FAO International Technical Conference
on Plant Genetic Resources

CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES IN WEST AFRICA

Sub-Regional Synthesis Report

Annex 1 of the Report of the
Sub-Regional Preparatory Meeting for
West and Central Africa
Dakar, Senegal
27-30 November 1995

Food and Agriculture Organization of the United Nations

Note by FAO

This Sub-Regional Synthesis Report was endorsed by the Sub-Regional Meeting for West and Central Africa, Dakar, Senegal, 27-30 November 1995, preparatory to the FAO International Technical Conference on Plant Genetic Resources, as a useful input for the preparation of the Report on the State of the World's Plant Genetic Resources. It constitutes Annex 1 of the Report of the Preparatory Meeting. The Report is being made widely available by FAO as requested by the International Technical Conference.

The Report was drafted by Dr. Ankon Goli with the guidance of IPGRI's Regional Office for Sub Saharan Africa and the FAO Secretariat for the International Technical Conference. The Collaboration of those whose assisted by reviewing Country Reports and drafts of this report is acknowledged, in particular Vincent Lebot. The Report was finalized at the Sub-regional Preparatory Meeting, taking into account modifications proposed by the countries.

Table of contents

I. INTRODUCTION

A. The Sub-region and Its Agricultural Sector

1. West Africa lies between 5-25° north and 18° west to 24° east. It covers a total land area of 7,324,000 km^2, representing about one fifth of the continent, and comprises the States of Benin, Burkina Faso, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Cape Verde, Liberia, Mauritania, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.

Relief

2. West Africa is a vast plateau some 300 metres high, which undulates and curves towards the Niger basin. One may observe: to the north, a series of mountainous massifs: the Tagant, Adrar des Ifoghas, Air and Djado plateau; to the south, a chain of hard rock which has resisted erosion: the Fouta-Djallon massif (1,550 m), Mount Loma (1,947 m), Mount Nimba (1,854 m), the Atacora mountains and the Bauchi plateau.

Hydrography

3. There are no permanent watercourses in the desert area north of the sixteenth parallel. The south, however, is crossed by three great rivers: the Senegal river, 1,700 km long, starts as a mountain stream on leaving the Fouta-Djallon massif; the Niger is navigable on some stretches of its 4,200 km length; the Volta, in which the three Volta rivers - Black, White and Red - converge, flows into a great lake in Ghana.

Climate and vegetation

4. West Africa is exposed to the alternating effects of a cold, dry air mass originating in the Azores anticyclone and of a humid air mass from the direction of Saint Helena anticyclone. The continental land-mass is dried by the air from the sea, in a south-to-north and west-to-east direction. There is a gradual transition, with the overall geographical area being characterised by three climate-types: the desert zone, N of the 16° parallel, where annual rainfall is below 400 mm; the Sudano-Sahelian climate zone, in which the dry season becomes longer nearer the Tropic of Cancer. The rainy season takes place in summer when the sun is at its zenith. Annual rainfall is over 1,000 mm in the south of Mali, but less than 800 mm in the north of Nigeria; a wet tropical climate prevails from Gambia to the east of the sub-region, characterised by two unequal dry seasons, in August and from December to March. Annual rainfall is close to 1,500 mm.

5. Savannah is the most widespread form of vegetation, extending from Senegal to northern Cameroon. This is a sylvo-pastoral zone characterised by thorn scrub, principally *Acacia*. Tree savannah extends further south, from Senegal to Nigeria, and is the dominant vegetation in the Sudano-Sahelian zone. The tallest trees do not exceed 15 m in height and are to be found along water courses.

6. The wet tropical climate areas are covered by lowland tropical forest. Trees may grow as high as 30 metres and lose their leaves during the dry season. This type of vegetation is found in a band running parallel to the coast, from Cameroon to Sierra Leone. Mangroves are found in several areas along the coast, mostly in Nigeria and in Sierra Leone but also in other coastal countries. *Rhizophora* is predominant in these zones.

Population

7. The population of West Africa is estimated at 198 million inhabitants, of whom slightly more than half live in Nigeria. Annual population growth is around 3% (Table 1) and life expectancy about 51 years. The population is young, with a little over half the inhabitants being under 20.

8. Average population density is 23 per km^2. Desert and densely forested areas are almost empty. The highest population densities are in regions where natural conditions have allowed the development of intensive agro-pastoral systems (Niger and Senegal river valleys, coastal plains and mountains around the Gulf of Guinea), and in the major cities such as Lagos (six million), Abidjan (three million) and Dakar (two million).

Agriculture

9. The peasant societies of the savannah are governed by the alternating dry and rainy seasons. Farming is cereal-based - rice, maize, millet, sorghum - and supplemented with tubers (yams, cassava, sweet potatoes) and the products of sheep and cattle raising. Cash crops are groundnuts, sugarcane and cotton. In the arid zones, land is given over to itinerant livestock raising, which allows scarce water resources and temporary pastures scattered over vast distances to be used to advantage (Table 2).

10. In forest areas with a long rainy season, traditional activities mainly centre on root and tuber plants (dasheen, cocoyam, yam, sweet potato, cassava), maize, bananas, plantains and palms. The wet tropical zones have also seen the development of plantation crops such as coffee, cocoa, rubber, palm oil and pineapples, specially along the coast. However, the increase in the areas given over to industrial crops has led to intense pressure on natural forest areas.

11. The agricultural sector makes a significant contribution to the national economy of the region. It accounts for 22-48 per cent of GDP, depending on the country. Between 60-70 per cent of the active population is engaged in agriculture.

Forestry

12. Forests undoubtedly constitute an appreciable source of revenue for the countries of the sub-region. Forest genetic resources are generally used for:

- food;
- energy production;
- production of undressed timber and posts;
- land protection and local landscaping, dune stabilization, anti-erosion planting, improvement of pastures (hedges, fencing), etc.;
- maintenance and restoration of soil fertility through improved fallow lands;
- traditional medicine.

13. In areas of tree savannah, multiple-use species are grown in agroforestry parks, helping to maintain the environmental balance. These savannah areas are characterised by the following forest species: locust bean tree (*Parkia biglobosa)*, rosewood (*Pterocarpus erinaceus)*, kapok tree (*Ceiba pentandra), Tamarindus indica,* baobab *(Adansonia digitata), Acacia* spp.*,* silk cotton tree *(Bombax costatum)* and *Butyrospermum paradoxum*. Numerous quick-growing exotic species have been introduced, in particular *Eucalyptus* spp., *Casuarina equiseifolia, Leucaena* spp. etc. These are well-accepted due to their fire-resistant and good sprouting qualities.

14. The main rainforest species are *Triplochiton scleroxylon, Terminalia superba*, kola tree (*Cola nitida*) and some Guinean tree savannah species such as *Chlorophora excelsa*, mahogany (*Khaya grandifolia*), African mahogany (*Khaya senegalensis*), palmyra palm (*Borassus aethiopicum*) and vitex (*Vitex cuniata*). Plantations of various exotic species have also been established in wet zones (*Acacia mangium, Cedreaia odorata, Gmelina arborea, Tectona grandis*), thereby helping to ease the pressure on natural forests.

B. Plant Genetic Resources of The Sub-region

Forest genetic resources

15. Plant life is extremely diverse at the level of species and genera. Several endemic families are to be found in evergreen tropical forest zones, mainly represented by the Dioncophyllaceae, Hoplestigmataceae, Medusandraceae,

Melianthaceae, Octoknemaceae and Scytopetalaceae. In the Sudanese zone, monotypic endemic genera are more commonly found, such as Butyrospermum, Haematostaphis and Pseudocedrala.

16. Natural vegetal formations take up around 60 per cent of the surface area, with relatively significant areas of gallery forest, thin forest, scrub savannah and tree savannah. There are a great many fodder plants (*Gramineae, Cyperaceae, Papilionaceae, Capparidaceae*, etc.). The tropical rainforests are highly localized. The forest offers wood products (firewood, industrial timber, craft carving wood) and non-wood products (fruits, grains, gum, resin, fodder, traditional medicines, etc.) (Table 3).

Cultivated and allied species

Indigenous species

17. Although West Africa is not a centre of diversity as identified by Vavilov and Harlan, it is home to many indigenous species of regional importance: millet (*Pennisetum*), sorghum, cowpea (*Vigna unguiculata*), Bambara *groundnut (Vigna suterranea*), African rice (*Oryza glaberrima*) and fonios (*Digitaria spp.*). Some of these are neglected by national and international research institutes, yet offer real agricultural and economic potential. These species are still used by the rural population for various purposes: nutrition, multiple uses and adaptation to surrounding conditions. A good many of these species are still being adapted to cultivation by farmers (as is the case with yams, for example). Others belong to species complexes in which there is a flow of genes between cultivated and spontaneous forms, and between allied wild species and cultivated ones (*Sorghum, Pennisetum, Oryza*). This genetic diversity is traditionally conserved by local people. These species and cultivars constitute gene pools which give them a certain protection against disease, insects and climate variations. They probably provide a key to food safety and sustainable development which needs to be preserved.

18. In the countries of the Sahel and the savannah regions, many traditional varieties are disappearing as a result of drought, soil depletion and introduction of improved varieties with higher yields.

19. In rainforest areas the threat is much smaller, but introduction of new varieties may have considerable impact. For example, the Florido yam variety (*Dioscorea alata*) quickly became a favourite with Ivorian farmers during the 1980s, supplanting the local cultivars. Farmers then abandoned cultivars of *D. cayenensis* and *D. rotundata*, although the exclusively vegetative propagation of this variety is dependent on seed yams being kept from one year to the next.

20. Numerous underexploited indigenous species are found in the region which are nevertheless of local or regional importance.

Local ecotypes of introduced species

21. One outstanding feature of this sub-region is the predominance of exotic cultivated species which have come to take a more prominent place in national agricultural production than the indigenous species. West Africa is not an area of primary differentiation for most of the main species which are widely cultivated in the region today. These species originated either in the Americas (pineapples, cotton, groundnuts, cocoa, rubber, cocoyam, maize, cassava, sweet potato, tobacco) or in Asia (bananas and plantains, citrus, coconuts, sugarcane, mango, taro, rice, etc.). Some of these crops were introduced several centuries ago and farmers have endeavoured to select cultivars adapted to local climatic and soil conditions. This is the case for:

- **rice**: (*Oryza sativa*, introduced in the fifteenth or sixteenth century) West African cultivars are particularly well-adapted to pluvial rice-growing conditions and have provided the basis for numerous international improvement programmes, as is the case of the Moroberekan cultivar, which is especially interesting due to its resistance to pyriculiariosis, thread worms and drought. *Oryza* spp., including *O. glaberrima*, are a valuable species group for agronomic introgression and the genetic improvement of rice;
- **maize**: Local ecotypes are well-adapted to cereal-growing on acid and ferralitic soils and some are drought-resistant;
- **cassava**: cultivars have been locally selected to meet the organoleptic requirements of consumers, etc.

22. Although threatened by the introduction of improved varieties and exotic species, the indigenous species and local cultivars are still conserved by local populations for a number of reasons:

- reliable yield, hardiness and plasticity: these cultivars guarantee a minimum harvest when local conditions are harsh, without requiring any fertilizer or major care. This is the case of some local varieties of fonio (*Digitaria exilis*), which grow in the laterite soils of arid zones;
- nutritional and therapeutic value: as in the case of certain weedy forms of *Gossypium spp.*, the seeds of which are used as a source of protein for the under-nourished or to treat certain illnesses;
- economic importance: as in the case of Bambara groundnuts (*Vigna subterranea*) and fonio (hungry rice), which are sold in the markets at times when the major food crops are unavailable.

Threats to biodiversity

23. Genetic erosion in the sub-region is mainly due to the following factors:

- gathering for food or medicine
- systems of shifting cultivation which have an adverse effect on the environment when fallow periods are reduced
- heavy pressure on forests due to demand for land for plantations and cash crops
- bush clearance and uncontrolled exploitation for firewood and timber
- replacement of indigenous species and landraces by exotics and improved varieties
- poor knowledge of local germplasm (and of its scientific, social, cultural and economic importance)
- in all the Sahelian countries, it is impossible to dissociate forestry from pastoralism, since the same forests for which efforts are made to preserve and protect are also transit zones for livestock
- overgrazing
- development of infrastructure
- civil strife
- drought

24. The degradation of tree resources, partially linked to climatic factors, has led to heavy mortality of the least resistant species, resulting in extensive genetic erosion and changes in the floristic composition. The extent of this degradation evidently varies from zone to zone, but in most cases the dynamics of the plant communities involved have been seriously altered.

II. EVALUATION OF PLANT GENETIC RESOURCES PROGRAMMES AND ACTIVITIES IN THE SUB-REGION

25. All the countries of the sub-region have realized the importance of PGR to their development and wish to consolidate *in situ* and *ex situ* conservation activities. Expressions of their commitment to structure national programmes are made by scientists, but real budget constraints prevent the intentions

expressed from becoming reality. In most cases there is a lack of will at the political level.

A. National Programmes

Status of national programmes

26. In general, national programmes to co-ordinate PGR activities virtually do not exist (Table 4). Initiatives are however undertaken in some countries, more particularly in Nigeria and Ghana, where there is a National Centre for Plant Genetic Resources. These initiatives are undoubtedly successful.

27. PGR conservation activities are carried out in a sectoral manner by the various institutes concerned, and co-ordination is quite often non-existent. Efforts are made along the lines of establishing national committees, but these are confronted by operational budget problems or quite simply by problems of official recognition. They currently serve as co-ordinating structures for PGR-related activities pending the establishment of more widely-based committees at a national level.

28. The management of PGR is carried out in a very localized manner by plant breeders in the context of their research programmes. These programmes are designed in accordance with the needs expressed by farmers through development bodies and private organizations.

29. After the United Nations Conference on Environment and Development, a new impetus has become apparent. National symposia on PGR were held in several countries of the sub-region (Benin, Côte d'Ivoire). These have resulted in the establishment of national committees charged with preparing an appropriate strategy for PGR management at a national level. The mandate of these committees (sometimes called Working Groups) is to ensure better co-ordination of the activities of the various ministerial departments, and private bodies, to promote the exchange of information and germplasm, and to contribute to the establishment of networks.

National strategies and policies

30. All the countries of the sub-region are signatories to the June 1992 Convention on Biological Diversity. Since then, they have adopted new policies which they are implementing through National Forestry Action Plans (NFAP). This evolution has come about as a direct result of international influence and the realization by decision-makers of the positive effects of participatory activities.

31. It is clear that national policies are basically concerned with in situ conservation of whole ecosystems (carried out by the networks of protected parks) rather than *ex situ* conservation. Programmes are followed,

implementing the regulatory provisions forbidding forest logging without prior authorization from the competent authority, usually the Water, Forest and Environment Services. It should be said that this approach does not always meet with the approval of the local people.

32. However, more and more there is a movement towards the reconciliation of forest logging and environmental concerns. Thus in some countries, new forestry regulations have been brought in to guarantee the protection and rehabilitation of forest stands and areas dedicated to forest. This plan seeks to incorporate an increased and more direct involvement on the part of the local people. It is based on the empowerment of local people and seeks to be in line with the policies of other development sectors.

33. In practice, it is very difficult to enforce respect for property rights over State-owned land because of strong human pressure and the limited resources available for monitoring.

The funding of activities

34. Lack of funding is a major problem. In many cases, the budget is included in that of selective programmes. In countries such as Ghana and Nigeria, there is a separate budget for the PGR programme, but it is rather inadequate, given the magnitude of the tasks to be undertaken.

35. Many countries do not have specific budget allocations for plant genetic resources conservation and there is a clear tendency to depend exclusively on international aid. The programmes are weakened by lack of funding. It is clear that insufficient financial resources will not allow for the maintenance and follow-up of living collections in the field.

36. The situation is all the more critical since the maintenance of collections of many perennial tropical plants (oil palms, coconut palms, coffee plants) require large areas, with consequent maintenance demands. There is a similar problem with those species that are multiplied vegetatively, such as cassava, dasheen, macabo, sweet potato and yams, whose shoots need to be kept *in vivo* in the field and replanted almost every year.

National legislation

37. There is no specific legislation for PGR, but there are existing provisions concerning plant health regulations, seed distribution and property rights.

38. **Phytosanitary regulations**: these countries do not place any difficulties in the way of import or export of PGR. National laws do not limit cropping of imported PGR. The only restrictions placed on their movement are those to

do with plant health regulations. The exit of PGR is subject to prior authorization by the competent authority, usually the agricultural service. The majority of countries only require that an import permit be obtained from the Government services concerned and a plant health certificate issued. The import of seeds is therefore subject to checks regarding plant health. The primary aim of this is to detect possible diseases and pests that might constitute an immediate or potential danger to local crops; in this case a quarantine period is enforced by those responsible for plant protection. These regulatory provisions are only really applied in Côte d'Ivoire, Ghana and Nigeria.

39. **Seed regulations**: Laws relating to seed certification and licensing have been drawn up by several countries. In practice, seeds, whether imported or not, are freely distributed and sold. Farmers may obtain them from wherever they wish. As the Governments have no real policy regarding PGR, the farmers themselves keep their own traditional varieties, by custom and necessity rather than by Government encouragement. These local varieties may therefore be legally sold, since no legislation regulates the sale and distribution
of these seeds.

40. **Intellectual property rights**: A good number of countries have signed intellectual property rights agreements, but for the time being existing laws in this area do not impinge on genetic resources and no official laws have been drawn up on the matter. Plant varieties resulting from selection processes are not, in general, covered by any legal framework regulating their use. All countries are in agreement about the need for assistance in the matter of legislation. The member countries of the WTO (World Trade Organisation) must, in future, adopt systems of IPRs to protect plant varieties, either through patents, or through the elaboration of a *sui generis* system.

Human resources

41. Very few officials or scientists have received specific training in PGR. For the most part, Government officials are trained in agronomy or general forestry, and occasionally are breeders or specialists in plant breeding. In some rare cases (Ghana), officials have been trained in overseas universities offering specialized courses (e.g. Birmingham). Technicians are in a similar situation, and, for the most part, have not had the opportunity of specific training.

42. Short term courses are organized by IITA, ICRISAT and WARDA for a limited number of scientists and senior technicians. None of the curators and few of the technicians are full-time. There are frequent staff changes in the ministries.

B. Sub-regional Activities and International Collaboration

Sub-regional organizations

43. In West Africa, there are no specific regional PGR networks. There are, however, some crop networks or inter-governmental organizations with the capacity to undertake PGR activities. The main sub-regional organizations concerned with PGR are:

- CORAF (Conference of Directors of Agronomic Research in West and Central Africa), whose networks deal separately with: peanuts, cotton, cassava, maize and rice. These crop networks all have a variety enhancement programme, but none has a section on PGR. It should be noted that CORAF now includes English-speaking countries.
- CILSS (Permanent Interstate Committee for Drought Control in the Sahel). The member States are Burkina Faso, the Niger, Mali, Mauritania, Chad, Senegal, the Gambia, Cape Verde and Guinea Bissau. This organization's aim is to combat desertification in the Sahelian countries.
- ECOWAS (Economic Community of West African States). This is basically an economic and political group. It can play a role in the conservation of genetic resources and phytosanitary controls.
- WARDA is a unique institution in the sense that it is one of the few CGIAR institutes whose mandate is exclusively regional.

44. Most of the major crops are common to all the countries of the sub-region. Networks were established with the aim of increasing production of these crops. To give some examples: the millet network (ROCAFREMI), sorghum (ROCARS), and one for yams.

45. There are several inter-governmental collaborative initiatives, among which can be noted the one for *Irvingia gabonensis* between Nigeria, Ghana, Cameroon and Gabon, and the one for *Parkia biglobosa* between Burkina Faso, Cameroon and Nigeria.

International programmes and their impact on the sub-region

The Institutes of the CGIAR

46. The CGIAR institutes already working in a network in the sub-region are:

- The West Africa Rice Development Association (WARDA), based in Bouake, Côte d'Ivoire, with a branch in St. Louis, Senegal;

- The International Plant Genetic Resources Institute (IPGRI), whose sub-regional base is in Niamey, which co-ordinates and promotes PGR activities;
- The Institute Crops Research in Semi-Arid Tropics (ICRISAT), for cereals and food legumes in dry zones, the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria, for root crops, cowpeas, soybeans, rice, maize and cooking bananas. It has branches in Benin and Côte d'Ivoire;
- The International Centre for Research in Agroforestry (ICRAF), based in Nairobi. This institute has also distributed numerous batches of grains for multiple-use species in this sub-region, and collaborates in various agroforestry projects.

47. Other large international institutions have scientists based in some countries of the sub-region. Such is the case of the Centre for Maize and Wheat Improvement (CIMMYT), the International Centre for Tropical Agriculture (CIAT), the International Rice Research Institute (IRRI) and the International Livestock Research Institute (ILRI) for forage plants.

48. The countries of the region consider that the CGIAR institutes should be in a position to meet their needs for training, equipment, storage installations and documentation for their PGR. A good number of countries hope that the CGIAR institutes may be able to continue to conserve part of their PGR, regenerate them and return them when they need these resources.

49. These institutes distribute much genetic material to the countries of the sub-region. Such is the case of CIP, which has distributed many potato and sweet potato cultivars; IITA, which distributes cassava cultivars; IRRI, which supplies numerous varieties of rice; and ICRISAT which does the same for pigeon peas, millet, sorghum and cowpeas.

50. International programmes favour activities dealing with the major crops, but growing attention is being paid to minor or "orphan" crops. It is often observed that collaboration with international institutions is a guarantee of success for regional network activity. IPGRI, incidentally, has a research project on this topic. The Community Biodiversity Development and Conservation (CBDC) programme also conducts similar activities in Sierra Leone.

Bilateral programmes

51. Activities supported in the context of bilateral collaboration are undertaken by the co-operation agencies of some developed countries (e.g. Germany, United States, Japan). Thus USAID contributed to the establishment of refrigeration chambers in Guinea and Senegal. The Japanese co-operation agency funded a germplasm collection mission and trained personnel in Ghana in the PGR field.

52. Aside from these, it was noted that French research organizations were involved in work in the majority of French-speaking countries in the sub-region. These are the French Institute of Scientific Research for Cooperative Development (ORSTOM) and the International Cooperation Centre on Agrarian Research for Development (CIRAD). These institutes are working on various crops, including: rice, sorghum, maize, coffee, cocoa, rubber trees, cotton, oil palms, fruits and vegetable crops. All these international institutions make important contributions in the areas of training, laboratory material equipment and conservation. Particular stress is put on PGR activities, such as collection, characterization, evaluation, regeneration and documentation.

UN System

53. In regard to training, it should be pointed out that short practical training courses have been organized regularly for scientists and technicians from African countries by IITA, with the collaboration of FAO and IPGRI. FAO has also developed many project involving multiplication of planting natural, for example : assistance in seed multiplication on the Sahel zone in Chad and Mauritania, multiplication of basic seed in Mauritania, and the micropropagation of ginger in Nigeria.

International agreements

54. The majority of West African countries have signed conventions dealing with the safeguarding and conservation of natural resources. These are, among others:

- The African Convention for Conservation of Nature and Natural Resources
- The Convention on Wetlands of International Importance (RAMSAR)
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- The Convention on Biological Diversity (Rio).

55. Lastly, most countries are signatories of the FAO Convention on PGR.

C. PGR Conservation

In situ conservation

56. This heading basically concerns the conservation of forest species and takes place in classified and protected areas. Classified areas include classified forests, reforestation and rehabilitation areas, strict nature reserves, national parks and special reserves. A protected area, which includes non-classified forest not part of land set aside for farming and pastoral uses, is an area where logging and hunting are authorized (Table 6).

57. In most countries, land-use legislation relies on laws making the State the sole proprietor of forests. The land-use regime, codified by the law on the public domain, prevents any private appropriation of forest areas, which are considered property of the State and whose management is entrusted by the State to the water and forest ministries. Forest areas include two categories: classified forests, that belong to the State, and protected areas that are private property. It is perhaps in these forest areas that diversity is best conserved, particularly in national parks that enjoy the status of a strict nature reserve. In most countries, satisfactory progress has been made in the establishment of protected areas, and further ones are scheduled to be established in the near future, in some cases even doubling their total area.

58. In spite of certain pilot schemes (the Tai forest in Côte d'Ivoire, the Hippopotamus Water Hole and Nazinga Ranch in Burkina Faso, for example) there are very few projects with the declared objective of conserving genetic resources *in situ* and whose efforts in genetic management are correctly planned from a technical and scientific viewpoint. To cite some by way of example: the Tai Forest, which represents a unique, preserved sample of the dense West African forest (it contains 1,300 species of plants of which 54% are endemic to the sub-region of Upper Guinea); in Nigeria, the Cross River Forest with a great diversity of mangroves; in Senegal, the Basse Casamance Forest, rich in dry tropical forest species and savannahs.

59. In Niger, for example, apart from the forests named as classified which legally belong to the State, all the remaining natural forests belong to communities. As such, their use is free and collective. However, the State grants a rural concession to the people living close by these forests, who, on account of this, enjoy the right to exclusive commercial logging of the wood extracted from them. In the context of the policy of transferring the management of forest resources to rural communities, grassroots organizations and associations have been formed, and they contribute to the improvement of the management of these areas. But these initiatives are too recent to draw conclusions about their real effectiveness in the long term.

60. Besides the above-mentioned conservation schemes, there are evidently other methods of conservation, such as the traditional methods linked to socio-cultural practices. To a certain extent these contribute to the conservation of the genetic variability of germplasm. The most classic example is that of sacred forests. These are areas of varying size having a sacred value because they are places of worship. Clearings, crops, wood-cutting and even the harvesting of non-wood products are all formally forbidden there. The sacred forests favour the free growth of all the species present together with the complete expression of their genetic potentialities. This form of community management of PGR which properly integrates the issue of nature protection can in many respects serve as a point of reflection in the search for solutions to the problems posed by species preservation.

61. Programmes basically concern forest genetic resources and conservation *in situ*. Experience of on-farm conservation is virtually non-existent. The lack of experience of the conservation of diversity on the part of farmers can be partly explained by the fact that this is a new approach for scientists in these countries. The approach is relatively complex in the sub-region, given that, apart from millet and sorghum, the majority of crops are exotic species being used outside of their places of origin. One form of conservation *in situ* is carried out in community farms to meet the needs of traditional herbalists, in the form of the protection of certain natural species used in plant therapy preparations and in accordance with certain cultural practices. It might be noted that presently, Burkina Faso is developing, in collaboration with IPGRI, a first project on on-farm conservation.

Ex situ conservation

62. Through the whole sub-region, one can distinguish traditional conservation (conservation of ears and seeds in farm stores, conservation in homegardens) from modern conservation (in cool chambers and freezers). These forms of conservation deal with species with orthodox seeds. Conservation of recalcitrant species is mostly in the form of field genebanks because of the relative scarcity of in vitro facilities. Examples include coconut, oil palm and rubber and coffee.

63. One of the weak points of the national programmes lies in the virtual non-existence of appropriate conditions for medium and long-term conservation. The equipment used for these activities requires the sort of maintenance that is not always available to the countries of the region.

64. This conservation effort is the work of public authorities, private sector agro-industrial companies, (particularly for cash crops), and bilateral and international aid bodies. It should be pointed out that certain collections were set up and conserved over 40 years ago, in particular those for rice and maize (Table 3).

Traditional conservation

65. Cereals such as millets, maize and sorghum are traditionally stored as ears. These are either suspended from trees or roofs, or stored on false ceilings (over stoves) made from branches of wood or in grain lofts. There are two kinds of lofts, one for short-term conservation (for use during the current season) and the other for medium-term conservation (for use two or three seasons later). For the first type, branches of a local species of wood are used, for example *Guiera senegalensis*. For the second type, the walls are plastered with clay. The conservation of peanut, millet and sorghum grains is carried out in gourds in jute or even plastic sacks. In the case of cowpeas, the grains are often mixed with ash or wrapped in leaves of the *Khaya senegalensis* tree or the neem tree (*Azadirachta indica*) whose insecticidal properties are well known to peasant farmers. Drums or metal containers and glass jars are all in use for the conservation of grains. Besides traditional conservation, there is also modern conservation, which consists of the phases described below.

Collection

66. National institutions collect genetic resources made up of local and introduced germplasm. Breeders are the main prospectors, collectors, depositories and users of PGR. Priority is certainly given to the conservation of seeds of major crops and those whose financial importance and sizes of areas cultivated justify the existence of an enhancement programme.

67. The CGIAR institutes have carried out numerous surveys of germplasm in the region. Most of the collections have been duplicated for long-term conservation and replicas have been left in the countries where the survey took place. These included surveys for millet and sorghum by ICRISAT, and for yams and maize by IITA. Exploration and collection of *Irvingia gabonensis* was carried out by ICRAF. About 3,000 rice accessions originating from this sub-region are kept by IRRI for long-term conservation and were collected by IITA, the NARS, CIRAD and ORSTOM. WARDA has benefited, since 1973, from donations of collections from various international bodies (CIRAD, ORSTOM). Its stations located in the various bioclimatic zones have enabled it to collect numerous local ecotypes. The WARDA bank now conserves over 8,000 specimens and part of the data is computerized. Other surveys have yielded coffee trees, oil palms, cereals, legumes, yams, okras, aubergines and cowpeas. In Ghana, for example, collected species were amaranths, cucurbits, coffee and forages.

68. In 1979, some 800 local accessions of sorghum were gathered in the Niger, Burkina Faso and Senegal. In 1984, two collecting missions for forage crops were organized in the Niger, one mission in Mauritania for millet and sorghum, and another in Mali and Guinea for millet. In 1992, a survey for cassava and maize was carried out in Benin, Guinea and Nigeria.

69. Some national institutions demanded the repatriation of a part of the specimens. This request did not always receive a favourable response on the part of international institutions, who consider that these countries do not yet have the appropriate facilities for a totally secure conservation of the germplasm requested. It would seem that a sizeable part of the material stored in the countries of the sub-region has, for various reasons, disappeared or lost its viability.

Characterization, regeneration and documentation

70. Some national institutions try to evaluate and characterise their PGR using the standard IPGRI morphological descriptors. The description of the morpho-agronomic characteristics of the specimens and the determination of the levels of resistance of the germplasm to various biotic and abiotic constraints (disease, pests, drought) are carried out by scientists in the context of multi-disciplinary programmes. These activities are carried out on the basis of recommendations prepared by the international bodies that collaborate with these programmes (IPGRI, ICRISAT, IITA, IRRI, CIRAD, ORSTOM, etc.).

71. Knowledge of plant material is often insufficient and the need for on-site or laboratory characterization is of great importance before being able to prepare computerized databases. Some countries encounter problems because there is no list of morphological descriptors available in their official languages.

72. As far as the use of molecular markers is concerned, only the isoenzyme electrophoresis techniques are used locally. In collaboration with overseas laboratories, a large number of specimens and collections have been screened with the help of neutral markers to study the allele diversities of the germplasm. The results obtained were published jointly by local and foreign scientists in international publications. By way of example, we can cite the diversity studies on moulds in millets, yams of the *D. cayenensis-rotundata* complex, cultivated rice (*O. sativa* and *O. glaberrima*) and sorghum. There are also numerous publications on cash crops (coffee, cocoa, rubber trees and oil palms). The use of molecular markers is, however, limited.

73. Propagation and regeneration are undertaken with the aim of responding to the demand from breeding programmes or when a drop in viability is observed. These activities often face a lot of difficulties, because of the lack of monitored areas (particularly for cross-pollinated). The low level of technical installations, such as greenhouses, propagators and crop chambers constitute constraints that are common to all the countries of the sub-region.

Storage

74. Only two institutes in the sub-region have refrigerated chambers that meet international standards for long-term conservation: the National Institute of Horticultural Research (NIHORT) in Ibadan, Nigeria and the Institute for the Savannahs (IDESSA) in Côte d'Ivoire. They each have a cool chamber and laboratories for seed processing and conditioning. The two institutes have received support from IPGRI and FAO for the consolidation of their facilities. Côte d'Ivoire has a cool chamber for medium-term conservation as well as several freezers. Other countries such as Ghana, the Niger, Benin, Guinea and Senegal use freezers or air-conditioned chambers for the medium-term conservation of germplasm. Despite its lack of a cool chamber, it has to be recognized that Ghana is particularly effective in its conservation and PGR management activities. Moreover, Ghana and Nigeria are the only countries with a national PGR programme having permanent staff.

75. A few countries have benefited from external aid for the installation of cool chambers to preserve working collections or backup collections. This is the case with Côte d'Ivoire, Guinea, the Niger, Nigeria and Senegal. Of these countries, only Côte d'Ivoire and Nigeria still have operational installations. Virtually all the installations set up in the other countries have broken down and have not been able to start up again. Another factor still to be overcome, particularly in the coastal areas, is the high humidity (Côte d'Ivoire, Guinea, Ghana, Nigeria).

76. An important aspect of PGR conservation is the adequate drying of seeds before storage. For conservation at a temperature lower than 0°C, the water content of seeds must be reduced to about 6%, which is difficult to achieve by natural drying in sunlight in coastal areas, where the relative humidity is particularly high (averaging between 60% and 90%). In fact many national facilities do not achieve the level of dryness required before storage in freezers. Natural drying in sunlight or shade is possible, however, above all in the Sahelian region. Trials carried out in Niamey indicate that millet, maize and peanut seeds can be dried to a humidity level of about 5% in sunlight or shade during the months of October and November.

77. For the time being, there is no problem with the storage of very large volumes. Senegal, for example, has a large storage capacity, about 440 cubic

metres. However, the defective state of most of these facilities gives no guarantee of the good physiological state of the stored seeds (variations in temperature due to electricity cuts, excessive humidity, etc.). The use of freezers for long-term conservation seems appropriate for the sub-region, and should be encouraged at the expense of cool chambers, which are too complicated to maintain. Freezers have been used effectively in the Niger, Côte d'Ivoire and above all in Ghana where PGR activities are relatively well-organized.

78. *In vitro* laboratories in the sub-region try to contribute by addressing long-term storage problems, more particularly for species with exclusively vegetative propagation but also for species that are resistant. This is the case with the URCI/ISRA-ORSTOM laboratory in Senegal, involved in a research programme on shrubs, fruit trees and forest trees.

79. The infrastructures set up for the conservation of the seeds of forest species are either defective or undersized in relation to existing needs.

80. Very evident, in the majority of the countries of the sub-region, is the weak role played by botanical gardens. For various reasons, there are very few of these. This form of conservation could therefore contribute more to the conservation of endangered forest species in West Africa. Similarly, the role that should be played by grain plantations or grain orchards in *ex situ* conservation is not well-defined and few initiatives exist. Although the need for reforestation is substantial, especially in the Sudano-Sahelian area, repository plots, the source of quality or genetically enhanced forestry seeds, are seriously lacking. It is also important to note national and international programmes such as those on *Terminalia ivorensis* and *T. Superba* (Côte d'Ivoire and Congo in collaboration with CIRAD-Forèt) and those on eucalyptus and tropical pines (in several countries with the support of FAO).

D. Use of PGR

Use of forestry genetic resources

81. Gathering from the wild is an important activity in West Africa. Forest products such as the roots and fruits constitute a large part of the daily diet of families, and also provides medicines. Many natural species are not exploited commercially but constitute the main food sources during bridging periods. Various species are used for feeding animals in the dry season or are used in traditional medicine for the treatment of some tropical diseases.

82. Forests are effectively veritable pharmacies for the people of these areas, who obtain from them all the medicines required for their families. Traditional herbal treatments are also to be found in towns as well as in rural

areas (after the devaluation of the CFA Franc). It is estimated that several hundred species are used by traditional herbalists. Most of these species are endangered. The *Guiera senegalensis*, for example, is among the best-known medicinal plants in Senegal, but it urgently needs protection.

83. In the National Institutes of Forest Research, local and exotic species are used in variety improvement programmes. Comparative trials of ancestors and descendants are carried out in these research institutions. Genetic improvement programmes more often involve exotic species (*Eucalyptus* spp., *Tectona grandis*, *Cedrela odorata*) and are based on the introduction of provenances, comparative trials, the breeding of trees, the comparison of the worth of descendants and the start of recurrent breeding schemes.

84. Significant progress is evidenced by the refining of vegetative propagation techniques (by cuttings, grafting, and even *in vitro* culture). Several vegetative propagation programmes have had very encouraging results for genetic improvement, allowing the generation of material of the most useful genotypes for clonal orchards.

85. There is an insufficient number of improvement programmes for indigenous species in countries within the region but some rare instances are worth mentioning: this is the case of the genetic improvement of *Acacia senegal* in Senegal, and also that of Frake, Framire, Samba, which are of great importance for reafforestation in Côte d'Ivoire.

86. With regard to predominantly allogamous species, the setting up of orchards for seeds is an appropriate example that allows the integration of conservation and utilization of exotic germplasm. In general, the situation in the area of supplying forestry seeds is characterized by the lack of specialized and operational structures. The methods of collecting seeds are inadequate and lack sufficient scientific knowledge of the characteristics of mother-trees.

87. The collection of seeds is often done by the rural population themselves from stands already identified. They are supervised periodically by water and forestry officials who henceforth organize the redistribution of these seeds during reforestation campaigns. The distribution of seeds is also carried out by development organizations, NGOs etc.

Use of agricultural resources

88. For exotic species, the widening of the genetic base is envisaged regularly, to increase the chances of productivity for improvement programmes and also to avoid the cultivation of some genotypes. This is the case of the rubber tree. For the cultivation of cash-crops, the varieties introduced generally have a performance already tested by international

institutes of their origin. The main objective for selection is to identify genotypes to ensure that their performances are at least equivalent to those of local cultivars used as examples in agronomic trials. Selectors come frequently to put into place various activities by using appropriate cultural techniques with optimistic potentials which are not always at the disposal of the peasants.

89. The objectives of the selection programmes vary according to the type of cultivation or desired characteristics. In general, cultivated plants are selected for their performance, their exploitation facility and their adaptability to the conditions of local cultivation. Industrial plantations are essentially established for the purpose of exportation (coffee, cocoa, rubber, cotton) and their selection is made with the aim of improving productivity and the quality of the product. However, the majority of food-crops are cultivated for subsistence. Hence selection programmes aim at achieving self-sufficiency by freeing the inputs (improving tolerance and resistance).

90. Farmers also play an important role in the conservation and improvement of PGR. In effect, they conserve the best seeds from plants each year. Traditional varieties are used by peasants as products for subsistence legacy. They are conserved by farmers as ancestral legacies for certain specific socio-cultural and economic reasons.

Germplasm evaluation

91. In West Africa, this activity is mainly handled by national institutions. Various tests deal with several species every year and the results are compiled in annual reports. However, efforts made for synthesis and valorization by publications at the international level seem insufficient, due to the accumulation of data during campaign trials.

Varietal selection and improvement

92. The activities are geared towards the improvement of yield components of food crops (cereals, roots and tubers, fruits and vegetables) with the aim of achieving food self-sufficiency. In the case of cash crops, the improvement of parameters of technological quality character is also taken into account. Selection activities aim at widening the genetic base of cultivated species.

93. The genetic material conserved is also used in countries and institutions which have the capacity to use them in undertaking the activities for selection, improvement, or seed production. The lack of enhancement programmes for a large number of species cultivated for national interest hinders conservation by PGR. Practically, there are no genetic improvement programmes for species which are of great regional importance, e.g. *Dioscorea spp.* *Ex situ* conservation of the germplasm consequently becomes problematic.

94. Major export crops have been given priority in certain countries and they benefit from effective breeding programmes (e.g., rubber, coffee, cocoa, oil palm in Côte d'Ivoire, Ghana and Nigeria), but several crops of economic importance are neglected due to lack of resources.

95. Collections held in agronomic research centres are generally rich in exotic materials but poor in local materials. The latter is used often in the creation of synthetic varieties. In most cases, a genetic improvement is by bulk selection. The local varieties attract certain interests from income point of view and adaptability to local systems of production. With regards to exotic varieties, they are either used directly and propagated, or used for improving the local varieties by simple methods of introgression of some quantitative aspects.

Biotechnologies

96. *In vitro* laboratories of the sub-region contribute to PGR enhancement by providing solutions to stocking problems, more particularly to perennial species (woody fruit trees) and/or species that are difficult to propagate. Manipulations have been carried out with success in Côte d'Ivoire in several perennial tropical plants (oil palms coconut, coffee) whose seeds viability does not exceed one week to some months. These activities are undertaken in collaboration with French Research Institutes (CIRAD, ORSTOM). Cryopreservation techniques are also carried out in the laboratories on the oil palms, yams, sugar-cane, banana and lime.

97. In most countries it is hoped that morpho-agronomic characterization will be followed-up at the molecular and cytological levels, but this will need a considerable reinforcement of programmes and human resources. Hence regional and international collaboration programmes are envisaged by researchers.

98. In Senegal, the *in vitro* laboratory of RCI/ISRA-ORSTOM aims at developing classical vegetative propagation techniques and *in vitro* methods suitable for indigenous woody fruit trees. It is meant particularly for the propagation and conservation of germplasm *in vitro*.

99. Most countries in the sub-region wish to see IPGRI and CGIAR institutes reinforce their activities in biotechnologies.

Seed production and distribution

100. Ideally, the breeder provides elite material to the national seed department or private producers of prebasic and basic seed, which will be put at the disposal of producers. The control and certification of seeds is ensured by competent agricultural services. All the countries are striving to achieve this, with variable success. Seed supply to the rural community is ensured by:

- counter sales,
- a lump-sum withheld by national organizations for development,
- credit by the National Agricultural Credit and Popular Mutual Funds which deals directly with producers co-operatives, development organizations, NGOs and private operators.

101. In the past supplies of all sorts of seeds were made with no difficulties, but in the recent past farmers have constantly been faced with the problem of access to seeds. In fact, with the recent disruption in the state of production and distribution, it has become necessary for farmers and their organizations to develop strong relations with their suppliers with a view of having an adequate supply in seed quality. This activity is problematic in all the countries at the level of quality and quantity.

Plant genetic resources and economic development

102. The impact of PGR in the economies of the countries in the sub-region is better perceived in industrial cultivation of cash crops such as coffee, cocoa, pineapples, rubber, oil palms, cotton and sugar-cane.

103. The exploitation of PGR has had a significant impact on the agriculture of the sub-region. The following species have benefited from improvement programmes:

- millet, sorghum and maize: development of more productive varieties for rainfed cultivation in the countries of the Sahel;
- cowpea: development of varieties insensitive to photoperiod and tolerant to major diseases of the sub-region;
- cassava: development of more productive varieties tolerant to bacteria and mosaic virus which are the two main diseases of this area;
- soybean: the development of several varieties adapted to savannah areas has facilitated the introduction of this crop in the production systems of Nigeria, Burkina Faso, Ghana, Guinea, Gambia and Senegal;
- rice: the results obtained with upland rice have made it possible to develop this crop in difficult regions, particularly those with soil salinity problems or widespread pyriculariosis;
- coffee, cocoa, rubber, oil palm and cotton: the quantitative and qualitative benefits of improved varieties are appreciable. Products derived from these species are highly valued on the world market, rendering them a significant source of foreign exchange for the States concerned.

104. In forestry, exploitation of clones of Triplochiton scleroxylon has contributed to the success of reforestation schemes using this species in Côte d'Ivoire and Nigeria. Selection of better stock and descendants for numerous species (particularly families of half-sibs and, occasionally, families of full-sibs), has allowed significant gains. This approach has also made it possible to launch recurrent selection and even reciprocal recurrent selection schemes. For example, the establishment of seed orchards of *Tectona grandis* in Côte d'Ivoire has led to the emergence of an artificial variety from genetically bred descendants.

III. NEEDS AND CONSTRAINTS OF THE GLOBAL PLAN OF ACTION

A. Current Situation

105. In summary, the opportunities offered by the sub-region arise from the similarity of the situation in most of its constituent countries. The problems encountered are of the same nature and could therefore respond to common political, institutional and technical solutions devised at a regional level:

- Lack of well-structured national programmes and effective co-ordination of activities relating to plant genetic resources.
- Insufficient budget for activities relating to plant genetic resources. Inadequacy of logistical and financial resources with which to maintain and follow up programmes and ensure the maintenance of *ex situ* live collections.
- Unclear legal framework for plant genetic resources. Legal assistance required in this field. No legislation or policy exists on the exchange of genetic material.
- All the countries of the sub-region envisage setting up a legal and institutional framework for the management of forests and natural vegetation. The need for this is particularly urgent in semi-arid areas due to strong human pressure.
- All the countries recognize that existing policies and institutions need to be reorganized in order to reach a balance between conservation objectives and economic development. In many countries policies are encouraging deforestation by not giving due value to forestry products.
- Inadequate number of specialists working on plant genetic resources programmes and tremendous weakness in terms of human resources and qualified personnel.

- Inadequacy of genetic improvement and varietal introduction programmes for food crops. Priority is usually given to industrial and cash crops.
- Lack of functioning storage infrastructure and seed treatment laboratories. Lack of biotechnology laboratories to characterize germplasm at the molecular level. Lack of *in vitro* facilities for the medium and long term storage of recalcitrant and vegetatively propagated species.
- Lack of prospection and collection programmes for important indigenous species. Lack of taxonomic, ecogeographic, phenological and genetic diversity information on endangered species.

B. Opportunities for Conservation and Use of Plant Genetic Resources

106. The sub-region, offers several opportunities, which include the following:

- Overall, the countries of the sub-region have expressed their wish, in the context of elaborating the Global Plan of Action, to draw upon the reserves available to them, namely their human resources, infrastructure and natural and logistical reserves.
- Training for researchers and technicians in seed conservation and treatment techniques, collection, characterisation, evaluation, and management of data and documentation could also be organized locally by research institutions and universities.
- Nigeria, Ghana, Côte d'Ivoire and Senegal may be in a position to provide training in plant genetic resources, in the form of short courses (technical workshops, recycling) and study at MA and DEA levels.
- In the field of scientific research, satisfactory results have been obtained in orthodox seed conservation and mastering techniques of vegetative propagation in ligneous plants (cuttings, grafting). On the other hand, there has been less success with *in vitro* storage of plant tissue and/or recalcitrant seed embryos.
- A great many parks, reserves and protected forests, with a fundamental role to play in in situ conservation. These areas have been insufficiently studied and deserve the attention of concerted international protective efforts. A comparative advantage is that West Africa's flora has by no means been properly studied yet.

APPENDIX
GAMBIA

Characteristics

Gambia covers an area of 11,147 km^2. It lies between longitudes 13° 35' to 16° 50' West and 13° 12' to 13° 35' North, and is almost entirely surrounded by Senegal. The population is estimated at 1,025,000 inhabitants, with an annual growth rate of 4.2 per cent.

The climate has two seasons: a cool, dry season from November to June and a rainy season from July to October. The vegetation of the country has undergone some changes due to drought and human activities. Agriculture, animal husbandry and fishing are the country's main resources.

Local Plant Genetic Resources

During 1970-1990, prospection and collecting missions were carried out for sorghum, millet, groundnuts, rice and maize. More recently, the horticulture service carried out collecting missions for okra, peppers, tomato, sweet potato and cassava.

Forest resources are abundant and include species of: *Parkia spp., Khaya spp., Acacia spp., Terminalia spp., Prosopis spp., Combretum spp., Pterocarpus spp., Cassia spp.*, etc. Mangroves, of the genera *Rizophora spp.* and *Avicennia spp.*, are found along the banks of the river. Oil palms and wild vegetables and fruits are also found, as is a range of medicinal plants.

National Activities to Preserve Plant Genetic Resources

Agricultural plant genetic resources are evaluated and passed on to farmers after being recommended. A number of local species are being used in the context of a reforestation programme. These include species belonging to the following genera: *Borassus spp., Khaya spp., Parkia spp. and Prosopis spp.* These species are naturally used by the peasants, who keep them in their fields. Collection of forest seeds is done in traditional manner by village populations.

National Legislation

In the context of environmental protection, a number of decrees have been enacted by the Gambian Government, which has also ratified the Convention on Biodiversity. Nevertheless, there is no specific legislation on PGR conservation, since there is no national programme to date.

International Collaboration

Gambia is open to all international organizations for collaboration. Three national researchers have benefited from training in fodder evaluation techniques at the International Livestock Centre for Africa (ILCA).

Needs and Perspectives

Gambia needs assistance in creating a national PGR programme. It is important to sensitize the rural population on the need to preserve local plant genetic resources. To do this, appropriate training is called for at all levels.

Proposal for a Global Plan of Action

- a global funding mechanism for PGR activities, particularly in tropical regions;
- a global genebank;
- gene banks for the tropical developing countries.

GHANA

Characteristics

The country covers 238,530 km^2. It lies between latitudes 4° 44' to 11° 11' North and longitudes 01° 12' to 03°11 West. At administrative level, Ghana is divided into 10 regions. The current population is 14.9 million, with an annual growth rate of 3.3 per cent. Approximately 52 per cent of the population is rural.

There are five agro-ecological zones: rain forest, semi-deciduous forest, transitional zone, coastal savannah and Sudano-Guinean savannah. Each zone is characterized by specific rainfall levels, soil type and crops. The main cash crops are cocoa, coffee and kola. Cocoa alone represents 48 per cent of the gross domestic product (GDP) of agricultural origin.

The Ministry of Food and Agriculture is responsible for all agricultural production except cocoa, coffee, shea-nuts and kola nuts, which come under the Ghana Cocoa Board, which is under the Presidency of the Republic.

Ghana has a National Centre for Plant Genetic Resources, based at Bunso.

Indigenous Plant Genetic Resources

There are several types of timber and medicinal plants, of which the most threatened are *Pericopsis elata* and *Milicia excelsa*. Wild species such as *Thaumatococus daniellii* and *Discoreophylum cuminisii* are potentially useful to the pharmaceutical industry. Many wild species allied to cultivated varieties are endangered by annual bush fires. Vegetable species indigenous to Ghana are: *Dioscorea spp., Vigna spp., Kestingiella geocarpa, Sphenostylis stenocarpa, Mucuna pruriens, Sorghum bicolor, Digitaria exilis, Penisetum glaucum* and *Oryza glaberrima*. Other species found are: *Amaranthus spp., Abelmoschus esculentus* and *Solanum spp.*. Local species of industrial importance include oil palm, shea-nut tree, cashew tree and kola nut tree.

National Plant Genetic Resource Conservation Activities

The National Centre for Plant Genetic Resources at Bunso undertakes most of the conservation activities. With regard to *in situ* conservation, the Forestry Department accounts for 279 forest reserves and several arboreta. For *ex situ* conservation, collections have been made for many crop species and are kept at low temperatures or in fields at the Centre. Germplasm is mainly used in agricultural research. Other research institutions have cold rooms for maintaining working collections.

Use of Plant Genetic Resources

Material is mainly used in crop improvement programmes. Young fruit trees are distributed to farmers for their orchards. Many of the species conserved in situ are used for medicinal purposes. The forest reserves and arboreta are also used in education and tourism. Some forest reserves are traditionally regarded as sacred and are of cultural significance.

National Strategies and Legislation

The Centre for Plant Genetic Resources has a mandate to execute and co-ordinate national programmes for the conservation and use of plant germplasm. A nine-member national committee has been established. The budget of the centre is provided by the central government. The centre has qualified personnel, but their numbers are very limited.

There is no legislation relating specifically to plant genetic resources. The existing legislation is limited to quarantine laws.

International Collaboration

The Centre has received training and equipment from IPGRI. Some training has also been provided by IITA, ICRISAT and IRRI. Japan has provided assistance for training and germplasm collecting.

Needs and Perspectives

Logistical needs are connected with the structures for storing and conserving collections, either in cold rooms or using *in vitro* cultures. Infrastructure is also required for the quarantine service and training is needed to increase the numbers of scientific personnel. Activities which must be undertaken include identification and protection of endangered species. The existing germplasm needs to be characterized and evaluated so that it can be used by breeders.

Proposals for a Global Plan of Action

- International sanctions should be applied in order to ensure sustainable exploitation, use and management of timber species and other forest resources in Ghana.
- The poorer countries whose genetic resources are exploited by developed countries should receive royalties.

NIGERIA

Characteristics

Nigeria is located between longitude 3° 14' east and latitude 4° 14' north, covering an area of 942,000 km^2. The country has a population of over 88 million, according to the 1991 census, and is made up of 31 states. Vegetation ranges from rain forest in the south to the Sahel in the far north, with savannah areas in between. Different crops are grown in each agro-ecological zone.

Plant Diversity

Nigeria has around 4,600 named plant species, of which 205 are endemic. Over 110 plant families are represented. A number of species are threatened with extinction, particularly those in the families Acanthaceae, Apocynaceae, Compositeae, Cyperaceae, Euphorbiaceae, Graminaceae and Orchidaceae. A survey found that almost 500 species, belonging to 12 families, are endangered in Nigeria.

Local Plant Genetic Resources

There are numerous local forest species, of which the main ones belong to the genera Terminalia, Khaya, Milicia, Lovoa, Pericopsis, Mansonia, Parkia, Prosopis and Vitellaria. Indigenous edible species include African rice (*Oryza glaberrima*), yams (*D. cayensis* and *D. rotundata*), cowpeas (*Vigna unguiculata*) and Bambara groundnuts (*Vigna subterranea*).

National Plant Genetic Resource Conservation Activities

In situ conservation is carried out in 12 state-owned natural reserves. Botanical gardens and arboreta are also maintained by some universities.

For *ex situ* conservation, each agricultural research institution has a working collection for the crops concerned. The National Centre for Genetic Resources and Biotechnologies (NACGRAB) was set up in 1986, with responsibility for co-ordinating all activities connected with genetic resources. The NACGRAB gene bank contains some 5,000 acquisitions, including edible, fodder, medicinal, industrial and forest species. This material is kept in cold storage or in the field. There are also a few freezers and equipment for germination tests

and assessing the water content of seed grains. The acquisitions are partially described. There has been no breeding so far. Documentation work is done manually, limiting the exchange of information.

Use of Plant Genetic Resources

Available genetic resources are used by national and international research institutions in varietal improvement programmes. The main crops involved are cowpeas, maize, cassava and sorghum.

National Laws and Strategies

The Federal Government has created the National Centre for Genetic Resources and Biotechnology (NACGRAB) in order to preserve the country's genetic patrimony, particularly cultivated species. The Centre's annual programme is controlled by the parent ministry, which is the Ministry for Science and Technology. The operational budget is, however, approved by the Ministry of Finance.

In terms of legislation, Nigeria has a quarantine service for which import and export permits are required. The Government has passed a law to confirm and authorize new varieties and another law controls the distribution and sale of seed material.

International Collaboration

Nigeria receives plant matter, equipment and publications and has benefited from training courses organized by international institutions such as IPGRI, IITA, ICRAF, Centre for Maize and Wheat Enhancement (CIMMYT) and FAO. At sub-regional level, Nigeria is collaborating with Ghana, Cameroon and Gabon in a project to collect the forest species *Irvingia gabonensis*. The country also collaborates with Burkina Faso in a project on *Parkia biglobosa*.

Needs and Perspectives

There are many needs in the following areas:

- collection and conservation of endangered species;
- inventory of species conserved *in situ*;
- training of researchers and technicians;
- computer equipment for documentation purposes.

Proposals for the Global Plan of Action

- development of a regional programme on PGR in the sub-region.

Table 1: Area and populations of West African countries

Country	Aera (km^2)	Population	Density (person/ km^2)	Population increase (in %)	GNP per habitant (in US$)	Agriculture (% GDP)
Benin	112 622	4 800 000	42.1	3.4	380	40
Burkina Faso	274 120	9 200 000	33.6	2.6	340	36
Cape Verde	4 033	380 000	94.2	2.5	750	
Côte d'Ivoire	322 462	12 200 000	37.8	4.0	792	35
Ghana	238 537	15 000 000	62.9	3.0	400	48
Gambia	11 295	815 000	72.2	3.1	360	
Guinea	245 857	7 100 000	28.9	2.4	450	27
Guinea-Bissau	36 125	981 000	27.1	2.3	190	47
Liberia	111 400	2 500 000	22.0	3.2	450	37
Mali	1 240 190	8 400 000	6.8	2.7	280	46
Mauritania	1 030 700	2 020 000	2.0	2.6	510	34
Niger	1 267 000	7 700 000	6.1	3.5	300	36
Nigeria	923 768	100 000 000	92.6	3.4	290	39
Senegal		7 500 000	39.6	3.0	720	22
Sierra Leone		4 150 000	57.3	2.4	210	
Togo		3 800 000	66.9	3.5	410	34

Table 2: Main food crops and cash crops in West African countries

Country	Main crops		Collections of germplasm and improvement programmes (*)
	Food crops	Cash crops	
Benin	cassava, yams, maize, millet, sorghum	cotton, palm oil, peanut groundnut, shea (tree)	maize, sorghum, rice, cassava
Burkina Faso	millet, sorghum, rice, maize	sugarcane, cotton, sesame, shea (tree)	sorghum*, millet*, maize*, rice
Côte d'Ivoire	millet, sorghum, maize, rice, yams, cassava, plantains, sweet potato	cocoa, coffee, rubber, cola, palm oil, cotton, bananas, pineapple	rice*, maize*, sorghum*, millet*, cotton*, yams, cassava, sugarcane*, coconut palm*, coffee*, cocoa*, palm oil*
Cape Verde	cassava	sugarcane	sugarcane
Gambia	millet, sorghum, maize, rice	peanut groundnut	
Ghana	cassava, plantains, rice, yams, millet, sorghum	cocoa, sugarcane, palm oil, cotton, tabac	cocoa*, sugarcane*, palm oil*
Guinea	rice, yams, maize, cassava, sweet potato	peanut groundnut, bananas, palm oil, pineapple	rice, maize, sweet potato, yams, cassava
Liberia	cassava, rice	rubber, sugarcane	rubber
Mali	millet, maize, sorghum, rice	sugarcane	
Mauritania	millet. rice, beans		
Niger	rice, millet, maize	peanut groundnut, cowpea	
Nigeria	yams, cassava, millet, plantains, beans, rice maize	peanut groundnut, cotton, rubber, palm oil, cocoa, sugarcane	millet*, cassava, cowpea*, cocoa*. sugarcane*, palm oil*, peanut groundnut*, sugarcane*, palm oil*, cotton*

Country	Main crops		Collections of germplasm and improvement programmes (*)
	Food crops	Cash crops	
Senegal	rice, millet, sorghum	peanut groundnut	peanut groundnut*, rice*, cowpea*, sorghum*, millet*
Sierra Leone	rice, sorghum, maize, cassava	cocoa, coffee, palm oil	rice, maize, millet, cassava, sorghum, cowpea, sweet potato, peanut groundnut
Togo	yams, cassava, maize, millet	cotton, shea (tree), coffee, cocoa,. palm oil	millet, maize, rice, sorghum, coffee, cocoa, cotton

Table 3a: Number of accesions kept for main crops in West Africa

Foodcrops

Country	Rice	Maize	Sorghum	Millet	Cowpeas	Underground peas
Benin						
Burkina Faso	527	201	865	884	161	59
Cape Verde						
Côte d'Ivoire	9 675	600	445	150	91	
Ghana	258	421		51	177	65
Gambia						
Guinea-Bissau						
Guinea	880	119			316	
Mali						
Mauritania						
Niger						
Nigeria	12 000				15000	
Senegal	1 044	171	981	269	516	
Sierra Leone	160					
Togo	160	89	300	350	80	420

Foodcrops (continued)

Country	Beans	Cassava	Yams	Sweet potato	Taro
Benin					
Burkina Faso		2	50	6	1
Cape Verde					
Côte d'Ivoire		308	300	135	
Ghana		161	375		
Gambia					
Guinea-Bissau					
Guinea	107	227	15	3	2
Mali					
Mauritania					
Niger					
Nigeria			2600		
Senegal		221	50	30	
Sierra Leone					
Togo	20	629	850	24	42

Table 3b: Number of accesions of main crops in West Africa

Cash crops

Country	Peanut groundnut	Cotton	Sugarcane	Palm oil	Cocoa	Coffee
Benin						
Burkina Faso						
Cape Verde						
Côte d'Ivoire		532	524	461	700	7500
Ghana	76					
Gambia						
Guinea-Bissau						
Guinea	279					794
Mali						
Mauritania						
Niger						
Nigeria						
Senegal	869	433				
Sierra Leone						
Togo	85					

Cash crops (continued)

Country	Coconut palm	Cola nut	Plantain	Soybean	Rubber	Tobacco
Benin						
Burkina Faso						
Cape Verde						
Côte d'Ivoire	53	130	133	3 727	3 674	6
Ghana						
Gambia						
Guinea-Bissau						
Guinea		12	13			
Mali						
Mauritania						
Niger						
Nigeria						
Senegal	16					
Sierra Leone						
Togo		78				

Table 4: National programmes in Western Africa countries

Country	National programmes	Conservation *in situ* (km^2)	Conservation *ex situ* PGR agriculture	PGR forestry	Bio-technologies
Benin	no	8 400	seed/station ($100m^3$)		
Burkina Faso	no	26 400	seed/station	seed, orchards	
Cape Verde	no		seed/station		
Côte d'Ivoire	no	19 000	seed/station	seed, orchards	*in vitro* collections
Ghana	yes	10 700	seed/station		*in vitro* collections
Gambia	no	100	seed/station		
Guinea	no	1 700	seed/station ($100m^3$)		
Niger	no	97 000	seed/station ($25m^3$)		

Country	National programmes	Conservation *in situ* (km^2)	Conservation *ex situ* PGR agriculture	PGR forestry	Bio-technologies
Nigeria	yes	28 700	seed/station	seed, orchards	
Senegal	no	21 800	seed/station (440m^3)	seed, orchards	*in vitro* collections
Sierra Leone	no	800	seed/station		
Togo	no	6 500	seed/station (30m^3)	seed, orchards	

Table 5: Conventions and Agreements signed by countries in West Africa

Country	Member of the Commission	Adherring to the Undertaking	Date of signature CBD	Member of CITES
Benin	yes	yes	30.6.1994	yes
Burkina Faso	yes	yes	2.9.1993	yes
Cape Verde	yes	yes	29.3.1995	
Côte d'Ivoire		yes	29.11.1994	
Ghana	yes	yes	29.8.1994	yes
Gambia	yes		10.6.1994	yes
Guinea	yes	yes	7.5.1993	yes
Guinea-Bissau	yes		27.10.1995	yes
Liberia	yes	yes		yes
Mali	yes	yes	29.3.1995	
Mauritania	yes	yes		
Niger	yes	yes	25.7.1995	yes
Nigeria			29.8.1994	yes
Senegal	yes	yes	17.10.1994	yes
Sierra Leone	yes	yes	12.12.1994	
Togo	yes	yes	4.10.1995	yes

Table 6: Protected areas of Western Africa countries

Country	Area (km^2)	Natural forest (per km^2)	Annual deforestation	Protected areas Area (km^2)	Protected areas % of the total area
Benin	112 600	39 000	0.7	8 400	7.5
Burkina Faso	274 120	47 000	0.8	26 400	9.6
Cape Verde	4 033				
Côte d'Ivoire	322 462	98 000	2.6	19 900	6.2
Gambia	11 295				
Ghana	238 537	85 000	0.7	10 700	4.5
Guinea	245 857	107 000	0.9	1 700	0.7
Liberia	111 400	20 000	0.5	1 300	1.2
Mali	1 240 190	73 000	0.4	40 100	3.2
Mauritania	1 030 700	6 000 000	0.1	17 500	1.7
Niger	1 267 000	26 000	0.7	97 000	7.7
Nigeria	923 768	148 000	4.0.	28 700	3.1
Senegal	196 722	110 000	0.5	21 800	11.1
Sierra Leone	73 325	21 000	0.1	800	1.1
Togo	56 785	17 000	0.1	6 500	11.4

Source: World Development Report 1992, Development and the Environment, World Bank, Washington.