BRAZIL:

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

(Leipzig,1996)

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BRASILIA-DF, June 1995

Note by FAO

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INTRODUCTION

The Brazilian Agricultural Research Corporation (EMBRAPA), by means of its National Centre for Genetic Resources and Biotechnology, as designated by the Brazilian government, has the pleasure of presenting the "Country Report for Brazil" to be discussed during the FAO Sub-Regional Meeting for South America. This meeting will take place in Brasilia-DF, Brazil from August 29-September 1, 1995, and is being held in preparation of the "4th International Technical Conference on Plant Genetic Resources" sponsored by the FAO and scheduled to take place in Leipzig, Germany, in June, 1996.

This report contains a summary of the main activities being carried out by Brazilian institutions with the goal of enriching the genetic variability, conservation, evaluation, characterization and documentation of phytogenetic resources in the country.

The establishment of multilateral mechanisms aimed at conservation and use of phytogenetic resources is a challenge that nations should face with frankness and honesty and with a positive attitude. This is especially true when dealing with species that are considered the staples which feed the greater part of humanity. This report highlights some relative points in the search for a greater understanding of how to use these resources and make them available to the international scientific community, under terms which are mutually agreed upon and which respect the sovereignty of the nations over their own resources.

With this opportunity, EMBRAPA extends its gratitude to all the institutions and people who have collaborated in the preparation of this document, a landmark for future initiatives which will certainly involve an even greater number of organizations, groups, and individuals in favour of the quantitative and qualitative enrichment of actions to be permanently undertaken on a national level. In particular, EMBRAPA congratulates the Food and Agricultural Organization of the United Nations for the strategic manner in which it is preparing the 4th International Conference on Plant Genetic Resources. We feel certain that from this initiative, mankind will be able to depend on multilateral mechanisms of access and utilization of plant genetic resources, which will provide for a sustainable level of production of basic foods for the present and future generations.

CHAPTER 1
Information about Brazil and the Agricultural Sector

1.1 LOCATION AND BOUNDARIES OF THE COUNTRY

Brazil is located in South America, between the 5°16'20" northern latitude and 33°44'32" southern latitude parallels, and between the 34°47'30" and 73°59'32" meridians west of Greenwich. Bordered on the east by the Atlantic Ocean, Brazil has several ocean islands, the most noteworthy being Fernando de Noronha, Abrolhos and Trindade. To the north, west, and south, the country is bordered by all of the South American countries with the exceptions of Chile and Ecuador.

With an area of 8,511,965 km², Brazil is the largest country of the South American continent. Compared to the other nations of the world, only the former Soviet Union, Canada, the People's Republic of China, and the United States surpass Brazil in terms of territorial size. The general shape of the land, similar to a triangle, with one side parallel to the terrestrial equator, results in a greater concentration of land in the northern part of the country. The measurements between the extreme points are considerable and practically equidistant: 4,394.7 km in the direction from north to south extremes and 4,319.4 km in the direction from east to west extremes.

The shape and set-up of the Brazilian lands result in the boundaries extending over a line of 23,086 km, of which 7,367 km are bordered by the Atlantic Ocean, and 15,719 km make up the borders with their South American neighbours. The process of settling in Brazil occurred most densely along the coast, and as a result, a great part of the land frontiers are the areas of lowest demographic density. The population of Brazil is approximately 150 million inhabitants; roughly 70% of the total population live in urban centres.

1.2 POLITICAL-ADMINISTRATIVE ORGANIZATION

The political-administrative organization of the Federal Republic of Brazil is composed of the Union, the Federal District, the States, and the Municipalities. Each of these units are considered autonomous under the terms of the Federal Constitution of October 5, 1988.

The Federal District, where Brasilia, the capital of the country, is located, is an autonomous unit and houses the headquarters of the three branches of the federal government: the executive, legislative, and judicial divisions. The Federal District has the same legislative power as the states and municipalities, which is enforced by organic law.

The States, twenty-six in all, compose the units of greatest hierarchy inside the political-administrative organization of the country and subsequently are subdivided into municipalities. The municipalities number approximately 4,500 and are the autonomous units of lowest hierarchy.

1.3 CLIMATE

Brazil is divided by the Equator and the Tropic of Capricorn. The majority of its lands are located in the lowest latitudes of the globe, giving it the characteristics of a tropical country. In spite of this, the Brazilian territory possesses a wide diversification of climate. This is due to a number of factors, including geographic configuration, a combination of maritime and continental climate, variations in altitude, great territorial extensions both in terms of latitude (5°N to 33°S) and longitude (34° to 73°W), and the topography and dynamics of air masses. This last factor is of great importance as it acts directly upon the temperature and rainfall of the country. The air masses of greatest importance in Brazil are: the Equatorial (Continental and Atlantic), Tropical (Atlantic and Continental) and the Polar Atlantic, which allows for differences in climate between the regions.

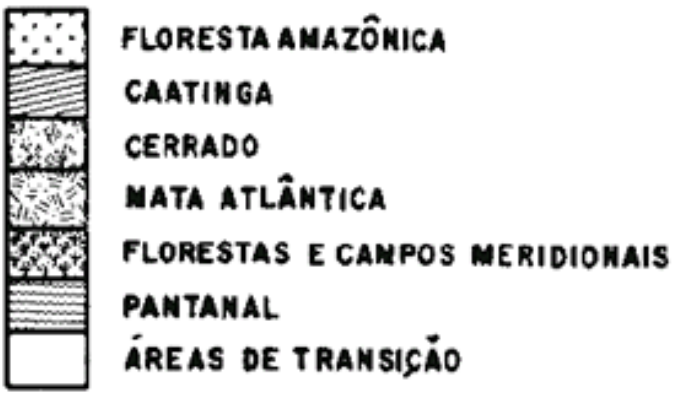
1.4 ECOSYSTEMS: AGRICULTURE, FORESTS, AND LIVESTOCK OVERVIEW AND TERRITORIAL OCCUPATION

With an extensive surface of continuous land, and a great part of these lands appropriate for cultivation, Brazil has, at its disposition, abundant water resources, a tropical and subtropical climate, and is considered one of the countries with the greatest biological diversity in the world. Among the 250,000 species of higher plants, nearly 60,000 are native to Brazil.

The Brazilian flora is important because it possesses a great number of wild relatives of many cultivated plants, including: guarana (*Paullinia cupana*), cocoa-bean (*Theobroma cacao*), the rubber tree (*Hevea brasiliensis*), cotton (*Gossypium spp.*), cashew (*Anacardium accidentale*), pineapple (*Ananas comosus*), peanut (*Arachis hypogea*), and cassava (*Manihot esculenta*). The plant life is also important because of the richness of species which have a potential for direct use in agriculture, genetic breeding, and domestication. The variety

of species include forest trees, fruits, palm-tree varieties, forage, medicinal, industrial, and ornamental plants. In the Amazon alone, nearly 800 species were identified with a potential foreconomic exploitation. This diversity of species is due to the edaphic-climatic characteristics of the land. The result of this is the existence of vegetation formations that can be grouped into six different ecological domains, whose distribution is shown in Figure 1. These different vegetations include: Amazon Forest, Cerrado, Caatinga, Atlantic Forest, Meridional Forests and Grasslands, and the Pantanal.

FIGURA 1. DISTRIBUICAO DOS DOMINIOS ECOLOGICOS BRASILEIROS



1.4.1 Amazon Forest

The Brazilian Amazon Forest (tropical rainforest) covers a surface of approximately 3.5 million square kilometres and corresponds to nearly 40% of all national territory. Of this total, 2 million km^2 are made up of "dense ombrofila" forest (57%), and 1.1 million km^2 are composed of open "ombrofila" forest (31%). The remaining land, 400 thousand km^2 (12%) is covered with other kinds of vegetation, including ecotones, stationary forests, natural fields, and grasslands and savannahs.

In spite of the human disturbance, which is changing the Brazilian into systems of less biodiversity and a shrinking biomass, particularly in the South and Southeast regions, forest resources are still plentiful in the Amazon, which is covered by the largest continuous forest on the planet. With its multilayered structure, high trees and other related plant life, in conjunction with the variety of fauna, the forest forms complex, intricately connected trophic chains, which stabilize the ecosystem, despite the naturally low fertility of the soils.

In spite of the high levels of primary productivity of tropical rain forests, this ecosystem is rather fragile, and its productivity and stability depend, over the long run, on the recycling of nutrients, whose efficiency is directly related to the biological diversity and the structural complexity of the forest.

For centuries, the occupation of the Amazon occurred by means of the waterways and the small population was dedicated to extraction of plant life (rubber, wood, and the Brazil nut), animal life (through hunting and fishing), and minerals, depending on their cycles of high and low demand and economic value. But, beginning in the 1960's, an intensive colonization began of small, medium, and large land owners and businessmen who migrated from the South, Southeast, and Northeast, attracted by the settlement projects created by the government or private businesses. These colonies have taken agricultural techniques or cultivars with them that are not always adequate or appropriate for local conditions. This, in turn, contributes to the intensification of environmental problems. It is, in general, a process of disorderly and predatory colonization, characterized by deforestation and indiscriminate burning of plant life, with a consequent reduction in agricultural productivity, erosion of the soil and genetic resources, land conflicts, and a lack of infra-structure and basic services.

1.4.2 Cerrado

"Cerrado" is the name given to the second largest ecological dominion of Brazil, which is composed of different vegetation types (savannahs and forest)

of the raised plains of Central Brazil and adjacent areas, where a continuous herbaceous stratum is joined to an arboreal stratum, with variable density of woody species. The cerrados cover a surface area of approximately 25% of Brazilian territory.

The most important climatic characteristic of the Cerrado is in relation to the seasonal distribution of pluvial precipitation. There are two well-defined seasons, one rainy and the other dry.

The rain season lasts approximately five to seven months, and during this time, roughly 90% of all precipitation falls in the region.

The dry season lasts approximately five to seven months, and determines yearly hydric deficits during this period. There are frequently dry spells which occur during the rain season. These are called “veranicos”.

As a consequence of the variability of these and other factors, the vegetation of the Cerrado presents great diversity, and is a source of potentially important genetic resources such as fruit-bearing, medicinal, and ornamental plants. It is estimated that there are nearly ten thousand plants in existence in the “Cerrados”, besides the macro and micro fauna and flora which are extremely diversified.

Evaluation studies of the agricultural potential of the “Cerrados” have reconciled what is known about their potential, limitations, and the adequate and appropriate technologies for the most productive use of this land. As a result of the use of this technology, the grain production of the region increased fivefold during the past twenty years, reaching nearly 20 million tons per year. Due to the topographic facilities for mechanization, combined with good infrastructure of the region and easier occupation, when undertaken in a rational and logical manner, the Cerrados currently make-up the best alternative for agricultural expansion.

During the period from 1975-80, the surface area of the “Cerrado” which was occupied by rural establishments or organizations underwent a growth of 21.3 million hectares. Yet to this day, this region is of great interest to large enterprises, as well as, to people migrating from other states, notably from the southern part of the country. However the environmental impact and pressure on the vegetation is difficult to measure.

Important agricultural goals have been achieved in the “Cerrado”, such as the adaptation of soybeans to low latitudes. Ten years of research were necessary at the beginning of the last decade to trigger the expansion of this crop on a large scale. Because of its lower degree of susceptibility to the dry spells, soybeans were rapidly incorporated into the productive systems of the regions.

Once the high levels of productivity were reached and the need for fertilizer for the absorption of nitrogen from the atmosphere was reduced, it became the preferred crop of the Cerrado.

1.4.3 Caatinga

The "Caatinga" extends over areas of the states of the Brazilian Northeast, and is characterized by the xerofitic vegetation typical of a semi-arid climate.

Different from the majority of the Brazilian biomes, the semi-arid region of the north-east is made up of soils that are relatively fertile which, due to the nature of their original materials and the low level of rainfall, experience minor runoff of bases.

The typical vegetation of the Caatinga present variations, depending on the topography and soil type. Nevertheless, its high level of biodiversity makes it rich in genetic resources. A variety of fruit species and medicinal plants have their centres of genetic diversity in this region.

The rain period is very short, varying from two to three months. The dry season, particularly due to its intermittent and unpredictable nature, is a restrictive factor to be considered when using the land, and also aggravated by the land ownership which is too concentrated. The agricultural lands are generally located in lowlands, flatlands, and alluvial beds of deep soils, with good retention of humidity. In these soils, high levels of productivity can be reached, which compensates for the losses that occur during the years of drought.

The expansion of agriculture in the Caatinga region was most profoundly influenced by the cotton crop during the first half of this century. With the recent use of an agriculture more dependent on technology, the jobs for field-hands were reduced, which, in turn resulted in migrations to the big cities of the region or to the Central-Southern regions of the country. The growing incidence of the "bicudo" pest (*Anthonomous grandis*) in the cotton crop increased the levels of migration of agricultural workers.

Irrigated agriculture, which accounts for more than 640,000 hectares, is an activity of economic significance for the region. The regularization of product supplies, particularly fruits and vegetables, by means of irrigation gave way to the appearance of diverse agricultural industries, making possible the local industrialization of production.

1.4.4 Atlantic Forest

The Atlantic Forest, covering an original area of nearly 1.5 million square kilometres, extends over nearly the whole Brazilian coastline, and is one of the most endangered ecosystems of the world. Over 90% of the original area covered by Atlantic forest was destroyed, leaving less than 10% of the original forest and the majority of this is found in Official Units of Conservation. The climate is predominantly hot and tropical, with a strong influence from the ocean. The precipitation ranges from 1,000 to 1,750 mm but some areas can reach levels of rainfall as high as 4,000 mm. The typography of the land is composed of hills and coastal plains, accompanied by a mountain range. The soils are of average fertility, however areas with an uneven relief have serious limitations for intensive, annual agricultural use.

In spite of all the destruction, it is estimated that there are still some 10,000 species of higher plants, besides a rich animal life which inhabits this environment. Studies clearly indicate that diverse types of vegetation are severely affected, representing high levels of degradation. Little remains of the original continuous forest which covered the area north of the Todos os Santos Bay in the state of Bahia. However, in the southern part of the state of Bahia, large areas of primary forest can still be found. Another significant factor is the existence of nearly 600,000 hectares of natural forests bordering the cocoa-bean plantations, in the region known as the cocoa-bean region, although the occurrence of more valuable species such as the jacaranda (*Machaerium spp.*), pau-brasil (*Caesalpinia echinata*) and other trees, abundant in the past, have greatly diminished. The current crisis felt by the cocoa-bean industry puts even this small remaining area of Atlantic forest at risk.

The mountain ranges of Serra da Mantiqueira, Serra do Mar and Serra Geral, extending from the Northeast of Brazil to the state of Rio Grande do Sul, encompass important remains of Atlantic forest which should be conserved. The intensive human activity in these encroachments of forest negatively affect the endemic populations and the diversity of local flora and fauna.

Agricultural activity in the region centres around a mechanized type of land use, with high usage of modern inputs, and emphasis upon the sugar, alcohol, paper, and cellulose producing agricultural enterprises, which have replaced a great part of the native forest.

1.4.5 Meridional Forests and Grasslands

The territory of the Meridional Forests and Grasslands includes the mesophytic tropical forests, the subtropical forests, and the meridional grasslands of the states of Parana, Santa Catarina, and Rio Grande do Sul, as well as

parts of the states of Sao Paulo and Mato Grosso do Sul. This land has a tropical and subtropical, humid climate, with some areas of temperate climate.

In general, soils are naturally fertile, many of them derived from basaltic rocks, which together with the mild climate, allowed for a rapid colonization during the last century, mainly by European and, more recently, by Japanese immigrants. As a consequence, these areas present high levels of productivity, comparable (for some products) to that of developed nations.

The Meridional Tropical Forest extends over the western portion of the ocean mountain range to the raised plains of Sao Paulo and Mato Grosso do Sul, formed by calcitic sandstone. The Subtropical Forest involves basically all the Araucaria woodlands, distributed fundamentally over the uplands where basaltic rock is naturally distributed and characterized by the notable presence of the Parana Pine tree (*Araucaria angustifolia*).

In the context of territorial occupation, the uncontrolled exploitation of wood, during the first half of this century, greatly aided in the gradual expansion of agriculture in the region. In the beginning of the century, native forests of the region were estimated to cover an area of 16 million hectares. In 1950, the total area was 8 million hectares, and from 1970 onward, the native covering was less than 20% of this total.

In the past few years, the cultivation of temperate fruit crops has experienced significant advances and created new pressures over the forested areas and natural grasslands as a result. On the other hand, the selective extraction of wood species has put the remaining areas of forest at serious risk.

Despite the advances made by application of technology in agriculture in the region, such as increased rates of production, this technology has also brought environmental problems including devastation of vegetation, degradation and soil compaction, contamination and reduction of water, due to the inadequate management of crops. These regions still possess restricted areas of natural ecosystems, which because of their reduced dimensions and the high ecological value they represent, have become targets of concern in relation to their conservation and preservation.

1.4.6 Pantanal

The Pantanal is a geologically lowered area filled with sediments which have settled in the basin of the Paraguay River, integrating territories of Brazil, Bolivia, and Paraguay. Of these lands, approximately 140,000 km^2 are on Brazilian territory, covering part of the states of Mato Grosso and Mato Grosso do Sul. The water cycle conditions life in this ecosystem. The floods in

this region can be caused by pluvial waters, fluvial waters due to overflowing of the rivers, and by an elevation in the water table. During the flooding process, many rivers flow along a growing series of branching beds. False rivers also arise, without their own basin, and some rivers may lose their identity. This complex system of drainage, branched and undefined, by its dynamic nature of seasonal and multi-annual floods, decisively influences the biodiversity and productivity of the ecosystem, demanding systems of multiple sustainable use of its natural resources.

The climate is sub-humid, with an average yearly rainfall of roughly 1,100 mm, and characterized by a rain season (October to March) and a dry season (April to September). Flooding perios are not necessarily synchronous to the rain season. The soils of the pantanal are, for the most part, of a sandy texture and have a naturally low level of fertility, although they present accentuated levels of hydromorphic characteristics. Higher fertility and clay soils are typical of the southernmost areas.

The plant life of the Pantanal is composed of species from the following ecosystems: Cerrado, Chaco, Atlantic and Amazon Forests. The species from the Cerrado are the ones with the greatest influence and they occupy the sandy areas. The species from the Chaco penetrate the southern region and are found in clay, saline, and alkaline soils. Some Amazonian species, on a small scale, come through the wooded area of the riverside forests in the northern area. The influence of the Atlantic Forest vegetation is minimal, entering from the south-east. The plant life of the Pantanal has great economic potential, including : native pastures; melliferous plants, edible plants, natural dyes, and medicinal plants. So far, more than 10,000 plants have been recorded, including more than 200 species useful for human and animal consumption, as well as of industrial use in general.

The productive system is guided by the exploitation of agriculture, cattle raising and natural resources. The main economic activity is linked to cattle raising, with a herd of approximately 4 million heads. Agriculture is not seriously pursued and is mainly used for subsistence on farms. Other noteworthy areas of economic importance are fishing, tourism, and mining. The flora and fauna resources are not well utilized in spite of their high economic potential.

Humans have occupied this ecosystem since the eighteenth century, adapting themselves over time to the environmental phenomena of the region, and maintaining the environment in a state of balance.

Nevertheless, since 1970, progressive changes have been verified in the structure and functioning of this biome, caused by:

a) disorderly human action, which occur in the adjacent uplands, and in some places in the lowlands, caused increased flooding, provoked by deforestation as a result of the advancing agricultural frontiers;

b) the establishment of cultivated pastures at the expense of natural vegetation;

c) irrigation projects; and

d) engineering projects, such as river drainage, construction of dikes, dams, and roads.

These changes are a source of concern to environmental groups and other organizations working to protect the environment, such as national institutions of research and planning.

CHAPTER 2
Native Genetic Resources and Activities for Conservation of Genetic Resources *In Situ*

With nearly 55,000 native species, Brazil is considered the country with the greatest biodiversity on the planet. These species are distributed over six quite distinct biomes, which include everything from the largest extension of forest "ombrofila densa" of the planet, in the northern (Amazon) region, to savannahs and temperate forests in the southern part of the country.

Table 1 presents, in a summarized form, the official units of *in situ* conservation (UC), at the federal, state, and municipal levels. In this Table, the UC's are divided into two groups: those of "indirect use" and those of "irect use" of the resources. The "units of indirect use" refer to non-occupation of the space under consideration for direct exploitation, while the "units of direct use" refer to the occupation of the space under consideration for use by man, in a rational manner.

Note in Table 1 that the largest area included in the Units of Conservation corresponds to Indigenous Areas (554 Reservations, which occupy an area of 94,645,222 hectares), whose communities are composed of 146 different ethnic groups, and are located mainly in the northern region. This is followed by the UCs under responsibility of the Federal government, as the UCs connected to the States and Municipalities (included as one item, by region, in Table 1) occupy considerably smaller areas. Nevertheless, almost all the states and many municipalities have systems of Parks and Reserves which aim to conserve areas representative of the ecosystems in which they are located.

With the incentives and legal assistance for the conservation of biodiversity given by the Brazilian government, other institutions and Non-Governmental Organizations are also involved in the *in situ* conservation, within the diverse types and levels of existing management.

With the purpose of *in situ* conservation of genetic resources in mind, covering of native and exotic acclimated species, four main levels of management can be distinguished:

Level 1 - Little or no management: At this level of management, wild species or the cultivated relatives of these are included. This includes all of the forest genetic resources. In this situation, the main concern is to guarantee that the size and structure of the populations maintain genetic diversity in their native

state, as in the case of national parks, sanctuaries, and other natural environments. This category of management is intricately linked to the conservation of the environment, with the objective of integrating the participating institutions in the conservation of biodiversity. The establishment of a pilot research programme in these areas is underway along with the installation of germplasm banks in conservation units. This is being done through the cooperation among the following organizations: Brazilian Institute for Environmental Studies (IBAMA), CENARGEN/EMBRAPA, the "Luiz de Queiroz" Superior School of Agriculture of the University of Sao Paulo-ESALQ/USP, the State Institute of Forestry of Minas Gerais-IEF, the Emilio Goeldi Museum from the State of Para, the Dalmo Giacometti and Biodiversity Foundations. The project receives support from the Global Environmental Facility (GEF) and the World Bank, and was selected by FAO, IPGRI, and CIFOR as a pilot project for South America, and one of eight pilot projects in forestry at the world level. The forest species that are considered a priority for this study in Brazil have been listed in Table 2, which was compiled with data provided by FAO (1986 and 1994), Roche (1987), The Botanical Society of Brazil (1992), and the Government Decree from IBAMA No. 6 from January 15, 1992, which refers to the Official List of Endangered Species of the Brazilian Flora.

Through these studies, management projects are being sought for a variety of categories of pilot species which are representative of different ecological types in the diverse Brazilian biomes. Such studies examine the biology and ecology of ecosystems, communities, and especially of plant populations, besides reproductive biology and population genetics, using techniques involving isoenzymes and DNA with the objective of adequate management of *in situ* germplasm banks, as well as banks of seeds and other propagules.

Level 2 - Moderate Management: This type of management is practised by human communities, in wild or semi-domesticated resources, with a minimal disturbance on the native plant populations, as is the case of exploitation reserves. Brazil was a pioneer in the establishment of this type of reserve. The first reserve of this kind was established in 1989 for the rubber tree (Hevea brasiliensis) in the northern part of the country. Today there are 8 reserves in Brazil, the majority located in the northern region, covering an area of nearly 2,290,000 hectares, mainly for rubber tree and babassu (*Orbignya phalerata*). Studies are also being done to implement exploitation reserves for the Brazil nut (*Bertholletia excelsa*) and for ornamental species for Central Brazil.

The level 2 of management is of interest for the northern region as demonstrated by the National Centre for Surveying and Conservation of Soils (CNLCS) of EMBRAPA which showed that 26% of the Amazon Basin is only appropriate for exploitation. It has also been shown that research is necessary in this area to transform exploitation of certain species in viable

economic alternatives for the region. In the case of babassu, there has been a price freeze since 1950, which has diminished its use. On the other hand, the extraction of natural rubber is subsidized by the government, in a proportion two and a half times the world market price, in order to prevent a social disaster in the region where it is exploited.

Level 3 - Intermediate Management: This type of management is adopted in situations in which the resources are used extensively, and where human interference represents an important role in maintaining the system in balance, as is the case in natural pastures used by domesticated animals. This is true for all neotropical grasslands which have been adapted over the past 500 years for the grazing of exotic, herbivorous domesticated animals.

Although a serious conservation programme is necessary to protect native pastures, the majority of conservation efforts have been directed towards forests. So, in a general sense, the units of conservation used for grazing are established, as a priority in function of the conservation of related arboreal vegetation in the area, as is the case of the Parana Pine tree (*Araucaria angustifolia*). The conservation of native grasslands deserves special attention, especially since these areas are the preferred targets for implementing new agricultural developments.

Level 4 - Intensive Management: This type of management is used for domesticated or semi-domesticated species, where humans are the most important element because they are either partially or totally responsible for the structure of populations and communities, besides caring for the species and its survival. This is true for numerous local breeds of cultivated species, forests under management, and the National Forests.

In Brazil, as a rule, the conservation of local breeds/races is taken care of by small farmers and indigenous communities ("on farm" conservation). Although it is frequently said that by introducing new. improved varieties there is a loss of genetic variability, as was observed by researchers in Brazil and abroad, the tendency is to plant the traditional or native material just as much as the improved material. Besides the native material, many traditional farmers also conserve local breeds of exotic materials. This happens in Rio Grande do Sul with the colonial varieties of wheat, and in the rest of the country it can be observed with fruits and vegetables of African origin. The indigenous communities mainly conserve native material of cultivated species and local breeds of regional cultivars, frequently maintaining very promising materials for the use of agricultural research.

In the case of intensive management, it is necessary to encourage research which attempts to provide assistance and technical support to the communities which carry out traditional agriculture and to the indigenous communi-

ties. The objective of this is to integrate traditional knowledge with the technological advances in order to develop new alternatives which help to maintain these conservation systems.

Among the material preserved by the communities which employ traditional methods of agriculture, there are hundreds of species in diverse stages of domestication and utilization. For example, Giacometti and Coradin (1989) estimated that there are about 800 plant species of economic or social value in the Amazon. Of these, 190 are fruit-bearing plants, 20 are oil plants, and there are hundreds of medicinal plants. Similar data can be cited from other regions.

In Table 1, it is shown that there is a greater interest and concern about conservation in the northern region of the country than in the rest of the country. Today, about 7% of the Amazon region is legally being preserved and if the indigenous areas are also taken into account, the percentage rises to 31%. Recent data indicates that less than 10% of the vegetation was destroyed in that region. On the other hand, the Atlantic Forest, the Southern Brazilian Forests, and the Caatinga were almost completely decimated a mere 10% of the original vegetation remains. In these three ecological provinces, less than 1% of the area is under official protection. In the Caatinga region, the protected area with "critical status" is less than.3%. These three ecosystems are among the most endangered ecosystems of the planet. The Cerrado is another cause for concern as it is being occupied with the expansion of the agricultural frontier. Less than 1% of the cerrado is legally protected, and it can be foreseen that the situation will worsen in the upcoming years.

The political concern and attention from the international media about the Amazon have caused us to forget about the situation of the other Brazilian biomes which are equally important. The Atlantic Forest, for example, had a biodiversity comparable to that of the Amazon at one time. For that reason, its remaining vegetation deserves more attention. In the context of *in situ* conservation, the most endangered areas should receive more emphasis in the attempts of conservation.

There are five forest genetic reserves already implemented *in situ* in the country, even though three of these still do not appear in the official Brazilian data (Table 1) concerning units of conservation. These reserves are the following: one in the Tropical Rainforest in the state of Para, another in the Caatinga in the state of Minas Gerais, two in the Gallery Forest of the "Cerrado" in the Federal District, and the last in the Meridional Forest (Subtropical) in the state of Santa Catarina. Four other genetic reserves are being created; there are two in the Atlantic Forest in the states of Rio de Janeiro and Espirito Santo, one in the Caatinga in the state of Piaui, and another in the Tropical Humid Forest in transition with Cerrado in the state of Minas Gerais. These

reserves aim to conserve the most endangered species and those of greatest economic interest. They seem promising not only for conserving the target species, but also the entire ecosystem, avoiding the degradation and loss of biodiversity. The Genetic Reserves are essential pillars for research activities concerning *in situ* conservation.

CHAPTER 3
National Action in Conservation of Genetic Resources *Ex Situ*

3.1 A HISTORICAL SUMMARY

Since the beginning of the 1970s, there has been a growing concern world-wide with the need to preserve the genetic resources that are threatened by extinction. This threat is posed by, among other things, the development and spread of modern agriculture. In the 1970s, FAO stimulated the establishment of a world-wide network of Centers for Conservation of Genetic Resources, located in the regions of greatest genetic variability. In 1974, the Consultative Group for International Agricultural Research (CGIAR) created the International Board for Plant Genetic Resources (IBPGR). In that same year, EMBRAPA created a research unit whose basic mission was to " coordinate the appropriate means of management of the genetic resources of the country." This unit was called the National Centre of Genetic Resources (CENARGEN). In 1984, CENARGEN also incorporated research activities using biotechnology aimed at the conservation and use of genetic resources. The name of the organization was slightly modified to National Centre of Genetic Resources and Biotechnology, but the acronym stayed the same.

Before the establishment of CENARGEN, the activities concerning genetic resources in Brazil were carried out (with some rare exceptions) in a random and sporadic way. Frequently, there were gaps in some areas of research and duplications in other areas of research throughout the country. Until that point, the acts of introduction, collection, and most importantly, conservation of germplasm, depended largely upon the effort, interest, and personal relationships of some researchers. It should be recognized, nevertheless, that institutions dedicated to broad areas of research of certain products were the pioneers in the formation and maintenance of germplasm banks. Some well-known and successful examples of this are: the Agronomy Institute of Campinas (IAC), working with coffee and citrus; the Institute of Sugar and Alcohol (IAA), and the Sugarcane Producers' Cooperative (COOPERSUCAR), working with sugarcane; the Executive Commision for the Recuperation of Cocoa Plantation (CEPLAC), which work with the cocoa bean; the Luiz de Queiroz Institute for Higher Education in Agriculture (ESALQ/USP), which deals with corn and vegetables; and the Federal University of Vicosa (UFV), which studies the beans and soybean. The majority of these collections were incomplete, however, or aimed at resolving immediate and

quite specific problems. The disposal and/or loss of newly introduced material was a constant problem. This situation put Brazil in a position of dependence on foreign germplasm. Besides this, the documentation of the collection and the information and/or communication processes were precarious, which greatly complicated the exchange of germplasm, both at the national and international levels.

3.2 *EX SITU* CONSERVATION

With the creation of CENARGEN and the consolidation of the Cooperative System of Agriculture Research (SCPA), today called the National System of Agriculture Research, an environment was established for a national network of genetic resources. This helped to organize and make the following activities more efficient: Collection, Exchange and Quarantine, Characterization, Evaluation, Documentation, and most importantly, Conservation and Utilization of Germplasm. SNPA is formed in part by EMBRAPA with its research units, its congenerous corporations supported by the state, not to mention the federal and agriculture state institutions of research as well as universities and private enterprises. With the participation of all these different entities, a national network was formed for Genetic Resources Conservation which presently holds 83 Active Germplasm Banks (BAGs), distributed in 47 locations (see Figure 8), which work in conjunction with CENARGEN.

The Base Collection (COLBASE) of plant germplasm is kept at CENARGEN, and the active collections, such as perennial plants, are maintained at the respective BAGs.

A recent study, within this system, discovered that, in Brazil, there are nearly 194,000 accessions of plant germplasm including duplicates, with 60,000 stored at the COLBASE and 134,000 in other collections (see Table 3). Of the accessions conserved in the system, nearly 76% are exotic and 24% are native/local populations.

It can be clearly seen that the great germplasm collections are of exotic species, that include, mainly, products of social and economic interest, so their maintenance and growth are necessary. It is opportune, at this time, to point out that the main food crops which are important to Brazil are dependent on exotic germplasm. Almost 95% of the grain accessions conserved in the country, in SNPA collections, are from exotic species (see Table 3). The maintenance and continual enrichment of the genetic variability of these collections has been a constant source of concern.

Tables 4 and 5 show respectively the number of accessions conserved in the SNPA (except at COLBASE) of the main cultivars of the Brazilian exportation list and those of social importance.

The crops for exportation (Table 4) are listed in decreasing order of number of accessions conserved. Coffee (*Coffea spp.*) is the product for which Brazil possesses the largest collection in this category, followed by soybean (*Glycine max*) and sugarcane (*Saccharum officinarum*).

Comparing the total number of conserved accessions from Table 3 with the data from Table 4, it is proven that nearly 19.8% of the accessions maintained at SNPA (except at COLBASE) represent the six most important Brazilian crops of exportation. Concerning the main crops of social importance (Table 5), it is observed that bean is the product with the greatest number of conserved accessions, followed by rice, cassava, and corn. In this category, nearly 24% of the conserved accessions are native and/or local populations and 76% are exotic. The total number of conserved accessions in the country of the five crops of greatest social importance is 33,323 (Table 5), which corresponds to 24.8% of the total number of accessions maintained by SNPA, except at COLBASE.

Ex situ conservation in Brazil is carried out in the form of conservation of seeds in cold chambers, in vitro conservation, cryopreservation in liquid nitrogen, and conservation in the field.

In the Brazilian system of genetic resources, long range conservation of germplasm has mainly been carried out with the use of conservation of orthodox seeds in chambers at a subzero temperature. The orthodox seeds are also stored in cold chambers at above zero temperatures for short and medium periods of conservation.

For the species of recalcitrant seeds, *in vitro* conservation, for short and medium time spans, as well as conservation in the field through collections of live plants, have proven to be promising alternatives for conservation.

The conservation in the field of perennial plants, carried out at the BAG centres, is a lot of work and costly. Another problem this system poses is the vulnerability of the plant as it is exposed to a number of adverse biotic and abiotic factors.

The Country's "Base Collection" (COLBASE), which is located at CENARGEN, has four available chambers with a current capacity to hold 100,000 accessions. These chambers operate at a temperature of -20°C and are designed to conserve the seeds over a long period of time, to monitor and distribute of research materials.

The system of long term conservation of seeds has an adequate infrastructure at its disposal to carry out the following activities: reception, preparation, quality control of physiological and phytosanitary conditions, packaging and documentation of the stored germplasm, and even greenhouses and screenhouses for multiplication and regeneration of germplasm.

For *in vitro* conservation, there are two special chambers which are utilized. There is a chamber for species of temperate climate, which operates at 10°C. The other chamber which is designed for tropical climate species operates at 19°C, as well as *In Vitro* Culture Laboratory (LCV), with a respective isolation room for preparation of materials.

The routine activities involved with long term conservation at CENARGEN are executed through the efforts of a team of fourteen researchers working part-time and twelve assistants working full-time. Nearly one-third of the researchers presently under training at the graduate level.

The technical support group works exclusively in the routine activities of base collection materials, while the researchers develop research projects and advise students doing internships and students with scholarships, in addition to the routine activities they carry out.

Besides the routine work, research is being developed with seeds from species that have never been studied before. These studies include the areas of anatomy, physiology, and pathology. The long term goal of these studies is to build up the system of germplasm conservation with new scientific information. The objective of these studies is to classify the different varieties of seeds (recalcitrant, orthodox, or intermediate) according to their behaviour and determine an appropriate methodology for their long term conservation. In the same manner, research has been developed with cryopreservation using not only seeds, but also other types of plant material, especially in the case of autoctonous tropical species that produce recalcitrant seeds.

The Brazilian system for conservation of genetic resources has adopted the international standards of seed quality, established by IBPGR and FAO, making adjustments when necessary, depending on the circumstances and the species being conserved.

The multiplication and regeneration are carried out at the active gene banks (BAG-centres) where the active collections of germplasm are stored.

Besides the active collections, the BAG centres have the capacity to maintain collections for long term conservation, notably for the perennial species con-

served in the field. In this case, the collections are used not only for inherent activities of conservation of genetic resources, but also for plant breeding.

3.2.1 System of Curatorial Germplasm Management

Curators of product germplasm are researchers at CENARGEN, designated by the head/director of the centre, who offer advice and guidance to the Technical Directors concerning the germplasm that is considered relevant to national agriculture and cattle breeding. There are twenty-two curatorships at CENARGEN (see Table 4) which operate at both the national and international levels. They deal with the areas related to enrichment, documentation, and germplasm conservation of the products under their care, and they depend on support from the institutional structures for these activities.

Recognizing the importance of the curators' role for the enterprise (EMBRAPA) and for national agriculture as a whole, the Executive Board of Directors of EMBRAPA officially established the System of Curatorial Germplasm Management on July 7, 1993. This was done through the Deliberative Rule n° 028. The objective of this measure was to define and organize all of the technical and administrative activities necessary for the management, conservation, and use of germplasm in the realm of the enterprise (EMBRAPA) and in the context of the Programme for Conservation and Use of Genetic Resources. In this way, it was possible to take care of the following needs:

a) definition of procedures pertaining to the management, use and conservation of germplasm;

b) official nomination of the individuals to be permanently responsible for the activities related to management, use and conservation of germplasm of a product or a group of products;

c) setting up an adequate structure for the activities mentioned in a and b above, which could be carried out at EMBRAPA and the participating institutions of the National System for Agriculture Research (SNPA).

3.2.2 Joint Efforts between CENARGEN and BAG Centers

This interaction or link is done through the Curators of product germplasm, with the Curators from the respective BAG centres. The Curator of product germplasm at CENARGEN has among other things, the right to promote, to put into action, and to follow the activities related to conservation, multiplication, and/or regeneration of germplasm of the products under his direction. The Curators of the Active Germplasm Banks are responsible for maintaining, multiplying, regenerating, and distributing the germplasm.

Despite the fact that the Brazilian system is well-structured, the activities of multiplication/regeneration present a number of problems concerning the areas of management of finances, infra-structure, and training of human resources. In the meantime, attempts have been made to improve the system, with the objective of perfecting the processes to better conserve the existing genetic resources for immediate or future use.

3.3 GERMPLASM COLLECTION

Various governmental and private institutions have developed a tradition in the collection of genetic resources of diverse products in Brazil. In SNPA, these activities have been coordinated by CENARGEN.

The collection activities aim to rescue the material for conservation and to make it available to the scientific community for research. One of the main objectives is to provide enough genetic variability for the breeding programmes, especially those working with improvements in the adaptation and tolerance to biotic and abiotic factors.

Germplasm collection expeditions have been carried out all over Brazil, especially in the areas threatened by the advance of the agricultural frontier and by the installation of large works of engineering, such as hydroelectric projects and mining sites. During these expeditions, primitive cultivars that are still in the hands of traditional farmers are collected with the final objective being conservation and research. Wild species of value are also collected and utilized for the sake of research related to plant breeding and plant genetics. Besides the species of immediate economic interest, species with future economic potential are also gathered. These plants are of interest because of their value in the areas of nutrition and human consumption, the medical industry, the fibre/textile and dye agents industry, and for the production of energy. So far, more than 300 expeditions have been carried out and almost 40,000 accessions have been collected, although the majority of these accessions (approximately 32,000) have still not been included in the data base kept at CENARGEN.

The germplasm that was collected during the expeditions in the form of sprouts, cuttings, seeds, or underground systems, makes up the most representative accession possible of the plant population, considering each population as a accession. Each accession is registered as it should be with the passport information. Normally, along with the collected accession, attempts are made to collect herbarium vouchers as well. From this material, with a number of four or five duplicates, a specimen is deposited at the Herbarium of CENARGEN

(CEN). The duplicated material is distributed to specialists in diverse botanical groups and to other herbaria, through an exchange system between national and international herbaria. The germplasm that is collected is sent to a respective BAG centre. For some products such as forage, peanut, rice, beans, and others, the collection activities present a wide and intense encompassing of the Southern, South-eastern and North-eastern regions of the country. These regions gather the most traditional centres of Brazilian agriculture. Likewise, in the Central-Western and Northern regions, there is a new expansion of agriculture. For this reason, there is not a perspective of lengthy expeditions in these regions, but rather there will be a re-examination of these areas already studied, and a more detailed collection undertaken in areas where access was restricted in the past.

On the other hand, the activity of collection in the North and the Northeast should increase. Examples of this can be seen with pineapple, cucurbits, cassava, etc., due to the rapid genetic erosion of these products in these two regions. It is of special interest, as well, to collect materials that show resistance to acidic soils, saline soils, and to drought. In addition, local races will be conserved on farms by small, traditional farmers or indigenous communities.

3.4 INTRODUCTION, EXCHANGE, AND QUARANTINE OF GERMPLASM

The area of Introduction, Exchange, and Quarantine of Germplasm (AIQ) at CENARGEN is responsible for the coordination and processing of plant germplasm exchange at SNPA, for the execution of quarantine of imported germplasm during the initial phase after the material has entered the country, as well as domestic quarantine, for germplasm in transit within the country. As a result of this action, it was possible to prevent over sixty pathogens from entering the country. In close collaboration with the National Department of Defence and Plant Inspection of the Ministry of Agriculture, Food Supply, and Agricultural Reform (MAARA), the AIQ carries out the registration, phytosanitary analysis, eradicating treatment, quarantine, and shipment of plant germplasm to the participants of the germplasm exchange system. The germplasm comes from all over the world and is handled with the utmost security and care.

The exchange of germplasm in Brazil is done in an informal way with countries and institutions that do not have restrictive measures. When there are political or phytosanitary restrictions involved in the exchange, at the national level, contracts are set up to give the exchange an official status, and the negotiations take place between competent institutions of each country.

During the last two decades, the movement of germplasm in the country, through importation, exportation, and transport within the country reached a level of more than 272,000 accessions (see Table 7).

The largest providers of germplasm for Brazil are the International Centers for Agricultural Research, the United States Department of Agriculture (USDA), and the North American Universities.

3.4.1 Brazilian Legislation

The presidential decree no. 24.114 from April 12, 1934, approved the Regulation of Plant Sanitary Defence to become effective in Brazil. This decree is composed of ten chapters and one hundred and forty-three articles.

During the sixty-one years that this decree has been in effect, more than five dozen complementary, government decrees have been signed in an effort to keep up to date with the current demands caused by the appearance of diseases and pests which do not yet occur in Brazil, but which pose a potential threat of being introduced by means of germplasm or commercial seeds.

This decree was also modified by two others, one in 1943, and another in 1961. These decrees, respectively, deal with the permission to internally transport live plants and with the validation of the certificate of stored grain disinfection.

The Federal Commision of the Ministry of Agriculture, through the deputy of each state, is at work in the airports, the sea and river ports, and the land borders, controlling the entrance of plant and animal materials into the country.

To legally bring germplasm into Brazil, it's necessary to observe the following regulations of Brazilian legislature:

a) Non-Prohibited Material

To bring material classified as “non-prohibited” into Brazil, the only thing that is required is a Phytosanitary Certificate from the official institution of the country of origin. The introductions of plant germplasm destined for SNPA are carried out through CENARGEN, which offers a dynamic, safe, and effective mechanism to solicit materials from abroad, and bring them in and liberate them once they arrive. Since 1986, nearly 10,000 materials like this have been brought into the country each year.

b) Material with Conditional Restrictions

To bring in germplasm of species that fall under this category it is not necessary to have the authorization of MAARA, but on the Phytosanitary Certificate issued by the country of origin, there should be an additional declaration included which refers to specific diseases and pests of concern.

c) Material whose Importation is Prohibited

It is forbidden to bring plants (or parts of plants) of a number of species into the country. Among these, the most important are: citrus, cotton, soybeans, banana, beans, rubber tree, sugarcane, sorghum, cocoa bean, and corn. The introduction of these species into the country is only permitted for research purposes and with prior authorization from MAARA.

3.5 CHARACTERIZATION AND EVALUATION

Brazil has at its disposal relevant germplasm collections of the majority of the agricultural products of interest for human consumption, for agricultural industry, and for exportation. These collections are continually being enriched through new material that is introduced or collected. Nevertheless, the degree of utilization of the available variability is very low, due to the lack of intensity of characterization and evaluation of the accessions for direct use or for plant breeding programmes. Within this context, the studies developed at SNPA have the following objectives:

1. to characterize and evaluate the germplasm collected or brought into the country, based upon the following aspects: taxonomic, morphological, cytogenetic, biochemical, and molecular;
2. to carry out basic studies in biology concerning gene flow and the determination of reproductive systems;
3. to analyze the viability of pollen germination;
4. to study the genetic instability in germplasm by cytogenetic and biochemical methods;
5. to identify markers, related to different ploidy levels, the means of reproduction, and mechanisms of pollination;
6. to develop, consolidate, and adapt methodologies for the characterization of the genetic resources in the following areas: taxonomy, morphology, cytogenetics, biochemistry, and molecular biology;
7. to promote and carry out training in the area of human resources in biological characterization;

At SNPA, characterization and evaluation are considered to be two distinct activities that should have multi-disciplinary foundations, need to be specific for groups that have a limited number of accessions, and require objectivity. The characterization considers simple and more descriptive aspects. When it is of an experimental nature, the aspects it examines tend to be more sophisticated. Evaluation, on the other hand, is always carried out in comparison of known parameters. The minimum target to be reached when considering its performance is the perspective of its use (in other words, its potential usefulness). When they are well directed, characterization and evaluation guarantee additional benefits: (1) they permit the identification of duplicates; (2) the development of core collections; and (3) the identify the mode of reproduction of the accessions. The fundamental stages of characterization and evaluation include: (1) the correct botanical identification of each accession; (2) the elaboration of a record of accessions for each species; (3) the biological characterization, per se, based on attributes that are mainly qualitative, and to a high degree inherited, and implemented by the application of descriptor lists; (4) the preliminary evaluation, based on more quantitative characters, always in contrast with known parameters; and (5) the more thorough evaluation, undertaken over a smaller number of accessions which permit adequate outlines, in replicated trials at different times and locations.

Regarding the biological characterization, the disciplined use of descriptors is the most efficient means to search for the desired information. Nevertheless, limiting factors of a physical, temporal, human and financial nature require objectivity in their use.

Several groups of germplasm accessions available in Brazil are in distinct situations in relation to their descriptors:

1) In the most privileged group, there are international manuals of descriptors and even lists of descriptors adapted to the variability present in Brazil. A great part of the descriptors are applied to a large portion of the available accessions.

2) There are groups of accessions with international descriptors available, but which have a low level of application in germplasm banks.

3) There are also situations where the international descriptors need to be adapted for use.

4) In other cases, it is necessary to create the specific list of descriptors itself (and analyze its discriminatory capacity).

5) Other groups, in general, gathering native species associated with crops, require taxonomic identification of the majority of their accessions.

6) In other situations, there aren't even taxonomic revisions available.

7) Lastly, there are groups in which the application of any descriptor without knowledge of the mode of reproduction merely leads to the accumulation of data which is difficult to interpret.

At SNPA, studies are being developed that examine the morphological, cytogenetic, genetic-biochemical, and molecular characterization.

The morphological characterization and the agricultural evaluation are being undertaken in a partial manner, as much for the number of descriptors as for the number of accessions, in the BAG network. In terms of the biochemical, cytogenetic, and molecular characterization, these are restricted to certain laboratories of SNPA which have the infra-structure to carry out these activities.

CENARGEN, besides being equipped with a good infra-structure, has a respectable research team. This allows CENARGEN not only to carry out the characterization of materials, but also to act as a disseminator of these modern techniques, through training programmes which it offers to technicians and researchers from universities and other institutions.

Brazil, following the policies of IBPGR, now called IPGRI, invested in activities of introduction of new material into the country, collection, and conservation of germplasm during the 1970s and 1980s. But at this same time, the activities of characterization and evaluation became marginalized. For this reason, a great collection of conserved materials exists within the country, however only a small percentage of this has been characterized and evaluated, and the information that exists is incomplete.

The great mass of germplasm that still needs to be characterized and evaluated, together with the slow nature of these activities and the limitations that exist of a technical, political, financial, and personal nature, indicate that this situation will continue for quite some time. In the meantime, modern methods of biochemical and molecular characterization are already being employed, which will certainly contribute to an increment in the research development in the centre. This could, in some cases, shorten the time necessary to complete the work or even to obtain important data, which will enable the utilization of specific accessions.

3.6 DOCUMENTATION AND INFORMATION

The increase in the levels of usage of genetic resources is closely linked to the availability of information. This fact has stimulated the establishment of an

efficient system of documentation and information cope with demands of genetic improvement and resource conservation.

This experience has shown that the potential offered by these genetic resources will only be used to their full potential in higher proportions than current ones, if the necessary information is available.

The activities of documentation and information for genetic resources carried out in the country have been directed toward the processing and monitoring of data related to:

1) the enrichment of genetic variability (surveying, collection, and exchange of germplasm),

2) the registration or inventory of collections, inventory and monitoring the state of conservation of the accessions, and

3) the characterization and evaluation of germplasm.

Even with gaps of information, the data base kept at CENARGEN presents information related to:

- Collection (approximately 8,000 are registered).
- Exchange, Introduction of material, and Internal movement of material within Brazil (approximately 220,000 are registered).
- *Ex situ* Conservation (approximately 172,000 are registered)
- Characterization and Evaluation (still in process).

The first system that was organized to process information related to the activities which gathered genetic resources in Brazil was developed by EMBRAPA/CENARGEN. This was known as the Germplasm System (SG) and was in use during the period from 1977-1980. This system utilized an IBM 360 computer and possessed two important applications. The first, called SICAPRE, controlled the information from collections, exchange, and conservation. The second, called SCG, to utilize the information from the characterization and evaluation phases. The activities of documentation are carried out with three focal points:

1) the processing of information utilizing the resources offered by the Genetic Resource Information System (SIRG 4.0), with applications for one-time users;

2) the development of a new Brazilian System of Information Concerning Genetic Resources (SIBRAGEN) to be used as a national network; and

3) the establishment and support of a national network, both at the regional and continental level, as is the case of SIBRAGEN, of the Amazon network known as SUDAM-GENAMAZ, and of the network called IICA-PROCISUR.

3.6.1 Genetic Resource Information System (SIRG)

The Genetic Resource Information System (SIRG) of EMBRAPA/CENARGEN was developed to operate microcomputers such as IBM PC and the operational system DOS. Since the space on the diskette for storing or holding information was a limiting factor at the time of development of this system, it was set up so that each group of activities was organized for specific applications. Nonetheless, the tables and codes that were used all had a common use, which can be seen in the following groups:

a) for collection, with the title COLETA;

b) for exchange, introduction, and internal transport, with the title REGISTRO;

c) for *ex situ* conservation, in both base and active collections, with the titles COLBASE and COLATIVA;

d) for monitoring the charts having information about family, genus, and species, using the title name DICTAB;

e) for monitoring the addresses and acronyms of the institutions, with the titles ENDERECO and DICTAB;

f) for characterization and evaluation, with the title AVALIA.

The structure of SIRG, Version 4.0, has the following design

COLLECTION	EXCHANGE	BASE COL.	ACTIVE COL.	TABLES	EVALUATION
Data Entry	Data Entry	Data Entry	Data Entry	Data Entry	Organize
Correction	Correction	Reports	Correction	Correction	Data Entry
Sort	Sort	Support	Sort	Sort	Sort
Reports	Reports	Tables	Reports	Reports	Reports
Tables	Tables	Ret.System	Tables	Ret.System	Correction
Support	Support		Support		Ret.System
Ret.System	Ret.System		Ret.System		

3.6.2 Brazilian System of Genetic Resource Information (SIBRARGEN)

Strategically, it is necessary that a scientific community regulates the information dealing with genetic resources that exist within the country, with the goal of orienting itself in the decision making process concerning the utilization and/or enrichment of these resources.

Due to the vast amount of information that Brazil possesses about the germplasm that is collected, introduced, exchanged and conserved, it was necessary to develop an automated and computerized system, in network form, to cope with the ever-growing needs of its users. The Brazilian System of Genetic Resource Information (SIBRARGEN) which is being developed by CENARGEN will aim to fill this gap. At SIBRARGEN the information will be stored and separated according to related activities. The topics which shall be discussed separately include the following:

a) Taxonomic information;

b) Information about institutions and people involved with germplasm activities;

c) Information about germplasm that enters the country, registered at CENARGEN;

d) Requests and filling these requests for germplasm to be done by CENARGEN;

e) Conservation of germplasm collections on short and long term bases;

f) Evaluation and characterization of germplasm;

g) Germplasm collection activities;

The management of data involves everything from gathering the information to the access of this information by users, through direct consultations or reports, publications, and catalogues.

These data will be available to the national and international scientific community through Internet.

3.6.3 The Computer Network

CENARGEN has been increasing its investment in computer science by hiring skilled individuals, training the users of the computers, and acquiring hardware and software besides the installation of the communication network. The first great step was made with the acquisition and training of the technical team at the Software Administrator of the Data Bank ORACLE. This software will allow CENARGEN to integrate all of the Unit's data and make them available for the easy and safe use of the user. The second step was the installation of the local network of computers which were linked to the National Network of Research (RNP) and to the INTERNET, which permitted the installation of the Brazilian Centre of Bioinformatic Resources. In this network, there are a number of data bases, discussion lists, softwares and

computer resources installed for the use of the national and international scientific communities in the areas of Genetic Resources and Biotechnology, besides allowing the use of the electric mail system (e-mail) and giving access to other data bases.

The third step will be the development and implementation of systems, other than SIBRARGEN, to automate the technical and administrative routines and to create the data bases for CENARGEN, in an integrated way and with a high level of availability of the information.

CHAPTER 4
Utilization of Genetic Resources in the Country

In a general way, the use of genetic resources in Brazil involves the germplasm from the country itself, as well as from outside sources.

Nearly 76% of the germplasm available for agricultural use in the country have an exotic origin and were introduced into the country during the twentieth century. The cultures which have the greatest impact on Brazilian exportation such as soybean, coffee, sugarcane, citrus, and others of great interest for national consumption such as wheat, make up the first group of plants where breeding is based on introduced materials. A second group of products includes cultivated species that are not from the Americas, such as rice and oats, whose exotic genetic base is amplified by crosses with local breeds and associated native species. Finally, accessions of populations of wild Brazilian species, of forage, and of medicinal and fibrous plants are stored at germplasm banks, with plans for future use.

In the North and Central-West regions, a great number of species that present excellent potential for use and a possibility to be put in the market within a short time have received little attention.

In general, the natural resources of the country have not been studied well and haven't been exploited to their full potential, both from the botanical and phytotechnical points of view. This situation indicates a need for taxonomic, floristic, ecological, and other studies, which would attempt to better use the autoctonous species already known and/or potentially important as lactiferous, insecticides, medicinal, roots and tubers, forage, condiments, legume grains, fruits, leafy vegetables, forest plants, besides others.

A recent study done by corn and soybean breeders of both the public and private sectors demonstrated that both groups preferred to use their own collections from their work or even to exchange accessions with other breeders rather than use materials from the Germplasm Banks. This perhaps is a result of the fact that there is a lack of knowledge about the conserved germplasm (in the banks), especially concerning the characteristics that can be utilized with efficiency and efficacy in the breeding programmes.

Some new-world products, like peanut, cassava, pineapple, sweet potato, and some types of forage, were among the plants most studied. This made them

available for genetic improvement programmes which are being carried out throughout the country and in conjunction with other international institutions.

In the Germplasm Banks, the collections of rice, beans, corn, cassava, wheat, soybean, potato, sorghum, forest plants, and forage were the plants that presented the highest index of usage. These products are part of 32 Research Projects of Genetic Improvement Programmes, of the EMBRAPA System of Planning (SEP).

The genetic improvement programmes at the national level have, as their main function, the goal of improving the agricultural characteristics of the local varieties, the adaptation of imported germplasm to the local needs by introducing specific characteristics, such as resistance to biotic and abiotic conditions. The majority of these programmes, financially supported by the government and private institutions, aim to increase the productivity and production, as well as enlarge the genetic base of the cultures and reduce their vulnerability. The national activities of plant breeding are primarily concentrated in satisfying the demands of consumption within the country, and increasing the opportunities for exportation, among other goals. The genetic improvement programmes, mainly those of SEP, are developed based on the demands of the users.

The utilization of Forest Genetic Resources in Brazil, during the period of observance of the Law of Fiscal Incentives for Reforestation which was concluded in 1986, was based on the fact that it was mandatory to use seeds from sources that were accredited (received credentials) from the government. This credentializing measure worked as an instrument to control the genetic quality of the seeds being offered on the market. Today, in Brazil, there is a great effort being made to improve the production and the supplying of seeds of forest species. Normally, the great enterprises that work with reforestation have their own programme of seed production, as much for their own use as for
commercialization.

In relation to the utilization of germplasm that is conserved *in situ*, such as autoctonous plants or primitive varieties in protected areas or areas of indigenous population, the constant use of plants mainly for nutrition or medicinal purposes has great economic and social importance for the area. These can be transformed into potential sources for utilization in genetic improvement programmes and for other scientific purposes. The role of exploitation reserves also deserves special attention, particularly with rubber tree (*Hevea spp*) from the state of Acre and babassu (*Orbignya phalerata*) in the state of Maranhao, because they allow for the rational use of these genotypes among the native populations in the locations where they have been implemented.

It is known that only a minimal percentage of genetic variability which is available on the planet is actually being used in the breeding programmes. This is mainly due to the fact that there is a universal tendency among breeders to utilize the elite germplasm from their work collections which is detrimental to the primitive material.

Despite the fact that attempts are being made to develop breeding programmes in the country which look for adequate variability in the germplasm banks to obtain the desired genetic gains, efforts to utilize autoctonous germplasm must be intensified. This is especially true in relation to the autoctonous species that are used for human consumption in the diet of the Brazilian population. The fact remains that nearly 80% of the products that are consumed are of an exotic origin.

In a more advanced stage of utilization of genotypes, that is to say, the use of basic seeds from cultures that were developed in breeding programmes and whose materials originated in germplasm banks in Brazil, EMBRAPA possesses a consistent "Service of Production of Basic Seeds." This service guarantees the distribution of high quality seeds to seed producers, cooperatives and farmers, with the goal of enhancing commercial seed production.

CHAPTER 5
Objectives, Policies, Programmes, and National Legislature

5.1 INTRODUCTION

In the National System of Agricultural Research (SNPA), the activities of genetic resources are inserted in the Genetic Resource Conservation and Use Programme, which together with fifteen other programmes makes up part of the EMBRAPA System of Planning (SEP).

The Brazilian Enterprise of Agriculture Research (EMBRAPA) is a public enterprise, linked to the Ministry of Agriculture, Food Supply, and Agricultural Reform (MAARA), and that has the mandate of "generating, promoting, and transferring knowledge and technology for the sustainable development of the agriculture, agri-industrial, and forest sectors for the benefit of society."

The current Institutional Model of EMBRAPA entails two types of action:

1. Direct Action developed through four categories of units:

a) **National Centers for Research on Basic Themes.** These are units that focus on trained personnel and sufficient resources to advance the frontier of knowledge, while promoting the technical advancement of strategic areas. The National Centre of Genetic Resources and Biotechnology (CENARGEN) falls into this category;

b) **National Centers for Product Research.** These are units that deal specifically with the study of one or more products in particular, concentrating trained personnel and resources, in such a way that they become centres of excellence for the product or products being studied;

c) **Ecological-Regional Centers of Research.** These are units which should search for technological solutions that will contribute to the sustainable development of ecological regions and their integration to the national productive process;

d) **Special Services.** These are units whose main purpose is to promote, support, and execute the maintenance or distribution of products, processes, and services, through a close collaboration with the research centres. The Service of Basic Seed Production falls into this category.

2. Cooperative Action EMBRAPA encourages the development of joint activities, through the cooperative action and institutional integration with state systems of agriculture research and rural extensions, avoiding overlapping. It is still looking for a partnership with universities and the private sector in an effort to improve agricultural research, technical assistance, and rural extension programmes, through agreements and contracts of cooperation of services as a means to integrate all these related sectors with shared agricultural activities.

5.2 EMBRAPA SYSTEM OF PLANNING (SEP)

SEP is made up of programmatic figures and mechanisms of articulation. The programmatic figures have a) an institutional nature, which is characterized by the Directional Plans, Strategic Plans, and Yearly Work Plan and b) an inter-institutional nature, which is characterized by three basic elements: Programme, Project, and Sub-project.

The Programme defines the institutional policy in certain areas or in subjects of national priority. The structure of the programmes is established through the subsystem of surveying and prioritizing the demands, which in turn help to guide the formulation of projects. The Programme has clear and attainable objectives for medium and long range and it distributes the human, material, and financial resources among its projects. The programme encompasses the nation and involves activities that are typically multi-institutional.

The Programme joins a group of activities that aim at solving a relevant problem which was detected by users and clients of research; it is all encompassing, with a systematic and interdisciplinary nature, involving the work of multi-disciplinary teams from one or more institutions and it covers all the stages of the process of technological innovation, from the production of knowledge to the adoption of technology.

The Sub-project is an auxiliary, programmatic figure, in which the activities to be developed are ordained with the objective of solving specific and relevant problems within each project.

5.3 NATIONAL PROGRAMME

The introduction that was presented above was necessary to situate the Genetic Resources Programme in a national context, in a way to demonstrate that the same is an integral part of a system of research and development planned by SNPA. This Programme entitled “Genetic Resource Conservation

and Use Programme" has as its general objective "to enrich and conserve the exotic and native genetic resources of current social-economic importance and potential for the country and to promote and increase their utilization in breeding programmes, for the development of sustainable agriculture."

The basic activities of the Programme (enrichment of variability, evaluation, characterization, conservation and documentation of germplasm) are being developed through projects and sub-projects financed, for the most part, by funds from the Ministry of Agriculture, with the participation of besides the various EMBRAPA centres, State Enterprises of Research, Universities, State Institutions of Research, and Private Businesses.

The Programme is well-founded and technically supported by CENARGEN, which has the mandate of "securing the diversity of genetic resources and developing biotechnological methodologies and processes, whose utilization aims to benefit all of society." The projects and the System of Curators are the mechanisms of interaction between CENARGEN and the Programme.

The activities of the Programme related to research, management, and conservation of forest genetic resources are the ones that most deal with private industry, counting on the participation of 27 commercial businesses, besides the involvement of government institutions. Various germplasm banks of forest species are being implemented and diverse activities of cooperation are being developed with congenerous institutions from a number of countries affiliated with the Central American and Mexican Cooperative for Genetic Resources of Conifers (CAMCORE).

Although a variety of non-governmental organizations (ONGs) exist in the country, which work with the conservation of biodiversity, there has still not been any direct participation of these organizations in the genetic resources programme at EMBRAPA. The participation of farmers in the Programme occurs in an indirect way, through the demands directed toward genetic improvement which go through the Genetic Resources System.

The goals, objectives and maintenance of the Genetic Resources Programme in Brazil are directly inserted in the mission and objectives of EMBRAPA, which has the mandate to coordinate SNPA, according to directives of the federal government. Within this focus, the Programme appears as the main catalyst of activities dealing with genetic resources, from their introduction into the country to the diverse manners of conservation and sustainable utilization of germplasm in Brazil.

There is no official National Committee in Brazil which defines the policies related to genetic resources, although this has been recommended and said to

be extremely important and CENARGEN has been litigating the formation of one for many years.

In order to assure that the demands of society are met, guarantee the perfect integration and participation between institutions, and insure the technical quality of the programme, the EMBRAPA System of Planning foresaw the following mechanisms of articulation: a) National Advising Council (CN), b) Regional Advising Council (CR), c) Technical Commision of Programmes (CTP), and d) Internal Technical Committee (CTI) in each research centre. Each Programme has a Technical Commission formed by specialists, professors, and representatives from other segments of society who work with agriculture. The Technical Commissions of Programmes have a thoughtful and reflective nature and are responsible for the planning and initial mounting of the respective programmes, with a basis in national and regional priorities, in conjunction with the Councils. Nevertheless, the original function of CTP is the analysis, follow up, and evaluation of the integrated projects of its programme. The CTPs make up an important mechanism in the search for quality and efficiency within the programme. CTP has a president, who will always be the head of the centre where the Executive Office and the Executive Secretary (nominated by the president of EMBRAPA and who manages the activities of the Programme) are located.

In the case of the Genetic Resources Programme, the CTP is made up of five members, of which, currently, three are professors of different Brazilian universities, two others are specialists in areas of interest to EMBRAPA, and the president of CTP/RG is the head of CENARGEN, where the Executive Office of the Genetic Resources Programme is located.

The collections which are conserved at short, medium, and long terms in germplasm banks in Brazil are not protected by an official decree from the government. The most significant commitment of the country to conserve its biodiversity and consequently, its genetic resources, is the one that was undertaken at the Biodiversity Convention of 1992 in Rio de Janeiro. Besides this, there also exists pertinent legislature related to the protection of sanctuaries in private areas.

The System of Management, Conservation, and Use of Genetic Resources in Brazil is very well planned and founded. Nevertheless, it is necessary to go beyond the governmental regulations and legislation and the long range commitment of the institutions, and involve other segments of society, as for example, the non-governmental organizations (ONGs) who do not yet participate in these activities. In this way, the country will have the whole society involved and taking responsibility with the task of conserving its genetic resources for future generations and utilizing them in a sustainable manner.

Genetic resources are considered a vital component of biodiversity, however, and countries that are rich in biodiversity are not necessarily rich in genetic resources and able to guarantee sufficient food production for their populations. Brazil, for example, possesses approximately sixty thousand out of a total of two hundred and fifty thousand plant species. Brazilian agriculture, however, including even the Amazon region, where the highest number of plant species of the Brazilian flora are concentrated, would never progress without the systematic and increasing importation of germplasm. This national dependence tends to persist because agriculture will always need improved varieties, with ever increasing levels of resistance and adaptation to biotic and abiotic environmental factors, as well as commercial and industrial characteristics which are progressively more favourable.

5.4 QUALIFICATION

The National Programme of Genetic Resources depends on capable individuals working in their diverse specialized areas, although there aren't sufficient scientists to develop all of the necessary areas which arise in a programme as broad as this one. The training of researchers has been done in American and European universities and, more recently, within Brazil as some specialized courses are beginning to appear, connected mostly to important graduate courses related to plant research.

The Programme relies upon researchers who have been trained in techniques dealing with genetics and breeding, statistics, documentation, seed technology, taxonomy, and phytopathology. Over the past two years, it has also assembled a group of specialist who work with molecular genetics and computer networking databases. A recent concern has been the necessity to adopt a policy of forming groups and the replacement of researchers who are retiring or who change institutions or activities.

CENARGEN offers courses of short duration in germplasm management and conservation, plant protection, quantitative genetics, and molecular characterization of germplasm. There is a great demand in the Latin American countries for these types of courses to be extended to researchers in the region. In the meantime, there is a need for international resources so that CENARGEN can meet this demand.

The level of education and awareness of the national authorities and the users (breeders and farmers) is likewise unsatisfactory. Efforts in this sense are necessary to increase the awareness about the importance of conservation and utilization of the genetic resources.

The activities of the Programme are developed by professionals of both sexes. Recently, the direct involvement of indigenous groups which are highly acculturated has been highlighted in the activities of conservation of local varieties of diverse species that are important in their diet.

5.5 NATIONAL LEGISLATION

The rules and procedures for importation, exportation, and internal movement of germplasm are defined in the legislation referred to in Chapter 3 of this report. Although the post-entrance and the domestic quarantine processes may be slow, they constitute the only safe method of introducing plant germplasm into the country, avoiding the introduction of exotic pathogens and pests.

Meanwhile, the great failure of the Brazilian system of introducing and exchanging plant materials lies in the fact that the phytosanitary legislation is extremely strict for material introduced for research purposes, while the material introduced for production and commercial purposes enters the country in large quantities and with merely a random inspection, which greatly increases the risk of introducing exotic pathogens and pests into the country.

EMBRAPA, through its "Basic Seed Production Service", guarantees the distribution of improved cultivars to seed producers, cooperatives, and farmers, aiming for the production of commercial seeds.

Brazil cannot yet rely upon National Legislation Concerning Intellectual Property applied to inventions (patents) and obtained plant materials, including agricultural products. In the case of the legislation concerning "Breeder's rights", the Executive branch of Brazilian government is about to send a proposal dealing with this area to the Legislative branch of government. This proposal, called the Law of Plant Cultivars, will attempt to regulate the intellectual property in the case of obtained plant materials. This legislation was prepared having a base in the revised version of 1978 by UPOV, as a way for Brazil to affiliate itself to that International Convention if it were necessary.

On the other hand, the Federal Senate currently discusses a project concerning Industrial Intellectual Property (the so-called "Patent Law") in its Commission of Economic Issues. The project allows the patenting of transgenic microorganisms without, in the meantime, clearly defining in legal terms what is understood by "micro-organisms", and what could be modified afterwards

with a complementary law. This implies that, potentially, all or part of animal and vegetable cells could be patented. This situation could substantially reduce the availability of genetic resources for exchange in the country and abroad, due to the strong appropriation by patent of genetic resources modified by modern biotechniques.

CHAPTER 6
International Collaboration

6.1 INITIATIVES TAKEN BY THE UNITED NATIONS

Brazil is one of the countries which has signed the Agenda 21 and Biological Diversity Convention agreements. It also recognizes that promoting a sustainable use of biological diversity is a subject that transcends political frontiers and is highly dependent on international cooperation. In this particular matter, Brazil also recognizes the diverse agencies s of the United Nations such as the United Nations Programme for the Environment (PNUMA), the United Nations Programme for Development (PNUD), and the United Nations Food and Agricultural Organization (FAO), as adequate forums to discuss and see mechanisms of multilateral cooperation implemented, in order to promote conservation and sustainable use of biological diversity and genetic resources.

Brazil is a member of the Phytogenetic Resources Commission (CRF) of FAO, but it is not a signing member of the "International Undertaking." The fact that Brazil has not signed this agreement is mainly due to: 1) the lack of a clear definition of the term "Genetic Resources for Agriculture and Food", and the impression that it was too encompassing in terms of species to be included in the agreement to be accepted by the country; 2) the right of the country to enter into bilateral agreements concerning cooperation for collection, introduction, and exchange of germplasm, in agreement with the convenience of the parties who had signed the contract; and 3) the right of the country to restrict the access of certain species, groups of plant species, of great economic importance, negotiating them for germplasm, technology, and existing information in other countries according to the specific national interests.

6.2 MEASURES TAKEN TO IMPLEMENT CHAPTERS 14 AND 15 INTO AGENDA 21

Brazil, as one of the richest countries in biological diversity on the planet, has taken a number of measures attempting to evaluate and reduce the adverse impacts of biological diversity development programmes to the minimum degree. Among these, those that really stand out are the activities which monitor the environmental impact, developed by the National Institute for Special Re-

search (INPE), which belongs to the Ministry of Science and Technology; by the Nucleus of Environmental and Natural Resources Monitoring Via Satellite (NMA) and by the National Centre for Research Concerning the Monitoring and Evaluation of Environmental Impact (CNPMA), both research centres of EMBRAPA.

Great emphasis has been given by INPE in the mounting and distribution of electronic information from data bases, among which, those that deserve special mention are: The Global Resource Information Database (GRID), METEOSAT-3 Infra-RED Images, Amazonia from Space and the Remote Sensing of the Legal Brazilian Amazonia, besides the integrated efforts of NMA to follow and control the burned areas in all the national territory.

The Ministry of the Environment, of Water Resources, and of Legal Brazilian Amazonia (MMA) created, by the Law Decree 1354 from December 29, 1994, the National Programme of Biological Diversity (PRONABIO).

The main objectives of this programme are to motivate and promote partnerships between the public power and the civilian society in conservation of biological diversity, sustainable utilization of its components, and distribution of benefits, through the carrying out of the following activities: 1) to define methodologies, instruments and processes; 2) to motivate international cooperation; 3) to promote research and studies; 4) to produce and disseminate information; 5) to prepare individuals for this work and to perfect institutions and to raise the public's level of awareness; and 6) to develop demonstrative actions for the conservation of biological diversity and sustainable utilization of its components.

In the Federal sphere, the conservation of biological diversity in Brazil is the responsibility of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), which coordinates the activities carried out in different types of units of conservation distributed in the main biomes found throughout the country, and covering, approximately 4% of the national territory. To these, add another 430 units of conservation in the municipal and state circuit, besides the 554 indigenous reserves as mentioned in Table 1.

The conservation of genetic resources, mainly those important for agriculture and food production, are the responsibility of EMBRAPA, by means of CENARGEN, located in Brasilia-DF, headquarters of Programme II "Conservation and Use of Genetic Resources" of EMBRAPA. This group coordinates activities in 83 Active Germplasm Banks, 11 Nucleus of conservation of domestic animals threatened by extinction, and 5 Genetic Reserves for Conservation of genetic resources of plant material *in situ*, distributed in diverse research centres and private property in the country (see Table8).

6.3 WORLD SYSTEM OF FAO

After the Biological Diversity Convention (CDB) took place, and with the responsibility conferred on the nations who had signed this agreement for the FAO, with the goal of reviewing the "International Agreement", the need for member nations of the United Nations to discuss multilateral mechanisms for the conservation and sustainable use of genetic resources grows significantly in importance. This is due to the dependence of all nations in relation on the genetic resources important for agriculture and food production. In this particular area, the introduction, exchange and collection of genetic resources, the transfer of technology for characterization and conservation, the distribution of information, and the preparation of a global plan which includes the creation of a fund of financial resources to be applied to activities of conservation and utilization of genetic resources, is made up of aspects of priority which will be analyzed by the representatives in the CRF of FAO.

The Brazilian positions are examined with great interest by the CRF because Brazil is a country that is rich in biological diversity, possesses a strong system of conservation and use of genetic resources and it presents production and agricultural areas of great magnitude in the international markets.

It is hoped that the CRF finds mechanisms of multilateral cooperation which are able to promote the conservation and utilization of genetic resources for agriculture and food production which guarantee the sustainable production and distribution of food for all of humanity. These means would be supported by CDB initially, which is founded upon the sovereignty that the nations exert over their biological resources and in the fair and equal distribution of their benefits.

It is also hoped that in the next few years, solutions will be presented and accepted by the (participating) nations for the following questions/issues:

a) a clear definition for the term "genetic resources for agriculture and food production," composing a list of species or plant genera of great importance as sources for the alimentation of humanity, upon which the agreements that the country would accept would be based, within the multilateral system of FAO;

b) the possibility of the countries to reserve for themselves the right to enter in bilateral agreements for the cooperation involving specific genetic resources of their interest;

c) definition of a "Global Plan of Action" for the conservation and sustainable use of genetic resources for agriculture and alimentation, clearly defining who will participate, the concrete objectives and goals, besides

strategies and mechanisms to be used based upon the financial support given for these purposes; and

d) a clear definition of the role of the International Centers for Agricultural Research (IARCs), of the CGIAR, in the access, conservation, and use of genetic resources; how these centres can serve as a multilateral system and how they will relate with the governmental mechanisms.

6.4 THE ROLE AND IMPORTANCE OF THE INTERNATIONAL CENTERS FOR AGRICULTURAL RESEARCH(CIPA), OF THE CONSULTATIVE GROUP FOR INTERNATIONAL AGRICULTURE RESEARCH(CGIAR) FOR THE ACTIVITIES INVOLVING GENETIC RESOURCES IN BRAZIL

Brazil has a broad tradition of collaboration with the IARCs, both as a receptor and a donor of genetic resources of different species, among which deserve special attention the cooperative works dealing with Cassava (*Manihot*) in conjunction with the CIAT and IITA organizations, with Peanut and related wild species (*Arachis*) with the CIAT and ICRISAT organizations, with diverse types of forage and Bean (*Phaseolus* and *Vigna*) with CIAT, Corn (*Zea*) and Wheat (*Triticum*) with CIMMYT, and Potato (*Solanum*) and Sweet Potato (*Ipomoea*) with CIP. The long and useful cooperation between EMBRAPA and other national institutions with IPGRI must also be mentioned, in efforts of collection, conservation, characterization, and the establishment of patterns for the management of genetic resources of plants.

This cooperation has been fundamental for the activities of plant breeding conducted by various research institutions in the country which introduce new varieties to the market, according to the needs of national agricultural development. On the other hand, the collections of the International Centers have been significantly enriched by materials collected in Brazil (forage, *Arachis*, *Manihot*), which makes it possible for other countries and their genetic improvement programmes to benefit as well.

6.5 NETWORKS OF REGIONAL COOPERATION

Over the past two decades, regional networks of cooperation for the conservation and use of genetic resources have been created and strengthened. The initial emphasis has been on collaborating research projects for the evaluation of germplasm.

Among the advantages of regional cooperation, the following stand out: a) the standardization of methodologies between the different national programmes for the management of genetic resources; b) the establishment of qualification and training programmes; c) the establishment of regional collections, with reference to the prioritized species; d) the exchange of information about characterization; and e) the establishment of a harmonized national legislature concerning accession to genetic resources.

For this reason, networks were created for the Southern Cone countries (Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay) in the beginning of the existence of IICA/PROCISUR. These networks were developed to evaluate germplasm of peanut (*Arachis hypogea*), diverse types of forage of a temperate climate. With this objective the Network for the Evaluation of Forage of the Southern Cone (REFCOSUR) was created and Wheat (Triticum) by means of two networks called LACOS and ERCOS. These networks are currently being revised in relation to their technical efficiency and the utilization of the results for the countries of the Southern Cone, considering the objectives of the new Sub-programme "Conservation and Utilization of Genetic Resources" of PROCISUR. Brazil (via EMBRAPA/CENARGEN) has a responsibility to bring about the international coordination of this Subprogramme, which currently includes initiatives for fruit-bearing plants of a temperate climate, vegetables, and a network of information and documentation concerning genetic resources through the INTERNET.

In a similar way, the TROPIGEN NETWORK was created for the countries of the Amazon Basin (Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam, and Venezuela). This was done through IICA for cooperative projects of conservation and utilization of genetic resources originating from the tropical rainforest, cerrado, and savannah. The national coordinators of the eight countries mentioned above initially defined four genera of priority for the projects of TROPIGEN, which are the following: *Bactris*, *Ananas*, *Carica*, and *Theobroma*. Brazil internationally coordinates the Genetic Resources Sub-Programme of PROCITROPICOS, through EMBRAPA/CENARGEN, while the TROPIGEN NETWORK is coordinated with partial support from the office of IPGRI for the Americas, which is located in Cali (Colombia).

Among the activities already carried out by FAO in the regional circuit, the effort made in collaboration with the Amazon Cooperation Treaty (TCA) really stands out. This resulted in the preparation of the document "Regional Policy and Strategy Proposals for the Advantageous Use of Nutritive Crops and Fruit-Bearing Plants of the Amazon," published by the Protempore Ministry of TCA in Lima, Peru, in Portuguese and Spanish. This document, besides indicating important policies for perfecting the use of these genetic re-

sources, presents a list of priorities of the fruit and vegetable species of the Amazon region which is of great relevance.

CHAPTER 7
National Necessities and Opportunities

Since 1974, the Brazilian Government has been stimulating a systematic action for dealing with genetic resources through EMBRAPA. This action is founded on the following premises: 1) a strong, world-wide concern about conservation and use of biological diversity; 2) a need to enrich the genetic variability that is available for species of social-economic interest; 3) a need to raise the social-economic potential that has been offered by autoctonous germplasm.

In this way, an action was organized for working with genetic resources, with a balance between the routine jobs and research, and it focused on the following activities:

a) introduction and exchange of germplasm;

b) surveying and collection of germplasm;

c) conservation of germplasm *in situ* and *ex situ*;

d) increasing the level of knowledge about ethnobiology, characterization and evaluation

e) documentation and information, concerning both conservation as well as use of germplasm.

7.1 NECESSITIES

The experience that has been accumulated in the management of genetic resources during the period from 1974 to 1995, stimulates a continual reorientation of activities; among these, the following deserve special attention:

a) the strengthening of a closer relationship between the eco-geographical distribution of genetic diversity and the activities dealing with genetic resources, such as sampling and maintenance of genetic characteristics of populations, and the organization of collections arranged by characteristics of environmental adaptation and usefulness of genetic resources;

b) the establishment of regional activities, prioritized by biomes, within a systematic and social-economic focus (multi-disciplinary and multi-institutional);

c) the promotion of the use of available germplasm through the knowledge of its social-economic potential and from studies that facilitate its utilization in breeding programmes;

d) the utilization of modern biological techniques in routine activities and germplasm exchange.

Consequently, it is becoming necessary that actions related to the following aspects be carried out:

1) The organization of a National Council for Genetics Resources, as a superior organ, at the inter-ministerial level, to establish related policies for the genetic resources of the country.

2) The establishment of a national policy for scientific and institutional integration for activities that are integrated in the following aspects:

a) technical and scientific training,

b) a technological inventory at the national level,

c) institutional cooperation and complementation,

d) institutional strengthening,

e) support for the organization of technical and scientific teams and,

f) the establishment of priorities based upon the risk of loss of genetic variability.

3) The establishment of a national policy for the acquisition and *in situ* and *ex situ* conservation of genetic resources of interest to the country, through an integrated, institutional action, as a way to define the strategies needed to obtain and conserve the pertinent genetic diversity.

4) The establishment of a national policy for the use, protection, and exchange of national germplasm.

7.2 OPPORTUNITIES

The opportunities which have been presented by the country are related to the perspectives that different groups of actions offer, mutually interacting and which could be considered strategic. Within this context, the national opportunities are based upon the following aspects:

a) the potential value of national diversity, classified at a global level as "megadiversity" and the potential social-economic value of the existing genetic diversity in the country;

b) the potential offered by the institutional experience of a genetic resource system of operations, including in relation to the demands and pressures caused by institutional integration, conservation, and use of germplasm, and the potential that exists in relation to the installed expertise and experience in diffusion and transfer of technology for the conservation and use of genetic resources; and

c) the demand for knowledge and business opportunities demonstrated by the private sector and the potential that is offered by institutional integration in the form of regional networks as a strategy for discussing common problems and their solutions.

CHAPTER 8
Proposals for the "Global Plan of Action" for Phytogenetic Resources

8.1 PRINCIPLES

The Global Plan of Action should be founded upon the invariable terms of the Biological Diversity Agreement, with special attention paid to the principles established in its preamble and in the terms stated in Articles 15, 16, 17, 18, 19, and 20.

8.2 COMPONENTS

In agreement with the discussions that occurred in the circuit of the Commission of Phytogenetic Resources (CRF) of FAO, Brazil calls attention to the following components to be considered in the creation of a Global Plan of Action which aims to improve the conservation, and mainly, the use of phytogenetic resources by the international community:

a) To prioritize the definition of a multilateral plan of action aiming to strengthen the activities of conservation and the use of plant genera or species which are highly relevant to the sources of human nutrition on a world scale. In this programme, the main cereals and grains should be included (this includes corn, rice, wheat, oat, beans, and soybeans), roots and tubers (cassava, potato, and sweet potato), basic sources of energy (sugarcane), as well as forage species, given the importance of the chain of production of animal protein during the last few decades. Access to the information related to the Phytogenetic Resources conservation and utilization techniques, strategically and widely distributed, should be facilitated by the contractors of the Global Plan of Action.

b) To establish facilities and means of access to financial resources, scientific technology and knowledge, and specific programmes for training and qualification, by the participating countries.

c) To create a vast system of information and alert the international scientific community about the existing phytogenetic resources in the world (this information can be easily disseminated).

d) To establish an International Code of Conduct for the collection and exchange of germplasm, considering phytosanitary regulations to be followed by the convening countries.

e) To publish a periodic bulletin about the state of the art in conservation and utilization of genetic resources in the different regions of the world.

f) To create an International Fund for the conservation and utilization of the genetic resources, especially guided by the creation and support for national programmes in development.

Working together, these components aim to guarantee the conservation and the availability of phytogenetic resources that exist in *ex situ* collections, as well as *in situ* conservation which occurs in the regions of origin and together with the traditional farming and indigenous communities.

ANNEX 1

Table 1 Official Conservation Units in Brazil

REGION	BRAZILIAN CONSERVATION UNITS					
	INDIRECT USE			DIRECT USE		
	Type	N°	Area/ha	Type	N°	Area/ha
	Estação Ecológica	11	1,889,010	Área Proteçao Amb.	01	21,600
	Reserva Biológica	05	2,561,150	Área Indígena	305	79,249,634
	Reserva Ecológica	03	553,296	Floresta Nacional	24	12,527,983
	Parque Nacional	07	8,133,113	Reserva Extrativista	04	2,261,269
NORTH	Área Relevante Interesse Ecológico	02	18,288	-	-	-
	Área sob Proteção Especial	01	272,000	-	-	-
	Reserva Particular Patrimonio Natural	02	2,110	-	-	-
	Unid. de Cons.Estadual/Municipal	04	5,811	-	-	-
	Total	**35**	**13,434,778**	**Total**	**334**	**94,060,486**
	NORTH TOTAL				**369**	**107,495,264**
	Estação Ecológica	06	149,896	Área Prot. Amb.	05	93,740
	Reserva Biológica	08	402,503	Área Indígena	64	2,194,842
	Reserva Ecológica	01	99,772	Flor. Nacional	01	38,262
	Área Preserv. Perm.	04	688,142	Reserva Extrativ.	03	27,042
	Parque Nacional	08	540,268	Reserva Recurso	19	1,300
NORH EAST	Área Relevante Interesse Ecológico	01	7,500	-	-	-
	Área sob Proteção Especial	03	10,278	-	-	-
	Reserva Particular Patrimonio Natural	13	11,488	-	-	-
	Unid. de Cons.Estadual/Municipal	71	915,413	-	-	-
	Total	**115**	**2,825,260**	**Total**	**92**	**2,355,186**
	NORTHEAST TOTAL				**207**	**5,180,446**

(Source: IBAMA, 1995; FUNAI.)

REGION	BRAZILIAN CONSERVATION UNITS INDIRECT USE Type	N°	Area/ha	DIRECT USE Type	N°	Area/ha
	Estação Ecológica	07	1,520	Área Prot.Amb.	08	964,338
	Reserva Biológica	07	63,192	Área Indígena	26	77,562
	Reserva Ecológica	01	404	Flor. Nacional	04	8,119
	Área Preserv. Perm.	01	200	Unid.Cons. Est/Mn	62	1,995,251
	Parque Nacional	08	360,325	-	-	-
SOUTH EAST	Área Tombada	04	11,600	-	-	-
	Área Relevante Interesse Ecológico	09	2,835	-	-	-
	Área sob Proteção Especial	06	118	-	-	-
	Reserva Particular Patrimonio Natural	17	63,743	-	-	-
	Unid. de Cons.Estadual/Municipal	179	2,288,891	-	-	-
	Total	**239**	**2,792,828**	**Total**	**100**	**3,045,270**
	SOUTHEAST TOTAL				**339**	**5,838,098**
	Estação Ecológica	04	48,617	Área Prot.Amb.	03	612,500
	Reserva Biológica	01	17,600	Área Indígena	57	191,149
	Reserva Ecológica	02	272	Flor. Nacional	06	15,223
	Parque Nacional	06	318,612	Reserva Extrativ.	01	2,444
SOUTH	Área Relevante Interesse Ecológico	01	109	Reserva Recurso	01	1,000
	Reserva Particular Patrimonio Natural	07	11,487	Unid.C. Est/Mun	25	4,000
	Unid. de Cons.Estadual/Municipal	115	317.844	-	-	-
	Total	**136**	**714,541**	**Total**	**93**	**826,316**
	SOUTH TOTAL				**229**	**1,540,857**
	Estação Ecológica	04	2,100	Área Prot. Amb.	02	116,200
	Reserva Ecológica	03	244,635	Área Indígena	102	12,932,035
	Reserva Genética	02	51	Unid. C. Est/Mun	04	9,005,300
	Parque Nacional	03	389,868	-	-	-
CENTER WEST	Área Relevante Interesse Turístico	02	34,660	-	-	-
	Estação Biológica	01	360	-	-	-
	Reserva Particular Patrimonio Natural	02	2,418	-	-	-
	Unid. de Cons.Estadual/Municipal	28	46578	-	-	-
	Total	**45**	**720,670**	**Total**	**108**	**22,053,535**
	CENTER WEST TOTAL				**153**	**22,774,205**
BRAZIL	**TOTAL**				**1,297**	**142,792,870**

Table 2 Prioritized Forest Species for Conservation in Brazil. Data are from FAO (1986, 1994), Roche (1987), and SBB (1992)

Species	Status	Conservation Priority1		Action
		In situ	*Ex situ*	
Amburana cearensis	Am	2	2	I/E/P
Anadenanthera macrocarpa		1	2	I/P
Aniba rosaeodora		1	1	I/E/P
Aniba canelilla	Am	1	1	
Aniba fragans	Vul	1	1	
Araucaria angustifolia	Vul	1	2	I/E/P
Aspidosperma olivaceum	Vul	1	2	P
Aspidosperma pyrifolium		1	3	P
Aspidosperma polyneuron	Vul	1	1	I/P
Astronium balansae		1	2	I
Astronium fraxinifolium		2	2	I/E/P
Astronium gracile		1	2	
Auxema oncocalyx		2	3	
Bactris gasipaes	Am	2	1	I/E/P
Balfourodendron riedelianum	Vul	1	1	I/P
Bauhinia smilacina		1	2	
Bertholletia excelsa	Am	1	1	I/E/P
Britoa guazimifolia		1	3	I/P
Bowdichia nitida		1	2	
Bumelia sartorum		1	2	
Bursera leptophleos	Am	2	2	
Butia eriospatha		1	3	P
Caesalpinia echinata		1	1	I/E/P
Caesalpinia leiostachia		1	2	I/P
Campomanesia phaea		1	2	I/P
Carapa guianensis	Am	2	1	I/P
Cariniana estrelensis		1	1	I/P
Cariniana janeirensis	Am	1	2	
Cariniana kuhlmannii		1		
Cariniana legalis	Vul	1	1	I/P
Cariniana penduliflora	Vul	1		
Caryocar brasiliensis		1	2	I/E/P
Caryocar villosum		1	2	I
Cassia excelsa	Vul	2	3	
Cavanillesia arborea	Vul	1	2	
Cedrela fissilis	Vul	1	2	I/E/P
Cedrela huberi		2	2	P
Cedrella odorata		1	1	I/E/P
Centrolobium robustum	Vul	1	2	P
Colubrina glandulosa	Vul	1	2	I
Copaifera langsdorfii	Vul	1	2	I/E/P
Copaifera multijuga	Vul	1	2	I/P
Cordia goeldiana		1	2	I/E/P

Species	Status	Conservation Priority1		
		In situ	*Ex situ*	Action
Cordia trichotoma		1	2	I/E/P
Couratari asterotricha		1		
Couratari astrovinosa	Am	1		
Dalbergia cearensis		1	2	I
Dalbergia nigra		1	1	I/E/P
Dicypellidium caryophyllatum	Vul	1	2	
Didymopanax morototoni	Vul	2	2	I/E/P
Dipteryx alata		1	2	I/E/P
Dipteryx odorata		1	2	I/E/P
Enterolobium contortisiliquum		2	2	I/E/P
Esenbeckia leiocarpa	Am	1	2	I/E/P
Eugenia involucrata		1	3	I/P
Euterpe edulis		1	2	I/E/P
Euterpe oleracea		2	2	I/E/P
Feijoa selllowiana		1	3	I/E/P
Genipa ameriana		1	2	I/E/P
Glycidendron amazonicum		2	2	
Hevea brasiliensis	Vul	1	1	I/E/P
Hymenaea stibocarpa	Vul	1	2	I/E/P
Ilex paraguaiensis	Vul	1	2	I/E/P
Inidosculus phyllocanthus		1	2	
Jacaranda copaia		2	2	I/E/P
Jacaranda micrantha		2	2	P
Jacaratia spinosa		1	2	P
Jessenia bataua		1	2	I/E/P
Joannesia princeps		1	2	I/P
Lecythis pisonis	Vul	1	2	I/E/P
Machaerium villosum		2	3	I/E/P
Manilkara huberii		1	1	I/E/P
Marlierea edulis		1	1	I/P
Maytenus icilifolia		2	3	
Melanoxylon brauna	Vul	1	2	I/E/P
Miconia cinnammomifolia		1	2	P
Mimosa caesalpinifolia		1	2	P
Mimosa scabrella		-	2	I/E/P
Mimosa verrucosa		1	1	
Mycrocarpus frondosus		1	2	
Myrciaria trunciflora		1	3	
Myracroodruon urundeuva	Am	1	1	I/E/P
Myroxylon peruiferum		1	2	
Mycrocarpus frondosus		1	2	
Myrciaria trunciflora		1	3	
Myracroodruon urundeuva	Am	1	1	I/E/P
Myroxylon peruiferum		1	2	
Mycrocarpus frondosus		1	2	
Myrciaria trunciflora		1	3	

Species	Status	Conservation Priority1 In situ	Ex situ	Action
Myracroodruon urundeuva	Am	1	1	I/E/P
Myroxylon peruiferum		1	2	
Ocotea catharinensis	Am	1	2	I/P
Ocotea porosa	Am	1	3	I/E/P
Ocotea pretiosa	Am	1	1	I/E/P
Pachystroma longifolium		1	2	
Paratecoma peroba		1	2	I/E/P
Parkia pendula		2	2	I/P
Pachystroma longifolium		1	2	
Paratecoma peroba		1	2	I/E/P
Parkia pendula		2	2	I/P
Peltophorum dubium		1	1	I/P
Pilocarpus jaborandi	Am	1	2	I/E/P
Pilocarpus pennatifolius		2	3	I/P
Piptadenia macrocarpa		1	2	I/E/P
Piptadenia peregrina		1	2	I/E/P
Pithecolobium racemosum	Am	1	2	I/P
Platymenia foliosa		1	2	I/E/P
Platonia insignis		1	2	I/E/P
Podocarpus lambertii	Vul	1	2	I/E/P
Prunus brasiliensis	Vul	2	2	I/E/P
Pterogyne nitens		1	2	I/E/P
Quina glaziovii		2	3	
Schinopsis brasiliensis	Vul	1	2	I/P
Schinus terebinthinifolius		2	2	I/P
Schyzolobium amazonicum		2	2	I/P
Schyzolobium parahyba		2	2	I/P
Simaruba amara		2	2	I/E/P
Spondias macrocarpa		2	3	I/P
Spondias purpurea		1	2	I/P
Spondias tuberosa	Vul	1	2	I/P
Swietenia macrophylla	Am	1	2	I/E/P
Syagrus coronata		2	2	I/P
Tabebuia avellanedae		2	3	P
Tabebuia caraiba	Vul	2	2	I/P
Tabebuia cassinoides		1	1	I/P
Tabebuia impetiginosa	Vul	2	2	I/E/P
Tabebuia serratifolia	Vul	1	2	I/E/P
Theobroma cacao		1		I/E/P
Virola surinamensis	Am	1	1	I/P
Vochysia maxima		1	2	I/P
Voucapoua americana	Am	1	2	I/P
Zeyheria tuberculosa		1	1	I/P
Zizyphus joazeiro	Vul	1	2	I/E/P

E = Ex situ Conservation; I = In situ Conservation; P = Research; Vul=Vulnerable;Am = Threatened.

Table 3 Ex situ Conservation of Plant Germplasm Stored at the National System of Institutions of Agriculture Research (SNPA)

Groups of products	Number of accessions				
	Autoctonous/Local pop.		Exotics		
	TOTAL	%	TOTAL	%	TOTAL
Fruit trees	4,238	37	7,269	63	11,507
Grass-forages	6,393	60	4,253	40	10,646
Fiber Crops	30	1	2,251	99	2,281
Forest Species	851	22	2,991	78	3,842
Roots and tubers	3,660	91	356	9	4,016
Grain legumes	1,855	19	7,891	81	9,746
Horticultural species	3,240	45	3,881	55	7,121
Cereals	2,116	5	38,509	95	40,625
Grain legumes	5,521	21	21,306	79	26,827
Medicinal Species	466	86	78	14	544
Latex producing Species	1,329	100	-	-	1,329
Spices	163	41	234	59	397
Stimulant species	2,294	15	12,976	85	15,270
Insecticidal species	152	99	2	1	154
TOTAL	**32,308**	**24**	**101,997**	**76**	**134,305**

Table 4 Germplasm Management System: Curatorship, Products, and Respective Curators at CENARGEN

CULTURAS	Number of accessions				
	Autoctonous		Exotics		
	Total	%	Total	%	TOTAL
Coffee (*Coffea spp.*)	-	-	9,216	100	9,216
Soya-bean (*Glycine max*)	-	-	5,616	100	5,616
Sugar Cane (S. *officinarum*)	-	-	5,058	100	5,058
Cocoa (*Theobroma cacao*)	2,925	100	-	-	2,925
Citrus (*Citrus spp.*)	-	-	2,408	100	2,408
Cotton (*Gossypium hirsutum*)	-	-	1,462	100	1,462
Total	**2,925**	**11**	**23,760**	**89**	**26,685**

Table 5 Number of Germplasm Accessions Managed by CENARGEN from 1976 to 1994

CULTURAS	Number of accessions				
	Autoctonous*/LocalPop.		Exotics		Total
	Total	%	Total	%	
Beans *(Phaseolus vulgaris)*	2,400	15	13,160	85	15,560
Rice *(Oryza spp.)*	-	-	10,818	100	10,818
Cassava *(Manihot esculenta)*	3,190	93	232	07	3,422
Corn *(Zea mays)*	2,013	67	988	33	3,001
Sweet-potato *(Ipomoea batatas)*	450	86	72	14	522
Total	**8,053**	**24**	**25,270**	**76**	**33,323**

* Considering germplasm being utilized by small farmers in the form of traditional cultivars

Table 6 Active Germplasm Banks, Genetic Reserves, and Nuclei for Domestic Animal Conservation in Brazil, by Counties and States

Curatorship/Products	Curator
01. Domestic farm Animals	Arthur da S. Mariante
02. Domestic small farm animals	Silvia T.J.Ribeiro
03. Winter Cereals	Clara O. Goedert
04. Summer Cereals	José Ronaldo Magalhães
05. Dye and Spicing Species	Terezinha A.B. Dias
06. Sweeteners and Stimulant Species	José Nelson L. da Fonseca
07. Fibers	Antônio R. de Miranda
08. Autoctonous and Exotic Forest Species	José Alves da Silva
09. Temperate Fruit Trees	Eduardo A. V. Morales
10. Tropical and Sub-tropical Fruit Trees	Francisco R. Ferreira
11. Grain-Forages	José F. M. Valls
12. Horticultural Species	Antonio Carlos Guedes
13. Latex Producing Species	Afonso C. C. Valois
14. Grain Legumes	Marco Aurélio Althoff
15. Legume-Forages	Lídio Coradin
16. Medicinal, Aromatic and Insecticidal Species	Roberto F. Vieira
17. Microorganisms	João B. T. da Silva
18. Grain Legumes	Maria Magaly Veloso Wetzel
19. Ornamental Species	Marta Camargo de Assis
20. Palm Trees	Eduardo Lleras Perez
21. Roots and Tubers	Ivo Roberto Sias Costa
22. Other products	Antonio Carlos Guedes

Table 7 Number of germplasm accession exchanged by CENARGEN during the 1976-1994 period

Year	Imported	Exported	Internal Transit	Total
1976	1,670	308	4,047	6,025
1977	5,975	2,499	1,875	10,349
1978	1,185	633	1,269	3,087
1979	2,508	1,266	1,529	5,303
1980	8,675	2,045	1,651	12,371
1981	9,457	2,287	1,922	13,666
1982	3,696	1,230	2,943	7,869
1983	6,978	1,721	5,606	14,296
1984	23,554	1,503	4,175	29,232
1985	4,765	3,233	4,573	12,571
1986	18,048	3,514	2,696	24,258
1987	10,076	3,496	2,578	16,150
1988	11,070	2,519	4,262	17,851
1989	9,639	2,796	2,858	15,293
1990	10,145	2,492	1,188	13,825
1991	10,901	2,257	1,515	14,673
1992	22,218	4,167	1,496	27,881
1993	9,192	2,732	4,521	16,445
1994	9,388	1,264	439	11,266
Total	**179,161**	**41,962**	**51,143**	**272,266**

Table 8 Active Germplasm Banks Genetic Reserves and Domestic Animal Conservation Nuclei, by States and Counties

1. Aracaju (SE)	coco
2. Bagé (RS)	forrageiras, ovinos
3. Belém (PA)	forrageiras, guaraná, ipecacuanha, mandioca, pimenta-do-reino, patauá, urucum
4. Bento Gonçalves (RS)	Uva
5. Boa Vista (RR)	Cavalos selvagens de Roraima
6. Brasília (DF)	abacate, alho, amendoim, batata doce, brassicas, ervilha, forrageiras, mandioca, medicinais, seringueira, aroeira, cerejeira R.G. Tamanduá, R.G. do Gama, bovinos, caprinos, asininos
7. Caçador (SC)	pomaceas, R.G. de Caçador
8. Campina Grande (PB)	algodão, sisal
9. Campinas (SP)	amendoim, café,citrus
10. Campo Grande (MS)	forrageiras
11. Conceição Almeida (BA)	fruteiras tropicais
12. Coronel Pacheco (MG)	forrageiras
13. Corumbá (MS)	bovinos, equinos
14. Cruz das Almas (BA)	abacaxi, banana, citros, mamão, mandioca, manga, maracujá
15. Dionisio (MG)	R.G. do Parque Florestal Estadual do Rio Doce
17. Fortaleza (CE)	medicinais
18. Goiânia (GO)	arroz, caupi, feijão
19. Ibimirim (PE)	goiaba
20. Itaberaba (BA)	mamona
21. Itaguaí (RJ)	quiabo, tomate
22. Jaboticabal (SP)	fruteiras nativas, maracujá
23. Lages (SC)	forrageiras, bovinos
24. Londrina (PR)	soja
25. Manaus (AM)	pupunha, seringueira, dendê
26. Maria da Fé (MG)	batata, oliveira
27. Belo Horizonte (MG)	suínos
28. Monte Alegre (PA)	bubalinos
29. Monte Dourado (PA)	R.G. do Rio Jari

Table 8 Active Germplasm Banks Genetic Reserves and Domestic Animal Conservation Nuclei, by States and Counties

30. Pacajus (CE)	caju
31. Curitiba (PR)	suínos
32. Passo Fundo (RS)	aveia,trigo, triticale
33. Pelotas (RS)	cebola,prunoideas
34. Petrolina (PE)	orrageiras
35. Piracicaba (SP)	cana-de-açúcar, orquídeas
36. Recife (PE)	mandioca
37. Rio Branco (AC)	castanha-do-Brasil
38. Pedro Avelino (RN)	asininos
39. São Paulo (SP)	orquídeas
40. Serra do Ouro (AL)	cana-de-açúcar
41. Sete Lagoas (MG)	milho, sorgo
42. Sobral (CE)	forrageiras, caprinos
43. Soledade (PB)	umbu
44. Taquari (RS)	citros
45. Teresina (PI)	babaçu, bovinos, caprinos
46. Vitória de Santo Antão (PE)	sorgo
47. Viçosa (MG).	batata-baroa, cucurbitáceas, feijão-fava, pimentão

Abbreviations

List of the Institutions which collaborated with the information for the elaboration of the Brazilian Country Report for the FAO Sub-Regional Meeting for South america in preparation for the International Conference and Programme for Plant Genetic Resources (ICPPGR).

CEPLAC	Comissão Executiva do Plano da Lavoura Cacaueira/CEPEC - Centro de Pesquisas do Cacau
EBDA	Empresa Baiana de Desenvolvimento Agrícola
EMAPA	Empresa Maranhense de Pesquisa Agropecuária
EMBRAPA/CNPUV	Centro Nacional de Pesquisa de Uva e Vinho
EMBRAPA/CPAC	Centro de Pesquisa Agropecuária dos Cerrados
EMBRAPA/CPACT	Centro de Pesquisa Agropecuária de Clima Temperado
EMBRAPA/CNPMS	Centro Nacional de Pesquisa de Milho e Sorgo
EMBRAPA/CNPGL	Centro Nacional de Pesquisa de Gado de Leite
EMBRAPA/CNPAF	Centro Nacional de Pesquisa de Arroz e Feijão
EMBRAPA/CNPF	Centro Nacional de Pesquisa de Florestas
EMBRAPA/CPAP	Centro de Pesquisa Agropecuária do Pantanal
EMBRAPA/CPAMN	Centro de Pesquisa Agropecuária do Meio-Norte
EMBRAPA/CNPC	Centro Nacional de Pesquisa de Caprinos
EMBRAPA/CPAA	Centro de Pesquisa Agroflorestal da Amazônia Ocidental
EMBRAPA/CPAF-AP	Centro de Pesquisa Agroflorestal do Amapá
EMBRAPA/CNPH	Centro Nacional de Pesquisa de Hortaliças

EMBRAPA/CNPT	Centro Nacional de Pesquisa de Trigo
EMBRAPA/CNPGC	Centro Nacional de Pesquisa de Gado de Corte
EMBRAPA/CNPMF	Centro Nacional de Pesquisa de Mandioca e Fruticultura Tropical
EMBRAPA/CNPA	Centro Nacional de Pesquisa de Algodão
EMBRAPA/CPATSA	Centro de Pesquisa Agropecuária do Trópico Semi-Árido
EMBRAPA/CNPAB	Centro Nacional de Pesquisa de Agrobiologia
EMBRAPA/CNPSo	Centro Nacional de Pesquisa de Soja
EMBRAPA/CPATU	Centro de Pesquisa Agroflorestal da Amazônia Oriental
EMBRAPA/CPPSE	Centro de Pesquisa de Pecuária do Sudeste
EMBRAPA/CENARGEN	Centro Nacional de Pesquisa de Recursos Genéticos e Biotecnologia
EMCAPA	Empresa Capixaba de Pesquisa Agropecuária
EMEPA	Empresa Estadual de Pesquisa Agropecuária da Paraíba S.A.
EPACE	Empresa de Pesquisa Agropecuária do Ceará
EPAGRI	Empresa de Pesquisa Agropecuária e Difusão de Tecnologia de Santa Catarina S.A.
EUAFBA	Escola de Agronomia da Universidade Federal da Bahia
FEPAGRO	Fundação Estadual de Pesquisa Agropecuária do Rio Grande do Sul
IAC	Instituto Agronômico do Estado de São Paulo
INPA	Instituto Nacional de Pesquisas da Amazônia
IPA	Empresa Pernambucana de Pesquisa Agropecuária

UFV	Universidade Federal de Viçosa
UNESP/FCAVJ	Universidade Estadual Paulista/Faculdade de Ciências Agrárias e Veterinária de Jaboticabal
UNITINS	Universidade do Tocantins - Centro Universitário de Gurupi