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

GHANA

Ghana Country Report on the State of Plant Genetic Resources for Food and Agriculture

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EXECUTIVE SUMMARY

This report is an update of the previous Country Report on the State of Plant Genetic Resources for Food and Agriculture presented at the Leipzig Conference in 1996.

Agro-ecological zones found in Ghana include the High Rain Forest, the Semi-deciduous forest, Transitional zones, the Coastal, Guinea and Sudan Savanna zones. Diverse agro-ecological conditions are at the origin of the great diversity of plant genetic resources that exist in the country.. Ghana is a centre of diversity for *Dioscorea rotundata, D. cayenensis, D.dumetorum, Vigna unguiculata and V. subterranea*

Agriculture represents the most important sector of the country's economy. Most important food crops include maize, yam, cassava, rice, plantain, cocoyam, millet, sorghum, oil palm, pineapple and cashew. Cocoa is the main export crop..

There are several organizations engaged in agricultural research playing an important role in the conservation and sustainable use of plant genetic resources for food and agriculture (PGRFA). Among these are the Council for Scientific and Industrial Research (CSIR) with its eight research centres, the three main public Universities, the Cocoa Research Institute of Ghana (CRIG) and the Ghana Atomic Energy Commission (GAEC).

Despite the existing richness of PGRFA diversity, *in situ*/on-farm conservation of PGRFA is not well organized in Ghana mainly due to lack of financial resources and national strategies. Sites for *in situ* conservation are both in wild and farmed areas. Even though there are over 200 forest reserves and a number of protected areas representing the different ecological zones in Ghana, none has been surveyed to show the percentage presence of crop wild relatives; but it is always assumed to contain a high proportion of these. Activities related to on-farm conservation of plant genetic resources are mostly led by the Crops Research Institute (CRI) and the Savanna Agricultural Research Institute (SARI) from CSIR.

Ghana was one of first countries in the world to set up a national collection of PGRFA in 1964. More than 40 years later, PGRFA *ex situ* conservation activities in Ghana are carried out by various institutions, including the Plant Genetic Resources Research Institute (PGRRI) responsible for the national genebank. The institute conserves orthodox seeds including 9987 accessions in cold storage at -200C and 5-7% moisture content, and living plants in orchards and the arboretum of about 166 species; Crops Research Institute (CRI), Savanna Agricultural Research Institute (SARI) and Department of Crop Science in Legon have cold storage facilities to conserve seeds at 50C. The Botany Department of the University of Ghana, Cocoa Research Institute, Crop Science Department of Kwame Nkrumah University of Science and Technology (KNUST), Crops Research Institute (CRI), Biotechnology and Nuclear Agricultural Research Institute (BNARI), School of Agriculture of the University of Cape Coast and Forestry Research Institute of Ghana (FORIG) all have facilities for *in vitro* conservation of PGRFA. There are also several institutions which conserve tree crops and other living collections in field gene banks.

Utilization of PGRFA stored in *ex situ* collections is high. Plant breeding is one of the most important ways of PGRFA utilization, as it aims to ensure adaptation while enhancing performance of important crops. Main users of stored genetic materials are Crops Research Institute (CRI), Savanna Agricultural Research Institute (SARI), the Universities, Cocoa Research Institute of Ghana (CRIG) and Oil Palm Research Institute (OPRI). Crops whose varieties have been released by breeding programmes include yam, maize, rice, cassava, sweet potato, cowpea, plantain and soybean. PGRFA have also been used to breed oil palm varieties under the Presidential Special Initiative (PSI). Living collections of plant genetic resources with pharmaceutical properties are used for medical purposes.

Ghana has a national programme on PGRFA with the Plant Genetic Resources Research Institute (PGRRI) as the focal institution. There are several national institutions and other stakeholder organizations which contribute to the national PGR programme. Through the PGRRI this programme feeds into other networks including the Genetic Resources Network of West and Central Africa (GRENEWECA) whose goal is to contribute to sustainable agricultural development through the conservation and use of the diversity of local PGRFA.

The country has cooperated in several international endeavours. In 2002 it ratified the International Treaty on Plant Genetic Resources for Food and Agriculture. In the past Ghana has benefited from a number of collaborative projects with FAO, Bioversity International, the Technical Centre for Agricultural andRural Cooperation (CTA) and the International Institute of Tropical Agriculture (IITA). There has also been bilateral collaboration with organizations from Germany, the Netherlands, United Kingdom and Japan.

Though Ghana has ratified the International Treaty for Plant Genetic Resources for Food and Agriculture, it has no legislations on access to PGRFA, sharing of benefits arising out of their use and farmers' rights. The country is in the process of enacting such legislation.

PGRFA management plays a very important role in food security and sustainable development in the country. In times of disasters, availability of PGRFA of particular crops helps to replenish stocks which have been destroyed. Also availability of PGRFA has contributed in a great way to poverty alleviation, economic development and agricultural sustainability through effective utilization.

AN INTRODUCTION TO THE COUNTRY AND THE AGRICULTURAL SECTOR

Ghana is situated in the centre of the countries along the Gulf of Guinea in West Africa. The country has an area of 238 530 square kilometers and lies between latitudes 4°44' and 11°11'N and longitudes 01°12' and 03°11'W. It is bordered on the east, west and north by the Republics of Togo, Cote d'Ivoire and Burkina Faso respectively. On the south it is bordered by the Atlantic Ocean. The sea coast is 550 km long. Administratively, Ghana is divided into ten administrative regions (capital centers in brackets): Ashanti (Kumasi), Brong Ahafo (Sunyani), Central (Cape Coast), Eastern (Koforidua), Greater Accra (Accra), Northern (Tamale), Upper East (Bolgatanga), Upper West (Wa), Volta (Ho) and Western (Sekondi-Takoradi). The population of Ghana is about 22.5 million (2007) with a growth rate average of 3.3% per annum. About 60% of the population live in rural areas and derive their income from agriculture and related activities. Ghana is a democratic country with a presidential system of Government in which power is shared between the executive (the presidency), the legislature (parliament) and the judiciary.

1. Agriculture

In Ghana the agricultural sector consists of crops, livestock, fisheries, and the cocoa sectors. Crop production is vital to the overall economic growth and development of Ghana and it is the largest contributor to the Gross Domestic Product (GDP), accounting for about 38%[1]. Cocoa accounts for 18% of agricultural GDP, other crops for 62%, livestock for about 7%, fishing for about 3% and forestry about 7%. The principal food crops are maize, cassava, plantain, yam, cocoyam, rice, sorghum and millet. Maize accounts for between 50% - 60% of the total cereal production. Vegetables include pepper, eggplant, tomato, okra and beans. The country's important cash crops are cocoa, oil palm, cotton, coconut, tobacco, groundnut and rubber.

Cocoa is the most widely cultivated crop, grown on about half of the country's total cultivated land area, followed by cereals (25%) and roots and tubers (20%). The bulk of farmers are small holders who account for about 80% of agricultural production. Average holding is less than 1.5 hectare. Shifting cultivation is widely practiced and subsistence farming is common in the rural areas. Productivity is low mainly because of low fertility of the land, limited use of available technical packages, non-timely delivery of inputs (particularly fertilizers), and, poor credit availability. In recent years a few commercial farms have been initiated and have started exporting pineapples, mangoes, pepper and yams.

2. Food security situation

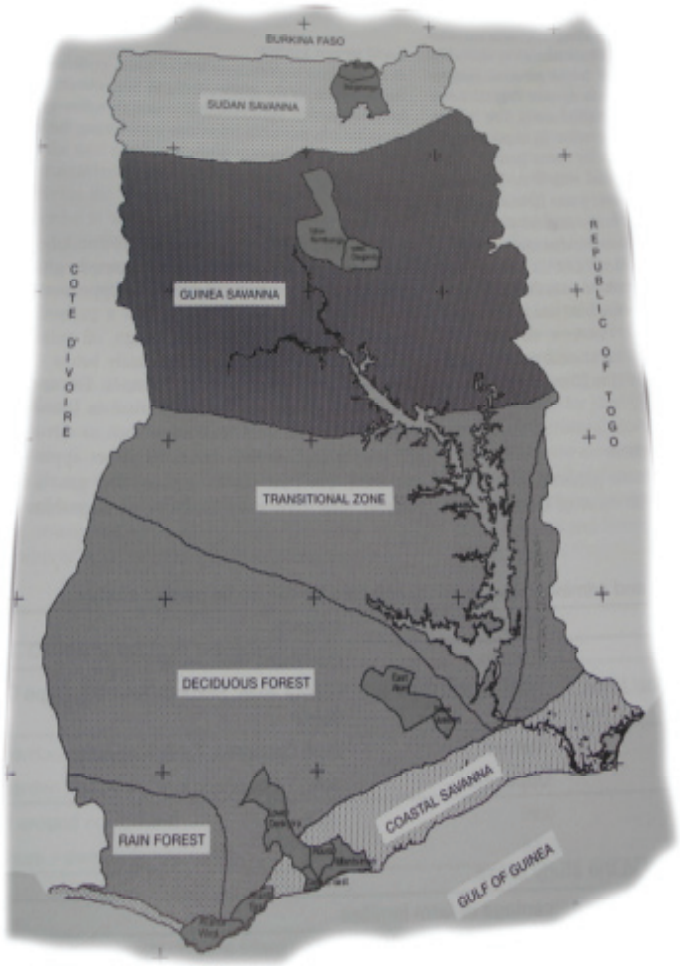
Food security is under threat because of the desire to go into mono-cropping of cash crops. With the new drive for the cultivation of Biofuel crops such as oil palm, and woodstock for energy and other needs, the pressure on land changes is quite severe.

3. Agro-ecological zones

There are six main agro-ecological zones defined on the basis of climate, reflected by the natural vegetation and influenced by the soils (Figure 1).

[1] Source: Data on incidence of Agriculture on GDP Ghana see World Bank http://devdata.worldbank.org/external/CPProfile.asp?CCODE=gha&PTYPE=CP and attached file

FIGURE 1
Agro-ecological zones of Ghana



These are: High Rain Forest, Semi-deciduous Forest, Transitional Zone, Coastal, Guinea, and Sudan Savanna Zones.

- **The High Rain Forest** is found in the south-western part of the country. The annual rainfall of this zone is between 1 700 and 2 100 mm and there are two rainy seasons. The soils in this zone are heavily leached and fertility is relatively low. The major crops grown are oil palm, rubber, coconut, rice, banana, plantain and cocoyam.
- **The Semi-deciduous Forest** constitutes 21% of the land area of the country. It has two rainy seasons: March to July and September to November and a rainfall amount of 1 200 - 1 600 mm. Soils are more fertile than in the High Rainfall Forest and are suitable for cocoa, coffee, oil palm, maize, plantain, cocoyam, cassava, rice and vegetables including eggplant, beans, pepper and okra.
- **The Forest-savanna Transition zone** has two rainy seasons with an annual rainfall of 1 300 - 1 800 mm. The major season is from April to June and minor from September to November. Soil fertility is fairly high but the soil is liable to erosion. Major crops grown include maize, plantain, cassava, yam, cocoyam, cotton, tobacco, groundnut, tomato, pepper, eggplant, cowpea and beans.
- **The Coastal Savanna** forms 7% of the land area of Ghana. It has two rainy seasons. The major season is from March/April to June whilst the minor is from September to October. The average rainfall is 600 - 1 000 mm. Relief is gentle and soils are either heavy clay or light textured and underlain by clay. Among the crops grown are cassava and maize. Vegetables are grown on lighter soils while rice, cotton and sugarcane are planted on the heavier soils. Coconut is found on the coastal fringe.

- **The Sudan and Guinea Savanna zones** cover about 41% of the land area of Ghana. These zones are sometimes referred to as interior savanna and are characterized by level to gently undulating topography. Unlike the rest of the country the interior savanna has only one rainy season that is, April/May to October. Annual rainfall ranges from 800 to 1 200 mm. It declines from South to North. Soils are generally poor. Important crops include millet, sorghum, maize, rice, yam, Xgroundnut, cotton and tomatoes. The sheanut tree grows wild and it is an important cash crop. Over 70% of Ghana's livestock: cattle, sheep, goats are raised in these zones.

The Ministry of Food and Agriculture (MOFA) has the responsibility for agricultural production with the exception of cocoa, coffee, sheanuts, cashew and cola, which are the responsibility of the Ghana Cocoa Board (COCOBOD). MOFA is headed by a Minister who is assisted by two Deputy Ministers for Crops and Livestock. There are eight departments namely, Bilateral and Multilateral Relations and Aids, Agricultural Engineering Service, Policy Planning, Monitoring and Evaluation, Manpower Development, Agricultural Extension Service, Crop Services, Animal Production and Fisheries and Plant Protection and Regulatory Services. Each department is headed by a Director. In the regions there is a Regional Director of Agriculture for co-ordination and supervision of agricultural disciplines. Under the Regional Director are Regional Agricultural Officers who in turn supervise the activities of the District Agricultural Officers in the districts and sub-districts.

There are several institutes within the Council for Scientific and Industrial Research (CSIR) which are presently placed under the Ministry of Education,Youth Science and Sports (MoESS). CSIR institutes are mandated to carry out agricultural research in Ghana. These institutes include the Crops Research Institute (CSIR-CRI), Kumasi, Plant Genetic Resources Research Institute (CSIR-PGRRI), Bunso, the Soil Research Institute (CSIR-SRI), Kumasi, the Oil Palm Research Institute (CSIR-OPRI), Kade, Animal Research Institute (CSIR-ARI), Achimota, Savanna Agricultural Research Institute (CSIR-SARI), Nyankpala, the Food Research Institute (CSIR-FRI), Accra and the Water Research Institute (CSIR-WRI), Accra. CSIR also co-ordinates nation-wide agriculture research under the framework of the Agriculture Services Subsector Implementation Project (AgSSIP).

The Cocoa Research Institute of Ghana (CRIG) at Tafo which is solely for cocoa, coffee, cola and sheanut, is under the Ghana Cocoa Board (COCOBOD).

The country's universities including the University of Ghana (UG), Legon, the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, the University of Cape Coast (UCC) and the University for Development Studies (UDS) also carry out agricultural research. Other institutions which carry out research in agriculture include the Ghana Atomic Energy Commission (GAEC), Kwabenya and the Irrigation Development Centre (IDC), Ashiaman.

The Seed Growers Association has the mandate to produce certified seeds and planting material to meet the requirements of farmers. The CRI, SARI and UG provide breeder and foundation seeds of food crops, such as maize, cowpea and soybean for the production of certified seed. The Ghana Grains and Legumes Development Board (GGLDB) also produces foundation seed for certified seed growers. However only a few farmers patronize; most farmers use their own selection of seeds. Vegetable and ornamental seeds are imported from Holland, Israel and Japan for vegetable growers.

Main staples of the forest areas are root and tuber crops made up of cassava, yam and cocoyam. These contribute about 46% of agricultural GDP with yam exhibiting the largest growth rate in area planted. Agricultural production varies with total rainfall distribution and soil factors with strong regional diversities. Crops which have suffered major losses at times due to drought, pests and diseases include cocoa, maize, rice, sorghum, oil palm and okra. Landraces and introductions of these various crops are tested and utilized in breeding programmes to produce cultivars which are resistant to pests and diseases. Local cultivars or landraces are facing genetic erosion and efforts are being made to collect them for conservation and utilization for breeding programmes.

CHAPTER 1

THE STATE OF DIVERSITY

The most important food crops in Ghana are maize, cassava, yam, plantain, and rice. Still, there are some regional differences with regards to the relative importance of crops. In southern Ghana maize, cassava and plantain are the staple crops, contributing to the food security of the population. In the north, sorghum, millet, yam and rice are the most important crops for food security.

The most important commercial crop in Ghana is cocoa, followed by oil palm, pineapple, cashew and cotton. Ghana has the reputation of producing the highest quality cocoa in the world market. Today Ghana exports 700 000 tons of cocoa.

Indigenous species/landraces of bambara groundnut, groundnut, cocoyam, kola and millet are under threat in Ghana. The major identified causes of genetic erosion are summarized below under the heading of Genetic Erosion. For these reasons it is a priority to rank areas in the country with highest PGRFA diversity and to carry out systematic PGRFA surveying and inventorying of these species. Regional and international assistance is needed as resources and capacity are limited at the Plant Genetic Resources Research Institute (PGRRI), the organization responsible for these activities.

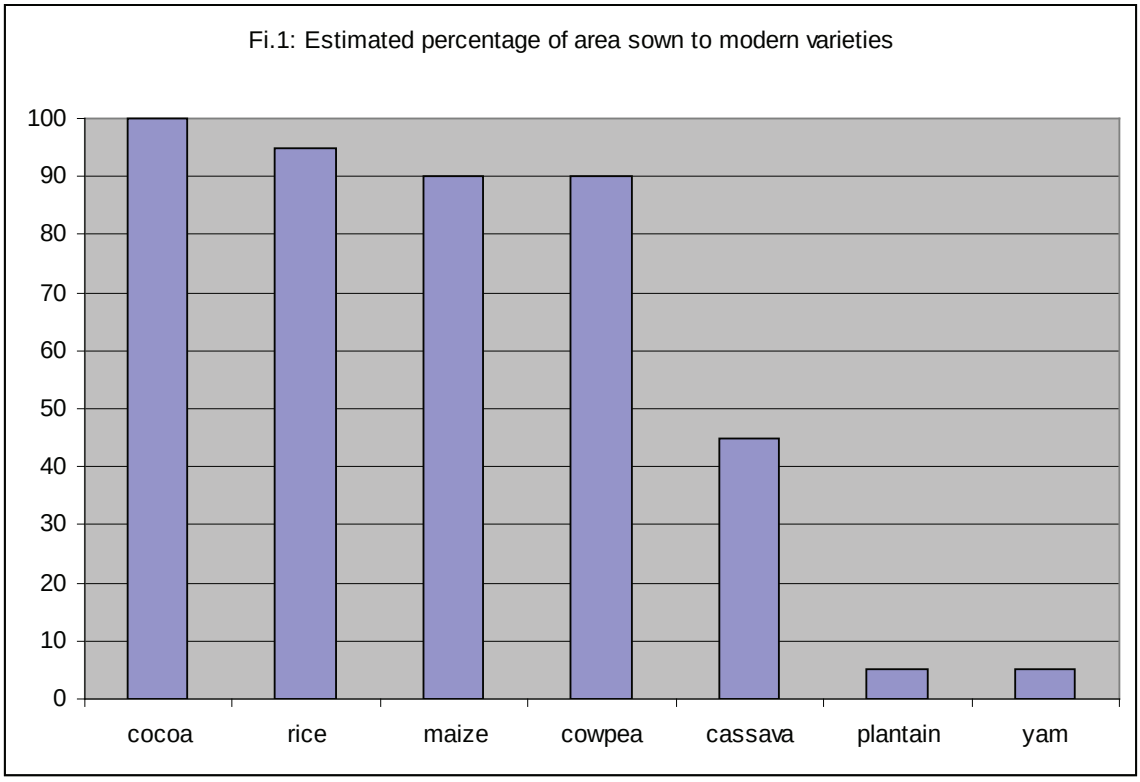
Overall, very limited work has been done to determine the state of diversity of minor crops and underutilized species in Ghana. Although there are no national plans for the conservation of crop wild relatives and wild plants relevant to food production, accessions of wild cowpea have been collected and secured in *ex situ* storage for further research and use. In addition, some activities on wild crop relatives and underutilized species have been carried out by the following projects:

- The People, Land use Management and Environmental Change (PLEC) Project, carried out by the University of Ghana in the late 1990s. The project identified good land use systems for food security and human welfare.
- Edible wild fruit and nut germplasm collection and conservation project, carried out by the Plant Genetic Resources Research Institute conducted in 2000 under the Agricultural Sub Sector Investment Project (AgSSIP). This project focused on collecting edible wild fruits and nuts throughout Ghana for characterization and conservation.
- Savanna Resources Management Project – surveys of underutilized plant species in the northern savanna zone carried out between 1999 and 2007

In general terms, the national policy supports the conservation of crop wild relatives and other wild plants relevant to food production through the National Biodiversity Strategy. However, these species are normally not considered in Environmental Impact Assessments (EIAs). There is therefore a general need to elaborate and strengthen national strategies and policy for the conservation and sustainable use of these wild plants relevant to food production in Ghana.

The proportion of area cultivated with modern varieties is presented for some crops in Figure 2. These are only rough estimates of the situation, given by a group of national crop experts and plant breeders. .

FIGURE 2
Estimated percentage of area sown to modern varieties



The figure illustrates that modern varieties are dominating the traditional ones. In the official lists of registered varieties at the Ministry of Food and Agriculture (MoFA) no traditional varieties are registered. There is no firm data on number of modern cultivated crops, but with time it should be possible to estimate the number of cultivated modern varieties that are cultivated for each crop. Through this it should be possible to also estimate an increase of the number of cultivated varieties in the past number of years.The state of diversity of landraces/farmers' varieties is therefore uncertain. In the future, there is a need to carry out more research on this.

Genetic erosion

Although there are no precise figures to quantify it, genetic erosion is widespread in the country. Reports of extensive land uses and land use change are proof for this. There is an overall consensus among PGRFA stakeholders in Ghana that the major factors causing PGRFA erosion in the country are in order of importance the following:

1. Replacement of local varieties
2. Land clearing
3. Pests/weeds/diseases
4. Population pressure
5. Changing agricultural systems

Bambara groundnut – replaced by improved cowpea and Kersting's groundnut – replaced by improved cowpea are examples of replacement of local varieties by improved variety. This means that risks of genetic erosion occur not only within crops with the displacement of local landraces but also between different crops. There are in fact evidences that introduction of improved varieties of cowpea is indeed putting pressure and reducing the cultivation of bambara groundnut and Kersting's groundnut. In Ghana there are currently no systems in place to monitor and report on genetic erosion, neither *in situ* nor *ex situ*. The main constraints to monitoring genetic erosion in Ghana are lack of skilled personnel, lack of appropriate and easy to apply methodologies and lack of financial resources. The implementation of a simple methodology for monitoring genetic diversity *in situ*, on-farm and *ex situ* is a priority. It would help to put in place and periodically revise conservation and utilization strategies that limit occurrence of genetic erosion and its effects on most vulnerable production systems such as those that prevail in our country.

CHAPTER 2

IN SITU CONSERVATION

In situ conservation of PGRFA is not well organized in Ghana, mainly due to the lack of financial resources and national strategies. PGRRI is the organization responsible for coordinating the *in situ* conservation activities nationally. Sites for *in situ* conservation are both in wild and farmed areas. These are the sites that contain most of Ghana's forest and wildlife resources. Surveying and inventorying of plant genetic resources, crop-associated biodiversity and wild plants for food production has been rather neglected in Ghana during the past 12 years.

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

PGRFA on-farm management in Ghana benefits from extension services that are provided free to farmers and from research conducted by the country's research organizations and universities. However outcomes from these two services appear to be insufficient and rather inadequate to the effective needs of farmers, particularly smallholders.

A few organizations carry out some sporadic activities related to on-farm management and improvement of PGRFA. These are: the Crops Research Institute (CRI), Cocoa Research Institute of Ghana (CRIG), and the Savanna Agricultural Research Institute (SARI) Savanna Resource Management Project (SRMP). But in general on-farm management of PGRFA is not properly integrated into national programmes.

Ghanaian farmers play an essential role in conserving on-farm diversity of plant genetic resources very important for the country's food security. Farmers' preservation role however extends also to other indigenous resources of cultural importance and minor economic value, for example, trees such as shea, baobab and dawadawa.

One important programme related to on-farm conservation of PGRFA and recognized in national plans is the People Land and Environment Conservation (PLEC)/SLAM, carried out by the University of Ghana.

There are no direct incentives to develop local or small scale production of indigenous seed in Ghana.

At the moment there are no national mechanisms, plans or agreements in place to assist farmers to recover and preserve PGRFA following disasters.

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

Crop wild relatives are wild species that are related to crop plants. Crop wild relatives are very important reservoirs of traits and characteristics useful for improving crop varieties. Their use has indeed increased the productivity of globally important crops such as barley, maize, oats, potatoes, rice and wheat. Crop wild relatives are best conserved *in situ*, in their natural habitats to allow evolution and adaptive changes.

At present in Ghana there are no national plans that specifically contemplate the conservation of crop wild relatives and wild plants relevant to food production. Even though national policy supports the conservation of crop wild relatives, there is a general need to increase the national capacity to conserve these resources. Crop wild relatives and wild plants relevant to food production are being conserved in protected areas including national parks, but only as an indirect effect of the establishment of these protected areas. These resources are not directly included or mentioned in the plans or strategies for the conserved areas except when they are generally referred to in the categories of non-timber forest products (NTFPs).

In synthesis, efforts to support *in situ* management of PGRFA in Ghana at present are insufficient and need to be improved particularly with regard to the assistance to farmers for PGRFA on-farm management and improvement. International collaboration on this topic should be strengthened, as it does not receive adequate consideration and support at national level.

CHAPTER 3

EX SITU CONSERVATION

3.1 Sustaining and expanding *ex situ* collections

The CSIR-PGRRI holds the national genebank. It was established in 1964 and has a total of 10 000 accessions conserved at Bunso.

At PGRRI there are two types of *ex situ* collections: orthodox seeds under cold storage and living plants in orchards. The orthodox seeds are conserved in deep freezers at -20°C and at moisture content of 5 to 7% . These seeds are from cereals, vegetables, cucurbits and legumes and are kept under short, medium and long term storage conditions.

Other institutions also have facilities for short term conservation of seeds, mainly of breeders' materials. For example the CSIR - Crops Research Institute (CRI) has a cold storage facility at 5°C for the conservation of breeders' seeds. Similarly, the Ghana Grains and Legumes Development Board in Kumasi, SARI in Tamale and the DCS, all have short term storage facilities for the conservation of grains, mainly of cereals and legumes. Materials conserved by SARI include millet, sorghum, groundnut, cowpea, pigeon pea and bambara groundnut.

In vitro facilities also exist in some institutions for the conservation of plant genetic resources. The Biotechnology and Nuclear Agricultural Research Institute (BNARI) at Kwabenya has *in vitro* facilities for germplasm conservation. The plant materials conserved in these facilities include pineapple, plantain, cassava and yams. The Botany Department (BD) of the University of Ghana, also conserves some crop germplasm like, cocoyam, cassava, frafra potato (*Solenostemon rotundifolius*), yams, sweet potato and pineapple. Other institutions like the Crop Science Department of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, the School of Agriculture of the University of Cape Coast, the Cocoa Research Institute of Ghana (CRIG), Forestry Research Institute of Ghana (FORIG) and the CRI all have *in vitro* facilities for research and conservation of germplasm.

The Botany Department of the University of Ghana is the only institution with facilities for cryopreservation. Currently these facilities are used on experimental basis only, mainly for frafra potato conservation.

There are several institutions in the country that conserve tree crops and other living collections in field gene banks. PGRRI has several tree crop species collections conserved in the field, including citrus, mango, avocado, *Musa* species and various palms and spices, like nutmeg.

Most tree crop species have been duplicated at the University of Ghana - Agricultural Research Centre (ARC) at Kade. Other institutions also conserve various tree crop species *ex situ*. CRIG conserves its mandate crops namely cocoa, cola, coffee, cashew and shea tree (*Vitellaria paradoxa*) in field genebanks at Tafo, Bunso, Afosu, Bole and elsewhere. OPRI conserves collections of oil palm (*Elaeis guineensis*) and coconut (*Cocos nucifera*) as living plants, seeds and pollen at Kade and Ainyinase respectively. CRI also maintains some field germplasm which include *Musa* spp., citrus, mangoes, yams and cassava. SARI conserves root and tuber crops in the field. These include yams, cassava, sweet potato and Frafra potato. The UCC also has a collection of tiger nuts, *Cyperus esculentus* which is currently being characterized for conservation.

There are also institutions in the country that have arboreta and clonal banks where various tree species, medicinal plants and timber species are conserved. FORIG has clonal conservation banks and orchards of forest species at Mesewam (a town in the Ashanti Region). PGRRI also has an arboretum with over 100 tree species. These species include introduced species like Brazil nut (*Bertholletia excelsa*) and Monkey nut (*Lecythis zabucajo*). The Centre for Scientific Research into Plant Medicine (CSRPM) also has arboreta at Mampong-Akwapim, Mamfe and Ayikuma for *ex situ* conservation of medicinal plants used in their research and treatment of diseases. The CSIR- Animal Research Institute (ARI) maintains museum specimens of living local and introduced forage plants at Pokuase near Accra and in Nyankpala in the Northern Region. Examples of such plants include legumes like pigeon pea (*Cajanus cajan*), *Leucaena glauca*, *Stylosanthes spp*. and grasses, like *Brachiaria spp*., *Panicum spp*. and *Pennisetum spp*.

Botanical gardens for *ex situ* conservation of plant species exist in various parts of the country. The first botanical garden to be established in the country was the Aburi Botanical Garden. This garden was established in the latter part of the 19th Century and is now used to conserve many local and exotic plant species, including ornamental plants.

Currently, the garden serves as a destination for tourists and recreation. Other botanical gardens exist at the University of Ghana, Legon, University of the Cape Coast and at KNUST. In addition to conservation, these gardens are also used for educational and aesthetical purposes. The Botany Department of the University of Ghana houses the Herbarium of Ghana which has a collection of preserved plant parts. The Herbarium is useful for the identification of plants. The Botany Department of the UCC and CSRPM also have herbaria.

3.2 Planned and targeted collecting

Collecting local germplasm has been carried out throughout the country over the years by several institutions. Most missions were spearheaded by the national gene bank - the Council for Scientific and Industrial Research's (CSIR) - Plant Genetic Resources Research Institute (PGRRI) at Bunso. In most cases the PGRRI has coordinated the collecting of plant genetic resources in the country jointly with other institutions that multiply and/or breed them.

A lot of germplasm collecting was also carried out in the past as part of various research programmes. First was the National Agricultural Research Project (NARP), which took place during the mid 1990's. A lot of multipurpose germplasm collecting activities took place during this period by multi-disciplinary teams from various institutions. These activities included collecting legumes, (cowpea, groundnut, bambara groundnut), maize, root and tuber crops, vegetables, tropical fruits and nuts. Germplasm for the various crops were collected in 1996 and 1997. A total of 10 000 accessions of germplasm have so far been collected most of them being conserved at PGRRI.

Root and tuber germplasm was collected in the country during the period of the Root and Tuber Improvement Project (RTIP), which was carried out in the late 1990's and early 2000's. During this period collecting activities were carried out for various crops, including yams, cocoyam, colocasia, sweet potato, frafra potato and cassava. Most of this germplasm are conserved in the field at the PGRRI. Some of the materials are also duplicated at CRI, SARI, ARC-Kade, DCS and UCC.

The Agricultural Sub Sector Investment Project (AgSSIP) provided funds for the collection of wild and underutilized fruits in various parts of the country. This activity took place in the period between 2001 and 2006. In total 77 accessions of wild and under-utilized fruits were collected, conserved in the field and are currently being characterized. In addition, 250 accessions of various legume species were collected, characterized and conserved.

Collections of 400 accessions of kola have been carried out by CRIG in the forest zone. In 2005, the Cashew Development Project started collecting cashew throughout the country. This activity is still on-going.

A major constraint in the maintenance of the national collections has been lack of good storage facilities at PGRRI (and at other institutions). Currently unreliable supply of electricity makes the maintenance of the freezers very difficult. Even though a stand-by generator is available, its capacity is not enough to power all the facilities available. A bigger generator (100KVA) is urgently required to be able to sustain all the germplasm under cold storage. The absence of a good stand-by generator makes the germplasm under cold storage at risk of being lost.

3.3 Germplasm movement

Distribution of germplasm samples stored at the national gene bank has been considerable. Upon request, from scientists at Ghanaian universities, the University of Ghana (UG), Legon, KNUST, Kumasi, UCC, Cape Coast, University of Development Studies (UDS), Tamale and University of Education, Winneba (UEW), germplasm of various crops including vegetables, cereals, and legumes has been distributed for research work. Scientists from research institutes within the country as well as those outside, have been sent germplasm. Germplasm has also been sent to farmers, second cycle institutions and individuals, on request. Some amount of vegetable germplasm was introduced into the country. These included eggplant, pepper, tomato, okra, onion and *Amaranthus*.

The major constraint, cited by stakeholders, to *ex situ* conservation activities was lack of funding for operations. This assertion is true since *ex situ* conservation of PGR is capital intensive, especially for cold storage of seeds, *in vitro* storage of plants and field conservation of living plants. The other major constraint is lack of sufficient and well trained staff in the field of conservation of PGR. All stakeholder institutions that are in *ex situ* conservation of PGR must have a complement of staff well trained in PGR activities. Finally stakeholders indicated that the lack of facilities, equipment and insufficient and irregular supply of electricity greatly hampered their efforts in conserving *ex situ* collections of PGR. It is imperative that the PGRRI which is the major stakeholder in PGR conservation acquires the necessary facilities to be able to conserve all type of germplasm in full safety.

CHAPTER 4

THE STATE OF UTILIZATION

PGR have been utilized in many diverse ways in Ghana. One of the major ways of utilizing PGR is in plant breeding. Landraces of local germplasm acquire adaptation to various environmental stresses and attributes due to several years of their existence in the local environment. This adaptation is exploited in breeding programmes to impart the adapted characters to a product as a result of breeding. Some examples are crop yield, resistance/tolerance to pests and diseases, ability to withstand lodging, salinity and drought, just to mention a few. Locally adapted materials are usually used as building blocks in such programmes, sometimes with supplementary materials from other sources. For example, cowpea genotypes developed earlier in the country are known to be susceptible to the plant parasite *Striga gesneroides*. Using local material as the building blocks, some materials from Burkina Faso and Botswana, which have been identified as resistant to the parasite, have been used to help improve the locally adapted cultivars.

4.1 Utilization and enhancing the use of plant genetic resources

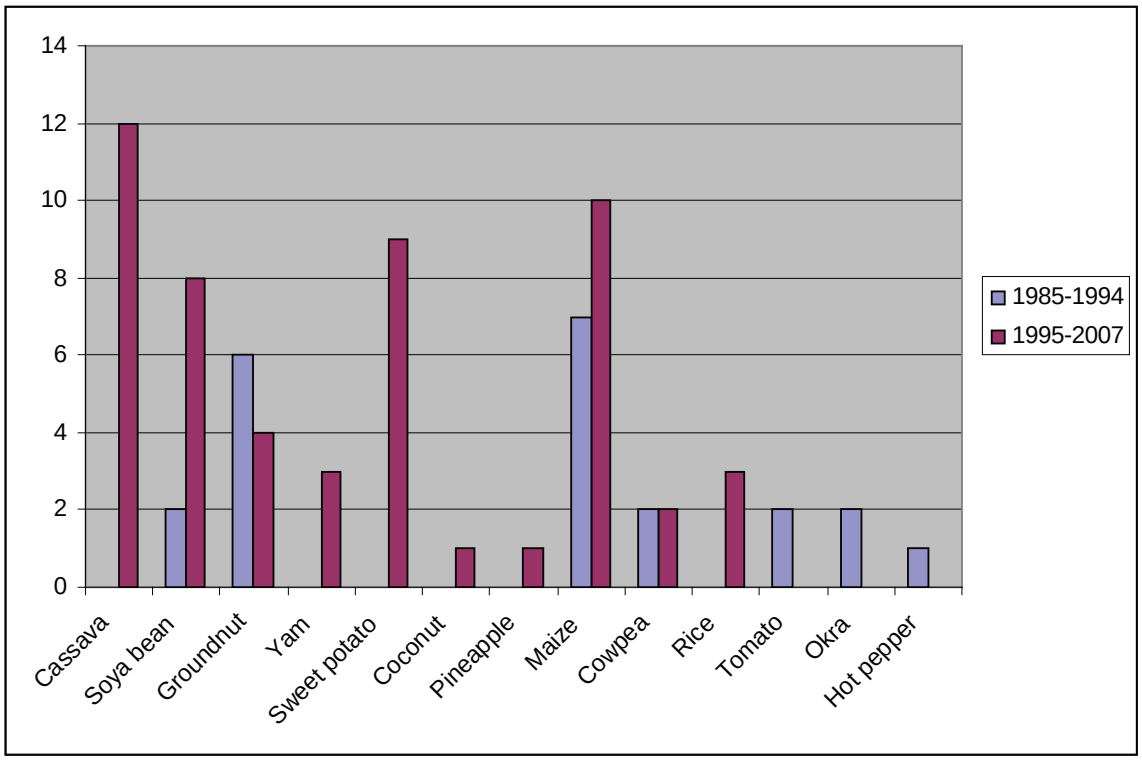
The main users of stored genetic material in Ghana are CRI, SARI, the DCS, UG, OPRI and CRIG.

The utilization of wild relatives and introduced germplasm is important for the transfer of desirable traits into locally adapted cultivars. Some examples of this are:

- The introgression of nematode resistant gene in wild rice (*Oryza glaberrima*) into the cultivated rice (*Oryza sativa*) (yet to be released).
- Local sorghum crossed with Kapaala (improved sorghum variety with compact head) to produce an open-panicle derivative called SARSORG M16, (yet to be released).
- A number of cassava varieties have been developed from local collections through mulitilocaltional evaluation e.g. IFAD (2004), NKABOM (2004), Capevars Bankye (2005).
- Similarly superior local accessions of yam were cleaned and released, e.g. Mankrong Pona (2004) released by CRI. Again collections of wild lines of *Dioscorea praehensilis* are extensively cultivated after domestication.

Finally, sometimes, in order to utilize local germplasm, mutants may have to be induced using irradiation or a chemical agent. Typically the objective is to transfer only the desired traits into the adapted cultivar. Many crop cultivars have one or more genes originating from induced mutations. However transfer of new mutations is a minor component of breeding programmes in Ghana. The technique of inducing mutation in breeding is carried out at the Ghana Atomic Energy Commission (GAEC) at Kwabenya, near Accra, where Gamma rays are used for irradiation of materials. An example of a variety released through this process is the cassava variety Tek Bankye.

FIGURE 3
Released varieties in Ghana in the two periods 1985-1994 and 1995-2007



The PGR under conservation have been utilized by various institutions in Ghana. First, several research institutions use these resources in crop improvement programmes. For example, CRI and SARI have utilized conserved germplasm crops like cowpea, rice, maize, cassava, yam, sweet potato, tomato, pepper, garden egg, soybean and other crops, in improvement programmes. In the last ten years varieties released as a result of breeding programmes are from maize, rice, cassava, sweet potato, cowpea and soybean. A plant breeding survey carried out in Ghana in 2007 by FAO (Fig.3) indicated that breeding activities have increased for most crops and in particular for cassava and yam in the past ten years.

Reasearch institutions and universities have also used *ex situ* conserved germplasm in improvement programmes. CRIG has developed improved cocoa cultivars which are early maturing, high yielding and have tolerance to pests and diseases. A cocoa cultivar, known as "akokorabedi" has been released and is being utilized for commercial production in the country. OPRI has a collection of both local and introduced germplasm of coconut and oil palm for their research work. Research work on coconut has been intensified during the past ten years in order to overcome the devastating Cape Saint Paul's Wilt or lethal yellowing disease. To achieve this, germplasm was introduced from Cote d'Ivoire and Vanuatu, among other places, and used in breeding programmes. Currently resistant/tolerant varieties have been bred for commercial production. Products of utilization of oil palm germplasm from OPRI are being used in the Presidential Special Initiative (PSI) which is a commercial drive to boost oil palm production in the country.

At FORIG both local and introduced timber species have been used in improvement programmes. For example the productivity and quality of West African teak plantations have been increased using the genetic diversity and sustainable management of existing germplasm collections in the country. Similarly, research on an endangered timber species like *Milicia excelsa* (Odum) has been intensified using locally available germplasm.

There was an integrated pest management programme for the reduction of impact of the insect pest, *Phytolyma lata*, which impeded the establishment of *Milicia excelsa*. At ARI germplasm of living forage plants conserved in museums at Pokuase and Nyankpala have been used in research aimed at the improvement of various grass and legume pastures in the Coastal and Guinea Savanna zones of the country. Similarly, the Crop Science Department of the University of Ghana, Legon has used local germplasm to breed new varieties of pepper and tomato.

Germplasm of tree crop species under conservation at PGRRI, ARC-Kade, OPRI and CRI are supplied to farmers for establishing plantations of various crops. These species include various species and cultivars of citrus, mango, avocado, coconut, oil palm, nutmeg and other introduced species.

Plant genetic resources under conservation in arboreta, botanical gardens and forest reserves are also used for medicinal purposes. Various medicinal plants are found in arboreta at PGRRI, Aburi Botanical Garden and CSRPM. These species include *Xylopia aethiopica*, *Piper guineense*, *P. nigrum*, *Citrus aurantifolia, Aframomum melegueta*, *Monodora myristica* and *Rauwolfia vomitoria*. The PGR in forest reserves, arboreta, botanical gardens and nature reserves are very important for educational, aesthetic and tourism purposes. Students from various educational institutions visit such sites for educational tours every year. Tourists both from within and outside the country also visit these sites.

Judicious use of the genetic resources of the forest ecosystem is of immense economic importance. Controlled extraction of timber and other useful species from the forest areas is an important source of income for the country. On the other hand uncontrolled exploitation of timber and other resources from the forest without replacing them may in the long run lead to the depletion of these species. It is imperative that replanting programmes are instituted so that forest resources which are harvested can be replenished. Species which are at risk in this respect include various timber species like *Milicia excelsa* (Odum), *Pericopsis elata* (Afromosia), *Entandrophragma cylindricum* (Sapele), and other useful species like *Calamus deerratus* (Rattan), *Raphia hookeri* (Raphia) and *Garcinia afzelii* (Sokodua).

PGRs are part of the ecosystem in which they live. The disturbance of these resources by human activities poses a threat to the stability of the environment. A less disturbed environment is a source of beauty and joy. It will be beneficial if the environment can be protected from activities such as bush burning, destruction of forests and farming along river banks and head waters, all of which degrade the environment.

PGR are also a source of animal feed and forage. Maize for example is an important component of animal feed. Sorghum and millet are also used as animal feed and fodder in the savannah regions of the country. Cassava leaves and peels are used as feed for livestock on the domestic level in areas where cassava is abundant. There are some wild and weedy species of plants which are used for forage. These include *Baphia nitida*, *Centrosema spp*., *Panicum maximum*, *Digitaria decumbens* and *Ficus exasperata*.

Traditionally, various repositories of PGR are of cultural importance in the country. Various cultural activities take place in forest groves scattered all over the country. Some of these groves are used as burial grounds for kings and chiefs and they are as such considered as sacred. They are also used for religious activities. Entry into these sacred groves is very restricted therefore the PGR there are usually protected.

4.2 Crop improvement programmes and food security

The main crop groups that have benefited from breeding programs are cereals (mainly maize and rice) and root and tubers (mainly cassava, sweet potato and yam). Groundnut and cowpea are also crops that have benefited from breeding.

Breeding capacities of national institutions in Ghana have been either stable or increasing for most crop groups during the past few years. The only exception is the CRI whose breeding capacity in fiber plants reportedly has declined.

One of the major constraints to utilization of PGR is inadequate funding. Breeding procedures leading to plant improvement are capital intensive. Most of the time, adequate funding is not available, which may be a source of frustration to plant breeders.

Sometimes breeders are not available for some crops and therefore improvement in those crops cannot be carried out. There is the need for carrying out training of more breeders so that improvement programmes can be drawn up and executed for as many crops as possible.

Another constraint in the utilization of PGR is the absence of clear policy guidelines for crop improvement. There is a need to develop governmental and institutional policy guidelines for crop improvement and commercial production.

Conservation and utilization of underutilized crops and species is one major area of difficulty in the utilization of PGR. Since underutilized species are less known and are of little or no commercial importance, there are no incentives for breeders to improve them. Examples of such crops are Kersting's groundnut and fonio. Moreover, very often underutilized species, primitive cultivars and weedy/wild relatives have undesirable traits that have to be eliminated in the breeding process.

A major criterion, which influences the selection of a commodity/product for development is the availability of markets. Lack of ready markets for a commodity can be a great constraint to the utilization of material in improvement programmes.

The seed distribution system is another constraint to the utilization of PGR. Mainly decentralized and locally released varieties are given to certified seed growers for multiplication and sale to the farmers in the different agroecological zones. Most of the time these improved seeds are not available to farmers or are beyond their means.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

5.1 Building strong national programmes

The Council for Scientific and Industrial Research (CSIR) functions as the governance structure responsible for coordinating and facilitating PGRFA activities in the country. A five-year Strategic Plan for Ghana (2004-2008) proposed the following national PGR programme. CSIR will be the coordinating body for the overall PGR activities in Ghana. A steering committee for PGR activities will be set up from government institutions, NGOs, private sector, traditional authority, District Assemblies and small scale farmers' associations. The terms of reference of the steering committee include:

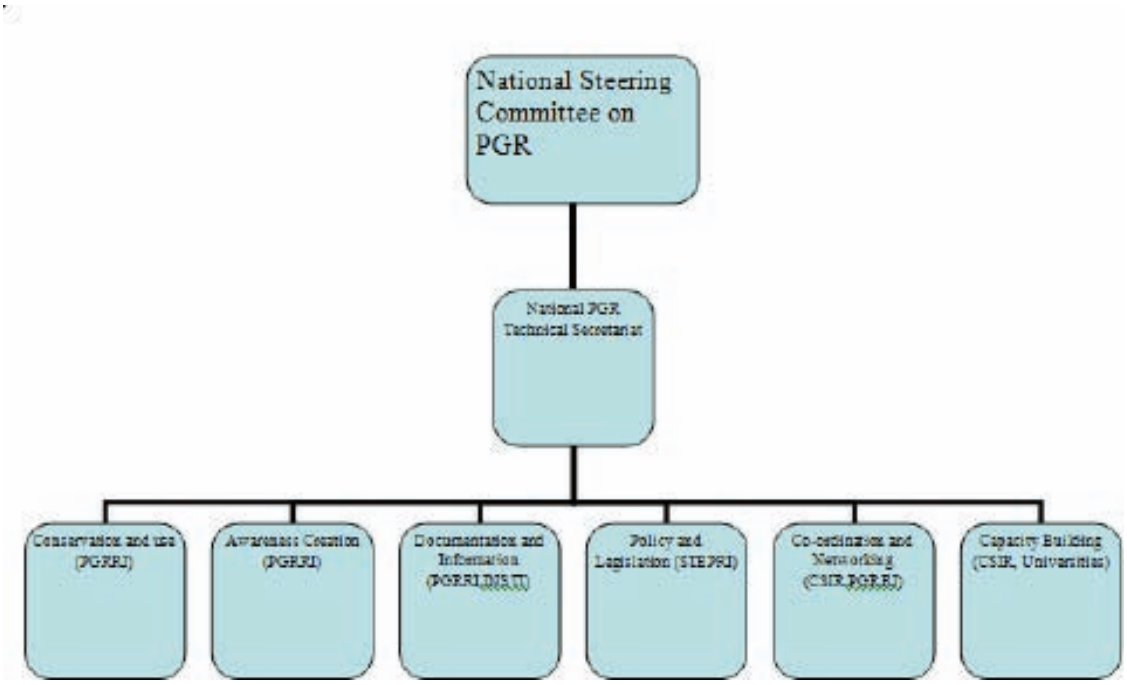
- monitoring the implementation of the national programme;
- providing policy direction after the analysis of the external environment;
- providing guidance and advising government on PGR issues.

Other responsibilities are development of a data base on all stakeholders, providing general oversight on PGR, dissemination of information on PGR, establishment of a clearing house for PGR and ensuring a cross ministerial and inter-sectoral involvement in PGR activities. A permanent secretariat will be established for the national PGR Technical Committee within the CSIR Head Office for the coordination of PGR activities. This coordination will be achieved through the PGRRI which will also coordinate all PGR activities carried out in various institutions nation-wide. The main functions of the Technical Secretariat will include the implementation of the strategic plan, organization of fund-raising activities to provide funds to enhance PGR activities in the country, ensure that acceptable standards are maintained by all institutions and that priorities are addressed.

Figure 4 shows the five components of the PGR Strategic Plan and their focal institutions. PGRRI has been identified as the focal institution for the component of Conservation and Use. CSIR, through PGRRI, will play a leading role in the Coordination and Networking in PGR activities. For Capacity Building, the focal institutions will be CSIR and the universities. The PGRRI will also be the focal institution for Awareness Raising. The Documentation and Information component will have the PGRRI and the Institute for Scientific and Technology Information (INSTI) as the focal institutions. Finally Policy and Legislation will have the Science and Technology Policy Research Institute (STEPRI) as the focal institution.

Though the national PGR Strategic Plan has been accepted by stakeholders, its implementation has been hampered by lack of funds.

FIGURE 4
Structure of national PGR programme showing components and focal institutions



5.2 Promoting networks for PGRFA

Ghana is a member of the Genetic Resources Network for West and Central Africa (GRENEWECA), which was established in 1998 under the auspices of the *Conference des Responsables de Recherche Agronomique Africains* (CORAF). The network secretariat is based in the Bioversity International Sub-Saharan Africa office for West and Central Africa in Cotonou, Benin. GRENEWECA's goal is to contribute to sustainable agricultural development in its member countries through the conservation and use of the diversity of local plant genetic resources. The network aims to increase the effectiveness of each of its member country's PGR programmes through regional collaboration. PGRRI represents the country in GRENEWECA and occupies the chair of the network as of 2007.

During the period when the National Agricultural Research Project (NARP), the Agricultural Sub-sector Investment Project (AgSSIP) and Root and Tuber Improvement Project (RTIP) were in operation, there were several commodity networks in which PGRRI participated. Members of these networks met regularly to deliberate on the progress of the activities of various commodity networks. There were committees for maize, rice, legumes, vegetables, root and tuber crops and fruit trees. All these committees had a PGR component which led to the collection of germplasm of the various crops for utilization and improvement. These committees existed as long as the projects lasted.

CRIG is also member of an international network 'Cocoa Germplasm Utilization and Conservation: A Global Approach', which is coordinated by Bioversity International.

5.3 Constructing comprehensive information systems for PGRFA

In 2004 a Local Area Network (LAN) was set up within the PGRRI and other stakeholder institutions to facilitate internal communication within the various institutions. In 2005 the various institutions were also linked with Internet connection by the AgSSIP. Now all the institutes of the CSIR, Faculties of Agriculture of the public Universities and the Ministry of Food and Agriculture have internet connection. A wide area network (WAN) is yet to be established.

All the national stakeholders are equipped with computers. In 2004, 3 out of 7 national stakeholders did not have internet connection, however the remaining stakeholders had continuous internet connection. It is therefore important that all national stakeholders improve their communication facilities in order to benefit from the network activities.

Most stakeholders use Excel and/or Access to organize and manage their PGRFA information. It has been observed that there is a general need in the country to carry out training of staff in computer and data management.

5.4 Expanding and improving education and training

Training for those responsible for managing and conserving PGR in Ghana is provided through in-service training programmes or at national and foreign levels. Training is recognized as important not only for managers of PGR but also for senior decision-makers, public representatives and local communities. Integration of sectors and multi-disciplinary approaches are essential in national programmes and institutions. Institutes providing training for biodiversity conservation and management require continuous support. PGRRI staff has had continuous training. Currently there are fifteen professional staffs at PGRRI. The qualifications of these range from BSc through MSc/Mphil to PhD. Training is provided for these staff both in national and foreign universities.

Table 1 reflects data collected during FAO's plant breeding and biotechnology capacity survey carried out in Ghana in 2007. The results from the survey showed that the number of breeders and biotechnologists in Ghana increased steadily in the 1985-2005 period

TABLE 1
Number of plant breeders and biotechnologists in Ghanaian institutions.

	1985-89	1990-94	1995-99	2000-04	2005-
Plant breeders					
BSc	6	5	5	5	4
MSc	10	7	11	21	24
PhD	7	10	14	20	25
Total	**23**	**22**	**30**	**46**	**53**
Biotechnologists					
BSc	-	-	3	2	2
MSc	-	2	5	10	12
PhD	3	5	4	7	9
Total	**3**	**7**	**12**	**19**	**23**

In addition to formal training provided by the universities, staff is also provided in-service training through workshops and seminars. There are also short courses that are open to all staff. Training is an area that has benefited from a wide range of support. Support for these courses was provided by international organizations such as the World Bank, Bioversity International and the International Institute of Tropical Agriculture (IITA) and bilateral donors like the German, Dutch, Korean and Japanese governments.

The scientific staff of PGRRI has expertise in the following fields: Botany, Plant breeding, Biotechnology, Tissue culture, Horticulture, Eremology, Plant pathology, Entomology, Agronomy, Information Technology, Library and Archival studies, Utilization and conservation of PGR and Seed Technology. Scientific staff working on PGR should be given the necessary training so that they can perform their duties efficiently.

5.5 National legislation

Although the country has ratified many conventions and international agreements including the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the country is yet to formulate appropriate policies on the conservation and use of PGR. However there is a law, ACT 307 of 1965 which regulates the importation and exportation of PGR in the country (Dixon and Entsie, 1997). This law established the Plant Protection and Regulatory Services Department (PPRSD) within the Ministry of Food and Agriculture (MoFA), which enforces quarantine regulations in the country. Import permits must be obtained for importation of plant materials of any crop. They must be accompanied by relevant phytosanitary certificates and export permits from the country of origin. Certain materials like soil or plants with soil, plant products infested with pests and diseases and specified

plants, are prohibited. The implementation of the law falls short of expectation since PPRSD lacks adequate facilities for effective discharge of its duties.

Laws on other aspects of seed production and plant breeders' rights are also in the process of being formulated by MoFA.

5.6 Public awareness

The level of public awareness of the value of PGR in the country is rather low. Over the years PGRRI has been trying to raise public awareness about PGR conservation through the various media: television, print media, open days, workshops and seminars. The task in this respect has been very tremendous but much more effort is needed for total success.

The commercialization drive of CSIR has also given impetus to public awareness on the activities of the PGRRI. There are some plants for which the institute has comparative advantage; clients have to get to the institute in order to obtain those plants. Examples are spice plants like nutmeg (*Myristica fragrans*), Grain of paradise (*Aframomum melegueta*), Cinnamon (*Cinnamomum zeylanicum*), etc.

The arboretum at the institute is one of tourist sites in the country and it attracts visitors both from within the country and from outside. In this regard brochures and posters have been made for distribution to tour operators.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

At international level, Ghana is a permanent member of the FAO Commission on Genetic Resources, which discusses and negotiates issues related to PGRFA of global importance.

Ghana ratified the International Treaty on Plant Genetic Resources in October 2002.

With FAO support, during 2004-2007, Ghana established a National Information Sharing Mechanism on PGRFA, a network of key national institutions which contribute to the conservation and sustainable use of PGRFA in the country. The Mechanism also counts on a national database on PGRFA and a web portal (http://www.pgrfa.org/gpa/gha). As a result of this process under the FAO assistance Ghana prepared a national strategic plan for PGR. In June, 2006 Ghana participated in the First Governing Body meeting of the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) in Madrid, Spain.

Ghana has had a lot of collaboration with the Bioversity International (BI), (formerly the International Plant Genetic Resources Institute, IPGRI) in the last ten years. Bioversity International sponsored a number of workshops and short courses in which Ghana participated to enhance human resource development and capacity building in the field of PGR. Apart from facilitating Ghana's participation in workshops and short courses, the Bioversity International also supplied Ghana with its publications on several and diverse topics. For example staff of the PGRRI and other institutions have been constantly supplied with the Plant Genetic Resources Newsletter over the years.

In the past Ghana has been involved in programme reviews of some international organizations like Bioversity International, and the International Institute of Tropical Agriculture (IITA). Ghana also hosted the Board meeting of the Bioversity International in June, 2001 and organized a stakeholder forum with the Board for an interaction between stakeholders and the Board. In 1997, an IPGRI manager for West and Central Africa participated in a review of the Ghana plant genetic resources landscape – a study which was sponsored by the World Bank and the Ghanaian government through the National Agricultural Research Project (NARP). Ghana also participated in a global project on "Home Gardens" which was coordinated by the Bioversity International and spanned 1998 to 2001. This project resulted in a number of publications. (Bennett-Lartey *et al*. 2001; 2003$_a$; 2004; 2006).

One of the most tangible changes since the last report has been the establishment of the Genetic Resources Network for West and Central Africa (GRENEWECA) in Cotonou, Benin in 1998 under CORAF/WECARD. Ghana has played a role in this network and is the chairman of the network. This network coordinates PGR activities within the West and Central African sub-region. The network is headquartered at the Bioversity International office in Cotonou, Benin and is coordinated by the BI's manager there. The main objective is to build/strengthen capacity in member countries in PGR activities.

In the early 2000's there was collaboration between Ghana and the International Institute for National Agricultural Research (ISNAR) in the area of evaluating capacity development. This institute sponsored a number of workshops for research and development (R and D) organizations around the world which culminated in a book titled "Evaluating Capacity Development" (Horton *et al*., 2003). The institute which represented Ghana in this project was the PGRRI. Also sponsoring Ghana's participation in some of these workshops and publishing the report on the Ghana study: "Capacity Development on Ghana's Plant Genetic Resources Centre: An Evaluation", was the Technical Centre for Agricultural and Rural Cooperation (CTA) (Bennett-Lartey *et al*., 2003$_b$).

In addition to the above collaboration with international organizations, Ghana also had bilateral cooperation with various countries. Scientists from various institutions in Ghana benefited from training workshops in PGR management in the past ten years from the governments of the following countries: Germany, The Netherlands and the United Kingdom. The Japanese government also sponsored a study tour, a sabbatical leave and a Post Doctoral fellowship for Ghanaian scientists. The United Kingdom's (UK) Department for Food and Rural Affairs (DEFRA) funded a capacity building programme, through the Royal Botanic Gardens, Kew in collaboration with FAO for various countries, including Ghana, on identifying and handling of difficult seeds. The German government, through its Ministry for Economic Cooperation and Development (BMZ) financed a series of international workshops on: "Towards sustainable national plant genetic resources programmes – policy, planning and coordination issues" for top management personnel, policy makers,

planners and leaders, genebank managers, personnel from universities, national, regional and international institutions, non-governmental organizations and other key stakeholders from 15 Sub-Saharan African countries.

Ghana has subscribed to a number of international treaties, agreements and conventions over the last 15 years. Ghana ratified the CBD in 1994 and,the ITPGRFA in 2002. The main impact is that the organization mandated to coordinate PGR conservation activities, PGRRI, has been elevated to a full fledged institute within the CSIR system. By this, CSIR-PGRRI has been recognized as the focal point in Ghana on issues related to PGRFA. This institute needs to be strengthened in terms of human, infrastructural and financial capacity to be able to take up this role properly. With the recognition given to the PGRRI and commensurate support given to it, it will be able to discharge its functions efficiently and be able to remove all obstacles in the implementation of globally agreed targets.

CHAPTER 7

ACCESS TO PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURAL, SHARING OF BENEFITS ARISING OUT OF THEIR USE, AND FARMERS' RIGHTS

7.1 Access to plant genetic resources

In 2002 Ghana subscribed to the International Treaty for Plant Genetic Resources for Food and Agriculture. The Treaty establishes a Multilateral System for access and benefit-sharing of PGRFA and obliges all parties to use a Standard Material Transfer Agreement adopted during its first Governing Body meeting in Madrid 2006. It urges them to provide *inter alia* for the protection and promotion of Farmers' Rights. Since 2002, the country has not developed any national legislation and policies aimed at providing access to PGR and sharing of benefits arising out of their use. Action in this regard has just begun. In addition, no management action has been taken to maintain or enhance access to PGR located outside the country.

7.2 Fair and equitable sharing of the benefits from the use of PGR

As part of the International Treaty on PGRFA, Ghana shares its plant genetic resources with the other Parties to the Treaty by providing access to them under the conditions set in the Standard Material Transfer Agreement for Access and Benefit-Sharing and has the benefit of reciprocally accessing other Parties' PGRFA under the same conditions. PGR obtained from outside the country are generally used in crop improvement programmes. There are several institutions in the country which make use of introduced PGR in their breeding programmes. These institutions include CSIR-CRI, CRIG, CSIR-SARI, CSIR-OPRI, DCS of UG and DCS of KNUST. For these institutions the benefits which result from the introduced PGR are improved and higher yielding cultivars. The main beneficiaries of such PGR are the farmers and people of the country who consume the foodstuffs produced from them.

Currently there is no established national legislation for sharing the benefits arising out of the use of PGR and for the Farmers'Rights. Attempts in this regard should be pursued.

Maintaining or enhancing access to PGR is essential for crop improvement programmes of the country. Acquisition of PGR from sources outside the country broadens the genetic base of plants used in improvement programmes so that better adapted and higher yielding crops can be produced. This ultimately leads to increased food production and security.

7.3 Implementation of Farmers' Rights

The International Treaty in Article 9 recognizes the enormous contribution that the local and indigenous communities and farmers of all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production throughout the world.

It affirms that these contributions of farmers are the basis of Farmers' Rights. The Treaty also recognizes that the rights to save, use, exchange and sell farm-saved seed and other propagating material, and to participate in decision-making regarding, and in the fair and equitable sharing of the benefits arising from, the use of plant genetic resources for food

and agriculture, are fundamental to the realization of Farmers' Rights, as well as the promotion of Farmers' Rights at national and international levels.

All Parties to the Treaty have agreed that that the responsibility for realizing Farmers' Rights, as they relate to plant genetic resources for food and agriculture, rests with national governments. The Treaty calls for all participating countries take measures to protect and promote Farmers' Rights, including, (i) protection of traditional knowledge, (ii) the right to equitably participate in sharing benefits arising from the utilization of PGRFA, and (iii) the right to participate in making decisions, at the national level, on matters related to PGRFA conservation and sustainable use.

The country has just initiated action to develop a national legislation and policies to achieve the implementation of Farmers' Rights. The main obstacle to achieving this is the absence of guidelines and examples on how the Farmers' Rights can be implemented at country rlevel with positive repercussions on future PGRFA conservation and use and food security.

CHAPTER 8

THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

PGRFA management plays a very important role in food security and sustainable development in the country. In times of disasters PGRFA availability becomes very important. At such times the country relies on the genetic resources of particular crops under conservation to replenish the stock which has been destroyed. This happened during the Bimbila war in the 1990's when all stocks of yam were consumed. At the end of the war, yam (*Dioscorea rotundata*) was obtained from other sources and rapidly multiplied using the miniset technique to produce planting materials for replenishing the stock at the area of the war.

The genetic resources of some crops are useful in periods of scarcity. In the northern parts of Ghana, during the dry season and period of food scarcity, Frafra potato (*Solenostemon rotundifolius*) is a food source for the people. In the forest areas wild yams are harvested in the wild and used as food. Some of these wild yam species are domesticated in home gardens when they are cultivated over long periods of time. Wild leafy vegetables are important in times of grain scarcity.

It is therefore very important that PGR are duplicated elsewhere so that in case of a disaster the material that has been duplicated elsewhere can become available to replenish the lost material.

8.1 Contribution to agricultural sustainability

PGRFA are the reservoirs of genetic traits for adaptation to diverse conditions and therefore have built-in solutions to sustain agriculture in future conditions. They are in fact used to provide traits and characteristics for improving existing cultivars. New, improved cultivars may be developed to outperform under low input management, to tolerate/resist pest and diseases attacks/infections and or unfavorable environmental conditions.

8.2 Contribution to poverty alleviation and economic development

Ghana abounds in PGR that, when sustainably used, can be of great benefit to the country. Many of them are sources of food and therefore contributors to food security and income. Others are used in the craft industry. These include pestles and mortars, baskets, household furniture and canoes. Timber and other plant resources are used in the economic development of the country. Some of the tree species are used in the building industry locally and also for export. Plant genetic resources are also a source for the traditional medicine, which is used to supplement orthodox medicine.

Several minor forest genetic resources are gathered from the wild for the livelihood of several people. These include rattan (*Laccosperma opacum* and *Laccosperma secondiflorum*), cane (*Calamus deerratus*, *Eremospatha* spp.) and raphia (*Raphia hookeri*), which are used in the roofing, weaving and craft industry.

Similarly there are several timber species which have been exploited for reasons of economic development. These are used in several construction activities like housing, furniture and for export. The trees are often harvested and utilized.

There are several PGR which are used as ornamental plants both domestically and commercially e.g. *Duranta plumeiri*, *Thevetia peruviana* and *Delonix regia*. There are several species that are used as shade trees in the home, as hedge plants for fencing around the house and those used for decorative purposes such as *Vinca rosea*, *Jatropha curcas* and *Eugenia uniflora*. Most of these species have been developed and are sold for income.

Several thousand plant species are known to have medicinal values and are used by a large proportion of the population as traditional medicine and are encouraged by the World Health Organization (WHO). Such species include *Voacanga africana*, *Rauvolfia vomitoria*, *Piper guineensis*, *Cassia occidentalis*, and *Griffornia simplicifolia*. These medicinal

plants are used locally and some of them are exported. For example, the government has established the Centre for Scientific Research into Plant Medicine (CSRPM), under the Ministry of Health (MOH), which carries out research on the medicinal properties of such plants.

Since the PGRFA of the country is of such great value it is very important that we use them sustainably so that we can benefit from them for now and the future.

ACRONYMS AND ABBREVIATIONS

AgSSIP	Agricultural Sub-sector Investment Project
ARC	Agricultural Research Centre
ARI	Animal Research Institute
BD	Botany Department
BMZ	Ministry for Economic Cooperation and Development of Germany
BNARI	Biotechnology and Nuclear Agricultural Research Institute
BSc	Bachelor of Science
CBD	Convention on Biological Diversity
COCOBOD	Ghana Cocoa Board
CORAF	Conference des Responsables de Recherche Agronomique
CRI	Crops Research Institute
CRIG	Cocoa Research Institute of Ghana
CSIR	Council for Scientific and Industrial Research
CSRPM	Centre for Scientific Research into Plant Medicine
CTA	Technical Centre for Agricultural and Rural Cooperation
DCS	Department of Crop Science
DEFRA	Department for Food and Rural Affairs of U.K.
EIAs	Environmental Impact Assessments
FAO	Food and Agriculture Organization of the United Nations
FRI	Food Research Institute
FORIG	Forestry Research Institute of Ghana
GAEC	Ghana Atomic Energy Commission
GDP	Gross Domestic Product
GGLDB	Ghana Grains and Legumes Development Board
IAB	Institute of Aquatic Biology
IDC	Irrigation Development Centre
IFAD	International Fund for Agricultural Development
INSTI	Institute for Scientific and Technological Information
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IITA	International Institute of Tropical Agriculture
KNUST	Kwame Nkrumah University of Science and Technology
LAN	Local Area Network
MoESS	Ministry of Education, Science and Sports
MoFA	Ministry of Food and Agriculture
MOH	Ministry of Health
MSc	Master of Science
NARP	National Agricultural Research Project
NGOs	Non-governmental Organization
OPRI	Oil Palm Research Institute
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agricultural
PGRRI	Plant Genetic Resources Research Institute

PLEC	People. Land use Management and Environmental Change
PSI	President's Special Initiative
PPRSD	Plant Protection and Regulatory Services Department
PhD	Doctor of Philosophy
R and D	Research and Development
RTIP	Root and Tuber Improvement Project
SARI	Savanna Agricultural Research Institute
SLAM	Sustainable Land and Agricultural Management
SRI	Soil Research Institute
SRMP	Savanna Resources Management Project
STEPRI	Science and Technology Policy Research Institute
UCC	University of Cape Coast
UDS	University of Development Studies
UEW	University of Education, Winneba
UG	University of Ghana
UK	United Kingdom
WECARD	West and Central Africa Council for Agricultural Research and Development
WHO	World Health Organization

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