STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE IN NIGERIA

(1996-2008)

A Country Report

National Centre for Genetic Resources and Biotechnology, Ibadan / Federal Department of Agriculture, Abuja

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Contents

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Foreword

List of Acronyms

ADPSs:	Agricultural Development Projects
ARCN:	Agricultural Research Council of Nigeria
AVRDC:	World Vegetable Centre
CBN:	Central Bank of Nigeria
CENRAD:	Centre for Environment, Renewable Natural Resources Management, Research and Development
CIMMYT:	International Maize and Wheat Improvement Center
CRIN:	Cocoa Research Institute of Nigeria
FAO:	Food and Agriculture Organization
FDA:	Federal Department of Agriculture
FDF:	Federal Department of Forestry
FMEnv.:	Federal Ministry of Environment
FORMECU:	Forestry Management Evaluation and Coordinating Unit
FRIN:	Forestry Research Institute of Nigeria
GDP:	Gross Domestic Product
IAR:	Institute for Agricultural Research
IAR&T:	Institute for Agricultural Research and Training
ICRAF:	World Agroforestry Center
ICRISAT:	International Crops Research Institute for the Semi – Arid Tropics
IITA:	International Institute of Tropical Agriculture
ILRI:	International Livestock Research Institute
NACGRAB:	National Centre for Genetic Resources and Biotechnology
NARIs:	National Agricultural Research Institutes
NARS:	National Agricultural Research System
NASC:	National Agricultural Seed Council
NCRI:	National Cereal Research Institute
NIHORT:	National Horticultural Research Institute
NIFOR:	Nigerian Institute for Oil Palm Research
SNRs:	Strict Natural Reserves
WARDA:	Africa Rice Centre

Executive Summary

Nigeria covers an area of 923,768 square km enclosed within longitudes 3^{o} and 14^{o} East of the Greenwich Meridian and latitudes 4^{o} and 14^{o} North of the Equator. About 98.6% of the total area is land and the rest is water. It shares a common boundary with the Republic of Benin to the West, Chad and Cameroun to the East and Niger Republic to the North. The Atlantic Ocean with a 960 km coastline borders the south and is indented by lagoons and by the immense Niger River Delta. The River Niger with its tributary, the Benue, forms a large 'Y' across Nigeria. The country is a physically and climatically diverse country that is endowed with substantial natural resources. There are nine distinct ecological zones which can be streamlined into five, namely (i) sahel/sudan savanna, (ii) guinea savanna, (iii) derived savanna, (iv) lowland rainforest/montane forest and (v) freshwater swamp forest/mangrove forest and coastal vegetation. The physical and climatic diversity permits the growth of a wide variety of crops.

There are about 7,895 plant species from 338 families and 2,215 genera that have been identified in the country out of which 0.4% are considered threatened and 8.5% endangered. One hundred and forty-six species on the IUCN list of threatened species are found in Nigeria out of which 18 falls under the category 'endangered' and 15 under the category 'critically endangered'. The land use classification of Nigeria's 923,768 square km shows that 34% is occupied by crops, 23% by grassland and 16% forests. Approximately 13% is taken up by rivers, lakes and reservoirs, and the remaining 14% fall under *other* uses. Within the last 25 years, it is believed that about 43% of the forest ecosystem has been lost. Agriculture is strategic to the Nigerian economy supplying food for the country's 140 million people (2005 census), raw materials for industries, earning foreign exchange which is next only to that from crude oil, providing market for the industrial sector and a key contributor to wealth creation and poverty alleviation. The country is the world's leading producer of cowpea, cassava and yam. More than 70% of the population derives their living from agriculture and agro-allied activities. The sector accounts for 5% of total export, provides 88% of non–oil earnings, and contributes about 41% of the Gross Domestic Product (GDP) 85% of which is from crops sub-sector.

The importance of *in situ* conservation of germplasm in Nigeria has been recognized for a very long time and the strategy adopted involved a) Conservation areas/Forest Reserves, b) protected areas/wetlands, c) Parks, d) Natural Reserves, and e) Strict Natural Reserves. Thus, most *in situ*

conservation in Nigeria was hinged on the Forestry Management System within which are many species with traditional food, medicinal or cultural values. Only about 10 percent of Nigeria's land area remain as forest and with about 3.0% population growth, 3.5% annual deforestation rate and the increasing rate of de-reservation of forests by some State Governments, commensurate efforts are not being put into *in situ* conservation and there appears to be no serious commitment towards this.

Nigeria made a little progress to conserve plant genetic resources for food and agriculture *ex situ* in the last twelve years reported. The national focal point for genetic resources, the National Centre for Genetic Resources and Biotechnology (NACGRAB), commissioned many collection missions, undertook stock inventorization, viability monitoring, as well as evaluation and characterization of germplasm. In addition, National Agricultural Research Institutes (NARIs) were encouraged to have a genebank for collections of their specific mandate crops. The major and daunting challenges for the *ex situ* conservation efforts in Nigeria are primarily inadequate infrastructure and human capacity.

Germplasm is exchanged freely within the National Agricultural Research System (NARs) as well as with the International Agricultural Research Centres present in the country and the materials have been used almost exclusively in research to develop elite varieties that have been released. There is a positive correlation between the number of accessions of a particular crop species in the genebank and the degree of their utilization. However, there is need to strengthen the national focal point for the coordination of germplasm exchange and storage.

The Nigerian Government realized the fact that valuable genetic resources constitute a capital asset with great potential for yielding benefits. It was in this light that the NACGRAB was established to ensure collection, conservation, preservation, utilization and maintenance of valuable germplasm for agricultural development. In addition to regular PGR-related short-term training courses, efforts have been made to introduce PGR into the curriculum of selected Universities and Faculties of Agriculture. The subsisting National Biodiversity Strategy and Action Plan (NBSAP) was published in 2006 as a first step towards integrating biodiversity consideration into national planning, policy and decision-making process.

Nigeria signed and ratified the Convention on Biodiversity in August 1994. There exist a mutual and close working relationship with relevant International and Regional Organizations notably IITA, WARDA, CIMMYT, AVRDC, ICRAF and ICRISAT. The country's relationship with other regional centres is mainly in the area of information dissemination.

There is no mechanism for access and benefit sharing in Nigeria. However, a “National Environment (Conservation of Biodiversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations within which access and benefit sharing is embedded, has been drafted and efforts to pass it into law has reached an advanced stage.

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INTRODUCTION

Nigeria, with an area of 923,768 square km enclosed within longitudes 3^{o} and 14^{o} East of the Greenwich Meridian and latitudes 4^{o} and 14^{o} North of the Equator, is the most populous country in Africa. Of the total area, 910,768 square km is land while water occupies 13,000 square km. It shares a common boundary with the Republic of Benin to the West, Chad and Cameroun to the East and Niger Republic to the North. The Atlantic Ocean with a 960 km coastline borders the south. The country's total land boundaries are 4,047 km in length, comprising 773 km with Benin, 1,690 km with Cameroun, 87 km with Chad, and 1,497 km with Niger Republic. Nigeria's population is about 140 million (2005 census) and the annual growth rate is estimated at 3%.

Nigeria is a physically and climatically diverse country that is endowed with substantial natural resources. It encompasses three major ecological regions, a humid forest region, a sub-humid region with highland, and a semi-arid region, with annual rainfall ranging from about 250 mm in the Sahelian north to over 3,000 mm in the southern coastal areas. The natural vegetation varies from rain forest to savanna. There are nine distinct ecological zones (Figure 1) which, due to similarity of characteristics, can be streamlined into five, namely (i) sahel/sudan savanna, (ii) guinea savanna, (iii) derived savanna, (iv) lowland rainforest/montane forest and (v) freshwater swamp forest/mangrove forest and coastal vegetation. The physical and climatic diversity permits the growth of a wide variety of crops. The 960-km coastal area in the south is indented by lagoons and by the immense Niger River Delta. The River Niger with its tributary, the Benue, form a large 'Y' across Nigeria. The geological characteristics of the country comprise a large number of base rocks of diverse origins, from plinths to sedimentary rocks. The landscape associated with these "older" granites is mainly narrow and deep valleys and pediments (surfaces made smooth by erosion) from the middle of which rose rounded hills with sheer rock faces. There are also numerous volcanoes and vast basaltic plateaus from lava flow, due to volcanic activity of the past in the south, a typical mangrove type sedimentation, has superimposed itself on the Niger Delta giving it its swampy outlook.

There are 7,895 plant species (Table I.1) from 338 families and 2,215 genera that have been identified in Nigeria (FMEnv., 2006). About 0.4 and 8.5% of the plant species are considered threatened and endangered, respectively. Of the IUCN list of threatened species, 146 are found in Nigeria, 18 under the 'endangered' and 15 under the 'critically endangered' categories.

Figure 1: A map of nine ecological zones in Nigeria

Table I. 1. Inventory of Plant Species in Nigeria

Group of Plants	No of Families	No of Genera	No of Species
Algae	67	281	1335
Lichens	-	14	17
Fungi (Mushrooms)	26	60	134
Mosses	-	13	16
Liverworts	-	16	6
Pteridophytes	27	64	165
Gymnosperms	2	3	5
Chlamydosperms	2	2	6
Monocotyledons	42	376	1575
Dicotyledons	172	1396	4636
TOTAL	**338**	**2215**	**7895**

Source: Nigeria's First National Biodiversity Report, FMEnv. (2006a)

The land use classification of Nigeria's 923,768 square km shows that 34% is occupied by crops, 23% by grassland and 16% forests. Approximately 13% is taken up by rivers, lakes and reservoirs, and the remaining 14% fall under *other* uses (Shaib *et al.*, 1997). Within the last 25 years, it is believed that about 43% of the forest ecosystem has been lost consequent upon which the Nigerian government has now made a commitment to conserve 25% of total forest area (FMEnv., 2006b).

Agriculture is strategic to the Nigerian economy and plays the key roles of supplying food for the population, raw materials for industries, earning high foreign exchange which is next only to that from crude oil, providing market for the industrial sector and a key contributor to wealth creation and poverty alleviation. More than 70% of the population derives their living from agriculture and agro-allied activities, with the sector contributing about 41% of the Gross Domestic Product (GDP) and accounts for 5% of total export. It provides 88% of non–oil earnings. Crops contribute 85% of the agricultural GDP, livestock 10%, fisheries 4% and forestry 1%. About 94% of the agricultural output is accounted for by small–scale, subsistent farmers cropping less than 2 ha.

There exist four broad systems of land use: crop production (rotational fallow, semi-permanent or permanent cultivation) and mixed farming; livestock production (predominantly pastoral); fisheries (inland freshwater and brackish water); and forestry (agro–forestry). Judging by international standards, most of the farms in Nigeria are small-farm holdings. Farm holdings in Nigeria fall into three broad categories- small-scale with 0.1 to 5.99 ha, medium scale with 6-9.99 ha, and large-scale with upward of 10 ha (Shaib *et al.* 1997). Small-scale farm holdings predominate in Nigeria, accounting for 81% of the total area and about 94% of agricultural output and commercial farms producing the remaining balance. It is estimated that about 79 million hectares of the total land area of Nigeria are cultivable (agricultural), while 13% are under forest and 32 million hectares are woodland. Only 46% of the agricultural lands are under cultivation (arable and permanent crops) and the rest under permanent pastures. Similarly, of the estimated 3.14 million hectares of irrigable land area only about 220,000 hectares (7%) is utilized.

The productivity of the Nigerian agricultural sector is low in spite of enormous possibilities for growth and improvement. The use of agricultural technologies and external inputs to enhance productivity is dramatically sub-optimal in Nigeria. Fertilizer consumption is about 7 kg/ha, the

lowest in sub-Saharan Africa (SSA). There are only 12 private seed companies in Nigeria and together with community-based seed production initiatives, they are able to meet less than 10% of the national requirement for certified seeds of improved crop varieties. Farmers also have limited access to credit and the existing extension services are grossly inadequate with the ratio of 1 extension worker to 25,000 farming families. Mechanized assistance is grossly inadequate as most Nigerian agriculture is still characterized by the use of the hoe-cutlass technology. There are only about 30,000 tractors for all the 114 million farming families in Nigeria.

Local production of major staple food items like maize, cowpea, rice, cassava, tomato, meats, eggs, oil, e.t.c. is grossly inadequate to meet demand despite that the majority of the population lives below $1 per day and about 40% of family income is spent on food. Nigerian food situation is vulnerable to global trends because the country depends heavily on importation of food items like as rice, wheat, milk, among others. About 30% of livestock slaughters are imported from neighbouring countries. The daily animal protein intake per head per day is currently at 10 grams compared to FAO recommended 36 grams. Increased pressure on grazing lands, trans-boundary animal diseases, ineffective livestock marketing system, lack of efficient and hygienic livestock processing facilities and poor genetic quality (slow growth and low milk yields) are the major factors contributing to the scarcity. According to the Federal Ministry of Agriculture and Rural Development estimates, national fish demand for 2008 is 2.6 million metric tonnes out of which while local supply will be about 600,000 metric tonnes. Nigeria imports about 700,000 metric tonnes of fish annually. The 1.7 million hectares of available inland water bodies have not been utilized adequately for fish production and aquaculture. Therefore, Nigeria is a net importer of food and unless drastic and sustained measures at growing the agricultural sector is taken over the next decade, the country will experience more serious food shortages arising from the expected significant increase in the demand for agricultural production as a result of the current high population and the estimated growth rate.

The current efforts of the Nigerian government to diversify the economy and grow the agricultural sector in order to make the country not only food-sufficient and but also a net exporter are expected to reverse the down trend of the contributions of the agricultural sector to national GDP. Expectedly, agricultural scientists will depend heavily on available plant genetic

resources to develop new and elite crop varieties suitable for different agro-ecologies and consumer preferences. In order to meet these targets, urgent and immediate actions would be required to stem the high rate of biodiversity loss as a result of habitat destruction and the dependence on and over-exploitation of plant genetic resources by a larger proportion of the population dwelling in the rural areas.

Information sharing on plant genetic resources among all stakeholders is just emerging and weakly coordinated in Nigeria. This, coupled with the critical shortage of time of less than two months to prepare, validate and submit the report, posed a great challenge for the preparation of this report. It was not possible to cascade the training on the use of the management and operation of the database for recording data for the preparation of the country report. Consequently, a participatory approach was used in writing this report. Notable plant genetic resources experts based on competence, experience and past contributions were invited and the writing of the chapters was shared with each chapter committee mandated, as conveners for the chapter, to reach out directly to other stakeholders within the time limit. Thus, attempt was made to involve as many stakeholders as are relevant to each chapter in order to get the data presented in this report. The draft chapters submitted were synthesized and supplemented with data gathered by the National Consultant within the short period before the draft final report was presented for validation.

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The State of Diversity 1

Important Crops and their products

Nigeria is rich in plant genetic resources which exist in wild forms in the plants' natural habitats and in diverse crop landraces/ecotypes/cultivars. The extent of direct and indirect dependence on plants is high in Nigeria because for the majority of the population living in the rural areas, daily energy requirement is almost entirely from plant sources. Plants are used as food, spices/condiments, herbs, energy source, raw materials and many other uses as enumerated in Annex 1. The country is an epicentre of diversity for many taxa such as Cowpea (*Vigna unguiculata*), West African Okra (*Abelmoschus caillei*), West Africa Rice (*Oryza glaberrima*), Yams (*Dioscorea* spp.), Bambara groundnut (*Vigna subterranea*), Kerstin's groundnut (*Macrotyloma geocarpum,* previously *Kerstingiella geocarpa* Harms), African yam bean (*Sphenostylis sternocarpa*) and winged bean (*Psophcarpus tetragonolobus*). However, there is a wide gap in the knowledge of the genetic diversity of wild plants (FMEnv., 2006) owing to lack of up-to-date documentation of plant genetic resources for food and agriculture. Only a small fraction of the rich natural endowment of plant genetic resources is properly documented and profitably exploited for food and agriculture. The diversity of both the major and minor Nigerian crops is decreasing because the rate at which the diversity is lost due to habitat destruction and over-exploitation is far more than the rate at which collection and conservation are done.

The state of diversity and relative importance of major food crops

The major food crops in Nigeria are guinea corn/sorghums, millet, maize and rice (the cereals); cassava, yam and cocoyam (the tubers) and cowpea (grain legume) (Table 1.1).

Guinea corn (*Sorghum bicolor* L. Moench) is the most widely cultivated cereal crop in Nigeria and the most important food crop in the savanna areas. About 8 million tonnes of grain of *Sorghum* are produced annually from about 6.0 million ha covering more than three quarters of the total arable land area between latitudes 8ºEN and 13ºEN in the country. (Abbi and ABA,

1999). *Sorghum* is very zone-specific with different varieties bred for specific zones. The indigenous varieties (landraces) are generally tall while the exotic ones are dwarfish and grain

Table 1.1. Plants used for food in Nigeria

Crop Groups	Crops (Botanical name)	
	Major	**Minor**
Cereals	Guinea corn/sorghums (*Sorghum bicolor*), millet (*Pennisetum americanum*), maize (*Zea mays*), rice (*Oryza* spp.)	Bread wheat (*Triticum aestivum*), fonio / hungry rice (*Digitaria exilis, D. iburua*), nigerian tef (*Eragrotis tef*)
Food Legumes	Cowpea (*Vigna unguiculata*)	Lima bean (*Phaseolus lanatus*), common bean (*P. vulgaris*), pigeon pea (*Cajanus cajan*), sword bean (*Canavalia ensiformis*), kersting's groundnut (*Macrotyloma geocarpum*), soybean (*Glycine max*), bambara groundnut (*Vigna subterranea*), groundnut (*Arachis hypogea*), African yam bean (*Sphenostylis sternocarpa*) and winged bean (*Psophcarpus tetragonolobus*
Tubers	Cassava (*Manihot esculentus*), yams (*Dioscorea* spp.), cocoyam (*Celosia esculentus*)	Sweet potato (*Ipomea batatas*), irish potato (*Solanum tuberosum*)
Oil crops	Oil palm (*Elaeis guinensis*), egusi melon (*citrullus lanatus*), cotton (*Gossypium hirstutum, G. barbadens*)	Sesame (*Sesamum indicum*), coconut (*Cocos nucifera*), beni seed (*Ceratotheca sesamoides*), castor oil (*Ricinus communis*), sunflower (*Helianthus annus*)
Plant-based sweeteners	Sugarcane (*Saccharum officinarum*),	Sugar beet (*Beta vulgaris*), 'Eeran' (*Thaumatococcus danielli,*), 'Agbayun' (*Syncepalum dulficium*), serendipity berry (*Dioscoreophyllum cumminisii*)
Horticultural crops	**Vegetables:** Peppers (*Capsicum annum, C. frutescence*), tomato	**Vegetables:** West African okra (*Abelmoschus caillei*), 'Efinrin' (*Ocimum gratissimum*),

	(*Solanum lycopersicum,* formerly *Lycopersicon esculentum*), onion (*Alium cepa*), amaranthus (*Amaranthus cruentus, A. hybridus*), okra (*Abelmoschus esculentus*), jute mallow (*Corchorus olitorius, C. tridens*), egg plant (*Solanum raddi, S. melongena*), fluted pumpkin (*Telfairia occidentalis*), locust bean tree (*Parkia biglobosa*) **Fruits:** Banana (*Musa sapientum*) and plantain (*Musa paradisiaca*), pawpaw (*Carica papaya*), orange (*Citrus* spp.), pineapple (*Ananas comosus*), carrot (*Daucus carota*), mango (*Mangifera indica*)	cucumber (*Cucumis sativus*), pumpkin (*Cucurbita pepo*), lettuce (*Lactuca sativa*), African lettuce (*Launea taraxacifolia*), bitter leaf (*Vernonia amygdalina*), Lagos spinach (*Celosia argentea*), *Solanum americanum*, roselle (*Hibiscus sabdariffa*), *Gnetum africanum,* bottle gourd (*Lagenaria* spp.), *Gnetum africanum,* **Fruits:** Guava (*Psidium guajava*), pear (*Pyrus communis*), cashew (*Anacardium occidentale*) walnut (*Tetracarpidum conophorum*), *Annona muritata.*
Cash crops	Cacoa tree (*Theobroma cacao*), coffee (*Coffea arabica, C . liberica, C. robusta*), kola (*Cola nitida, C. acuminata*)	Tea (*Thea sinensis*), rubber (*Heavea brasiliensis*)

colour varies from white to different shades of brown, red and yellow. The tall varieties are common in the more humid savanna area because the stem is used as stakes for yam vines in the following season. *Sorghum* has wide genetic variability in Nigeria because of free gene exchange between the cultivated and the wild species (Morakinyo, 1988a, b). This accounts for varied morpho-types and grain characteristics. At present 85% to 95% of sorghum grains produced in Nigeria is consumed as human food nationwide, varying from *pap* (Ogi; Yoruba) in the south west to '*tuwo*" (Hausa) in the north. It is also used in preparing alcoholic beverage called *"burukutu"* and serves as a base for many pharmaceutical products. *Sorghum* is a major research crop for which improved cultivars have been released.

Millet *(Pennisetum americanum)* is widely cultivated in the drier northern part of Nigeria, but the distribution of its secondary and tertiary genepools extends deep to the humid south. Some of the cultivated varieties are Ex-Bornu, Dwarf composite, Dauro, Maiwa and SAMMIL-7 out of which SAMMIL-7 is an improved early maturing photosensitive variety. Considerable research had been carried out on the relationship of tillering, plant spacing and grain yield in millet. The optimal tiller number in different varieties that will give the highest contribution to grain yield at particular plant spacing was determined as a way of enhancing millet production (Egharevba, 1977; Iortsun 2003). Millet is not cultivated at all in the south because of high humidity that makes the grains highly susceptible to pest and diseases. Consumption is also highly restricted to the north.

Maize *(Zea mays* L.) is a very important cereal crop and is grown in virtually all the geo-ecological zones of Nigeria. Maize is most productive in the middle and the northern belts of Nigeria where sunshine is adequate and rainfall is moderate. Under these conditions storage of grain can be accomplished without much damage from the storage insect pests. The lowland humid forest zone which is characterized by high rainfall and humidity at elevation up to 800 meters above sea level is not particularly suitable for maize production due to the high incidence of the pest and diseases, low light intensity during the growing season and low soil fertility. The recent achievements by breeders in the development and release of superior varieties of maize with higher yield potential and better resistance to insect pests and diseases play a central role in increasing maize production in Nigeria. The Federal Government has supported efforts to promote the use of these varieties in a holistic technology package to farmers through the Presidential Initiative on Doubling Maize (PIDOM) production from 7 to 14 million t without increasing maize hectarage. Maize is not only a food crop but also an important raw material for the brewery, confectionary and livestock industries (Omueti, 1999). Since 1985, composite cultivars, open pollinated and hybrid varieties of maize have been developed and released.

There are only two domesticated rice species out of over 20 known species of the genus *Oryza.* Of these cultivated species, *O. sativa* is indigenous to Asia while the other *O. glaberrima* is indigenous to and endemic in West Africa. Following its introduction because of its higher yielding potential, non-shattering and superior grain qualities, *O. sativa* gradually pushed the cultivation of *O. glaberrima* to the marginal areas such as the deep-flooded plains and highly

drought susceptible upland conditions while *O. sativa* began to spread to the shallow swamps of the major rivers' flood plains of Niger, Benue and Kaduna rivers, and also to the inland valley bottoms nationwide. Today, *O. glaberrima* is completely abandoned in favour of *O. sativa* in rice production. Rice research began in Nigeria in the 1920's at Moor Plantation in Ibadan, and by 1953, a rice research station was established in Badeggi for research on rice irrigation. Pure line selection among the local heterogeneous population was practiced in the first stage while *O. sativa* was evaluated for adaptability. These efforts led to the release of FAROs 1-10 in Nigeria. (FARO is the acronyms for Federal Agricultural Research *Oryza*). Rice research got a boost with the establishment of IITA in 1967 and WARDA in 1971. The evolution of semi-dwarf rice in Asia led to significant yield potential (5-6 tons /ha) and to the development of early IRRI varieties. Some of these varieties got introduced into Nigeria among which were IR8 (FARO 13), Taichung native 1 (FARO 21) and FAROs 19-23. Other rice varieties released in Nigeria were FARO 24-51 which are adapted to different ecologies (Maji, *et.al.,* 1999). Rice is a staple food throughout Nigeria where it is eaten as loose boiled grains or mashed grains. To date, national consumption has always outstripped production, necessitating importation.

Cowpea (*Vigna unguiculata* (L) Walp) is the most important grain legume crop in Nigeria. It is widely cultivated for food and its seed is the major source of high quality plant protein in human diet. The seed protein content ranges between 23% and 30% and contain most of the essential amino acids, but low in sulphur amino acids, methionine and cysteine which deficiency may be ameliorated in diets based on cereals such as quality protein maize (QPM). Nigeria is the largest cowpea producer in the world with an annual production figure of 1.2 million tonnes from about 4 million hectares. Early efforts on cowpea improvement through breeding at Federal Department for Agricultural Research now National Cereal Research Institute (NCRI) resulted in the landmark release of the cultivar Ife brown (Franckowiak *et.al.,* 1973). This cultivar combines excellent seed and culinary characteristics with good growth habit and photoperiod insensitivity. Ife brown is a prominent parent in the pedigree of many cultivars that were subsequently released at NCRI, IAR&T and IAR (Fawole, 1999).

The establishment of the IITA at Ibadan in 1970 provided a great impetus to cowpea research in Nigeria and resulted in the release of several high yielding, disease resistance lines, and cultivars among which was TVX3236 which has excellent agronomic and culinary characteristics.

Cassava (*Manihot esculanta*, crantz) is a crop of the forest and guinea savanna zones of Nigeria where it is grown in monoculture or in mixed cropping with legumes. The root tuber is processed into *garri, fufu,* chips, flour and other products for human consumption. Currently the Nigerian government has recommended that at least 10% of cassava flour be mixed with wheat flour in baking bread. Foreign demand for cassava products has reached an all time high, encouraging high production in the country. Research into cassava improvement was started and has been sustained by IITA. Varietal trials of improved IITA cassava varieties were conducted between 1983-86 at four locations, Ibadan, Mokwa, Onne and Warri in Nigeria.

Six edible species of yam occur naturally in Nigeria. These are *Dioscorea alata, D. bulbifera, D. cayensis, D. esculenta, D. dumentorum, D. rotundata* out of which only the last three are the most popularly cultivated for their stem tubers. Yam is grown in the forest and humid savanna zones of Nigeria. Nigerian farmers prefer big tuber yams (3.7 kg), but production of big tuber yam is fraught with constraints which could be reduced by production of medium sized (1-2kg) tubers. Yam is a staple food in its areas of cultivation where it is eaten in various food preparations. It is now being industrially processed into various foodstuffs and packaged for export.

The state of diversity and relative importance of Minor Crops and Underutilized Species for Food Security and Agriculture

Some of the minor and underutilized crops in Nigeria were listed in Table 1.1 and the use to which they are put in Annex 1. The research attention given to these crops is far below their usefulness. The most ones according to the crop/utility group they belong are listed below.

Tubers:	Sweet potato, Irish potato,
Cereals:	Bread wheat, hungry rice.
Food legume:	Lima bean, common bean, pigeon pea, bambara bean, soyabean.
Oil crops:	Beniseed, coconut, castor oil, sunflower.
Plant sweeteners:	Sugar beet, sugarcane
Horticultural:	Amaranthus, plantain, guava, mango, cashew pawpaw.
Fibres:	*Hibiscus cannabinus,* (kenaf), *Corchorus capsularis, Gossypium hirsutum*, *Agave sisalina* (sisal)

Spices: *Zingiber officinale* (ginger), *Aframomum melegueta* (alligator pepper), *Piper guineese* (black pepper)

Forage Conservation in Nigeria

Nigeria, with its wide ecological range has a wide diversity of forage species. They include grasses and many browse species. It is well known in Nigeria that conservation of plant genetic resources on the range lands involves the wise and sustainable use of these natural resources. Nigeria has a list of 2,200 verified nutritious species which include 600 grasses, 540 herbaceous legumes and 380 browse species and over 600 others of lower values. Most of these species are components of the high forest, guinea savanna, sudan savanna and some very hardy plants in the sahelian zone. *Ex situ* conservation of many of the species have been effected in the National Livestock Research Institute (Shika, Nigeria) while ILRI, based at the IITA has identified a host of other new ones including exotic plants with potential value as forage plants.

In a 2008 survey of Fadama sites in Kebbi State, Nigeria, many forage plants were identified for use and conservation in both *ex situ* and *in situ* systems. Among the particularly significant species with good to excellent nutritive value and palatability to livestock and wildlife include those listed below (Houerou 1998).

Table 1.2: Forage species with high potential utilitarian value for livestock and wildlife

Family	**Species**
Combretaceae	*Anogeissus leicarpus, Combretum aculeatum, C. zeheri, Terminalia spp.*
Leguminosae	*Bauhinia rufescens, B. macrantha, Brachystegia* spp. *Colophospermum mopane, Cordeauxia edulis, Cordyla pinnata, Griffonia, simipliciflora, Julbernardia* spp. Mimosoideae, *Acacia clavigera, A. ehrenbergiana, A. gerrardi, A.hockii, A. Karroo, A laeta, A. mellifera, A.raddiana subsp. Raddiana, subsp. Tortilis, subsp. Spirocarps, A sengegal , A. seyal, A. xanthophloea, Faidherbia (Acacia) albida.* Papilionoideae: *Baphia bequaertii, B. massaiensis, B. nitida, Milletia*

	thonningii, Ormocarpum trichocarpum, Pterocarpus angolensis, P. erinaceus, P. lucens.

The state of diversity of wild plants harvested for food production.

The number of non-domesticated plants that are collected from the wild to bridge hunger gaps is far more diverse, often ecology- and culture-specific. The rate of loss of the diversity of these species is alarming and this calls for more urgent actions than is being done in Nigeria. Otherwise, some species will go into extinction in the course of the next decade.

Apart from *Irvingia gabonensis* which is on the joint ICRAF/NACGRAB project, all the species listed above and in Annex 1 are being over-exploited in the wild because there is no effort or commitment towards systematic improvement, collection, evaluation and conservation of the species. Nevertheless, they form part of valuable plant genetic resources that contributes to food security in Nigeria. *Parkia biglobosa* for example, though it remains undomesticated with little or no visible corporate attention, has attracted researchers' attention because the seed (locust bean) is about 40% protein, a higher protein content than found in most food legumes. It is the source of a popular condiment in the south west and north (*Iru*, Yoruba; *Dadawa,* Hausa). According to Babatola and Adelaja (1999), the indigenous fruits listed in Table 1.3 are not in regular cultivation because of religious and/or socio-cultural beliefs, non- availability of information on their husbandry as well as reproductive physiology and the long gestation periods of the available seedling trees for most of the species.

Factors affecting the state of diversity of plant genetic resources in Nigeria and areas of need

Baseline information on plant genetic resources that contributes to food and agriculture in Nigeria is grossly inadequate. Commissioned inventories and survey of wild plants for food production and of crop-associated biodiversity are few, uncoordinated and irregular, often based on the efforts of individuals. Related to this is the problem of poor or non- existent collection and conservation strategies. Knowledge of these plants and the plant themselves are fast disappearing due to:

1. Wanton deforestation by human and natural causes.
2. Ageing and dying farming population that is familiar with the traditional landraces of different crops.

3. Neglect of farming by the youths and village to urban drift, leading to drastically reduced crop farming and disappearance of landraces that require regular annual cultivation.

Table 1.3: List of some uncultivated plants with Food and Agriculture potentials in Nigeria

Crop	Common name	Relative importance (food security, economic & social)
Adansonia digitata	Baobab tree	Leaves used as vegetable fruit and for fruit drinks; source of fibre, savanna plant.
Aframomum melegueta	Alligator pepper	Seed used as spice in conjunction with kola; also used in ritual observance; forest/savanna
Afzelia africana	Akpalata	Seed used as condiment for thickening soup; leaves used as fermented vegetables. Savanna plant.
Artocarpus communis	Breadfruit	Big seedless edible fruit eaten like yam.
Baillonella toxisperma	Imi-igbo (Yoruba)	Fruit pulp edible and seed is a good source of oil. Forest plant.
Blighia sapida	Akee-apple	Seed and edible, forest plant.
Bosquesa angolensis (Trileplsium Madagascarlense)	Oze; Saworo (Yoruba)	Nut eaten roasted in African breadfruit, forest plant.
Borassus aethiopicum	Ope-okunkun	Fruit pulp edible; young ridicule used as vegetables; also tapped as palm wine. Savanna plant.
Brachystigia spp.	Achi	Seeds used as condiment for thickening soup. Forest plant.
Butyrospernum paradoxum subsp Parkii	Shea butter	Fruit pulp edible; seeds are source of oil and fat (ori); savanna plant.
Canarium schivenfuttii	Ube; Okpoko	Fruit eaten; source of fat, oil veneer plywood, forest plant.
Ceiba pentandra	Silk cotton tree; Araba	Leaves used as vegetables; source of Kapok, savanna plant.
Chrysophyllum albidum	African star apple; Agbalumo (Yoruba)	Fruit pulp edible and good for jam; forest plant.

Cola gigantean	Ebenebe	Seeds used as condiment for thickening soup, savanna plant.
Cola pachycarpa	Achicha	Testa eaten fresh; forest plant.
Cola lepidota	Achicha	Testa eaten fresh; forest plant.
Dacryodes edulis	African pear	Fruits eaten with maize; source of oil & fat; kernel suitable for animal feed formulation; forest plant.
Dennettia tripetala	Nmimi (Igbo) Igberi (Yoruba)	Fruit eaten fresh; served as kola; useful for insecticide preparation; forest plant.
Detarium spp.	Ofo	Seeds used as condiment for thickening soup, similar to ogbono; savanna plant.
Dialium guineanse	Velvet tamarind Awin (Yoruba)	Seed eaten fresh; very good source vitamin C; suitable for fruit drink and jelly; savanna and forest plant.
Dioscoreophyllum cumminsii	Serendipity-berry	Fruit pulp is edible; 2500 sweeter than cane sugar with protein as sweetening agent, therefore potential source of diabetic sugar; leaves and tubers as vegetables; forest plant.
Ficus capensis	Opoto (Yoruba)	Leaves use as vegetables; fruits eaten; leaf is also good browse; forest and savanna plant.
Garcinia kola	Bitter kola;	Seeds eaten fresh; served as kola; high medicinal value; reputed snake repellant; forest plant.
Garcinia polyantha	Bitter kola;	Seed edible and eaten fresh; forest plant.
Hidegardia barteri	Ufuku (Ibo) Okurugbedu (Yor)	Seeds used as condiment for thickening soup; stem bark use as fibre; forest and savanna plant.
Irvingia gabonensis var. excelsa	African mango	Fruit pulp eaten; suitable for fruit drink and jam; kernel used as

		ogbono in thickening soup; kernel as ogbono; forest plant.
Tamarindus indica	Tamarind	Fruit pulp eaten fresh; suitable for fruit drink and garnish for fish. Savanna plant.
Phoenix dactylifera	Date palm	fruit with sweet mesocarp; plant grows in the dry north but eaten nationwide.
Cyperus esculentus	Imumu (Yoruba); Tigernut	Plant of savanna with edible juicy tubers on rhizomes.
Tetracarpidium conophorum	Wanut	Seeds edible; very high in protein; source of conophor oil (drying oil); forest plant.
Tetrapleura tetraptera	Ushakirisha (Ibo); Aidan (Yoruba)	Seeds used as spice for flavouring yam pottage; fruits used medicinally; forest plant.
Treculia africana	African breadfruit;	Nuts boiled as beans or rice roasted as in groundnut; suitable for bread; biscuits and cake; leaves and fruits pulp good as browse and fodder; forest plant.
Vitex doniana	Oriri or oori (Yoruba)	Fruit pulp edible and sweet; good for jam and jelly with other fruits e.g. *Spondies mombin;* leaves used as vegetable; savanna and forest plant.
Xylopia eathiopica	Uda (Ibo); Erinje (Yoruba)	Seeds used as spice; fruits used medicinally in pot herb; forest plant.
Zyzgium guinense	Igi oro	Fruit pulp edible and bark used for dyeing clothes; savanna plant.
Ricinodendron heudelotii	Okwe (Ibo); Putu (Yoruba)	Seed used for edible oil extraction; condiments; leaves used as browse and for wrapping of foodstuff; forest plant.
Spondias momoin	Hog plum	Fruits eaten fresh; suitable for jelly and drinks; savanna/forest plant.

Strychnus spinosa	Atako (Yoruba)	Fruit pulp edible; savanna plant.
Syncepalum dulficicum	Miraculous berry;	Fruit pulp edible; could be used as sweetening agent; make bitter taste sweet for sometimes; forest plant.
Lendolphis oweriensis	Utu (Ibo); Panukuru (Yoruba)	Fruits eaten fresh; suitable for jam and jelly; forest plant.
Kondia whitei	Adoo	Fruits edible eaten fresh; served as kola; forest plant.
Monodora myristica	African nutmeg;	Seeds used as spice; forest plant.
Uvaria chamae		Ripe fruit pulp is eaten; the plant is a re-growth shrub in forest.
Piper guineense		Dried black berries and the red; fresh fruit are used in flavouring foods; it is a forest scardent-climbing plant.

4. Adoption of crop monoculture of improved cultivars that completely relegates landraces and therefore leads to their disappearance.
5. Inadequate records and storage of seeds of released improved cultivars by relevant government institutions and effective extension services to ensure the adoption of these cultivars alongside the landraces.
6. Lack of expertise and adequate funding for plant genetic resources collection, characterization/evaluation and conservation.

In view of these problems the following areas of needs are highlighted for urgent attention through national and international collaborative initiatives:-

1. Exploration, collection and conservation of some threatened plant genetic resources including wild relatives of some cultivated crops. Some of the species include species:
   i. *Cucurbits* (bottle gourd) H[1]

[1] Key: FTS- Forest tree species; F- Food tree; M- Medicinal tree; FT- Fruit tree; H- Horticultural crop).

ii. *Chrysophyllum albidum* (star apple). FT
iii. *Delschnedia manii* FT/S
iv. *Irvingia gabonensis* (already in ICRAF/NACGRAB project) FT
v. *Parkia biglobosa* F
vi. *Vernonia amygdilinia* FT
vii. *Onchobaca anbrevillei* FTS
viii. *Gossweiledendron sp.* FTS
ix. Kola sp (wild relatives only) F
x. *Zanthoxylum zythoxyloides* (Ex. Fagara) M

2. Utilization of plant genetic resources:
   - Support the establishment of crop networks.
   - Support basic training on breeding including seed/pollen storage and studies

3. Inventory and demarcation of *in situ* conservation site:
   i. Review State of Strict Natural Reserves in Nigeria.
   ii. Establishment of new SNRs to provide a better (vegetational) spread and creation of multiple strict natural reserves per ecology.
   iii. An evaluation of floral composition in selected crop gardens, compound forms and fetish groves in southern Nigeria.

4. Training:

Urgent needs are recognized in technical and professional training despite that substantial human resources are available in Nigeria. FAO should encourage the tapping of these and arranging for mostly local (Nigerian and sub-regional) or overseas training in case of specialized areas. Areas of training required include:

i. Genebank administration/management.
ii. Exploitation, collection and conservation of PGR
iii. Biotechnology (Tissue culture/roduction – conservation).
iv. Particularly if the oil palm and other species.
v. Recalcitrant seed management and conservation).

5. Strengthening and development of capabilities at NACGRAB:

NACGRAB is presently handicapped in various ways and will require support in the following areas:

i. Staffing (Expert support)
ii. Infrastructure and equipment (including generator, modern seed handling equipments and expansion of seed storage facilities.
iii. Linkage with an overseas genebank to enhance interaction in specific areas.

6. Documentation of genetic resources data:

The need to have a viable documentation procedure is recognized. Areas of need include:

i. Development of data base
ii. The acquisition of necessary hardware and software
iii. Developing a network system between NACGRAB, Research Centres or other Sub-regional Centres.
iv. In addition to these, is the need to enhance information services, i.e. provision of express mail network and production of good and quality information leaflets, etc

7. Support on the review of the existing national laws decrees, or legislations backing plant genetic resources conservation.

8. Expert assistance on the review of the existing laws or legislations supporting plant genetic resources conservation, and the development of appropriate new ones.

9. Support on review of international commitments on plant genetic resources conservation with the objectives of identifying progress and problems in their implementation including needs to join or committee efforts on other ones.

10. Specifically, the need for enhancing the National Herbarium at FRIN is solicited. This herbarium supports NACGRAB and other Centres but needs staffing, and the renewal of old collections which have now become poor and useless. Facilities to enhance these activities at the herbarium will help NACGRAB on plant identification and biosystematics research generally.

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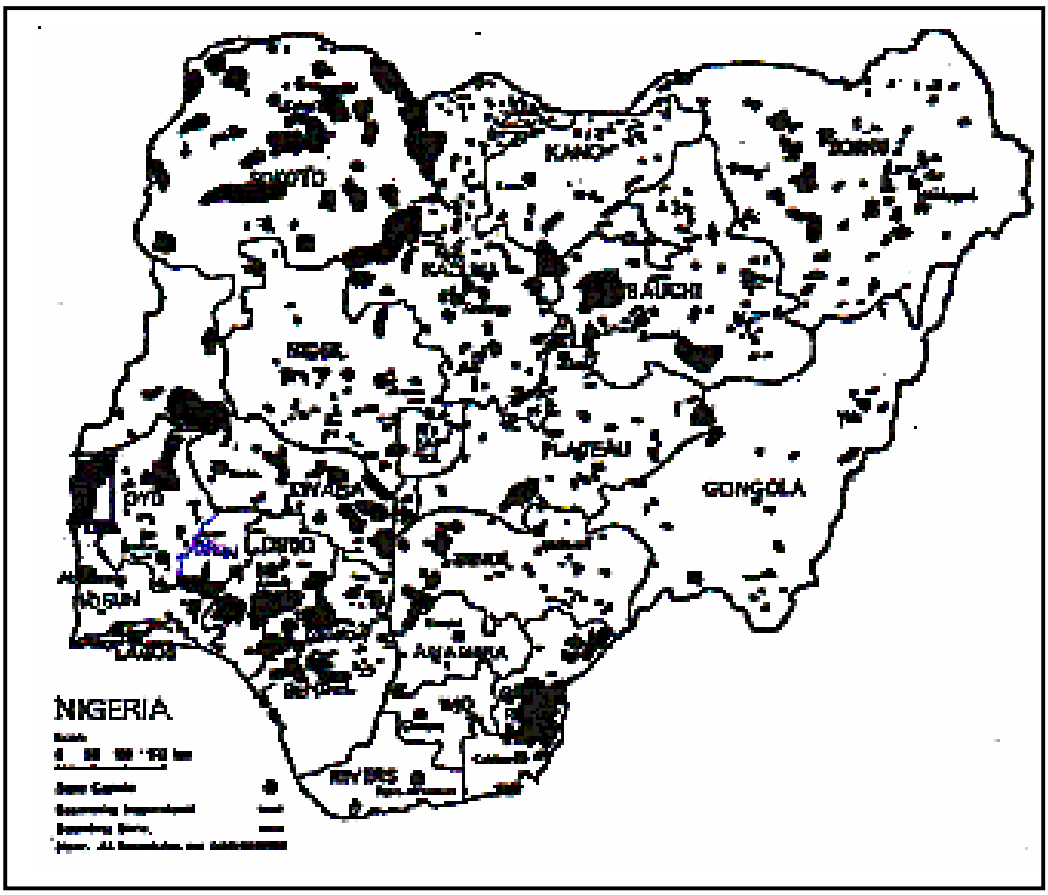
The State of *In Situ Management* 2

In situ conservation is the preservation and protection of genetic resources in their natural habitat, where it is aimed at achieving stability by maintaining self-perpetuating populations in natural ecosystems. Nigeria is endowed with a diverse vegetational and an ecological variation (see Figure 1.) which has enable the country to conserve a very high diversity of plant and animal species.

In situ Conservation in Nigeria is thus mostly hinged on the nation's Forestry Management System, where representative areas of the national forests are protected and referred to as Forest Reserves (FR) (Figure 2). Strictly speaking, this is ecosystem conservation but within these ecologies are many species with traditional food, medicinal or cultural values. In-situ conservation in Nigeria is thus very important for germplasm conservation.

Figure 2.1: Forest Reserves in Nigeria



LEGAL TOOLS FOR IN-SITU PROTECTION IN NIGERIA.

Article 8(a) of the convention on Biological Diversity required each contracting party to establish a system of protected areas where special measures need to be taken to conserve biological diversity. *In situ* convention means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable population of species in their natural surroundings where thy have developed their distinctive properties. Some of the legislation on *In situ* conservation includes the Forestry Law, Forestry Regulations, and the National Parks Decree, 1991. The 1991 decree established five national parks – Kanji Lake, Chad Basin, Cross River, Gashaka-Gumti and Old Oyo National Parks. The Yankari Game Reserves was elevated to the level of a national park by virtue of the Yankari National Park Decree of 1993. The objectives for the creation of National Parks include:

i. To promote the preservation, enhancement, beauty, protection, conservation and management of indigenous flora and fauna resources;
ii. To promote their sustained growth for zoological and botanical specimens;
iii. Encourage general interest and education in the knowledge of wild animals; and
iv. To encourage the general public to visit national parks and the study of nature it affords, thereby popularizing them as recreational and tourist attraction. The decree imposes restrictions on entry or residence, hunting, use of weapons in the Parks, e.t.c. It also prohibits introduction of wild animals, domestic animals and vegetables into the Parks. There are prescribed penalties for offences under this decree.

Inventories of these parks have been conducted in the past. In addition to these parks are on-site/on farm storage or protection of crop plants and seeds including those of traditional plants, or crops such as vegetables, gourd and fruit/food trees which are protected on compound farms for sustainable production and family food supply.

To emphasize the above, and before the current Forestry Policy and Act (2008) was enacted, policy guidelines for forestry were a subsector of the agriculture policy published by the Federal Ministry of Agriculture and Natural Resources in 1988. In these documents, vegetation

conservation was recognized as a major foundation for industrialization and stability of the rural population, a safeguard for agriculture, habitat for wildlife and the improvement of environmental stability, which today will include the potential impacts of climate change and similar local, regional or global environmental changes. The National Centre for Genetic Resources Conservation (NACGRAB) and Biotechnology (NACGRAB) was established in 1987 through the active support of the FAO, while NACGRAB was mandated to act as the national focal point for research, data gathering and dissemination of technical information on the Nation's plant and animal genetic (food and agriculture) resources.

In situ conservation in Nigeria is based on the establishment of:

a) Conservation areas (Forest Reserves)
b) Protected areas (wetlands)
c) Parks
d) Natural Reserves (Research plots), and
e) Strict Natural Reserves (SNRs).

The roles and relevance of home gardens to *in situ* conservation is well known and in spite of their existence across all ecologies, there is no documented information on home gardens.

History of *In situ* Conservation in Nigeria

Conservation during the colonial period was based on sustainable exploitation, a system which allowed exploitation of prescribed tree sizes. This system, even where productive forest regeneration was achieved was under intensive human presume until 1958 when the Forestry Research Institute of Nigeria (FRIN) was established and mandated to generate scientific data for sustainable management of Nigeria natural forests.

However, intensive forest management resulted in tremendous deforestation for wood (energy) timber, food industrial and urban development. Kio *et al.* (1985) after a critical evaluation of past forest management systems concluded that these past efforts did not succeed due to technical and socio-economic problems. A major part of this problem was the lack of adequate scientific and cultural knowledge such as on the structure and floristic composition of the forests and the specific silvicultural requirement of the more dominant or more desirable species. The recent

combined efforts of FRIN, the Federal Department of Forestry (FDF) and NACGRAB are now yielding positive results on the needs and techniques required for more effective vegetation or, and germplasm conservation systems in Nigeria.

Some of the species whose germplasm is conserved *in situ* with National Agricultural Research Institutes are as follows:

Table 2.1: Some crop plants conserved *in situ* in Nigeria

Crop species	**No. of accessions**	**NARIs**
Coconut	16	NIFOR Benin-city
Cashew	1025	CRIN, Ibadan
Tea	33	CRIN, Ibadan
Coffee Arabica	100	CRIN, Ibadan
Coffee canephora (robusta)	65	CRIN, Ibadan
Parkia biglobosa	15	FRIN, Ibadan
Sugar cane	467	NCRI, Badeggi
Citrus	210	NIHORT, Ibadan
Mango	17	NIHORT, Ibadan
Pineapple	2	NIHORT, Ibadan
Irvingia gabonensis	18	CENRAD
Dacroides edulis	10	CENRAD
Bitter leaf	40	CENRAD
Oil Seeds	8	NACGRAB
Root & Tubers- cassava, Yam, Cocoyam,	8	NACGRAB
Medicinal Plants	35	NACGRAB
Fruits	125	NIHORT, NACGRAB
Forest Crops	127	FRIN, NACGRAB
Other economic tree Crops	55	NACGRAB

Impact of International Collaboration

Nigeria has signed and ratified biodiversity-related conventions and protocols and tremendous efforts have been put into implementing these agreements because of the realization of the vast environmental problems, which the country now faces from improper forest, biodiversity or germplasm conservation. Most of these also include sub-regional (ECOWAS), regional (AU) and global agreements, such as the biodiversity – related Conventions and Protocols and the Federal Government has ensured that implementations of the provisions of the conventions, protocols and agreements are met.

It is also important to mention here the country's involvement and benefits from other global (i.e. UNESCO) activities in the past. The UNESCO Man and Biosphere Programme (MAB) Initiative launched in 1971 has had a very positive impact on *in situ* conservation in Nigeria. It has created the capability to generate conservation data through the study of its forests ecological characteristics and their needs for sustainable conservation within a global network system. This initiative also facilitated an in-depth understanding of the nation needs for wetland management.

In addition to the above, the world conservation strategy was developed for Nigeria by the IUCN. In addition to manpower development, this initiative also generated substantial data for sustainable maintenance of essential ecological processes, preservation of genetic diversity and the sustainable utilization of species and ecosystem.

World Bank support has been recorded from 1985-2007 and only recently, (2005-2007), the United Nations Development Programme (UNDP) supported the successful production of and completion of Nigeria's first, National Biodiversity Report to the UN (2006) and a National Biodiversity Strategy and Action Plan to support activities in unison with other global, regional and sub-regional players on biodiversity conservation.

New and Emerging Issues

A) <u>Continued Deforestation</u>

Deforestation can be defined as the loss of vegetation or the selective exploitation of forests for specific or group of first species for economic or social reasons. In Nigeria, deforestation is very common and in most areas major loss in vegetation, forest complexity (diversity) or in

germplasm (quality) have been recorded. Deforestation is still continuing in Nigeria and as the vegetation is degraded, so also are the wild food plants or their relatives they contain.

Deforestation in Nigeria is put at about 3.5% per annum translating to a loss of 350,000 –400,000 hectares of forest land per annum. Recent studies showed that forests occupy about 92,377 km^2 or about 10 percent of Nigeria's land area. This is well below the Food and Agriculture Organization of the United Nations (FAO) recommended national minimum of 25 percent. In addition, forest estates are de-reserved by some State Government. The State Forest Departments have been unable to curtail the spate of requests from the forest estate for the establishment of agricultural crops. The unfortunate impression has thus been created that the forest estate exists as a land bank for other sectors as the demands for de-reservation continue nationwide.

However, while deforestation of off-reserve land is due to the reasons given above, the most important cause for deforestation in the forest reserves can be linked to the State Departments of Forestry who have abandoned any form of forest management for natural forests since the 1970s. As a result, reserve forests are being treated as an infinite resource, with no effective management practices in place to regulate the harvest. Sustainability of the forest resources is further threatened by the practice of short-term concession allocation tenures of 1-3 years that encourage annual re-entries. Other reasons for degradation in the reserves include inefficient wood-utilization by industry and, therefore, a higher demand for industrial grade timber, and illegal logging. All these have contributed to the widening gap between forest resources supply, and demand. This call for an aggressive programmes on forest plantation development nation wide of about 80,000 to 100,000 hectares per annum as approved in our Forestry Development Programme. The private sectors and the communities have got major roles to play in this regard. The private sector is pivotal in the supply demand chain and has been instrumental in the demise of forestry in Nigeria because of its pervasive inefficiency. The private sector is involved in the business aspect of the forestry operation through commercial development of the forest resources, forest industries and trade.

Since the use of fuel wood cannot be eliminated at least in the short and medium term periods, the use of improved fuel wood stoves, ovens and kilns which have greater thermal efficiencies than the present stove technology and its variants will reduce the consumption of fuel wood, and

consequently the rates of deforestation, soil erosion and desertification. According to FORMECU data, between 1976/1978 and 1993/1995, the area occupied by natural forest (excluding plantations) shrubs/grassland decreased from 23,439,000 ha, which is 26% of the country to 15,097,000 ha (16.6%).

B) Invasive exotic Weeds

The maintenance of ecological stability in *in situ c*onservation sites in Nigeria has been significantly affected by the presence of invasive weeds detected recently. In some locations, these weeds have negatively impacted on species diversity. The most aggressive ones posing serious challenges currently include *Eichomia crasipes* (water hyacinth), *Titonia diversifolia* (wild sunflower), *Typha* spp. (cat tail), and *Nypa fruticans* (nypa palm). All these pecies have diminished *Chromolaena odorata* that used to be the most important invasive weed in Nigeria.

C) Climate Change

Local observations and experiences including scientific understanding of the phenomenon of climate change has helped Nigeria to prepare for this problem. A National Committee on Climate change has been established and effort to support the National Meteorological Agency (NMA) has commenced in order to effect better climate analysis and relevant data generation necessary for predictions or control.

D) Other Issues

Other issues germane to *in situ* conservation include population growth and poor rural infrastructural situations, which is causing farmer drift from the rural areas and the disinterest emanating from the younger population of farmers to continue to conserve germplasm on farms.

Challenges and opportunities to achieving sustainable development and conservation for food and agriculture

A Summary of status of Forest Management in Nigeria can indicate the present challenges being encountered in the nation quest to achieve sustainable conservation systems in Nigeria. The

International Tropical Timber Organization (ITTO) in 2005 released a report on the State of Tropical Forest Management in Nigeria.

This report is a very useful document and it concludes that there are several obstacles to Sustainable Forest Management (SFM) in Nigeria. These include the discretionary power of government to de-reserve or harvest the forest, the lack of a coherent forest policy; the prevalence of illegal logging and harvesting of NWFPS in most of the high-forest states; chronic under-resourcing of forestry programs and forest management; overlapping responsibilities amongst federal, state and local government and excessive bureaucracy, the lack of inter-sectoral coordination, and the overall absence of reliable data on which to base forestry planning and development. Nigeria has a long history of forest management and the formal goal is to achieve self-sufficiency in all aspects of forests production; however, the country, once a significant exporter, is now a net importer of primary forest products and so, considerable work must be undertaken to achieve a return to Sustainable Forest Management and Utilization.

- Nigeria has an estimated Permanent Forest Estate (PFE) of 4.11 million hectares, comprising 2.72 million hectares of natural production forest 1.01 million hectares of protection forest and 375,000 hectares of planted forest. The PFE covers less than 5% of Nigeria's total land area.
- Data are generally weak and the Federal Government cannot confirm the accuracy of the data presented herein.
- A forest reserve system was created in 1937 covering 9.7 million hectares (10% of the land area), but much of this is no longer forested.
- The goal of the 1998 forest policy is to expend the forest estate from 10% to 20%, but this has not occurred.
- Insufficient information is available to estimate the area of PFE under SFM.
- The forestry sector is administered at the Federal, State and Local Government levels according to the Nigerian constitution. However, there is a lack of clarity in the mandates of the levels.
- The main concerns of the Federal Government are to provide an adequate policy framework for the states and to support afforestation and conservation programs.

- State governments are solely responsible for the management of forest resources and the coordination of forest development activities with local communities.
- Forest production gas fallen, creating an imbalance between supply and demand. From its previous status as a significant exporter of forest products, Nigeria has become a net importer.

Needs and Priorities

The identification of needs and priorities can indeed help to generate viable polices or practical physical measures for the development of adequate protective strategies for our genetic resources. Within the context of *in situ* conservation, Nigeria will undertake the following:

a) Manpower development for conducting productive inventories.

b) Enhancement of taxonomic knowledge (training and re-training for those presently on the job)

c) Support procedures on Indigenous Knowledge system development for better understanding of the enhanced values of the species in the field *in situ* banks.

d) Support of trans-border wild land protection project between countries such as in the case of wetlands and rice wild relatives. Support workshops, and participatory interactions on better understanding of potential social benefits and so easier acceptance and encouragement of community forestry development in Nigeria.

e) Support Local Universities to establish specific courses on germplasm conservation.

f) Support on the consideration of climate change issues on diversity maintenance and conservation *in situ*.

g) Provision of support on the expansion or creation of more conservation areas with particular emphasis on wild resources conservation in order to prevent total losses in case of major disasters.

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The State of *Ex situ* Management 3

Crop improvement relies on genetic diversity available in crop species (landraces, wild-relatives and introductions). In Nigeria PGR are threatened by urbanization, forest fire, over-grazing activities of animals, genetic erosions, among others. The conservation of crop species and other economically important plant species have been undertaken in Nigeria for more than four decades, initially as botanical gardens across the agro-ecological zones of the country. Deliberate *ex situ* conservation for crop germplasm for food and agriculture started in Nigeria about three decades ago with the establishment of the National Bureau for Plant Genetic Resources, Ibadan under the Federal Ministry of Science and Technology. The name was later changed to the National Centre for Genetic Resources and Biotechnology (NACGRAB) to meet the emerging challenges in germplasm conservation, especially in the area of *in vitro* conservation, DNA fingerprinting and cryopreservation. Botanical gardens were placed under the Federal Ministry of Environment to conserve the nation's wide range diversity at different ecological zones of Nigeria. The Federal Ministry of Agriculture and Rural Development has been actively involved in the *ex situ* conservation through the various crop-based research institutions across the country. The NARIs and NACGRAB have the responsibility to plan and conduct genetic resources activities involving collection, characterization, evaluation, conservation, documentation and exchange as well as sustainable management of the crop diversity and their wild relatives with a view to ensuring their availability to breeders and other stakeholders.

NACGRAB works in collaboration with all NARIs, Universities with Faculties/Colleges of Agriculture and/or Department of Biological sciences. NACGRAB has three germplasm conservation facilities – Seed bank, field genebank and *in vitro* genebank. Depending on the type of crop for which they have mandate, the NARIs also conserve germplasm of their mandate crop *ex situ*. The Agricultural Research Council of Nigeria (ARCN) which has oversight responsibility over the NARIs also plan to establish genebanks in each of the five institutes serving as the zonal coordinating institute. Some Non-Governmental Organizations (NGOs) also collaborate with these institutions on specific areas of conservation. An example is the collaboration with Centre for Environment, Renewable Natural Resources Management, Research and Development (CENRAD) in the area of *ex situ* management of forest resources.

Table 3.1: Conservation Sites in Nigeria

Institutions	Types of Conservation	No. of facilities
National Centre for Genetic Resources and Biotechnology (NACGRAB)	Seed Genebank (Medium term collections at -4^0c)	1
NACGRAB, Federal Ministry of Agriculture and Rural Development, National Agricultural Research Institutes (NARIs)	Seed Genebank (Short term collection at 18^oC)	50
Federal Ministry of Environment, NGOs, Universities with Biological Sciences Department	Botanic Gardens	60
NACGRAB, NARIs	*In vitro* Conservation	12

Table 3.2: Number of Crop accessions conserved in the NACGRAB's Genebank as at Dec 31st, 2007

Crop Group	Seed Genebank	*In vitro* Genebank
Cereals – Sorghum Pearl Millet Rice	3400	_
Legumes – Cowpea Soybean Beniseed	2200	_
Oil Seeds	1800	16
Medicinal Plants -	_	9
Fruits – oranges, Mangoes, Cashew, Plantain, Bananas Pine-apple, Guava.	_	12
Vegetables	300	_
Economic Cash Crops- Rubber, Oil Palm, Cola nut cocoa.	_	1

At the IITA genebank, 1067 accessions of yam, 1502 accessions of cassava and 3779 accessions of cowpea are conserved on behalf of Nigeria.

The Constraints to Sustaining *Ex situ* PGR Collections over the Next 10 years:

Some of the constraints that will impact on the state of *ex situ* conservation of PGRFA over the next decade can be summarised as follows:

- Dwindling government fund / budget for PGR conservation and lack of Special project fund for PGR.
- Unavailability of state of the art seed gene banks / lack of serviceable spare parts for broken down equipments
- Epileptic power supply and rising cost of electricity due to unresolved energy crisis in the country
- Occurrence of pests and diseases
- Documentation and computerization of the gene banks
- Information exchange through training, seminars and workshops

Needs and Priorities of the Gene banks:

There is need for state of the art modern seed stores and seed laboratories to be built across the nation for germplasm conservation within the research institutes for long term storage of our seeds. Also to rehabilitate the non –functional long term storage facilities in NACGRAB, NIHORT, e.t.c. Erratic power supply is a major limitation in view of its attendant consequences for genetic erosion of accessions in the genebanks and hence need for adequate funding to maintain constant supply of electricity through installation of industrial electricity generating sets. Mutual co-operation among scientists in various gene banks within the country is solicited for complete safety of germplasm, and the need for reciprocal duplicate germplasm storage to ensure security of holdings cannot be over-emphasised.

Regenerating Threatened *Ex Situ* accession:

Routine seed germination tests are carried out to rejuvenate accessions as soon as significant reduction in viability of seeds occurs in storage. Embryo rescue and *in situ* conservation using tissue culture method are sometimes employed to salvage threatened species.

Supporting planned and Targeted Collecting of PGR:

The National Centre for Genetic Resources and Biotechnology (NACGRAB) always embark on exploration activities. Recently, the centre has made successful collections of some endangered plant species. Among these collections are *Kola pachycapa. Griffonia simplicifolia, Bulchozia*

coriacea, Discorephylum cumminsi etc. However, wild relatives of most crops and forages have not been fully explored for conservation purposes. Future explorations by the centre will now focus on collection of both the crops and their wild relatives.

Germplasm Movement

One of the functions of NACGRAB's core duties is to distribute germplasm to scientists and other agricultural workers on request for experiments. National Agricultural Research Institutes have distributed thousands of seeds of some major food crops and vegetable accessions to scientists, students, NGOs, Farmer Based Organizations (FBOs) and State Agricultural Development Projects (ADPs) in the last 5 - 10 years. Table3.3 shows the type of germplasm exchanged within and outside the country in the last few years.

Table 3.3: Germplasm distribution of 11 major crops and vegetables in Nigeria

Crop species	**Landrace**	**Breeding lines**	**Genetic stocks**	**Wild relatives**	**Cultivars**	**Total**
Pennisetum spp.	10	975	-	40	15	1040
Triticum spp.	-	500	-	-	500	1000
Arachis hypogaea	-	417	-	-	14	431
Orya spp.	604	-	616	80	55	1355
Abelmoschus spp.	254	-	20	110	80	464
Saccharum spp.	200	-	267	-	-	467
Dioscorea spp.	893	-	150	17	7	1067
Solanum tuberosum	534	230	-	-	234	998
Manihot spp.	1502	-	122	-	-	1624
Vigna spp.	3054	700	-	-	25	3779
Vegetable crops	105	120	-	-	80	305
Sorghum spp.	300	763	10	-	37	1110
Total	**7456**	**3705**	**1185**	**247**	**1047**	**13,640**

Priorities for Regional and International Co-operation:

Development of a regional programme on PGR in the West African sub-region for duplicate sample keeping of unique accessions seems inevitable particularly because of the damaging effects of unstable power supply in Nigeria which is the main cause of genetic erosion in our gene banks. We want to feel the impact of Bioversity International, FAO and other International organization in the area of training related to germplasm management, funding some special projects on PGR and capacity development of our facilities.

At sub-regional level, Nigeria is still collaborating with Ghana, Cameroon and Gabon in a project to collect the forest species *Irvingia gabonensis* and with Burkina Faso in a project on *Parkia biglobosa*.

The State of Use 4

With increasing urbanization and industrialization, coupled with rising population pressure, there is a gradual but steady decline in the area of prime land available for agriculture. Thus, there is an urgent need for increased food production as well as a more equitable distribution of food materials to avert large scale famine. This situation has been aggravated by global food shortages caused by natural and human-made disasters. These disasters were unfortunately complimented by ravaging desertification, erratic rainfall and invasion of quella birds (*Quella quella*) and desert locusts (*Schistocerca gregaria*) particularly in the northern part of the country.

There is therefore, a compelling need for a better utilization of plant genetic resources. This should apply not only to the conventional but also to the under-utilized (so called "minor") crop species through plant breeding. Such well-articulated promotion of the use of Plant Genetic Resources for food and agriculture will surely be a veritable way to contribute to the fair and equitable sharing of the numerous benefits derivable from these natural resources.

The use of plant genetic resources can be viewed from three broad perspectives:

i. Direct use by farmers and other interested parties in agricultural production systems including direct cultivation, use in rangelands, forest reserves etc.
ii. Use by plants breeders and other researchers in hybridization and selection to evolve improved genotypes.
iii. Direct use by the end-users either for consumption or manufacture of other products.

Being a big agrarian country, Nigeria has 18 National Agricultural Research Institutes 12 of which have responsibility (or mandate as it is generally called) for research on the agronomic and genetic improvement of specific crop plants (Table 4.1).

Use of Plant Genetic Resources by farmers

The indigenous system of PGR utilization is old and traditional in Nigeria. The seed industry is still in its nascent stage in Nigeria. The national regulatory agency (National Agricultural Seed Council, NASC) provides guidelines for production and marketing of seeds in the country. Apart from contract growers (licensed by NASC), there are only 12 private seed companies. These companies mostly multiply seeds of improved crop varieties developed by the NARS and market to farmers through poorly networked outlets spread all over the country.

Table 4.1: Crop-based National Agricultural Research Institutes and their mandate crops

	National Agric. Research Institute	Mandate Crop
1.	Institute of Agricultural Research and Training (IAR&T), Ibadan, Oyo State.	Maize, Kenaf.
2	Institute for Agricultural Research (IAR) Zaria, Kaduna State.	Cowpea, Sorghum, Cotton, Sunflower, Maize, Groundnut, Castor seed.
3 .	Lake Chad Research Institute (LCRI), Maiduguri, Borno State.	Millet, Wheat, Barley, Masakwa sorghum.
4.	National Cereals Research Institute, Badeggi, Niger State.	Rice, Sugarcane, Soyabean, sesame.
5.	National Horticultural Research Institute, (NIHORT) Ibadan	Vegetables (leaf and fruit), Pawpaw, Fruits trees (citrus, mango etc). Plantain/bananas,
6.	National Root Crops Research Institute (NRCRI) Umudike, Umuahia, Abia State	Cassava, Yams, Potatoes, cocoyam, Ginger, Tumeric.
7.	Cocoa Research Institute of Nigeria (CRIN) Ibadan.	Cocoa, Kola, Coffee, Tea. Cashew
8.	Forestry Research Institute of Nigeria, (FRIN) Jericho, Ibadan .	Timber, Non-wood forest resources
9.	Nigerian Institute for Oil Palm Research (NIFOR), Benin City, Edo State.	Oil palm. Rafia, Coconut, Date and other palms. Shear butter tree.
10.	Rubber Research Institute of Nigeria (RRIN) Iyanomo, Benin-City.	Rubber, Gum arabic and other latex producing plants of economic importance.
11.	National Animal Production Research Institute (NAPRI)	Forage species.
12	National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan	Conservation of genetic resources.

Every year new varieties of different crops specifically bred to address biotic and abiotic constraints and increase farmers' profit margin are released (Table 4.2). However, the seed industry limits the diffusion of these new varieties. The production capacity of all seed companies in Nigeria is less than 10% of national requirements. Yet, the companies are unable to sell their seeds not because farmers are not aware nor unwilling to buy the seeds but because the seeds are usually not available at the time the farmers want them and at points accessible to them. Surveys have shown that the apathy Nigerian farmers' to improved seeds is more out of lack of confidence in the industry to supply improved seeds timely year after year if the farmer abandons his landraces for improved cultivars. Seed companies are also not producing seeds of more recently released varieties but those of varieties of the mid- and late-80s. For example, there are recent open-pollinated maize varieties that yield more than the hybrid that seeds companies are marketing most widely. The practice whereby independent seed companies complement government efforts by engaging in active research to develop improved crop varieties is yet to take root in Nigeria. This is a far cry from what obtains in some African countries where such companies not only have research units but also extension arms that effectively complement government efforts in the generation and dissemination of improved technologies to local farmers across the country. Only Premier seeds Ltd has really developed improved varieties of maize seeds for release to the Nigerian farmers.

Participatory plant breeding wherein farmers are involved in most of the stages in the selection process is a veritable way of enlisting the interest of farmers in emerging varieties. Such varieties would be adopted quite easily since the superiority over the local varieties would was very. Secondly, the community seed production programme initiated by the National Agricultural Seeds Council some years ago was targeted at ensuring timely availability of planting materials to farmers. The concept involves using farmers in a community to undertake the seed production process under the watchful eyes of officials of the agency. The resultant produce will be certified and sold to members of the community at cost- recovery prices.

Use of Plant Genetic Resources by Plant-Breeders

It is a well known fact that genetic diversity is the major ingredient used by plant breeders to create new improved genotypes. Before such vital materials can be used, they must be available and in viable forms. These could be conserved *in situ* (in seed gardens, forest reserves etc), by regularly planting the materials (to retain the viability) or conserving them in genebanks. The

Nigerian enebanks holds over 15,000 accessions of different crop/plant species and on the average, the genebanks distribute over 2,000 samples every year (see chapter 3), both within and outside the country for utilization in crop improvement and basic research.

Table 4.2 Crop varieties released and registered in Nigeria

	Crop	No. of Released Varieties	No. of Institutions Involved
1.	Cassava	21	2
2.	Cotton	13	1
3.	Cowpea	23	4
4.	Soyabean	15	4
5.	Forage Legume	9	2
6.	Groundnut	23	3
7.	Maize	61	6
8.	Pearl Millet	10	3
9.	Rice	57	3
10.	Rubber	10	1
11.	Sesame	3	2
12.	Sorghum	39	2
13.	Sugar cane	20	6
14.	Tomatoes	14	3
15.	Wheat	7	2
16.	Yam	7	2
17.	Amaranths	6	1
18.	Celosia	2	1
19.	Pepper	5	1
20.	Melon	2	1
21.	Cocoa	6	1
22.	Cashew	1	1
23.	Kolanut	3	1
24.	Coffee	2	1
25.	Sweet Potato	5	1
26.	Irish Potato	3	1
27.	Sweet Oranges	11	1
28.	Tangelo	1	1

Source: Crop varieties released and registered in Nigeria by NACGRAB (December, 2007)

Resistance to disease of sorghum such as downy mildew and head bug have been developed through the crosses made from ICSV 400, an elite variety developed by International Crops Research Institute for the Semi – Arid Tropics (ICRISAT), Kano in Nigeria and the germplasm of Bagauda, Farafara and Nagawhite collected from Nigeria (Aladele and Ezeaku 2003). From a country wide maize germplasm collection of over four hundred and seventy accessions evaluated at the Institute of Agricultural Research and Training, Ibadan, Nigeria genotypes with resistance/tolerance to various maize diseases were identified and characterized (Ogunbodede *et al* 2003). A cowpea cultivar, Popse-1, was developed at the Institute of Agricultural Research and Training, Ibadan from a single plant selection in the third cycle of a population improvement programme. The base population consisted of Vita–2S into which disease resistant genes had been incorporated (Fawole *et al,* 1986).

Three cowpea landraces obtained from Kano in northern Nigeria have been used to improve the exotic ones for insect and disease resistance, these include Dan Illa, Jan Wake and improved Kananado (Singh and Emechebe, 1998). The Oil palm (*Elaeis guineensis* Jacq.) is endemic and is in abundance in the rain forest region of southern Nigeria, *Raphia* In the Niger Delta and the water logged regions, while Date palm (*Phoenix dactilifera*) and *Borrassus* are endemic in the Northern part of Nigeria. In the coastal regions of Nigeria, Coconut Palm (*Cocos nucifera L*) is planted to check erosion in the coastal lines of the sea and oceans. *Raphia* Palm, *Raphia hookeri* is perhaps the most exploited species on the forest belt of Nigeria for palm wine, and it offers a good source of long fibres for the pulp and paper industry.

A study carried out at the University of Ibadan on Beetroot plant (*Beta vulgaris*) collected from National Centre for Genetic Resources and Biotechnology live genebank (NACGRAB) indicated the presence of superoxide dismutase an antioxidant enzymes. The author concluded that the plant could be used for the treatment of anaemia (Adedayo 2003). Through the evaluation of 350 sugarcane germplasm conserved in one of the Nigerian genebanks at the National Cereal Research Institute (NCRI), Badeggi, sources of resistance to a very important disease of sugarcane (*Ustilago scitaminea* Syd.) has been discovered. About 28.55% of the accessions evaluated were wild relatives from Nigeria (Wada *et al*., 2001). Drought has been a serious problem in the Sudan and Sahel regions of Africa, and through evaluation of 900 African accessions of cowpea from the genebank of the International Institute of Tropical Agriculture

(IITA) during 1990 – 1991 at Kano Research Station, 22 accessions of Nigerian origin were found to be highly drought-tolerant (Watanabe 1997).

Sharma *et al*. (1987) reported that improved local types of rice made 10-20% increase in yield over the traditional types under local agronomic practices and ecological conditions. They also observed that drought and; pest and disease resistant varieties are also being utilized for wheat, maize, barley, millet, sorghum and the grain legumes, vegetables and fruits as well as medicinal crops. Groundnut rosette, a virus disease that ravaged the groundnut production in Northern Nigeria was tackled through the additional sources of resistance obtained from a selection of about 2,391 accessions evaluated at the Institute for Agricultural Research, Ahmadu Bello University, Zaria (Olorunju *et al.* 2001).

The distribution of available germplasm of major crops in the national genebanks (Table 4.3) shows that cowpea (*Vigna unguiculata*) germplasm was the highest with 3,779 accessions. About 280% of this was distributed between 1987 and 2003. This is followed by cassava (*Manihot esculenta*) with 1,624 accessions (12.2% distributed) while groundnut (*Arachis hypogaea*) has the lowest with 431 accessions and only 3.2% was distributed. The most widely distributed germplasm were landraces (55.1%) followed by breeding lines and wild relatives (1.9%).

Germplasm Utilization for Selected Crops

Table 1 shows the utilization of germplasm for selected crops. *Vigna unguiculata* was rated highest for accessions utilized for Research followed by *Manihot esculenta. Vigna unguiculata* rated highest in the number of accessions conserved and utilized, which implies that there is a positive correlation between the number of accessions of a particular crop species in the genebank and their utilization potentially. Information about the germplasm is sourced through scientific journals, oral presentations and catalogues; while the elite germplasm were shared through benefit sharing and genebank exchange.

Unfortunately, however, even as at that, information is indeed scanty on the proportions of preserved materials that have actually been utilized to develop improved varieties (the actual essence of the collection in the first instance).

TABLE 4.3: Germplasm use for 11 major crops in Nigeria

Crop	Research	Direct Use	Re-distribution	Total
Pennisetum spp.	381	N/S	15	1,040
Triticum spp.	2,000	N/S	-	1,000
Arachis hypogaea	834	14	-	431
Oryza spp.	1,047	8	300	1,355
Abelmoschus spp.	410	-	-	467
Saccharum spp.	467	-	-	467
Dioscorea spp.	1,060	-	5	1,067
Solanum tuberrosum	NS	NS	NS	998
Manihot spp.	1,624	NS	-	1,624
Sorghum spp.	1,863	-	37	1,110
Vigna spp.	3,500	25	250	3,779
Total	**13,186**	**47**	**607**	**13,338**

N/S - Not Specific

Many reasons can be advanced for this low rate of utilization. They include the following;-

1. Lack of funds to embark on germplasm collection or breeding work in general. Until very recently, many National Agricultural Research Institutes (NARIs) have little or nothing for research after settling staff emoluments.
2. Lack of data on characterization of the raw materials collected. This could still be a fall out of the poor funding situation.
3. Non-viability of the materials collected by different NARIs after some time due to poor storage facilities. At least each establishment deserves small storage facilities if only for a year or two while materials for long periods can be taken to a central gene bank.
4. Very few (two or so) functional gene banks are available in the country. This is due to poor planning at the national level. At least one gene bank in each of the six geopolitical zones would have been near the ideal situation bearing in mind the size of the country.
5. Poor linkage between genebanks and possible end users of these important resource materials. No network to facilitate information dissemination.

6. Dearth of plant breeders in many national research Institutes and Universities.
7. Lack of effective seed distribution system. Farmers still recycle their old unimproved varieties which are hardly included in gene banks for research purposes.
8. Bottle necks in the National Varieties Release mechanism. Oftentimes, there would be no funds for national multi location (farmer managed on farm) trials, a pre-requisite for release. Worse still, even funds to call a meeting of the committee to assess submissions from accredited agencies are often not available.

1. Direct use by end-users

Crops that are hitherto classified as food crops are gradually becoming industrial materials with the attendant increase in demand and price. Maize, apart from its growing use in the livestock industry is now used for malting, industrial alcohol distilling, industrial starch, glucose syrup, dextrin as well as in other pharmaceutical, textile, food and beverage industries. Similarly, the industrial uses of cassava are increasing. For example, total world cassava imports increased from 16.34 million tons in 1997 to 19.5 million tons in 2000. By 2004, total world import demand has reached 25 million tons. Nigeria is he world's leading producer of cassava while top importing countries include Netherlands, Spain, China, Indonesia etc. Since 2006, China has requested Nigeria to supply her with 500,000 tons of cassava annually. Local demands for feed mills will require over 200,000 tons per annum.

The output of sorghum and millet rose form 4.911million and 3.684million metric tones to 6.233 million and 4.771million metric tones respectively between 1985 and 1994 in Nigeria (Bukar Shuiab *et al.* 1997 and CBN 1994). Local Sorghum, Farafara, improved by the Institute for Agricultural Research (IAR), Zaria, is being used by Guinness Nigeria Limited for Malting and Brewing. This was made possible by the wide diversity that exists in Nigeria sorghum germplasm as reported by Appa Rao *et al.* 1994. It has been estimated that the company will require about 8,000 and 42,000 metric tones for malting and brewing respectively, apart from other multinational brewing industries (Personal Communication). These huge demands necessitate increased research to evolve high-yielding, pests/diseases resistant varieties with commensurate quality to satisfy the yearnings of the international community. The bottom line for such a revolution is the provision of functional gene banks with a network of motivated workforce that can deliver results on schedule.

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The State of National Programmes, Training, and Legislation 5

The Nigerian Government realizes the fact that valuable genetic resources constitute a capital asset with great potential for yielding suitable benefits. It was along this line that the NACGRAB was established to ensure collection, conservation, preservation and maintenance of valuable germplasm for agricultural development. The genetic resources programme is under the Federal Ministry of Science and Technology. Plant Genetic Resource (PGR) conservation, as one of the programmes of NACRAB, is within the national rolling plan, and has its own annual budget. However, a secure level of funding is presently not available but the need to ensure proper funding is recognized.

The National Centre for Genetic Resources and Biotechnology (NACGRAB – present name) was established in 1987 through the active support of the FAO. While NACGRAB was mandated to act as the National Focal point for research, data gathering and dissemination of technical information on the Nation's plant and animal genetic (food and agriculture) resources, the Forestry Research Institute of Nigeria (FRIN) was mandated to collect data, research and disseminate technical data on the conservation state and needs of vegetational preservation.

The programmes of NACGRAB include:

a) Exploration, conservation, preservation and maintenance of genetic resources for immediate utilization and posterity.
b) Networking and co-ordinating activities in biotechnology i.e. tissue culture.
c) Servicing the activities of the National Committee on Naming, Registration and Release of crop varieties, Livestock breeds and fisheries (Decree 33, 1987 & 72 of 1992)

Routine exploration, collection, evaluation and characterization of germplasm (indigenous and exotic) for agriculture development are vital function of the centre.

Structure and Functions of NACGRAB

The centre has two storage facilities in its genebank,

i. A prefabricated long-term storage room maintained at -20°C, and relative humidity of 15%, and

ii. A modified room for short term storage is maintained at 15°C and 30% R.H. The two storage facilities have dehumidifiers.

The long term storage room has the country's base collections whilst the short term storage room contains active collections. All seeds are stored in hermetically sealed containers at appropriate moisture content level. Functional laboratories at the Centre include germplasm extraction room, threshing room, and viability or germination room. Processing equipments such as seed dusters, ovens, incubators, seed separators and balances are also available.

Nigeria, being a member of the Economic Commission of West and Central African States (ECOWAS) will readily accommodate germplasm from the sub-region for safe keeping on terms agreeable to the parties.

The Centre operates as the central organ of the country for liaison with international organizations like Bioversity International, FAO, UNDP and IITA on plant genetic resources. It also advises government on matters concerning plant genetic resources and conservation of vegetation. Similarly, the Centre has working relationship with National Agricultural Research Institutes. Over the decade, the level of involvement of stakeholders in the planning and implementation of National Programmes on PGR had increased. In line with this, a National Stakeholders Workshop on PGR management, held in Abuja in 2004, led to the establishment of a committee on PGR management which was officially inaugurated in the same year. With this setup at the Centre, Nigeria has taken the lead among the African countries in establishing a well organized and effective plant genetic resources system.

Challenges, Needs and Priorities of Nigeria on Plant Genetic Resources Programme

For Nigeria to strengthen its National Programmes on Plant Genetic Resources for food and agriculture, in the next decade, there is need to:

i. Establish a supporting genebank in each of the five agro-ecological zones of the country.
   • Improve the working conditions of some infrastructures such as the short term storage and cooling systems of the NACGRAB genebank
ii. Provide information data base system at National, regional and global levels to back up conservation of genetic resources for not only immediate utilization of already conserved

and evaluated or characterized germplasm in the ongoing plant breeding programmes but also for future use

iii. NACGRAB needs to employ new technologies in conservation of genetic stocks such as:

a. Assessing genetic variation within a species or population, including small or endangered populations and estimate their effective population size.

b. Practical methods for monitoring and maximizing genetic diversity during captive breeding programmes and re-introduction schemes including mathematical models. To achieve these goals, Nigeria's strategy on PGR shall be based on promotion and enhancement measures for both *in situ* and *ex situ* conservation through identification, inventories, evaluation, monitoring, research, education, public awareness, training and incentives to farmers. This can be possible whenever the Programmes on PGR are well funded.

Education and Training

One of the major constraints militating against the effectiveness of PGR Programmes in Nigeria is inadequacy of technical support staff. Although some members of staff have benefited in one form of training or another through sponsorships by international organizations like Bioversity International, Wageningen International, and IITA, there is need for more trained staff in all spheres of plant genetic resources conservation for sustainable use, development and conservation of PGR. In addition to IITA, NACGRAB also offers short term training courses in various aspects of plant genetic resources conservation for participants within and outside Nigeria. Some of our National Institutions also offer basic plant genetic resources courses. These include the University of Ibadan, Ibadan; Obafemi Awolowo University, Ile-Ife; Ahmadu Bello University, Zaria; and the Federal Universities of Agriculture at Umudike and Abeokuta, Nigeria. It has been proposed that PGR should be introduced at the undergraduate level as a course in order to prepare a better base service in Nigeria. The Department of Plant Science of Ahmadu Bello University Zaria offers the PGR course to post-graduate students. Training in the area of PGR in Nigeria has been organized by IITA, ICRAF, and the Commonwealth Science Council among others. The involvement of ethnic groups and traditional farmers in PGR collection and conservation has increased over the decade to the advantage of all groups in Nigeria. Descriptive information on accessions stored in the gene bank has also been up-dated.

National Policy on Plant Variety Registration and Protection

The Federal Government of Nigeria formulated a policy for Biodiversity protection in 1999. The policy stresses the importance of conserving biodiversity for the present and future generations. The key goals of the policy are to:

i. Promote and enhance measures for both in-situ and ex-situ conservation
ii. Identify, evaluate, monitor, conduct research, on conservation of PGR as well as create awareness among the public on the same;
iii. Identify genetic resources at the species level based on their present or potential socio-economic value and their conservation status,
iv. Encourage the development of ex- situ facilities including rescue and breeding centres to protect threatened species,
v. Establish and maintain forest seed and cloned gene banks to conserve genetic diversity of tree species,
vi. Strengthen measures to reduce and eliminate release of substances that are harmful to species and genetic resources,

A National Seed Policy was formulated in 1990 with a view to:

1. Support variety improvement, registration, release and multiplication
2. Improve the quality of seeds sold to the farmers
3. Encourage private sector participation in seed operations through appropriate policies and promotion activities and
4. Re-design the operations of public sector agencies along commercial lines

The National Agricultural Seed Council (NASC) is responsible for planning, coordination and seed policy guidelines. It coordinates production and distribution of publicly bred foundation seed to public and private sector organizations. As regards restriction on plant genetic resources exchange, the regulatory body is the Nigerian Plant Quarantine Service (NQPS) regulations on importation and exportation of plant materials and products. This being an FAO arrangement, Nigeria follows the rules very closely to ensure the non-transference of pests and diseases across international borders. Imported genetic resources that have been cleared by Nigerian Plant Quarantine Services can be planted in the country. Thus, there is no law restricting planting of imported genetic resources if subjected to phytosanitary procedure.

The State of Regional and International Collaboration 6

The National Genebank of Nigeria (NACGRAB) was established through the support of the FAO, IPGRI/UNDP. This collaboration with organs of the United Nations (UN) thus precedes other international collaborations which have been relatively limited. In scope, IPGRI initiative on wild fruit tree collection (*Irvingia gabonensis*) has enabled the country to interact and collaborate with Ghana, Gabon and Cameroon in the West African region.

United Nations Initiatives

Nigeria was represented at the 1992 UN meeting by the head of the former Federal Environmental Protection Agency (now in Ministry of Environment), and actions taken on recommendations since the conference took place include review of the state of vegetation of the country, update and identification of changes in vegetation and biodiversity. Other actions undertaken include creation of national parks, game reserve and strict nature reserves (SNRs). As a clear demonstration of the concern of the Federal Government to the conservation of natural resources, Nigeria signed the following relevant treaties and conventions of the UN.

- Convention on biodiversity, signed in Rio de Janeiro in 1992 and ratified August 1994
- Convention on Climate Change, signed in Rio de Janeiro in 1992 and ratified August 1994.
- Convention on Drought and Desertification, signed in France in October 1994
- Convention on International Trade on Endangered Species of flora and fauna (CITES) in Washington 1973

Collaboration with FAO

Apart from the role of FAO etc. on NACGRAB's establishment, a second phase project document on plant genetic resources was developed for purpose of funding by UNDP, this has still not been implemented.

International Agricultural Research Centres

Nigeria also has close, cordial and mutually-beneficial relationship with IITA and ICRISAT but especially on training activities, workshops and conferences, among others. The country has also

gained a lot from ICRAF, ILRI, WARDA. For example, the forest trail project of IITA best described as denuded secondary forest within IITA has become an important *in situ* bank of important plant genetic resources. Over 15 threatened plant species are protected in this forest bank with *Milicea excelsa* being particularly plentiful at this site. Additionally, substantial genetic resources of some wild fruit and food crops are also available here (Ladipo, personal communication). This plant genetic resources bank has great potential for increased collaboration between IITA, ICRAF, IUCN/FAO and other NARS interested in conservation to translate it into a more effective research and conservation plot. Germplasm are also frequently received from IITA, ICRISAT and ICRAF on request and sometimes from CIMMYT as the need for them arises. The country has been collaborating in the rice germplasm exchange and evaluation through INGER and IITA. Some of the plant genetic resources conservation equipment at the National Centre were received from IBPGR now Bioversity International. The International organization further supplies documentation and publications on various GRC (Genetic Resources Conservation) issues. From all indications, the CGIAR centres are in the position to provide the assistance being sought for now in view of the level of our needs. However, additional support would be needed in the area of training, supply of modern equipment and also assistance in forms of communication gadgets that would facilitate collaboration between the National programme, NGO's and the centre. The most important contribution of Bioversity International in the next decade should be intensification of efforts in the promotion of plant genetic resources collection, characterization, conservation and utilization in Nigeria.

Regional Research Centres

The country's relationship with other regional centres is mainly in the area of information dissemination as relates to plant genetic resources conservation. The magnitude of involvement with any of these regional research outfits or international organisation is thus low.

Regional Intergovernmental Initiatives

Within the ECOWAS framework, a Scientific Collaborative arrangement is included. However, there was also an arrangement under the Technical Cooperation among developing countries (TCDC) programmes through the National Planning Commission with the Government of India in the area of germplasm exchange which is yet to materialise. There is thus a good potential for regional intergovernmental initiatives in Nigeria. Recently, the Genetic Resources Network for

West Africa and Central Africa (GRENEWECA) under the umbrella of Conseil Ouest et Centre Africain pour la Recherche et le Development (CORAF) instituted a project to assist member countries in conservation and utilization of plant genetic resources by implementing national policies, strategies and action plans in conformity with international and regional legislation endorsed by member countries. Apart from the support given by the network in form of equipment and materials for germplasm conservation, further intervention is still required in areas such as strengthening of biotechnology facilities, sharing of germplasm within and outside the sub-region and implementation of conventions, laws and treaties in West and Central Africa. However, this has not grown into any specific projects.

Bilateral Intergovernmental Initiatives

Presently there is no bilateral agreement between Nigeria and other countries, but the ECOWAS articles of association as mentioned above supports collaboration, and this is already entrenched in the articles. This is a possible seed for stronger and more specific bilateral initiatives in the future with other countries in this sub region. Additionally ICRAF started an initiative on *Irvingia germplasm* collection in West Africa. It involves ICRAF, Ghana, Cameroon, Nigeria, and Gabon. This arrangement has put these countries on a multilateral relationship on this species. The distribution of *Irvingia* over West Africa covers these countries. Finally, the European Economic Commission also has a project on *Parkia biglobosa*. It involves, Nigeria, Burkina Faso and some other countries in West Africa. The activities of this project involve *parkia* germplasm collection and characterization (Ref. University of North Wales Bangor - F. Sinclair). Efforts to revive a West African initiative on Hardwoods Improvement through FAO, has for over 10 years not been successful.

Access to Plant Genetic Resources for Food and Agriculture, sharing of Benefits Arising out of their Use, and Farmer's Rights

7

Nigeria has been a part of the global effort on Plant Genetic Resources and signatories to Convention on Biological Diversity (CBD), International Treaty on Plant Genetic Resources for Food & Agriculture (IT-PGRFA), Trade Related Aspects of Intellectual Property Rights (TRIPS), Global Plan of Action and committed to working with the international community to meet the objectives of these conventions. Additionally, Nigeria is a member of Genetic Resources Network of West and Central Africa (GRENEWECA) with the potential for access and benefit sharing of plant genetic resources among the member states in West and Central Africa.

The key provision of Access and Benefit Sharing of plant genetic resources are provided in Article 15 of the Convention on Biological Diversity (CBD) which recognizes the sovereign rights of state over their natural resources. Consequently, it also recognizes the authority to determine access should rest with the national government and is subject to national legislation. Nigeria though being a signatory to CBD is yet to be protected by any form of legislation on ABS and this creates an environment where nation's biological resources and indigenous knowledge are being pirated, exported, and commercialized overseas without benefits to the nation and the people who are custodians of these resources and knowledge. National Environmental (Access to Genetic Resources and Benefit Sharing) Regulations 2008 is about to be enacted in the country following section 34 of the National Environmental and Regulations Enforcement Agency (NESREA) Act 2007. This will in no way affect utilization of the Nigerian biodiversity.

Nigeria is a Party to CBD and has benefited immensely over the years as she continue to receive germplasm from CGIAR centres all over the world, which has contributed to her food and nutrition security. Access to plant genetic resources continues to improve substantially over the years in Nigeria despite the constraints associated with information and documentation of various germplasm.

Fair and Equitable Sharing of Benefits

The use of plant genetic resources has been by National Agricultural Research Institutes (NARIs) and International Agricultural Research Centres located in Nigeria. Improvements of local germplasm include crops such as cowpea, maize, cassava, soybean and rice. There is a direct and clear benefit from our indigenous plant genetic resources in respect of the crop improvement programmes. Use of indigenous plant genetic resources is made by researchers and plant breeders for the overall agricultural development and specific materials are provided for overseas institutions on request.

Nigeria currently does not have any mechanism for access and benefit sharing on ground though a signatory to CBD. However, efforts are on going at the national level to pass the draft "National Environment (Conservation of Biodiversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2008 into law. The draft legislation is currently with the Technical Committee on Environment, Housing and Urban Development (NCE, H & UD) for endorsement. The mechanism of benefit sharing as put together in the proposed National Environmental (Access and Benefit Sharing) regulations of 2008 stipulates that: "*Any person who intends to access genetic resources in Nigeria shall apply to the National Environmental Standard and Regulations Enforcement Agency (NESREA) for an access permit in the form set out in the first schedule, and such applications shall be accompanied by the fees prescribed in the second schedule of the regulations*".

Implementation of Farmers' Rights

International agreements that were relevant to the Implementation of Farmers Right, such as International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) and Convention on Biological Diversity (CBD) have been subscribed to by the relevant authority in Nigeria. The draft National Environmental (Access to Genetic Resources and Benefit Sharing) regulation 2008 when signed into law will achieve and enhance the implementation of farmers' right. Benefits would be shared fairly and equitably with all those have been identified as having contributed to the genetic resources management, scientific and /or commercial process. The later may include governmental, non- governmental or academic institutions, indigenous people and local communities. Benefits would be directed in such a way as to promote conservation and sustainable use of biological diversity. All these are partly ways of implementing farmers' right.

However, it should be noted that several factors might serve as obstacles in the implementation of farmers' right.

i. Practical implementation of ABS might have adverse effect on farmers' right.
ii. Control of Genetic Resources within government systems fall under different domain. e.g. Federal Ministries of Science and Technology (FMST), of Environment and Urban Development (FME &UD), and of Agriculture and Rural Development (FMA&RD).
iii. Several chains of stakeholder involved in ownership of Genetic Resources.
iv. Bureaucracy; ABS legislation will be implemented by public officers; this may leave the indigenous people and local communities at the mercy of benevolence of bio-prospectors and companies that want access to genetic resources.
v. Farmer Based Organizations (FBOs); Poor and ineffective farmers' organizational structure in existence in the country might hinders full benefits of farmers in ABS regime and makes its administration difficult.

Contribution of PGRFA Management to Food Security and Sustainable Development 8

PGR has contributed immensely to the food security, poverty alleviation and job creation in Nigeria over the last Fifty years. This is in addition to other social and political benefits derived from different eco-geographic zones of the country. The crop improvement programmes of Nigeria are either conducted by the National Agricultural Research Institutes (NARIs) independently or jointly with other relevant International Agricultural Research Centres (IARCs). These had resulted into quick development of new crop varieties and hybrids. In addition better crop management and technology transfer to farmers have been achieved in the last couple of decades.

The acquisition of germplasm through collection of indigenous diversity across Nigeria and germplasm exchange through introduction from other countries has contributed tremendously to available gene pool for breeders to work with in different crop species. Introductions were generally carried out by the National Centre for Genetic Resources and Biotechnology (NACGRAB) in collaboration with Nigerian Plant Quarantine Service (NPQS). In some exceptional cases private seed companies and Agricultural Universities were also permitted to make some introductions from other countries but with the knowledge of NACGRAB and NPQS to ensure no GMO or alien pathogens are imported to the country and for proper documentation. The rich diversity of different crop species in Nigeria has made it easy and fast to develop new varieties of crop in Sorghum, yam, pearl, millet, cowpea and cassava among others.

Over fifty rice varieties have been released to farmers by the National Cereals Research Institute (NCRI) in collaboration with West African Rice Development Association (WARDA) – African Rice Centre. The latest being the New Rice for Africa (NERICA) developed *from Orya sativa* (Asian rice) crossed with *O. glaberrima* (African rice). Ten pearl millet varieties and one hybrid have been released for commercialization by the Lake Chad Research Institute (LCRI) in collaboration with International Crops for the semi-Arid Tropics (ICRISAT). High yielding maize varieties and hybrids, groundnut varieties and sorghum varieties have been developed and released to farmers in Nigeria by the Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU) in the last four decades.

The germplasm conserved by NACGRAB have been rich sources of research materials for Universities and other Agro-Based research institutions. NACGRAB continues to collect, characterize and conserve all crop species to ensure adequate supply to end users. Hundreds of maize accessions have been introduction from CIMMYT, Mexico during the early 2000s while vegetable landraces are also being introduced from Asian Vegetable Research and Development Centre - The world Vegetable Centre, Taiwan.

Many lesser leguminous plants such as African yam bean, Pgeon pea, aba bean among others have been collected and are getting more acceptability among consumers as a result of the awareness of their nutritional contents. In addition, the possibility of exploiting the lesser legumes to transfer important traits to cultivated leguminous crop varieties such as cowpea, pigeon pea and groundnut are being considered. Some of the edible wild plants in Nigeria contain high beta carotene which is a precursor of vitamin (A) known to be important for both visual and reproductive integrity of animal species including man.

The availability of rich diverse germplasm in Nigeria had contributed significantly to the training of plant breeders and other agricultural experts on various crop species. Most of the problems of biotic and abiotic stresses had been tackled as result of accessibility to a lot of diversity in crops such as cassava, sorghum, pearl millet and cowpea among others. The current global trend on value added products has also provided opportunity for the establishment of many cottage industries. These had translated into more employment for the teeming population, income generation and ultimately poverty alleviation. New equipment had been fabricated to meet the emerging demands from the cottage industries.

There is an apparent need to strengthen the capacity of the national focal point (NACGRAB) to be able to undertake molecular characterization of the diverse plant genetic resources for food and agriculture.

Annex 1: Plants that are currently used for Food and Agriculture in Nigeria

S/n	Plant	Common name	Use	Status (Major/minor) Improved/unimproved	Relative importance (food security, economic & social)
A	**TUBERS**				
1.	*Manihot esculentus*	Cassava	Root tuber, processed into starchy foods, e.g. *garri,* flour, (*elubo*), pure starch, *fufu* or eaten boiled, used as industrial raw materials notably pharmaceuticals, bakery, etc	major and improved.	Most important in the south particularly south east, south-south and more recently south west as a staple food and item of local trade. Cassava is gradually gaining prominence in export trade.
2.	*Dioscorea* spp.	Yam	Stem tuber, processed into starchy foods e.g. yam flour or boiled and eaten directly or pounded into a fine solid of uniform consist-ency (pounded yam).	major and mostly unimproved because no new cultivar have been released.	Most important in the south and the guinea savanna as staple food, item of local trade and an import-Ant item for traditional marriage Nigeria
3.	*Ipomeae batatas*	Sweet potato	Root tuber, boiled and eaten directly or pounded with yam or fried in oil. It is a source of carbohydrate food.	minor / unimproved	grown mainly in south west as supplement to other crops. It is most important to the Ibolo community (Offa) of Kwara state as a traditional food item.
4.	*Solanum tuberosum*	Irish potato	Stem tuber, used as a carb-ohydrate food in different forms, boiled, mashed, fried or flaked.	minor / unimproved	This is an exotic crop grown mainly in Plateau state where the the weather is conducive but sold and eaten throughout Nigeria
5.	*Colocacia esculentus*	Cocoyam	Root tuber/Rhizome, pro-	major/unimproved	Grown and eaten mainly in the

		cessed into different carbohydrate foods.		southern Nigeria where it is also An item of local trade.
B CEREALS.				
1. *Zea mays*	Maize(corn)	Grains are eaten boiled or roasted, can be processed into different food items, as feed for livestock, as ind-ustrial raw materials.	major/improved	Grown and eaten throughout the length and breadth of Nigeria. The forest and the guinea and sudan savanna are particularly suitable for maize cultivation. It is an item of local trade.
2. *Sorghum bicolor*	Guinea corn	Grains are eaten boiled, roasted or processed into different food items; also used as industrial raw materials and in brewery. dry culms are used as stakes for stands of yam in the South west.	major/improved	Grown mainly in the savannas and therefore a staple cereal food in the northern Nigeria. It is also cultivated in part of the The south west where it is a minor food items. It is an item of nation-al and international trade.
3.*Pennisetum americanum* *P. glaucum*	Millet	Grains are used in various forms of food preparation and the crop is the source of staple food, the dry calms used as building materials.	major/improved	It is most suitable to the drier savannas where humidity is minimal. The grain is a major food item while the dry calms are tradit-ional building materials in many parts of northern Nigeria. It is an item of trade with the neighbouring countries to the north of Nigeria.
4. *Tritium aestivum*	Bread wheat	Main source of flour for bread, cake, and other confectionary.	minor/ improved	Cultivation is yet to gain wide a acceptability.

5. *Oryza* spp. *O. sativa* *O. glaberrima*	Rice	Rice is a staple food, a major source of carbohydrate food in Nigeria.	major *O. sativa* is improve- *O. glaberrima* is near extinction.	Rice cultivation is restricted to particular areas of Nigeria that support the growth of paddy and upland rice. consumption is nationwide especiallly in the urban and sub-urban areas because of its relative ease of preparation.
6. *Digitaria spp.* e.g. *D.exilis* *D. iburua*	Hungry rice	A cereal crop with tiny but nutritious grains; used as a supplement to the major cereal crops particularly in times of need in areas too poor to support the growth of major cereals.	minor and largely unimproved with many wild and weedy features.	A crop of the dry north and of marginal areas of cultivation. Generally unknown to the Southern Nigeria.

C. FOOD LEGUMES

1. *Vigna unguiculata*	Cowpea	The most important grain legume in Nigeria cultivated for food, forage and often use as a cover crop and manure. It is a major source high quality plant protein in human diets.	major and a crop that has attracted sustained improvement efforts since 1960s.	consumption of cowpea as a staple food is more in wetter south, but cultivation is mainly in the drier savanna ecologies and to a lesser in the more humid south. It is a major item of north-south trade in Nigeria.
2. *Phaseolus lunatus*	Lima bean	Edible seeds	Minor and mostly Unimproved	It is of limited cultivation in the savanna agro-ecologies.
3. *Phasoelus vulgaris*	Common bean	Edible seeds	,,	,,
4. *Cajanus cajan*	Pigeon pea	Edible seeds	,,	,,

5. *Canavalia ensiformis*	Sword bean	Edible seeds	,,	,,
6. *Kerstingiella geocarpa voandzeia goecarpa*	Bambara bean	Edible seeds	,,	,,
7. *Glycine max*	Soya bean	Soya bean is an import-source of plant protein and is processed to serve as food supplements as soya milk, soyabean or to fortify other food products such as soya ogi, soya iru. Soya flour is used in producing food analogs. Meat products and high grade oils are produced from soyabean. Soy proteins are also used in infants food and livestock feeds formulation.	Minor. Improvement efforts on soyabean are relatively recent and a number of cultivars still retain the wild trait such as seed shattering.	Soyabean has natural appeal because of its important as a rich source of plant protein that can be processed into different food items or serves as source of valuable additives to other foods. It is therefore being promoted as a remedy For protein deficiency health condition particularly in infants and invalids.
8. *Arachis hypogaea*	Groundnut/ Peanut	groundnut is a very rich in plant protein and is a source of rich vegetable oil. The nuts are processed into various food items such as cake, butter and soup, and is an important component of livestock feeds.	major and improved	Groundnuts and its products are used nationwide, but the major cultivation areas are the north. It was a major export commodity, but now mostly for internal trade because of reduced production
9. *Parkia biglobosa*	Locus bean tree	Friut pulp is eaten and used in a local brew.	It is unimproved but in high demand for	*Parkia biglobosa* is a tree of the Nigerian guinea and sudan savannas where it is

			The most important part is the seed which is processed into a popular condiment called iru (Yoruba) or Dadawa in Hausa.	culinary purposes. It is harvested mostly in wild except for a few stands dotting farm lands and village compounds.	hunted for its fruit and seeds. The locust bean (i.e seeds) are either processed to the condiment by individual local women sold as industrial raw material for the production of the condiment.
D.	**OIL CROPS**				
1.	*Elaeis guinensis*	Oil palm	Source of red oil and kernel Oil that have immense culinary and industrial uses. The stem, the fond, the mesocarp fiber and the kernel shall have various traditional and domestics use.	Major and improved; improved varieties has been made available to the farmers by NIFOR, an institute whose main mandate is oil palm research.	Oil palm is plant of the more humid south where it is also heavily used in food preparation and in the industrial. It used to be an important commodity for export trade, but now restricted to local trade because of reduced production.
2.	*Sesamum indicum* (*Ceratotheca Sesamoides*	Sesame (Beniseed)	source of highly priced rich vegetable oil. The leaves are also eaten as a pot herb.	Minor, improved having being added to the Mandate of NCRI but retain a number of the wild traits such as seed shattering.	There is good traditional market, but production is low and restricted to the middle belt of Nigeria. It is used mainly as a leaf vegetable in the southwest where It is harvested in the wild.
3.	*Citrullus lanatus*	Egusi, melon	Very rich in vegetable oil that is obtainable from the seeds. Shelled seeds are also milled into granules which are used in food preparations.	Major but improvement status unknown.	Egusi melon has high demand for local trade because of its culinary uses. It is cultivated in the southern savannas and the oil is highly sought after for food preparations.
4.	C*ocos nucifera*	Coconut		Minor and largely improved. It has been	Coconut grows on the sandy beach of the Atlantic in the Banditry

			added to the mandate of NIFOR.	area of Lagos state. It is a crop of the rainfall areas of Nigeria.
5. *Ricinus communis*	Castor oil	The main use is the oil, which is extracted from the seeds.	Cultivated in very small holdings, it is a minor crop and is largely unimproved.	It produces an important oil for health care for babies. It therefore has pharmaceutical values.
6. *Gossypium spp. (G. hirsutum G. barbadens)*	Cotton	Source of cotton lint, valuable vegetable oil from the seed and the cotton cake for livestock.	Major and improved.	The lint cotton was a major commodity for international trade. It is a crop of the savanna.
7. Helianthus annus	Sunflower	The seed produce valuable vegetable oil which is used for food preparations.	Minor, but improved. the cultivated varieties are exotic.	Sunflower is a crop of the savanna but its oil is highly priced and therefore an item of trade and an industrial product.

E. PLANT BASED SWEETNERS

1. *Saccharium officinarium*	Sugarcane	Main source of the cane sugar used in sweetening various food items and beverages.	Major and improved to provide high sucrose content canes for the sugar producing factories in the country. Improvement efforts are carried out by NCRI and Unilorin Sugar Research Institute. (USRI).	Raw material for the sugar industry. The sugar is an item of local and international trade. The cane is also eaten raw to quench thirst and provide energy. It is grown under rainfall conditions in the south and in *fadama* and under irrigation in the north.
2. *Beta vulgaris*	Sugarbeet	The tuber is processed for extraction of sucrose and	Minor, and unimproved for the Nigerian	Cultivation is restricted to the Jos Plateau area where the cool-cold

		production of sugar.	climate; it is yet to gain prominence in Nigeria because of the temperate conditions needed for its growth.	conditions support its growth. It is a raw material for the sugar industry.
3. *Thamatococcus danielli*	Eran (Yoruba)	The fruit born on rhizomatons underground stem contains a protein sweetener which is several thousand sweeter than sugar; it is ideal for diabetic patients.	Grow wild and the wide aerial leaves are harvested for rapping food.	It is a plant of the southern humid forests where the leaves are harvested and sold for domestic use in rapping various food items.
4. *Syncepalum dulficium*	Agbayun (Yoruba)	The fruit (drupe) has a mesocarp that confers sweet taste to any food taken immediately after it an it liger on for sometime.	It grows both wild and under cultivation It is minor and unimproved.	It is planted as solitary stands on farms or around house in the humid south.
5. *Dioscoreophyllum Cumminsii*	Sededipity-berry	Fruit pulp is 2500 times sweeter than cane sugar and the sweetening agent is protein: ideal for diabetic patients.	Grows wild.	Grows in the humid forest of the south.
F. HORTICULTURAL CROPS				
1. *Capsicum spp. C. annuum; C. frutescence*	Pepper, Tatase, atarodo, ata wewe, shombo	Pepper is a major component of Nigeria food with variable degree of pungency.	A major crop of wide variability, Improved for fruit yield and capsicin content. .	The larger fruit producing varieties with less pungency are grown under irrigation and in *fadamas* in the north while the small fruit producing varieties (chillies) are grown bin the south under rainfed conditions. Pepper is use nation-wide and a major component of north-south trade.

2.	*Lycopersicon esculentus*	Tomato	Tomato is an important component of Nigerian food.	A major crop that has enjoyed much improvement.	The more fleshy with less water and seeds are grown under irrigation and in *fadamas* in the north while the less fleshy and more seeded and watery varieties grow in the south. The northern tomato is in high demand in the south.
3.	*Alium cepa*	Onion Alubosa, (Yoruba)	Onion is an important food.	A major crop, well adapted but with little improvement.	Onion is grown for its bulb in the north under irrigation and in *fadamas.* All onions consumed in the south come from the north.
4.	*Amaranthus spp.* *A. cruentus*, *C. hybridus*	Amaranthus Tete (Yoruba)	Amaranthus are important leaf vegetable.	A major vegetable with no visible improvement	Amaranthus are vegetables mostly grown and consumed in southern Nigeria.
5.	*Albelmoschus esculentus*	Okra Ila (Yoruba)	Okra is an important fruit vegetable in the southern Nigeria.	A major crop with many landraces and improved varieties.	Okra is grown and consumed mostly in the south of Nigeria extending to the middle belt.
6.	*Corchorus spp.* *C. olitorius,* *C.tridens* e.tc.	Ewedu (Yoruba) Pot herb	*Corchorus olitorius* is an important leaf vegetable.	A major vegetable with little improvement	*C. olitorius* is grown from south up to the middle belt. An important pot herb.
7.	*Solanum raddi* *S. melongena*	Eggplant (indigo) Eggplant (exotic)	The fruit of garden egg is eaten raw or cooked.	Eggplant is common fruit vegetable.	It is cultivated under rain fed or irrigation and in *fadamas* in both south and north respectively.
8.	*Musa spp.*		Fruit vegetable rich in iron.	Crops of the wet	Plantain and banana grow in the

M. sapietum *M. parasidisiaca*	Plantain Banana		southern Nigeria with little or no improvement.	south under rain fed conditions.
9. *Telfairia occidentalis*	Ugu (Ibo)	This is a leaf vegetable that is rich in iron.	It is a major leaf vegetable.	It is a prominent vegetable in the East which has gained prominence in the south west in the recent times.
10. *Carica papaya*	Pawpaw	This is a fruit vegetable notable for its thirst quenching properties.	A major fruit vegetable of variable landraces, and limited improvement.	A forest fruit that grows both wild and cultivated.
11. *Ananas cosmotus*	Pineapple	An important fruit salad component and raw material for fruit juice beverages.	A major fruit vegetable grown mainly in south from the landraces.	Cultivated under rainfed and irrigation condition or in *fadamas*.
12. *Daucus carota*	Carrot	An important root vegetable.	An exotic crop.	It is grown mainly around Jos Plateau, but it is eaten nationwide.
13. *Pisidium guajava*	Guava	Fruit is eaten fresh and as component of jam.	Minor fruit crop Varying from the seeded landraces to the improved seedless varieties.	It is grown mostly in the forest and derived savanna zones.
14. *Cirtus sinensis*	Orange	Peeled fruit is eaten fresh and extracted juice is used in beverages.	Major fruit crop varying from seeded to the seedless and improved varieties.	It is grown mostly in the forest area of the country.

15. *Mangifera indica*	Mango	The fleshy mesocarp of the fruit is eaten fresh and use in beverages.	Major fruit horticultural fruit crop with local and exotic varieties spread nationwide growing in cultivation or in the wild.	Mango fruit or it's processed juice. is taken nationwide.
16. *Anacardium occidentale*	Cashew	Cashew apple juice and cashew nuts are processed and taken nationwide.	Minor tree crop of the humid savanna and savanna and forest.	The nuts are important for local and international trade.
17 *Pyrus communis*	Pear	The fruit is delicious to table.	Minor fruit tree, largely unimproved.	Grown and eaten mainly in the forest of the south.
18. *Ocimum gratissimum*	Efinrin (Yoruba)	The spicy leaves are eaten as vegetable or used to ganish soups.	Minor, grows wild and and unimproved.	Grows in the forest and savanna areas of the country.
19. *Cucumis sativus*	Cucumber	Fruit vegetable.	Minor, exotic.	Grown under irrigation or in *Fadamas* in the north and under rainfed agric in the south.
20. *Cucurbita pepo*	Pumpkin	Fuit vegetable.	Minor, exotic	Grown under irrigation or in *Fadamas* in the north and under rainfed agric in the south.
21. *Latuca sativa*	Lettuce	Leaf vegetable.	Minor, exotic.	Grown under irrigation or in *Fadamas* in the north and under rainfed agric in the south
22. *Celosia spp;*		Leaf vegetable.	Minor, indegenous	Grown mostly in the southwest.

	C. argentia *C.trigyna*	Sokoyokoto (Yor) Ajefowo (Yor)		
23.	*Crassocepallum spp. C .biafrae* *C. crepidioides*	Woworo (Yor) Ebolo (Yor)	Leaf vegetable.	Minor, indegenous . Grown mostly in the southwest.
24.	*Vernonia amygydalina*	Bitter leaf Ewuro (Yor)	Leaf vegetable.	Minor, indegenous . Grows wild in the cultination in the south under rainfed condition.
25.	*Launaea taraxacifolia*	Yanrin (Yoruba)	Leaf vegetable.	Minor, indegenous . Grows wild in the cultination in the south under rainfed condition
26.	*Solanium americanum*		Leaf vegetable.	Minor, indegenous . Grows wild in the cultination in the south under rainfed condition.
27.	*Hibiscus spp.;* *H.sabdariffa* *H. cannabinus*	Isapa, Okun Yoruba repeacti-vely, Kenaf (the later)	Leaf vegetable.	Minor, indegenous . Grows wild in the cultination in the south under rainfed condition.
28.	*Gnetum africanum*		The leaves are used as salad (eaten raw) as cooked vegetable soup.	Minor vegetable. It is eaten nationwide but well known with the Itunkpa people of Cross river state.
29.	*Tetracarpidium conophorum*	Awusa (Yor)	The cotyledons are proteinous and eaten cooked.	Minor climbing crop of the south, mostly southwest unimproved. Cultivation and consumption is restricted to the southwest.
30.	*Annona muritata*		The fruit is big, 100% pulp, jiucy and sweet.	Cultivated in solitary stands around houses or in mixed orhardry. It grows under humid conditions. and wii trive where adequate water is provided.

G. CASH CROPS

1	*Theobroma cacao*	Cocoa	The dried seeds (cocoa beans) are used in the manufacture of coca type beverages and cocoa butter which is used in pharmaceutics.	Major cash crop and subject to intense research nationally and internationally. It is the first mandate crop for Cocoa Research Institute of Nigeria. (CRIN)	It is cultivated mainly in the humid south and is a major cash crop for international trade. It is an important source of revenue for the government and people of the southwestern Nigeria where CRIN is located.
2.	*Coffee arabica* *C.canephora* *C. liberica* *C. robusta*	Coffee	The dried seeds are processed into coffee, a stimulating beverage of universal appeal.	An important cash crop which is one of the mandate crop for improvement by CRIN.	It is cultivated in the south and on Mambila plateau where the temperature-like climate is conducive for its cultivation.
3.	*Thea sinensis*	Tea	The leaves are processed into tea, a beverage that is known worldwide.	A minor cash crop and part of CRIN mandate.	Grown manily in Mambila Plateau as source of raw material for a privately owned tea company.
4.	*Cola spp.;* *C. nitida* *C. acuminate*	Kola	Cola seeds called kolanuts are used as masticatory and raw material for winery and the pharmaceutical industry.	A major cash crop, part of CRIN mandate.	Kola is grown throughout the southern Nigeria. It is important for North-South trade because it is heavily consume in the north. Kolanut trade is therefore very lucrative. Kola also has social and religious values as an item of hospitality and communing with deities respectively.
5.	*Havea brasilensis*	Para rubber	Para rubber is an important raw material for the rubber industries in and outside Nigeria.	It was a major cash crop before the oil boom days in the southern Nigeria. Rubber Research Institute	It is a crop of the south where large plantations still exists and used to be a major source of revenue. This has however

of Nigeria was set up for its improvement	changed with the plantations giving way to other crops.