and programs of the three main government departments, i.e. DA, DOST and DENR. The prevailing concept is that this committee will set directions and formulate policies on PGR activities for priority agricultural crops in the Philippines. Structurally, the Committee will operate at three levels: (1) Advisory Committee (AC), (2) Steering Committee (NSC), (3) Implementing Agencies Committee (IAC).

The Advisory Committee should be sub-ministerial (undersecretary) level from DA, DOST and DENR The AC shall be composed of men/women with excellent reputation and known for their concern for PGR conservation and management, and *ex officio* are knowledgeable and actively involved in decision-making and/or other activities pertaining to PGR. It should establish directions for all PGR activities in the country, and formulate and harmonize national policies for PGR conservation and management.

The Steering Committee should be composed of Directors of the three monitoring and coordinating agencies of the three departments, i.e. PCARRD, DA-BAR and ERDB, the Chancellor of the University of the Philippines Los Banos, the Director of the Bureau of Plant Industry and a representative from the private sector. It should determine priority crop germplasm activities, depending on importance of crop and collections and urgency of the activity, undertake fund generation strategies to support PGR conservation initiatives, participate in national, regional and international deliberations on PGR issues, recommend policies for PGR conservation and management, prepare the country's position vis-à-vis compliance to national and international laws/treaties, promote the development of a national PGR information system, and promote measures to enhance public awareness of the importance of biodiversity and PGR conservation and sustainable use.

The Implementing Agencies Committee shall consist of the heads of key genebanks of research institutions. It should lead in development, packaging and implementation of collaborative programs/ projects for foreign assistance, participate in national, regional and international deliberations on PGR issues, and conduct studies in national, regional and international deliberations on PGR issues.

5.2 Education and training

An educational institution in the Philippines, UPLB, was identified as one of the centers for higher education on plant genetic resources conservation in the Asian region. UPLB has instituted a master of science program on plant genetic resources conservation and management, and is therefore in the position to provide post-graduate training to genebank staff in the country and in the region. In addition, the NPGRL has the necessary expertise, experienced staff and facilities to provide specialist training on different aspects of PGR conservation, including germplasm collecting, seed conservation, field genebanking, *in vitro* conservation, morphological and molecular characterization, and documentation.

In the Philippines, there exists in institutions conserving PGRFA a core of staff with scientific training in the agricultural/ biological sciences who can take the leadership of PGR programs of the institutions maintaining PGRFA. However, their fields of specialization are not on PGR conservation and use. As a stop-gap measure, specialist training needs to be provided in the different aspects of PGR conservation and management, to re-tool the staff to the special needs of the activity.

For the long term, postgraduate degree training in PGR conservation and management for at least one staff of each PGR unit is needed to provide leadership to institutional PGR programs.

Specialized short-term training needs to be provided to staff of the institutions handling specific aspects of PGR conservation and management. In the case of staff with no training in PGR whatsoever, basic short-term training is indicated to fast-track the acquisition of basic knowledge in handling and conservation of PGR. On-the-job training in institutions with well-developed PGR programs is a viable option in both cases.

5.3 National legislation

There are several legislation and policy statements that were promulgated in response to national priorities and international commitments on the conservation and use of PGRFA.

The integration of sustainable development objectives as set forth in the Philippine Strategy for Sustainable Development (otherwise known as the Philippine Agenda 21) promulgated in 1992 consolidated the legal and institutional foundation for a concrete plan of action to conserve and develop biodiversity, as set forth in the 1992 Earth Summit. In 1997 an assessment of Philippine biodiversity was conducted and the NBSAP came about which provided strategies and action plans for the Philippine for the conservation of biodiversity in the country. The NBSAP focuses on the conservation of biodiversity through improved knowledge and management systems, research and development; better information availability and institutional support mechanisms; the sustainable use of biodiversity; and the equitable sharing of the benefits of biodiversity.

Republic Act 8435

In R.A. 8435 (Agriculture and Fisheries Modernization Act), the measures for the modernization of agriculture and fisheries provided in the law similarly promote the sustainable conservation and utilization of agricultural crops. Such balance favors the conservation of diverse agricultural crops to alleviate poverty and improve nutrition as well. AFMA is the most comprehensive legislation affecting all elements of agrobiodiversity. It promotes crop diversification to ensure food security and nutrition of the Filipino people. This favorably enhances the conservation and sustainable use of agrobiodiversity.

R.A. 8435 designates the DA as the focal agency for the implementation of the Act, with support from state universities and colleges of agriculture. In turn, the DA designated the BPI as its focal institution for PGRFA conservation. The support of the DA to the project through the BAR and Regional Integrated Agricultural Research Centers (RIARCs) includes project counterpart funds and assurance of sustainability of the activities at the end of the project. In addition, the RIARCs and their provincial Research Outreach Stations (ROS) will assist in the project implementation at the regional and provincial levels. The PNNPGRFA of the DA-BAR has 29 member research institutions all over the country. Each institution has identified its priority banner crops for germplasm conservation. The UPLB, particularly the NPGRL, IPB is the leader in the implementation of the network goals and objectives.

Republic Act 7586

R.A. 7586 (National Integrated Protected Areas System Act) impacts on agrobiodiversity conservation and use, specifically in the buffer zones which are immediately adjacent to designated protected areas where management is required for multiple use and protection, habitat conservation and rehabilitation, diversity management, community organizing, socioeconomic and scientific researches, and site-specific policy development.

Republic Act 9147

The impact of R.A. 9147 (Wildlife Protection Act) on agrobiodiversity is mainly on wild plants that are used for food and agriculture. Specifically, the law designates critical habitats outside protected areas, where threatened species are found, on the basis of the best scientific data taking into consideration species endemicity and/or richness, presence of man-made pressures/threats to the survival of wildlife living in the area, among others. All designated, critical habitats shall be protected, in coordination with the local government units and other concerned groups.

Republic Act 8371

R.A. 8371 (Indigenous People's Rights Act) encourages the cultivation, conservation and utilization of indigenous species and medicinal plants in home gardens, health centers and school grounds as well. Indigenous knowledge systems are also conserved. Modalities of access and sharing of benefits derived from the use of PGRFA accessed from ancestral domains are specified in the legislation.

Joint DENR-DA-PCSD-NCIP AO1

(Guidelines for Bioprospecting Activities in the Philippines). The bioprospecting guidelines aim to streamline the procedure for access to biological resources and to facilitate compliance thereto by legitimate resource users; provide guidelines for obtaining the prior informed consent of resource providers, and in negotiations with these resource providers for fair and equitable sharing of benefits arising from bioprospecting; and establish a cost-effective, efficient, transparent and standardized system for monitoring compliance with the provisions on prior informed consent; collection quota; fair and equitable benefit-sharing; and transfer of materials to third party recipients.

Republic Act 7308

R.A. 7308 (Promotion and Development of the Seed Industry and the Creation of the National Seed Industry Council) provides for the development, conservation and utilization of improved varieties and the mechanism for the formal seed supply system. The set-up for varietal recommendation under this law is an improvement over that of the old Philippine Seedboard in that the technical working group for each commodity is composed of representatives from government research institutions, the private sector and the farmers ensuring participation of various stakeholders in varietal recommendation. The use of NSIC-released varieties qualifies growers to avail themselves of crop insurance. This however discourages the planting of traditional varieties of crops, thereby limiting the choice of farmers.

Republic Act 9168

In R.A. 9168 (Plant Variety Protection Act), the identification of depository genebanks and the allotment of 20% of the application fees in a gene trust fund to support accredited genebanks may help the conservation of plant genetic resources. It also provides protection of new varieties thereby promoting the entry, production and marketing of new crop varieties in the market.

Republic Act 7900

R.A. 7900 (High-Value Crops Development Act) provides for the development of high value and export crops. This could limit the number of crops in the food basket. Also, the traditional food sources which maybe used to promote the maintenance and utilization of agro-biodiversity maybe compromised.

Finally, the Government of the Philippines has identified the use of agricultural biodiversity as one of the important means for poverty alleviation as reflected in the Medium-Term Philippine Development Plan (2004-2010).

Presidential Decree No 1046-A of November 12, 1976 created and mandated NPGRL, IPB as the national center for the collection and conservation of seedstocks and fruit and tree crops. As well, R.A. 7308 and R.A. 9168 identified NPGRL, IPB as the national repository for plant genetic resources for food and agriculture.

The PNNPGRFA was then established under the DA-BAR, which provides continuing support to said network. The network is mandated to establish a national system for collecting, regeneration and utilization of PGR of importance to the economy of the Philippines and to support the country's efforts to sustainably conserve its biodiversity.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 Regional and sub-regional networks, international crop-specific networks and sub-regional collaboration for maintaining *ex situ* collections

The ASEAN has initiatives on plant genetic resources among its member countries. This avenue is largely untapped by the Philippines for the conservation and use of its agro-biodiversity.

The Philippines is an active member of the Regional Cooperation in Southeast Asia on Plant Genetic Resources (RECSEA-PGR). It has participated in the crafting of proposals for the conservation and use of PGRFA in the region.

The Southeast Asia Banana Germplasm Resources Center (SABGRC) based in the BPI-DNCRDC and national germplasm centers maintaining banana germplasm in the region retrieves and collects all banana cultivars within the Southeast Asian region.

The Banana Asia Pacific Network (BAPNET), of which the Philippines is a member, enhances Regional collaboration activities in the following areas: germplasm management, information development and exchange, banana resource development, and strategic planning.

The Asian Network for Sweetpotato Genetic Resources (ANSWER) employs various strategies (e.g. *ex situ*, *in vitro*, cryopreservation, and others) for the conservation of sweetpotato genetic resources. ANSWER has also initiated capacity building among member-countries with regard to maintenance, characterization, evaluation and documentation of their respective sweetpotato genetic resources.

UPWARD of the International Potato Center (CIP) collaborates with the national program to conduct field research projects, co-organize trainings and workshops, and support publishing and information sharing activities.

6.2 International programmes

Asia-Pacific Economic Cooperation (APEC): the Agricultural Technical Cooperation Working Group of APEC, of which the Philippines is a member, plans and implements information and knowledge exchange, workshops, training, safe exchange of genetic resources, and harmonization of policies on PGR and intellectual property rights (IPR) among member economies.

For organized dissemination of improved rice germplasm and information, the International Network for Genetic Evaluation of Rice (INGER) facilitates the unrestricted, free and safe exchange of rice germplasm and the free sharing of information not only among National Agricultural Research and Extension Systems (NARES) and International Agricultural Research Center (IARC) partners, but also with the private sector in the Philippines.

For banana, there is a collaborative arrangements with the International Network for the Improvement of Banana and Plantain (INIBAP). INIBAP coordinates a global research effort on Musa to promote and strengthen research collaboration in national and global levels.

For sweetpotato, the country has collaborative arrangements with the CIP. CIP supports germplasm conservation at national and global levels by monitoring duplicate collections, supplying clones as potential parent material for national breeding, providing training and expertise support in germplasm characterization. Sweetpotato is one of CIP's mandate crops through which it seeks to achieve food security and reduce poverty through scientific research and related activities.

For cassava, linkage with International Center for Tropical Agriculture (CIAT) is through introduction and testing of and elite clones from the advance selection materials.

For coconut, the International Coconut Genetic Resources Network (COGENT) has a regional network in Southeast Asia including the Philippines. The coconut accessions of Southeast Asia are listed in the Coconut Genetic Resources Database (CGRD) established by International Plant Genetic Resources Institute (IPGRI)-COGENT.

6.3 International agreements

During the last 10 years, the Philippines has subscribed to the following international agreements, treaties, conventions, and trade agreements:

Convention on Biological Diversity (CBD)

The Convention aims for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. It provides rules for access and benefit sharing for materials accessed after the coming into force of CBD. It is legally binding and requires ratifying countries to adopt appropriate legislation to be in harmony to the convention. The States are required to implement measure to ensure the *in situ* conservation of genetic resources, the NIPAS Act allows for the conservation of all levels of biodiversity *in situ*.

Since the CBD entered into force in 1993, its implementation has proceeded slowly. It seems so difficult to bring together the many disciplines and policy measures to achieve its objectives. The Philippines has so far enacted EO 247and RA 9147 to implement the provision of CBD on conditions on access of biological and genetic resources.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Trade in all species threatened to extinction is subject to strict regulation in order not to endanger further their survival and must be only be authorized in exceptional cases.

The following are the enabling laws for CITES

- DENR AO 45 - rules and regulations on the sale and farming of saltwater crocodile
- DENR AO 90 - Allowable Quota for certain wildlife species that may be collected from the wild under a wildlife permit for commercial purposes
- DENR AO 33 - guidelines on the issuance of permit for the collection and transport of biological specimens from protected areas for use by DENR biodiversity conservation programs
- DENR AO 17 - establishing the disposition program for the confiscated and donated wildlife rescue centers
- DENR AO 65 - guidelines on the sale of exotic animals from Calauit game refuge and bird sanctuary
- RA 9147 provides for the conservation and protection of wildlife of flora and fauna.

Global Plan of Action (GPA)

This non-legally binding convention was formally adopted by representatives of 150 countries including the Philippines during the Fourth International Technical Conference on Plant Genetic Resources in 1996. The Conference also adopted the Leipzig Declaration, which focuses attention on the importance of plant genetic resources for world food security, and commits countries to implementing the Plan. The main aims of the GPA are: a) to ensure the conservation of PGRFA; b) to promote sustainable utilization of PGRFA, c) to promote a fair and equitable sharing of the benefits arising from the use of PGRFA, d) to assist countries and institutions responsible for conserving and using PGRFA to identify priorities for action; and e) to strengthen national, regional and international programmes.

International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR)

This Treaty is in harmony with CBD. ITPGR considers the particular needs of farmers and plant breeders and aims to guarantee future availability of the diversity of PGRFA. The treaty will facilitate access to PGR and sharing of benefits to be derived from their utilization. It covers all PGRFA and addresses diverse topics including conservation, use, international cooperation, technical assistance and farmers' rights. It also establishes multilateral system for 35 crops and forages, sets rules for access for these materials both *ex situ* and *in situ*. However, the Philippines is not yet a signatory of the Treaty.

International Plant Protection Convention (IPPC)

This Convention is legally binding and addresses phytosanitary issues with the transfer of plants and animals. Signatories agree to establish national plant protection organizations that shall regulate the movement of plants and plant products to prevent the spread and introduction of pests of plants and plant products, and to cooperate with one another to achieve the aims of the Convention.

World Trade Organization-Trade Related Intellectual Property (WTO-TRIPS) Agreement

The Philippines as a member must comply with minimum standards of protection of intellectual property. This should ensure the protection of microorganisms, non-biological and microbiological processes, plant varieties that meet protection criteria. In compliance to this agreement, the Philippines enacted RA 9168, the Plant Variety Protection Act.

CHAPTER 7

ACCESS TO PLANT GENETIC RESOURCES

7.1 Policies on germplasm access in the Philippines

Prior to 1987, the National Museum of the Philippines was the primary government agency regulating collection of biological samples. In 1990, a memorandum of agreement on the Guidelines for the Collection of Biological Specimens in the Philippines for both local and foreign collectors of biological specimens including bioprospecting was executed. It aimed to provide restriction and control mechanisms for the entry and exit of biological specimens. The agreement proved to be inadequate because it was primarily an administrative coordination and permit system and not regulatory framework for access.

The Philippines adheres to the provisions of the CITES regulating international trade on the basis of permits and certificates.

The Philippines ratified the Convention of Biological diversity in 1993, which provides an international regime to facilitate access and ensure equitable sharing of benefits. The principles of the framework for access to genetic resources and sharing of benefits are set out in Art 15 of the CBD Access may only be granted on the following conditions:

- Prior informed consent
- Mutually agreed terms
- Adherence to sustainable uses
- Fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources

In 1995, Executive Order (EO) 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 other Purposes) was enacted as the Philippine response to the call of the CBD for signatories to take appropriate measures to ensure that countries providing genetic resources are given access to and transfer of technology that uses those resources on mutually agreed terms.

RA 8371 (Indigenous Peoples Rights Act) Section 35 provides access to biological and genetic resources and to indigenous knowledge related to the conservation, utilization and enhancement of these resources within the ancestral domain s of the Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) upon securing a free and prior informed consent from such communities in accordance with their customary laws.

The major criticism of EO 247 was that it made access to biological resources too difficult and that it discouraged legitimate bioprospectors. Similarly, securing a free and prior informed consent (FPIC) from ICCs/IPs prescribed in RA 8371 is even more complicated. Therefore, access to biological and genetic resources becomes difficult. In 2001, the Philippine legislature enacted RA 9147, An Act Providing for the Conservation and Protection of Wildlife Resources and their Habitats which has repealed by implication or amended accordingly EO247.

RA 9147 declares the policy of the State to conserve the country's wildlife resources and their habitats for sustainability with the following objectives:

- To conserve and protect wildlife species and their habitats to promote ecological balance and enhance biological diversity
- To regulate the collection and trade of wild life
- To pursue, with due regard to the national interest, the Philippine commitment to international conventions, protection of wildlife and their habitats
- To initiate or support scientific studies on the conservation of biological diversity

While the legislative mechanisms on access are in place, implementation has been problematic. There were only six academic research agreements and three commercial research agreements on PGRFA (Commercial Research Agreement all withdrawn) were received and reviewed by the Inter-Agency Committee on Biological Resources (IACBGR). Moreover, there is little guidance on the related benefit-sharing. In general, the resource user or bioprospector negotiates the benefit-sharing scheme with the resource provider as part of prior informed consent (PIC) requirement.

In response to this problem, a new set of implementing guidelines for bioprospecting activities in the Philippines in a joint DENR-DA-PCSD-NCIP AO #1 pursuant to Wild life Act and other relevant laws, namely EO247, RA 8371, RA 7308, RA 7586, RA 7160, RA 8423 and RA 7611 was promulgated on January 12, 2005. The Bonn Guidelines on access and benefit sharing adopted at the 6th Conference of Parties in 2002, were also considered in the guidelines.

The consolidated guidelines streamline the procedure for access to biological resources and facilitate compliance thereto by legitimate resource users It provides guidelines for obtaining prior informed consent of resource providers and in negotiations with these resource providers for fair and equitable sharing of benefits arising from bioprospecting and establish a cost-effective, efficient, transparent and standardized system for monitoring compliance with the provisions on PIC; collection quota; fair and equitable benefit-sharing; transfer of materials to third party recipients and other provisions of the Bioprospecting Undertaking.

Access to plant genetic resources from other countries

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.

Restrictions on access to PGRFA

There is only one specific case of restriction on access to PGRFA in the Philippines. This is on Manila hemp, the exportation of planting materials of which is prohibited by law. In other species, the restriction and regulation on exportation outside the country are due to their inclusion in the CITES list of endangered species.

7.2 Fair and equitable sharing of the benefits of the use of plant genetic resources

Benefits arising from use of plant genetic resources

Successes in crop improvement and boosts in agricultural production were mainly attributed to this system of free exchange.

Mechanisms for sharing benefits from use of plant genetic resources

Several laws have provisions on mechanisms for benefit sharing from the use of plant genetic resources.

EO 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 other Purposes). The benefit sharing provisions of EO 247 include:

- Payment of royalties to the national government, local or ICC and individual person or designated beneficiary in cases commercial use is derived from the biological and genetic resources taken
- Active involvement of Filipino scientists in the research & collection and in the technological development of a product derived from the biological and genetic resources taken
- Royalty-free use by Philippine institutions of any technology used or developed in case of endemic species

Joint DENR-DA-PCSD-NCIP AO #1 (Guidelines for the implementation of bioprospecting activities in the Philippines). The guidelines impose minimum benefits that must be obtained from resource users as follows:

- Biosprospecting fee of US$3000 for each Bioprospecting Undertaking, which may be increased or tempered based on certain criteria
- Minimum amount of 2.0% of the total global gross sales of the products made or derived from the collected samples to be paid annually
- US$1 000 per collection site annually for the duration of the collection period

Non-monetary benefits which may be agreed upon in addition to the minimum benefits may include:

- Equipment for biodiversity inventory and monitoring
- Supplies and equipment for resource conservation activities

- Technology transfer
- Formal training including educational facilities
- Infrastructure directly related to the management of the area
- Health care
- Other capacity building and support for *in situ* conservation and development activities

In addition, a Material Transfer Agreement (MTA) is entered into by the provider and user of genetic and biological resources.

Obstacles to implementing access and benefit sharing

There are four different national legislations that have access and benefit sharing provisions, many of which overlap and require harmonization. It took 10 years to craft and legislate the harmonized implementing rules and regulations, which contributed to the delay in the implementation of a unified access and benefit sharing regime in the country. Since the implementing rules and regulations are relatively recent, there is still no indication of the ease or difficulty of implementation.

Strategic directions for maintaining or improving access and benefit sharing.

To improve access and benefit sharing, the country needs to adopt the Standard Material Transfer Agreement (SMTA) developed by the ITPGRFA. This of course applies only to the crops listed in Annex 1 of the Treaty. For crops not listed in Annex 1, the country needs to develop a model MTA that will take care of the country's specific concerns.

The operation of an effective and efficient monitoring system, especially for non-Annex 1 crops which are being made available to other contracting parties, is necessary to ensure that the benefit redounds to the appropriate stakeholders.

7.3 Implementation of Farmers' Rights

International agreements relevant to the implementation of farmers' rights

The Philippines acceded to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) on September 28, 2006.

National legislation/policies to achieve or enhance the implementation of farmers' rights

- The RA 8173 (Indigenous Peoples' Rights Act) provides 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.
- The Plant Variety Protection Act (PVP) enacted in 2002 recognizes the traditional right of small farmers to save, use, exchange, share or sell their farm produce of a variety protected under this Act, except when a sale is for the purpose of reproduction under a commercial marketing agreement.
- In preparation for the accession of the Philippines to ITPGR, a bill on Farmers' Rights had been drafted and forwarded to the House of Representatives.

Obstacles to achieving or enhancing the implementation of farmers' rights

The pending accession of the country to ITPGR is a setback to further the deliberation of the draft bill on Farmers' Rights in Congress.

CHAPTER 8

CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

8.1 Contribution of PGRFA management to agricultural sustainability

The on-farm management of crops by farmers is still being practiced in many areas in the country. Ecosystem balance is maintained through the crop-based ecosystems like rice, coconut, Manila hemp, coffee, cacao and fruit trees. The management of diversity in these crop-based ecosystems contributes to the ecological resilience. The traditional practice of growing diverse populations/ varieties and crops ensures that sustainable production is achieved even with the pests and disease outbreak.

8.2 Contribution of PGRFA management to food security and poverty alleviation in the Philippines

The improvement of varieties of the staple crops, namely rice and corn is always a priority of the government. As well, the efforts in varietal improvement by farmers contributed to improved varieties adapted to the local conditions. The increases in rice and corn production had contributed to attaining food security in the country.

The use of genotypically diverse varieties and populations on-farm and in home gardens also prevents wipe-out of the crops ensuring harvests and food security. The varied crops including fruit trees and vegetables in the home gardens provide the essential nutritional needs of the family.

8.3 Contribution of PGRFA management to economic development of the Philippines

Agriculture consumes 37 percent share of the workforce, with a significant contingent farming and fishing at the subsistence level. In 2003, agriculture, forestry, and fishing accounted for 15 percent of the GDP.

From 2001 through June 2004, crops accounted for about 49 percent of the value of all agricultural production. In order of value, the major crops were rice, coconut, corn, bananas, sugarcane, mangoes, and pineapples. Since at least 1985, agriculture, forestry, and fishing generally have grown in output and the number of persons employed but declined in their contribution to the GDP, their percentage of the total labor force, and their amount of the total land area. Although the absolute number of persons employed in agriculture, forestry, and fishing has grown, that number as a percentage of the number of persons actually employed in the total labor force fell from about 50 percent in 1985 to about 37 percent in late 2004. From 1991 to 2002, both the total number of farms and the total area of farmland decreased, respectively, from 4.6 million to 4.5 million farms and from about 9.9 million hectares to 9.2 million hectares of farmland. The average size of each farm decreased from 2.2 hectares to 2.0 hectares per farm.

8.4 Priorities to better understand the roles of PGRFA

Economic role

There is a need to valuate the intrinsic and actual value of PGRFA. This could be done using economic tools and considering the parameters like its contribution to economy, livelihood and food security of the country.

Social and cultural roles

There is a need to document the importance and uses of crop species in the social and cultural aspects of the different sectors of the population including the cultural groups. As well, the indigenous knowledge systems and practices employed by the different cultural groups should be documented.

Ecological role

The interaction relationships and functions of the components of the different crop ecosystems must be studied and documented.

When the above information becomes available, these should be disseminated through an efficient and effective information and extension communication campaign. This is to share the knowledge of individuals and groups among the different sectors of society.

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 (2005)

Crop	Crop Area ('000 Ha)	Crop Production ('000 mt)
Rice	4 070.4	14 603.0
Maize	2 441.8	5 253.2
Coconut	3 243.3	14 824.6
Sugarcane	368.9	22 917.7
Banana	417.8	6 298.2
Cassava	204.8	1 677.6
Sweet potato	120.6	574.6
Coffee	128.0	105.9
Abaca	136.0	74.0
Tobacco	29.6	45.1
Rubber	81.9	315.6
Pineapple	49.2	1 788.2
Mango	164.1	984.3
Peanut	27.5	28.4
Mungbean	36.1	26.8
Onion	8.9	82.0
Eggplant	21.2	187.8
Tomato	17.7	173.7
Garlic	4.7	13.2
Calamansi	20.2	200.8

APPENDIX 3

VALUE OF EXPORT OF MAJOR PHILIPPINE AGRICULTURAL CROPS (2005)

Item	Volume of export ('000 MT)	Value of export (million US$)
Coconut oil (Crude and refined)	1 152.32	657.22
Coconut, desiccated	125.54	127.14
Coconut, young	2.79	0.69
Pineapple and products	536.72	204.28
Tobacco, manufactured	21.06	112.81
Mango, fresh	31.27	26.63
Abaca	13.44	11.91
Asparagus	3.12	6.67
Papaya	4.14	5.09
Shallot	20.66	4.38
Onion	0.38	0.11
Cassava	0.60	0.83
Yam	0.22	0.48
Garlic	5.94	1.98