Bioversity International

Cooperating to make the best use of plant genetic resources in West and Central Africa: A regional imperative

Edited by

Michael Halewood, Joseph Jojo Baidu-Forson, Evelyn Clancy and Raymond Sognon Vodouhe

CORAF/WECARD

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Bioversity International is a research-for-development organization that provides scientific evidence of the role that on-farm and wild agricultural and forest biodiversity can play in a more nutritious, resilient, productive and adaptable food and agricultural system. Bioversity International is working towards a world in which smallholder farming communities in developing countries of Africa, Asia and the Americas are thriving and sustainable. Bioversity International focuses on rain-fed farming systems, primarily managed by smallholder farmers, in areas where large-scale agriculture is not a viable option. Its research influences policy decisions and investment in agricultural research, from the local level to the global level.

Founded in 1974, the organization includes over 300 scientists and staff based in more than 15 countries with experts in the fields of plant science, agronomy, agroecology, nutrition, economics, forestry, geography, anthropology and many more related fields. www.bioversityinternational.org

Bioversity International is a member of the CGIAR Consortium. CGIAR is a global partnership that unites organizations engaged in research for a food secure future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources. It is carried out by the 15 centers who are members of the CGIAR Consortium in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia, and the private sector. www.cgiar.org

West and Central African Council for Agricultural Research and Development (CORAF/WECARD) is one of the four sub-regional organizations that constitute the Forum for Agricultural Research in Africa (FARA). The mission of CORAF/WECARD is sustainable improvements to the competitiveness, productivity and markets of the agricultural system in West and Central Africa by meeting the key demands of the sub-regional research system as expressed by target groups. CORAF/WECARD is currently composed of 22 National Agricultural Research Systems (NARS) of the following countries in West and Central Africa (WCA): Benin, Burkina Faso, Cameroon, Cape-Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, the Democratic Republic of Congo, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. These countries cover a total area of over 11.5 million square kilometres, with a population of over 318 million, 70 % of whom depend directly on agriculture for their livelihoods.

The CORAF/WECARD secretariat is based in Dakar, Senegal. CORAF/WECARD has revitalised its approach to tackling the region's agricultural challenges by using a commissioned report prepared by the International Food Policy Research Institute (IFPRI). This report lists priorities for the region based on commodities and thematic areas. Through an intensive participatory process involving a cross section of relevant stakeholders it has developed a new Strategic Plan (2007-2016) and, subsequently, an Operational Plan (2008 – 2013) defining its research direction and partnerships. CORAF/WECARD also targets the building of partnerships with relevant regional institutions and the private sector of economies across the sub-region. CORAF/WECARD's vision is a sustainable reduction in poverty and food insecurity in West and Central Africa through an increase in agricultural led economic growth and sustainable improvement of key aspects of the agricultural research system with a strong alignment and commitment to the overall goal of the Comprehensive African Agricultural Development Programme (CAADP) of the New Partnership for Africa's Development (NEPAD). www.coraf.org

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Foreword

Plant genetic resources for food and agriculture (PGRFA) are a precious heritage of the people of West and Central Africa (WCA) where the agricultural sector is the major contributor to the livelihoods of its people. The region is endowed with diversified agroecosystems in which plant genetic resources (PGR) play an integral role by contributing to the provision of food as well as ecosystem services. The region is recognized as a primary centre of diversity of key food crops such as millet, cowpea, fonio, several types of yam, African rice, Bambara groundnut and oil palm. It is a secondary centre of diversity for sorghum and robusta coffee. A significant number of staple food crops and commodities have also been introduced into the region and have developed genetic complexes and wild relatives that have adapted to environmental conditions in WCA. The pioneering development of the New Rice for Africa (NERICA) with the breakthrough in an inter-specific cross between the Asian rice (*O. sativa*) and the African rice (*O. glaberrima*) is an example of the tremendous potential of the PGR in the region.

There is a growing challenge, however, in ensuring that the potential benefits of the PGR of WCA are sustainably conserved and utilized for both the present and future generations of the region and also the world at large. The diversity of PGR in the field is threatened by unsustainable farming practices, including, in particular, shifting cultivation, deployment and reliance on monocultures, and a range of socioeconomic factors such as changing food preferences and urbanization. The challenges of climate change are also increasingly taking centre stage, threatening the existence of some *in situ* PGR and creating a demand for the diversity of PGR to be used as part of a country's strategy for adapting to climate change. Countries in the region are generally inadequately equipped to meet the challenges related to the conservation and sustainable use of PGR in the context of climate change.

The Food and Agriculture Organization of the United Nations (FAO) has carried out several activities that contribute to meeting these challenges. It has also initiated a number of related agreements, including the International Plant Protection Convention, the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture 1996 (revised and renewed in 2011) and the International Treaty on Plant Genetic Resources for Food and Agriculture ("the International Treaty"). The 15 CGIAR centers, which are members of the CGIAR Consortium, conserve important collections of major crop and agroforestry species from WCA under secure, medium, and/or long-term conditions, in seed banks, field gene banks and *in vitro*, and make material from the collections available on request.

It is encouraging to note that there is at least a growing awareness of the importance of PGR in food security as well as the realization of the potential threat to the erosion of PGR and its consequences in WCA. In this regard, there are ongoing initiatives at various levels, aimed at ensuring the sustainable management and utilization of PGR, including benefit sharing. The vast majority of countries in WCA, where the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) has the mandate to coordinate agricultural research for development, are signatories to the International Treaty.

CORAF/WECARD championed the creation of the Genetic Resources Network for West and Central Africa (GRENEWECA) in 1998. The objectives of this network were to provide a framework for efficient and effective *ex situ* conservation of the most important crop diversity collections in the region and to promote the availability of these PGRFA. One of the recommendations of participants at a regional conference on "Plant Genetic Resources Management and Food Security in West and Central Africa", which was held at IITA, Ibadan, Nigeria, 26–30 April 2004, under the auspices of CORAF/WECARD, was that CORAF/WECARD should initiate a process geared toward developing a regional approach to conservation of PGRFA, including exploring possibilities for establishing nodal centres of excellence (NCEs) for gene banking of priority species and collections in WCA. Another conference entitled "Towards Regional Cooperation for Effective and Efficient *Ex Situ* Conservation of PGRFA in West and Central Africa", held in Ouagadougou, in September 2006, resulted in the conclusions and recommendations dubbed the "Ouagadougou Declaration".

One of the major elements of change that constitutes the revised CORAF/WECARD Strategic Plan (2007– 2016) is the strategic choice of a programme approach over a network approach to implementing activities that would respond to major agricultural challenges in the region. The goals, objectives and activities of the former GRENEWECA were, as a result, incorporated within the CORAF/WECARD Natural Resources Management (NRM) Programme. The conservation and improvement of biodiversity is one of the four major themes of the Programme, identified through a regional scoping study and approved by stakeholders for research and development in the region. It is expected that the prevailing goodwill among member countries will encourage continued support for efforts that would lead a regional consensus and associated research and development initiatives related to the sustainable management and utilization of PGR in West and Central Africa.

Bioversity International (formerly IPGRI) has been a long-time supporter and ally in the development of national and subregional PGR programmes in WCA. For decades, Bioversity has supported projects geared toward strengthening the capacity of partners in WCA to conserve *ex situ* PGRFA and sustainably manage *in situ* agro-biodiversity. Bioversity has been a partner in projects targeting the collection of PGR; providing technical backup to genebanks; working with national partners and farmers to identify biodiversity hotspots and to support sustainable management on-farm, in genebanks and in the wild; developing markets for neglected and underutilized species; and strengthening the capacity of stakeholders at local, national and subregional levels to analyse and develop policy options in support of the sustainable use, conservation and exchange of PGRFA. This publication presents the results of collaborative efforts at subregional levels between CORAF/WECARD and Bioversity over the last 10 years.

CORAF/WECARD and Bioversity are very pleased to be co-publishing this collection of papers. The first chapter, authored by J. J. Baidu-Forson, R. Vodouhe, C. Fall and S. Bennett-Lartey, makes the case for the importance of regional cooperation in the conservation and sustainable use of PGRFA. The second paper, by A. Jalloh, H. Roy-Macauley, P. Sareme, M. Nwalaozie and C. Fall, describes the processes underway to date for developing such a subregional strategy. The third paper, by L. Withers, M. Halewood, K. Atta-Krah and R.S.Vodouhe, presents one of the high-water marks reached as regards the subregional process that is the Ouagadougou Declaration, made

in 2006. The fourth paper, written by M. Houssou, was originally developed as a technical background paper to provide information on deliberations that led to the development of the subregional strategy. Due to the richness of the information contained within it, however, it has been rearranged in this publication and presented as a useful record of the different capacities in the subregion at that time as regards the conservation and use of PGRFA. The last two papers are reflections on the effect of the International Treaty and its extraordinary potential to provide a basis for international cooperation for conserving and sustainably using PGRFA, for promoting facilitated access to PGRFA and equitable sharing of benefits, and for promoting farmers' rights. The authors of these two papers, G. Agbahunga and S. Nyamekye, describe the rationale behind Benin's and Ghana's respective decisions to become member states of the International Treaty and the internal processes they followed for ratification. They also provide some details on the status of the domestic implementation of the International Treaty, highlighting the need for strengthening capacity and for providing technical support for countries in their efforts to exploit the full potential of the International Treaty. On the whole, we feel that these papers make a compelling case for the importance of subregional cooperation in delivering the sustainable and equitable use and conservation of PGRFA.

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Acronyms

AfDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
ARI	advanced research institute
ARIPO	African Regional Intellectual Property Organization
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
Bioversity	Bioversity International (formerly IBPGR and IPGRI)
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung
BNARI	Biotechnology and Nuclear Agriculture Research Institute (Ghana)
Bt	*Bacillus thuringiensis*
CAADP	Comprehensive Africa Agricultural Development Programme
CAAP	Common African Agricultural Programme
CARBAP	African Research Centre on Bananas and Plantains
CBD	Convention on Biological Diversity
CBRST	Centre Béninois de la Recherche Scientifique et Technique/ Centre for Scientific and Technical Research of Benin
CDH	Centre for Horticulture Development (Senegal)
CEDEAO/ECOWAS	Communauté économique des États de l'Afrique de l'Ouest/ Economic Community of West African States
CEEAC	Communauté Économique des États d'Afrique Centrale/Economic Community of Central African States
CEMAC	Communauté Économique et Monétaire de l'Afrique Centrale/Economic and Monetary Community of Central Africa
CENAPI	Centre National de la Propriété Industrielle/National Industrial Property Centre (Benin)
CERAAS	Regional Center for Studies on the Improvement of Plant Adaptation to Drought
CERAG	Centre for Research on Genetic Improvements of Plants (Congo)
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIAT	International Center for Tropical Agriculture
CIDA	Canadian International Development Agency
CILSS	Permanent Interstate Committee for Drought Control in the Sahel/Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel

CIP	International Potato Center
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CMA-AOC	Council of Ministers of Agriculture
CNRF	National Center for Forestry Research (Senegal)
COAfEV	West African Catalogue of Plant Species and Varieties
CORAF/WECARD	Conseil ouest et centre Africain pour la recherche et le développement agricole/West and Central African Council for Agricultural Research and Development
Cowpea-PRONAF	Projet de lutte intégrée contre les ravageurs du niébé en Afrique
CRB	centre de ressources biologique
CRI	Crops Research Institute (Ghana)
CSIR	Council for Scientific and Industrial Research (Ghana)
CTA	The Technical Centre for Agricultural and Rural Cooperation/Centre Technique de Coopération Agricole et Rurale
DAGRI	Direction de l'Agriculture (Benin)
DCS	Directorate of Crop Services (Ghana)
DFID	Department for International Development (UK)
DGRST	General Delegation for Scientific and Technical Research
EU	European Union
FAAP	Framework for African Agricultural Productivity
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa/Forum pour la recherche agricole en Afrique
FORIG	Forestry Research Institute of Ghana
GDP	gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Technische Zusammenarbeit (formerly GTZ)
GM	genetically modified
GMO	genetically modified organism
GNP	gross national product
GPA	Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture
GRAIN	Genetic Resources Action International
GRENEWECA	Genetic Resources Network for West and Central Africa
GRPI	Genetic Resources Policy Initiative
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (now GIZ)

HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
IAR4D	Integrated Agricultural Research for Development
IBPGR	International Board for Plant Genetic Resources (now Bioversity International)
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institute for Rural Economy (Mali)
IGC-GRTKF	Intergovernmental Committee on Intellectual Property Related to Genetic Resources, Traditional Knowledge and Folklore
IER	Institute of Rural Economy (Mali)
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
INERA	Environmental and Agricultural Research Institute (Burkina Faso)
INGER	International Network for Genetic Evaluation of Rice
INRAB	Institut national de recherche agricole du Bénin/National Agricultural Research Institute of Benin
IPGRI	International Plant Genetic Resources Institute (now Bioversity International)
IPR	intellectual property rights
IPR/IFRA	Rural Polytechnic Institute for Training and Applied Research (Mali)
IRAD	Institute for Agricultural Research for Development (Cameroon)
IRAF	Institute of Agricultural and Forestry Research (Cameroon and Gabon)
IRD	Institut de recherche pour le développement (ex ORSTOM)
IRDCAM	Institut de recherche et de développement sur la biodiversité des plantes cultivées, aromatiques et médicinales/Medicinal Plant Biodiversity Research and Development Institute (Benin)
IRRI	International Rice Research Institute
ISRA	Institut Sénégalais de Recherches Agricoles (Senegal)
KIT	Royal Tropical Institute (the Netherlands)
LNRPV	National Research Laboratory on Plant Production (Senegal)
MAEIA	Ministère des affaires étrangères et de l'intégration africaine/Ministry of Foreign Affairs and African Integration (Benin)
MAEP	Ministère de l'agriculture de l'elevage et de la pêche/Ministry of Agriculture, Livestock and Fisheries (Benin)
MEHU	Ministère de l'environnement, de l'habitat et de l'urbanisme/ Ministry of Environment, Housing and Urbanization (Benin)
MICPE	Ministère de l'industrie du commerce et de la promotion de l'emploi/ Ministry of Industry and Trade (Benin)
NACGRAB	National Centre for Genetic Resources and Biotechnology (Nigeria)

NARS	national agricultural research system/s
NCE	nodal centre of excellence
NCFS	National Centre for Forest Seeds (Burkina Faso)
NEPAD	New Partnership for Africa's Development
NERICA	"new rice for Africa"
NGO	non-governmental organization
NRCRI	National Root Crops Research Institute (Nigeria)
OAPI	Organisation Africaine de la Propriété Intellectuelle/African Intellectual Property Organization
OBEPAB	Organisation béninoise pour la promotion de l'agriculture biologique/Benin Organization for the Promotion of Biological Agriculture (Benin)
ORSTOM/IRD	Office de la recherche scientifique et technique d'outre-mer/Institut de recherche pour le développement
PGR	plant genetic resources
PGRFA	plant genetic resources for food and agriculture
PGRRI	Plant Genetic Resources Research Institute (Ghana)
PNDSA	National Programme for the Development of Agricultural Services (Burkina Faso)
RAIP	regional agricultural investment programme
ROCAFREMI	Réseau Ouest et Centre Africain de Recherche sur le Mil
ROCARIZ	Réseau Ouest et Centre Africain du Riz
SADC-SRCU	Southern African Development Community-Sub Regional Coordinating Unit for Agricultural Research and Training
SARI	Savanna Agriculture Research Institute (Ghana)
SMTA	standard material transfer agreement
the International Treaty	International Treaty on Plant Genetic Resources for Food and Agriculture
the Trust	The Global Crop Diversity Trust
UEMOA	West African Economic and Monetary Union
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on the Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
URG	Genetic Resources Unit (Mali)
VIP	vegetative insecticidal protein
WAAP	West Africa Agricultural Productivity Programme
WARDA	Africa Rice Center (formerly the West Africa Rice Development Association)

WCA	West and Central Africa
WECAMAN	West and Central Africa Maize Network
WIPO	World Intellectual Property Organization

Chapter 1. Striking while the iron is hot: A strategy for subregional cooperation in PGRFA use and conservation in West and Central Africa

Joseph Jojo Baidu-Forson,[1] Raymond Sognon Vodouhe,[2] Cheikh Alassane Fall[3] and Samuel Bennett-Lartey[4]

1. Introduction

Over the last two to three decades, countries in West and Central Africa (WCA) have embarked on policy and institutional initiatives aimed at reaping benefits from strengthened cooperation among countries in the subregion. Some recent initiatives include the creation of subregional economic groupings such as the Economic Community of West African States (CEDEAO/ECOWAS) and the Economic and Monetary Community of Central Africa/Communauté Economique et Monétaire de l'Afrique Centrale (CEMAC), ratification of the International Treaty on Plant Genetic Resources for Food and Agriculture (the International Treaty), and development of a regional strategy for the conservation and use of plant genetic resources (PGR) with the support of the Global Crop Diversity Trust (the Trust).

In addition to these developments, the commonality of major food crops and agroecological zones, and the increased movement of people and goods facilitated by the creation of CEDEAO/ECOWAS and CEMAC provide additional impetus for operationalizing a regional strategy to enhance the conservation, use and exchange of plant genetic resources for food and agriculture (PGRFA). Over the years, a number of lessons have been learnt about the best way to approach such cooperation, and leaders of national agricultural research systems (NARS) in WCA and other relevant stakeholders have recently come to a shared vision. With the iron still so hot, now is the time to strike—and to finalize and implement a subregion-wide approach.

2. Plant genetic resources for food and agriculture in West and Central Africa

Agriculture contributes 30%–40% of the gross national product (GNP) in non-oil producing countries of WCA and employs about 60%–70% of the active population. Food and agricultural production are dominated by diversified production systems operated by smallholder farmers who contribute about 75% of total food production. The sheer size of the contribution of smallholders to food and agriculture in WCA makes it imperative to take the peculiarities of smallholder farmer practices into

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account when defining policy on the conservation of diversity and the exchange of genetic resources.

The WCA subregion (shown in Figure 1) is the origin of some food crops and contains others that have been grown there long enough to have developed substantial diversity. The subregion is widely acknowledged as the primary centre of diversity for millet (*Pennisetum* spp.), cowpea (*Vigna unguiculata*), fonio (*Digitaria exilis*), yam (*Dioscorea rotundata*, *D. cayenensis*, *D. dumetorum*, *D. bulbifera*), African rice (*O. glaberrima* Steud.), Bambara groundnut (*Vigna subterranean*) and oil palm (*Elaeis guineensis*). It is also the secondary centre of diversity for sorghum (*Sorghum* spp.) and robusta coffee (*Coffea canephora*). In addition, several introduced crops (e.g., pineapple, groundnut, cotton, cocoa, rubber, cocoyam, maize, cassava, sweet potato, tobacco, banana, plantain, citrus, coconut, sugarcane, mango, taro and Asian rice) have developed genetic complexes and wild relatives that are well adapted to the environmental conditions in WCA (IPGRI et al. 1997).

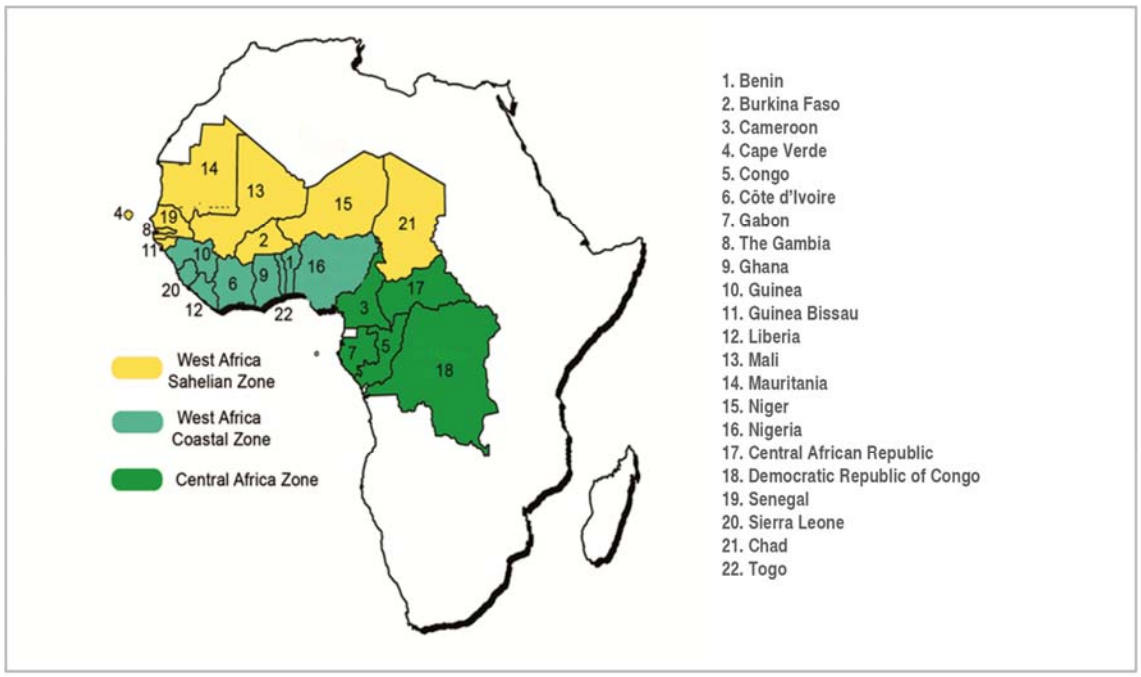

Figure 1. In this chapter, the West and Central Africa subregion is comprised of 22 countries, as shown

2.1 Important native crops

Cowpea is a very important native crop in WCA. Carbon dating of cowpea samples obtained from the Kimtampo rock shelter in Central Ghana provides the oldest archaeological evidence on cowpea in Africa. It shows the existence of gathering, if not cultivation, of cowpea for food by African people as early as 1500 BC (Flight 1976). Cultivated cowpea remains important in WCA, particularly in the savannah areas of northern Nigeria, southern Niger, Burkina Faso, northern Benin, Togo and the north-western part of Cameroon (Ng and Marechal 1985). In the 1990s, 2.6 million tonnes of cowpea were produced in WCA on about 7.8 million hectares, accounting for 69% of the world production (Langyintou et al. 2003). Currently, Niger, Burkina Faso, Mali, Cameroon, Chad and Senegal are net exporters, while Nigeria, Ghana, Togo, Côte d'Ivoire and Mauritania are net importers.

Yam is another important native food crop of WCA. More than 95% of global production takes place in the subregion. The major producing countries are Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria, Togo, Gabon, Central African Republic and the western part of the Democratic Republic of Congo. Outside WCA, Ethiopia and Sudan are the major yam producers in East Africa. Yams are also grown on the Caribbean islands (particularly for export), in Brazil (which leads in yam production in South America), Japan (which accounts for 85% of the production in Asia) and the South Pacific islands, especially Papua New Guinea. The widespread cultivation of yam across several continents signals opportunities for global access and exchange of yam genetic resources. The International Institute for Tropical Agriculture (IITA) conserves 3200 accessions of *Dioscorea* species (67% of the world's yam collection) comprising *D. rotundata, D. alata, D. bulbifera, D. cayenensis, D. dumetorum, D. esculenta, D. preussi* and *D. mangenotiana*. All accessions are grown in the field annually, but 1544 of them are also conserved in tissue culture as *in vitro* plantlets. A core collection of 391 accessions from six species has been defined, based on morphological characteristics, and characterized using 23 SSR markers.

Seed yams are derived from the edible tuber, which is expensive, perishable and bulky to transport, and has a low multiplication ratio in the field (less than 1:10). Scarcity of seed yams often results in unplanted mounds in farmers' fields. Some farmers avert this by keeping a reserve batch of seed yams (up to a third of the quantity originally planted) for replacement of those that do not germinate. The direct cost of the replacement seed yams and the labour implications of the replacement process are high. Poor-quality planting materials tend to carry problems from storage to the field, resulting in adverse effects on field establishment and low tuber yields.

Genetic improvement of yams in WCA, based on the available genetic resources, is focused mainly on *D. rotundata* and *D. alata*. The principal breeding objectives include a high, stable yield of marketable tubers, as well as plant morphology conducive to reduced labour requirements in yam-based production systems. Good progress has been made in revealing and analyzing the genetics of host-plant resistance to anthracnose and virus diseases. Resistant material has been used in the development of improved populations, and forms the basis for national and subregional collaborative trials that have led to varietal releases by the National Center for Genetic Resources and Biotechnology (NACGRAB) in Nigeria (NACGRAB 2004) and Ghana (Otoo and Asiedu 2005). Preservation of yam tubers as dried pieces, especially in urban areas of Nigeria and Benin, offers an avenue for limiting post-harvest losses and increasing the yam food supply to urban consumers at reasonable prices. Additional measures adopted to limit yam losses include curing (to heal damaged tubers) before storage, removal of rotten tubers, removal of sprouts, the application of pesticides, use of plant growth regulators to prolong dormancy and delay the rapid losses associated with the post-dormant phase, refrigeration combined with low relative humidity, irradiation and hot-water therapy to protect seed yams against nematodes.

The demand for yam tends to be volatile due to limited processing, poor market linkages and inconsistent policies affecting prices of other cheap sources of food energy. Most of the production in WCA is for consumption in the subregion. Average yam consumption per capita per day in 2003 was highest in Benin (395 kcal) followed by Cote d'Ivoire (331 kcal), Ghana (314 kcal), Togo (234 kcal) and Nigeria (204 kcal). Ghana is the leading exporter of yam (e.g., 14,460 tons in 2003). One very popular method of yam preparation for household consumption in coastal West

Africa involves boiling and pounding the tuber pieces into a thick dough (called *fufu*, *foutou*, or "pounded yam", depending on the country), which is accompanied by a stew. Other types of dough (called *amala* in Nigeria and *konkonte* in Ghana) are prepared with hot water from flour derived from dried yam tubers. Yam flour is also converted to grainy forms (*wassa-wassa*, similar to couscous) in Benin. Commercial products based on dry flakes or flours from the tuber are produced in Nigeria, Ghana and Côte d'Ivoire for sale in urban areas and for export. The flakes are produced from fresh tubers by peeling, dicing, sulphite bathing, cooking, mashing, drying and flaking followed by packaging.

2.2 Important introduced crops and plants

With the arrival of the first European missionaries, the exchange of plant material with other parts of the world increased over earlier introductions by the Arabs. As a result, in addition to native food crops, several introduced crops have gained economic importance in the subregion. The Arabs are said to have introduced onion (*Allium* spp.), Asian rice and cotton (*Gossypium* spp.) between the eighth and fourteenth centuries, while taro, banana and plantain are believed to have followed different routes, east to west, in the same period (Smith 1998). Portuguese explorers brought cassava and maize to WCA in the fifteenth century. Although cocoyam (*Xanthosoma*) originated in the New World, the greatest consumption is in WCA. Cocoyam and taro (*Colocasia*) together form the edible aroid complex, of which the corm and leaves are widely consumed. Cocoyam is the third most important root and tuber crop and a valued source of leafy vegetables. Other economically important introduced food crops include okra (*Abelmoschus esculentus*), onion, tomato (*Solanum lycopersicum*), pepper (*Capsicum* spp.), eggplant (*Solanum* spp.) and members of the Cucurbitaceae. Apart from food, some introduced crops are widely used in industry, e.g., barley (*Hordeum vulgare* L.), which is used as raw material for industrial-scale beer production in many countries). Others, such as cotton[5] are cultivated for export. Several introduced multipurpose trees are widely grown for use. For example, *Azadirachta indica* is used for wood, medicine and bio-insecticide, while *Eucalyptus* spp. are used for wood, timber and medicine.

Based on cultivated area and consumption levels, the main introduced food crops consumed in WCA are maize (originating in Mexico), cassava (originating in the lowlands of the Amazon region in South America), rice (mainly *O. sativa* cultivars from Asia), and banana and plantain (originating from India). These introduced food crops are essential for the food security of millions of people in WCA, banana and plantain, for example, being important food-security crops, particularly in Cote d'Ivoire, Ghana, Nigeria and Cameroon. In recent times, banana exports have also been on the ascendancy and plantain is being processed for export to Europe and North America.

Maize (*Zea mays*) has, over the last four decades, become a widely cultivated and very important food crop in WCA. Drought and *Striga hermonthica* are two important constraints to its production and productivity in the savannah ecologies of West and Central Africa, and it is estimated that annual yield losses due to *Striga* in the savannah region amount to US$7 billion and affect the lives of over 100 million African people (M'Boob 1989). Recognizing the potential threat posed by *Striga* on maize production and productivity, IITA initiated a breeding programme in 1980 to

[5] While cotton was independently domesticated in the Old and New Worlds, *G. hirsutum*, accounting for 97% of world fibre production, is widely acknowledged to have originated in Mexico.

tackle the problem (Badu-Apraku and Yallou 2009). It was thought that the level of genetic variation for resistance to *Striga* was too low to allow adequate progress by selection; therefore, wild relatives and African landraces were screened by IITA as potential sources of novel genes for resistance. Through this effort, an accession of *teosinte* (*Zea diploperennis*) that supported little or no *S. hermonthica* emergence was identified at IITA and crossed to normal maize adapted to the lowland tropics of WCA. Backcross progeny from these crosses, with high levels of resistance, were selected. Following four backcrosses to maize under artificial infestation with *S. hermonthica* in the screen house, the phenotype of maize has been fully recovered while retaining the *Striga* resistance of Z. *diploperenni*s. Several inbred lines and hybrids with high levels of *Striga* resistance and low emergence have been developed in the programme and are being extensively tested and promoted for adoption by farmers in WCA.

The development of extra-early maize varieties has enabled maize production to expand into new areas, especially the Sudanese savannahs where the short rainy season had adversely affected maize cultivation in the past. The two *Striga*-resistant inbred lines TZi 3 and TZi 25 were derived from temperate germplasm, and the resistance is inherited quantitatively in a multigenic system. The introgression of *Striga* resistance into each source population was followed by backcrossing, generation of S_1 progenies, selection of *Striga*-resistant S_1s from each population, and two cycles of recombination of selected S_1s under artificial *Striga* infestation. The resulting population from the recombined white S_1s was designated TZEE-W Pop STR C_0, and that from the yellow lines, TZEE-Y Pop STR C_0. Several *Striga*-resistant and/or drought-tolerant varieties and inbred lines from the source populations have been made available to the national maize programmes and farmers of WCA (Badu-Apraku et al. 2006a; Badu-Apraku and Fontem Lum 2007). Sixteen each of early and extra-early *Striga*-resistant inbred lines derived from the source populations were recently registered in the journal C*rop Science* (Badu-Apraku et al. 2006b; 2006c). The source populations and some derived inbred lines have also been used in the breeding programmes in Burkina Faso, Benin, Chad and Côte d'Ivoire. For example, the national maize programme of Côte d'Ivoire has extracted S_6 inbred lines and formed synthetics from TZE-W Pop DT STR and TZE-Y Pop DT STR. Among the extra-early varieties, 95 TZEE-W_1 and 95 TZEE-Y_1 have been released in Nigeria and widely adopted in the savannah zones of Guinea and Sudan, with the Premier Seed Company being actively involved in the production of the commercial seed of the varieties. These two varieties are being vigorously promoted by the national extension services and are presently covering several hectares of land in northern Nigeria, where they are playing a very important role in filling the hunger gap in July when the traditional crops (sorghum and millet) are not ready for harvest. The varieties have also been released in Togo, Chad and Senegal. The extra-early *Striga*-tolerant variety, 2000 Syn EE-W, developed from TZEE-W Pop STR C2, has been released in Benin and is at the pre-release stage in Togo and Nigeria. Also, the *Striga*-resistant cultivar, EV DT 97 STR C1, derived from Pool 16 DT x 1368 STR, has been released in Benin following several years of on-farm testing and is being vigorously promoted for adoption.

Annual loss in maize yields due to drought stress in the savannahs of WCA is estimated at 15%, although localized losses may be much higher in the marginal areas where the annual rainfall is below 500mm and soils are sandy or shallow (Edmeades et al. 1995). About 2 million hectares of land in WCA are cultivated to the early and extra-early varieties, which mature more quickly, are more productive and

responsive to fertilizer application than sorghum and millet, and constitute very important sources of food for filling the hunger gap.

Asian rice (*O. sativa*) is another introduced cereal that has gained prominence in the food baskets of WCA over the last two decades, particularly in urban areas. Africa Rice Center data for 2002 show rice self-sufficiency ratios of only 39% and 41% for West and Central Africa, respectively (Africa Rice Center 2005). Actual paddy production figures from the same source for 2002 were slightly more than 8 million tonnes for West Africa and 458,053 tonnes for Central Africa. This was complemented by imports of about 3.7 million tonnes of rice for West Africa and 140,420 tonnes, for Central Africa. To boost the levels of rice production in WCA, scientists have developed new more productive varieties called *NERICA* ("new rice from Africa", principally developed from a cross between *O. sativa* from Asia and the local *O. glaberrima* germplasm).

Groundnut[6] (*Arachis hypogaea* L.), is an introduced crop that is widely grown, particularly in Gambia, Senegal and Nigeria, for direct consumption, processing into oil and export. It is believed to have been introduced into Africa by the Portuguese.

The economic roles of introduced crops in WCA as food, industrial inputs and export crops show that the WCA subregion has benefited substantially from germplasm exchange with other regions of the world. Since the centres of diversity for the introduced crops naturally lie outside WCA, it has been necessary to obtain and use germplasm from these sources to provide diversity for improving productivity. An example is the contribution of *O. sativa* to the production of NERICA rice varieties). This supports the thesis that it is in the strategic interests of WCA countries to support and implement the International Treaty and related mechanism in order to facilitate the exchange of germplasm between WCA and other regions of the world. By the same token, since the subregion constitutes an important gene reservoir for native crops that contribute to global food security, as well as some introduced crops that have evolved local types with well-developed environmental, disease- and pest-resistant traits, it is important for WCA countries to be part of the global system for the benefit of food security in other regions.

3. Combating genetic erosion through conservation efforts

3.1 Genetic erosion

There is still uncertainty about the extent to which genetic erosion is taking place. On the one hand, there is considerable anecdotal evidence that landraces or farmers' varieties are disappearing; on the other, the evidence at the allelic level, albeit not extensively investigated or documented, is less conclusive. Regardless, evidence on the value of maintaining diversity dictates that we must be extremely careful not to squander the diversity that currently exists.

3.1.1 Anecdotal evidence of genetic erosion

As far as erosion at the varietal level is concerned, anecdotal information from scientists in national research institutions and from older generations in the

[6] Based on the earliest archaeological records, Hammons (1994) attributes the origin of groundnut to Peru with the first probable domestication occurring in the valleys of the Panana and Paraguay river systems in the Gran Chaco area of South America. However, Subrahmanyam et al. (1989) report that the cultivated peanut is believed to have originated along the eastern slopes of the Andes in Bolivia and northern Argentina.

subregion suggests the gradual disappearance of some cultivars. Smith (1998) identified the Hausa potato (*Solenostemom rotundifolius*), fonio, Kaffir potato (*Coleus dazo*, *Plectranthus floribundus*, *P. esculentus*) and African yam bean (*Sphenostylis stenocarpa*) as some indigenous food crops that are disappearing from cultivation and from diets. Field observations during the 1980s in Côte d'Ivoire show that, following the rapid adoption of a yam cultivar (*Dioscorea alata*) known as Florida by farmers, local yam cultivars were displaced and abandoned (IPGRI et al. 1997).

In Senegal, changes in agricultural activities, following the establishment of industrial companies close to communities, resulted in a decline in the cultivation of millet in some traditional millet-growing regions. For example, millet was abandoned in the Senegal Oriental region in favour of the higher-yielding maize and rice, with cotton as a cash crop. In the Senegal River valley, known as the *tiotandê*, traditional ecotypes of crops grown on receding waters during the dry season have disappeared. They have been replaced by high-yielding rice, maize and sorghum under irrigated dry-season cultivation. In the Sine-Saloum region, "sanyo" millet (*Pennisetum pycnostachyum* Stapf and C.E. Hubb) with a cropping cycle of 160 days underwent farmer selection to obtain cultivars with a cycle of 120 days' duration before finally disappearing from the farming system. It has been replaced by early-maturing (90-day cycle) cultivars in a new production system based on rice and groundnut. Also, the introduction of groundnut by colonial authorities and the activities of nomadic Ferlo herders, who moved southwards before "voandzou" (*Voandzeia subterranea*) was harvested, contributed to the disappearance of this indigenous crop from production systems in northern Senegal. Other traditional crops, such as fonio, have disappeared from certain regions of Senegal and have been replaced by millet and rice.

It is these shifts in cultivation and other similar examples that provide anecdotal evidence of the possibility of genetic erosion. In addition, throughout the Sahelian and savannah regions of WCA, landrace varieties and their wild relatives are suspected to be endangered due to a myriad of factors, including drought, soil degradation, alteration of natural habitats, socioeconomic changes and the introduction of new varieties. The incidence of conflicts and the resulting displacement of people, together with long periods of drought, in northern parts of West Africa could also constitute important drivers of PGR erosion. In addition, genetic erosion could result from the lack of a well-developed seed industry, poor seed conservation in traditional systems and inadequately functioning national genebanks. Based on available anecdotal evidence, other suspected drivers of the gradual disappearance of some crops and landraces in the subregion include dietary changes, climate change and the introduction of commercial monoculture cropping practices. The erosion of genotypes themselves would usually be accompanied by progressive erosion of traditional knowledge about their cultivation as well as dietary and other uses.

3.1.2 Evidence of genetic erosion at the allelic level

Notwithstanding perceptions and anecdotal evidence, there is a lack of precise information at the allelic level on what is happening to the genetic diversity of food crops, particularly those originating or with substantial diversity in WCA. In a study of rice genetic diversity monitored in Maritime Guinea where subsistence agriculture prevails, Barry et al. (2008) concluded that diachronic analysis of rice genetic diversity did not reveal genetic erosion. The results suggest the need for well-structured morphological and molecular analysis of the frequency of common,

locally available alleles, particularly targeting crops for which WCA is the centre of substantial diversity in order to address this knowledge gap in the subregion.

In conducting more in-depth studies to establish evidence for genetic erosion, it is worth bearing in mind the cultural significance of diversity. Farmers' varieties are maintained by farmers and selected, generation after generation, in accordance with the cultural preferences of the farmers. The erosion of diversity at the varietal level is an expression of the diminution of the determining influence of those cultural preferences (i.e., concomitant cultural erosion). For this reason, it is suggested that measuring the erosion of varieties could take the "farmer's-eye view" of diversity: how it is expressed, maintained and used. To measure at the allelic level is to dive down below the level of the conscious perception of the farmers concerned. The genes of a number of varieties may be included in the pedigree of a single improved variety, so while the number of varieties identified by farmers may decrease considerably, the level of erosion of diversity at an allelic level might not be as high. But this has yet to be demonstrated conclusively.

In the absence of definitive evidence on the loss or otherwise of diversity, it is prudent to take positive action in favour of conservation. The value of genetic diversity in stemming the incidence of diseases provides a strong justification for the scientific community in WCA to follow such an approach and take steps to minimize genetic erosion and the loss of associated traditional knowledge. The erosion of genetic diversity contributed to a rapid expansion of bacterial diseases and mealy bug in cassava during the 1980s. *Cercospora* diseases affected banana in West Africa. It is important to note that Craenen and Ortiz (1997) point to studies showing that the use of resistant host genotypes is an important component of an integrated approach to control black sigatoka, a serious banana disease caused by the fungus *Mycosphaerella fijiensis* Morelet.

3.2 Conservation efforts

The need to conserve PGR was not perceived as important by national research institutions in WCA in the 1980s. Therefore, efforts by external institutions to assist countries in building their national PGR programmes produced meagre results. The first report on the State of the World's Plant Genetic Resources for Food and Agriculture clearly indicated that most countries in WCA were at the very early stages in the development of their PGR programmes. National stakeholders and policymakers were made aware of the importance of PGR and of support for the development of national PGR programmes by global and regional developments, including the Convention on Biological Diversity (CBD), the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture (GPA), the International Treaty and the Cartagena Protocol on Biosafety, as well as regional seed regulation in West Africa.

Although still very weak, national programmes have been established in Benin, Ghana, Mali, Niger, Nigeria, Senegal and Togo. Staff resources are dedicated to PGR management in Côte d'Ivoire, Benin, Ghana, Mali, Nigeria and Togo. The National PGR programmes of Ghana and Nigeria have reasonably good infrastructure, equipment and personnel. In Ghana, the programme has developed into a full research institute with a dedicated budget and independent board of trustees. Apart from Ghana and Nigeria, plant genetic conservation under *ex situ* conditions is still very poor in WCA countries, despite some programmes being equipped with good conservation facilities (deep freezers, cold rooms, drying rooms, etc.). Major

difficulties commonly encountered include the absence of a constant, uninterrupted power supply, lack of financial resources for maintenance of equipment and for characterization/research and frequent staff turn-over.

Despite the challenges, successful efforts have been made so far in conserving and characterizing germplasm of yam in Benin and rice, fonio and millet in Senegal and Mali. Also, there are contributions by local communities to on-farm conservation of millet, sorghum, cowpea, rice, traditional leafy vegetables and fruit trees. Likewise, the motivation behind farmer decision-making in the domestication and conservation of PGR has been documented in Benin, Burkina Faso, Mali, Niger, Nigeria and Togo (Tourte 2005).

4. Evolution of national plant genetic resources programmes

4.1 Institutional development

Significant movement towards organizing research activities related to PGR conservation and use at the national level emerged in the mid-1980s. An example—Cameroon—is described in Box 1. Activities in Benin, Côte d'Ivoire, Mali, Nigeria and Senegal obtained substantial long-term assistance from development partners such as the Dutch Ministry of Foreign Affairs, French research institutes and the Consultative Group on International Agricultural Research (CGIAR) centres.

Box 1: Historical evolution of PGR management in Cameroon

Pre-independence management of agricultural genetic resources was carried out by French research institutions on such crops as food crops, oilseeds and cotton. Following post-independence reorganization of national research, crop and forest genetic resources were placed under the Institute of Agricultural and Forestry Research (IRAF) which was one of the five institutes under the General Delegation for Scientific and Technical Research (DGRST) set up in 1979.

A genetic resources conservation programme was created in 1984 and based at the Agronomic Research Institute under DGRST. Duplicates of the national germplasm collection were placed at IITA, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT) and the International Rice Research Institute (IRRI). Most of the root crops conserved are local yams, *macabo* (a type of cocoyam), cassava, Irish potato and sweet potato. *Ex situ* collections were also established for fruits (75% of them were exotic) and export crops such as oil palm, coffee, coconut, rubber and cocoa.

All research institutions were merged to become the Institute for Agricultural Research for Development) (IRAD) in 1996. Currently, most genebanks are at IRAD research stations. However, there are some that are managed by the Ministry of Agriculture and the Ministry of the Environment and Forests.

Source: Oscar Eyog-Matig, personal communication.

The pattern of evolution of national PGR programmes in anglophone WCA countries is exemplified by the case of Ghana. Documented historical records show that exotic plants were introduced into Ghana by explorers and missionaries from the fifteenth century onwards. The formal establishment of a PGR institution in Ghana followed discussions at the Food and Agriculture Organization of the United Nations (FAO) in 1961. Dr William Agble is credited with taking the initiative to formally set up a national institute—Plant Introduction and Exploration—in 1964. In the same year, an

arboretum established at Bunso in 1937 as a garden by Achimota College was attached to the institute, becoming the Plant Genetic Resources Unit under the Crops Research Institute (CRI) in 1985, and in 1994, being elevated to the status of an independent centre. In 2005, the centre became the Plant Genetic Resources Research Institute (PGRRI).

These institutional changes (together with greater autonomy in operations and increased infrastructural and scientific capacity) reflect greater focus and attention to building a national facility for PGR conservation and use. PGRRI has now attained the status of a fully autonomous institute within the Council for Scientific and Industrial Research (CSIR). Currently, in addition to PGRRI, eight research institutions, two universities and the Ministry of Food and Agriculture have field genebanks.

In the Francophone WCA countries, agricultural PGR were managed on a crop basis by French research institutes during the colonial era. The Institut de Recherches Agronomiques Tropicales managed food crops, the Institut de Recherches du Coton et des Textiles Exotiques focused on cotton and the Institut de Recherche pour Les Huiles et Oléagineux handled oilseeds. Base stations were established for the purpose of adapting introduced crops to serve a number of territories. New or exotic plant species introduced by the French colonial institutions into experimental and adaptation gardens were mainly vegetables of temperate origin (including *Brassica*, non-African *Phaseolus*, *Allium* and sugarcane), fruit trees (such as *Citrus* and their grafting materials, and coconut) and ornamental plants. The first adaptation garden was established in 1816 at Richard-Toll in the Saint-Louis region of Senegal. This was followed by the establishment of experimental gardens at Sor (Saint Louis, Senegal) in 1896, Porto-Novo (Benin) in 1899, Hann (Senegal) in 1903 and Niaouli (Benin) in 1904. Similar experimental stations were established in Guinea-Conakry (primarily for fruit trees), Côte d'Ivoire and Cameroon.

Significant selection and breeding by the French research institutions began around 1950. They focused their attention initially on selection and testing of introduced crops and staples. This was complemented later by field collection of food-crop germplasm for *ex situ* conservation. Some of the exotic species tested have become export crops, providing income and employment for rural and urban people in WCA.

4.2 Programme development

In the period prior to and immediately after independence, there were no established national programmes for the management of genetic resources in WCA countries. Research institutions limited their activities to acclimatization, selection and improvement of exotic species and, more specifically, targeted industrial crops grown as cash crops (e.g., cocoa, rubber, cotton, oil palm). Only the genetic materials of these crops were conserved for use in selection. Table 1 presents details of some (certainly not all) of the crop germplasm collections and the institutions involved since the 1930s.

In the 1970s, as awareness of threats to biological diversity grew, activities for the collection and conservation of genetic resources accelerated in the anglophone countries. The choice of species collected and conserved was determined by how widely the crops were cultivated. International collaboration in germplasm exploration in WCA commenced during the 1975–1980 period. Bioversity International (previously the International Board for Plant Genetic Resources

[IBPGR] and then the International Plant Genetic Resources Institute [IPGRI]), the Institut de recherche pour le développement (IRD ex-ORSTOM), ICRISAT and IITA partnered with local institutions to embark on exploration missions. The input of WCA countries mainly involved assistance in collecting the genetic material.

Table 1. Some Examples of Crop Germplasm Collecting between 1930 and 1990 in WCA

Year	Institutions involved	Countries visited	Species collected
1930–1961	Oxford University, UK; University of California, Irvine (explorations of 1930-1961)	Ghana	Several species
1977	Office de la Recherche Scientifique et Technique d'Outre-Mer (ORSTOM) and NARS	Benin	Millet, Bambara groundnut
		Togo	Sorghum, millet
1978–1990	IITA, ICRISAT and NARS	Benin	Several species including sorghum, millet, okra, rice, cowpea
		The Gambia	Several species including sorghum, millet, groundnut, rice
	IITA and NARS (2 missions)	Togo	Several species (cowpea, rice, maize, Bambara groundnut)
1981	University of Birmingham, UK, and NARS	Togo	Aubergine (eggplant)
1982	ORSTOM and NARS	Togo	Okra
1983	National Agricultural Research Institute (NARI), Gambia	The Gambia	Several species (okra, hot pepper, tomato, sweet potato, cassava)
1983/84	ORSTOM	Togo	Several species
	University of Maryland, USA	Togo	Bambara groundnut
1987/88	ICRISAT, IITA and CSIR	Ghana	Sorghum, millet, groundnut, cowpea, pigeon pea, Bambara groundnut
1989	ICRISAT and NARS	Togo	Early-maturing millet
	IITA and NARS	Togo	Yam
1988–1990	Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), IRD, IITA and NARS	Benin	Yam, cowpea, rice

The collected material was lodged in national genebanks, and duplicates were sent to foreign countries for conservation. In the absence of well-defined national policies and programmes on genetic resources, the transfer of duplicates to foreign research institutions became the norm. However, this was not motivated to any great extent by a strategy to establish fruitful and sustainable partnerships. Rather, in the absence of national policies for PGR conservation and use, the newly established national agricultural research institutions entrusted samples of the genetic resources to the international community because the practice was seen as cost-free to countries in the subregion. Instead of continuing this practice, Sarr (1977) argued for greater national awareness on the value of genetic resources. In concrete terms, he felt that research priority should be accorded to activities related to safeguarding genetic resources at the national, and even regional, level. While the line of thinking advanced by Sarr predated the CBD and the International Treaty (which emphasizes building a global system), it may well have influenced national arguments made at international meetings.

At present, NARS scientific leaders in WCA are more focused than they were in the past on promoting regional cooperation in conservation and use– informed mainly by the failures experienced at the national level due to the lack of human, financial and infrastructural capacity to cope with the demands of PGR conservation. Meanwhile, the CGIAR center genebanks have taken a generally global approach, paralleling other developments since the 1970s. The overall evolution in the development of PGR programmes could be described as (1) initial colonial forms of organization addressing, somewhat tangentially, PGR issues and, therefore, no focused PGR activities; (2) almost exclusive focus on national activities, institutions and organizations; and (3) regional cooperation, leading to global commitments in the context of international treaties, and global cooperation at a practical level for a number of crops within the Trust's global crop strategies.

Between 1995 and 1998, Bioversity catalyzed the process of emerging national PGR programme development through national workshops, which culminated in the setting up of national PGR committees. Equipment was provided to Côte d'Ivoire, Ghana, Nigeria and other WCA countries (with the exception of Guinea-Bissau, Liberia and São Tomé). Bioversity also stimulated the training of national personnel. Strong PGR institutions have emerged in Ghana and Nigeria, principally due to investment by national governments to improve human and infrastructural capacity.

The impact of this external assistance, as measured by the evolution of programmes towards functional institutions, is clearly visible only in cases where the programmes were also backed by national policy and investment. In the case of Nigeria, the Federal Ministry of Science and Technology established NACGRAB in 1986, in recognition of the need to conserve and protect valuable PGR for posterity, as well as to contribute to overall agricultural development and sustainable growth. Since the establishment of NACGRAB, other specialized research and teaching institutions have continued to explore, collect and conserve the germplasm of their mandated crops. NACGRAB plays an overall coordinating role in the country's PGR conservation activities and networks with individual institutions, and provides them with technical backstopping assistance.

4.3 Summary of the evolution of development of PGR programmes in WCA

National PGR programmes in WCA are at various levels of development. In anglophone countries, strong independent national units have been built with overall responsibility for conservation. Francophone countries have put more emphasis on the coordination role given to national plant breeding programmes. No specific PGR units have been created except in Mali, where such an independent unit exists at the Institute for Rural Economy (IER). Generally, plant genetic resources are still conserved and developed by various specialized research and training programmes/institutions. Government financial support is more visible now than before, although, in most cases, it is limited to payment of staff salaries. Ghana and Nigeria are the outstanding cases where the respective governments have supported the development of infrastructure, equipment and personnel for PGR conservation.

In conclusion, the trend in the evolution of PGR conservation in WCA has followed a definite identifiable pattern: (1) colonial forms of organization that focused on plant introductions and adaptation, addressing issues around genetic resources somewhat tangentially; (2) an almost exclusive focus on national activities, institutions and organizations promoted by international partners, including FAO and IBPGR; (3) movement towards regional cooperation in PGR conservation and exchange; and

most recently (4) signing on to global commitments in the context of international treaties (CBD, International Treaty) and to practical global cooperation (the International Treaty) for a number of crops, as well as through development of regional strategies and global crop strategies supported by the Trust.

It is important to note that, since the 1970s, genebanks located at the CGIAR centers have generally taken a global approach but are part of the evolving regional strategy for creating nodal centres of excellence (NCEs) in PGR conservation, exchange and use and related research and development.

5. Evolution of PGR collaboration in WCA

Since the colonial era, which was dominated by plant introduction and acclimatization, the PGR domain in WCA has been driven by evolving global developments and has followed three main phases: (1) an initial narrow focus on crop collections broadening to consideration of forests, crop wild relatives and ecosystems; (2) building emerging national germplasm collections in individual countries; and (3) movement towards subregional multi-country cooperation, particularly after the approval of the GPA in 1996. The scarcity of human and material resources and deficiencies in infrastructure have consistently hampered the efficient operation of individual national PGR conservation institutions in WCA, but the development of the GPA has facilitated regional and global collaboration in PGR conservation, use and exchange. With the entry into force of the International Treaty, WCA countries have had an international framework for PGR exchange within a multilateral system that simplifies access. The national collections, if properly linked to subregional collections, provide the platforms and basic building blocks in the evolution towards global collections.

Prior to the CBD, the collection and exchange of germplasm were mostly unregulated. However, the advent of the CBD and heightened awareness of the economic value of PGR has led to an increase in countries asserting their sovereignty over resources, along with the introduction of formal regulatory restrictions and administrative requirements with respect to access. However, to date, countries in the region have made little progress putting mechanisms in place to participate in the multilateral system, particularly as providers of germplasm using the standard material transfer agreement (SMTA). In this section, we examine regional cooperation, focusing on the conservation and use of PGRFA, facilitated by (1) crop genetic resource networks, (2) regional agricultural research organizations, (3) regional economic organizations, (4) CGIAR centers and (5) regional participation and cooperation in negotiations relating to international instruments.

5.1 Crop and genetic resource networks

The typology of networks that exist in WCA can be described as (1) crop- and commodity-specific networks predominantly composed of breeders, which focus primarily on broad development of the crop or commodity, including selection, use of specific germplasm for crop improvement, testing and sharing of new materials and (2) region-wide non-crop-specific networks predominantly composed of genebank managers, with a focus on overall germplasm conservation (mostly *ex situ*), documentation, information exchange and policy. Most of the crop networks have links to projects based at CGIAR centers, such as IITA, ICRISAT, the African Rice Center (WARDA) and the World Agroforestry Centre (ICRAF), with other networks being funded by Conseil Ouest et Centre Africain pour la Recherche et le

Développement Agricoles/West and Central African Council for Agricultural Research and Development (CORAF/WECARD) or by French research institutes (e.g., CIRAD). Several networks operate on the same crop.

In WCA, crop networks began in 1973 with the International Rice Testing Programme, the Africa component of the International Network for Genetic Evaluation of Rice (INGER-Africa). Many other crop networks (for maize, cowpea, cassava, yam, sorghum, millet, groundnut, etc.) were organized later, between 1980 and 2000. Each crop-specific network collected its own germplasm for conservation in national genebanks and advanced research institutes. Some of the crop-specific regional networks operating in WCA are Réseau Ouest et Centre Africain du Riz (ROCARIZ), Réseau Ouest et Centre Africain de Recherche sur le Mil (ROCAFREMI), West and Central Africa Maize Network (WECAMAN), and Projet de lutte intégrée contre les ravageurs du niébé en Afrique (Cowpea-PRONAF). ROCARIZ deals with rice species, including *O. glabberima,* which originates from West Africa. Rice is one of the International Treaty's Annex 1 crops, for which germplasm is held in trust by CGIAR centers and other signatory genebanks.

In WCA, rice research and development is primarily coordinated by WARDA, and its network is very active. IITA holds cowpea collections in trust and coordinates Cowpea–PRONAF. The network is active currently. A sorghum and millet network operates as part of a new global cereal network under CORAF/WECARD. Both crops are very important in WCA since the subregion is the centre of primary diversity for pearl millet and a secondary source of diversity for sorghum. ICRISAT, a CGIAR center, holds collections in trust for the global system. The non-crop-specific regional network in WCA is the Genetic Resources Network for West and Central Africa (GRENEWECA) operating under the aegis of CORAF/WECARD.

5.1.1 Rice

There have been four networks or working groups on rice:

- Réseau Riz under CORAF/WECARD
- Rice task forces at WARDA (Upland Rice Improvement, Lowland Rice Improvement, Integrated Pest Management, Sahel Irrigated Rice Improvement, Rice Economy)
- INGER-Africa, managed by IITA and now transferred to WARDA
- On-Farm Adaptive Research Network (a multi-crop network that includes rice, maize, cowpea and cassava, organized by IITA in collaboration with NARS and supported by the European Union)

5.1.2 Maize

There are two main maize networks plus a broader network involving maize:

- Réseau maïs CORAF/WECARD
- WECAMAN
- On-Farm Adaptive Research Network (multi-crop network)

5.1.3 Yam

Yam has three networks:

- CORAF/WECARD Yam Network (coordinated by IITA but not very active)
- CIRAD Yam Network
- IITA Yam Network

As a further step to overcome the dispersal of germplasm conservation efforts, several regional consultations were organized by NARS with assistance from FAO, Bioversity, CORAF/WECARD and other regional and international organizations. These took place in the period 1990–1998. At all the meetings, participants stressed the need for collaborative efforts on the conservation and development of the rich genetic diversity of the subregion. The meetings culminated in a recommendation made in 1998 to establish one non-crop-specific regional PGR network: GRENEWECA.

The activities of GRENEWECA are as follows:

- Conservation and utilization of genetic resources for the development of agriculture and the economy of the subregion, including
  - characterizing and developing the genetic resources of the region
  - documenting germplasm collections
  - establishing the sustainable use and exchange of genetic resources in the region and beyond
- Institutional capacity building in the management of genetic resources
- Cooperation and exchange of information among member countries and institutions
- Raising of funds for implementing genetic resource programmes within the subregion
- Raising the level of awareness in PGR activities in the sub region

At the inception of GRENEWECA activities in 1998, the African Development Bank (AfDB) provided funds to support NARS consultation meetings and to supply conservation consumables and equipment (deep freezers, viability testing apparatus and computers) and training in documentation. GRENEWECA has since become less active, but with the provision of funding by the Trust for regeneration of priority at-risk genetic resources in the region, the network has become the focal point for coordinating the regeneration work. GRENEWECA is currently implementing the regeneration of unique, at-risk collections in 10 countries of West and Central Africa (Table 2). National partners who submitted requests to regenerate collections were asked to check with relevant CGIAR centers to ensure that only truly unique accessions were to be regenerated and duplicated into the CGIAR genebanks or in genebanks in developed countries. The unique accessions are also duplicated and deposited in black boxes at the Svalbard Bank for long-term conservation. The Global Crop Diversity Trust approved a budget of US$120,375.00 to support the regeneration activities for three years, 2008 to 2011, with supervision by Bioversity International.

Across WCA, there is increasing awareness of the need to bridge the divide between breeders and genebank curators by linking up the non-crop-specific network with germplasm users (mainly breeders and farmers) for either crop improvement or direct use. This awareness is motivated by the need to demonstrate the value of PGR to livelihoods and, hence, justify their conservation. At an international technical conference on collaboration in *ex situ* conservation at the subregional level in WCA, the need for rural communities to benefit from farmers' rights was explored, along with the possibility of developing legal mechanisms to protect the varieties and knowledge of farmers and rural communities (FAO 1995).

Table 2. Regeneration of National Germplasm Collections Funded by the Global Crop Diversity Trust (2008–2011)

Country	Bambara groundnut	Cowpea	Millet	Sorghum	Rice	Yam
Benin	52	300		160		
Burkina Faso		200	400	500	200	
Côte d'Ivoire						500
Ghana						178
Guinea Conakry					500	
Mali	100		400		250	
Niger	75		500			
Nigeria		52				
Senegal			336			
Togo			40	140		
Total	**227**	**552**	**1676**	**800**	**950**	**678**

A number of networks involved in the conservation of crop genetic resources in WCA—such as the Cereal and Yam Networks, Cowpea-PRONAF, GRENEWECA, ROCARIZ and WECAMAN—have been set up over the years. The length of operation has varied, often depending on the availability of external funding, and since 2006, most of them have ceased working because of a lack of funds. In general, the countries contribute infrastructure and staff time, and the main focus of the networks has been on crop improvement and the dissemination of improved planting materials. To harmonize the networks' activities and to avoid duplicating effort and wasting scarce financial resources, CORAF/WECARD, in collaboration with the CGIAR centers, looked at reformulating some of the networks. For example, in August 1998, CORAF/WECARD and WARDA decided to create a single rice research network (ROCARIZ) to be operated by WARDA. In 2006, a cereal network operated by CORAF/WECARD was created to absorb all the individual cereal crop networks. In a further step towards consolidation, with the adoption of the CORAF/WECARD Strategic Plan (2007–2016) and its Operational Plan (2008–2013), all the individual crop networks were absorbed by the CORAF/WECARD Staple Crop Programme (described below).

5.1.4. CORAF/WECARD Staple Crop Programme

The priority commodities of the Staple Crop Programme include root and tuber crops, rice, the traditional grains (maize, sorghum and millet), banana and plantain, and pulses and oil crops (e.g., cowpea and groundnut). In finalizing the programme of work, CORAF/WECARD commissioned a survey to identify the major constraints and opportunities in the subregion. Thus, a consultation workshop was held at WARDA, Benin, 26–28 June 2008, to take the following steps:

1. Achieve a common understanding and shared vision
2. Develop the activities
3. Develop an operational mechanism

Six projects were adopted at the workshop, the first five listed below to be implemented on a competitive grant basis, and the sixth to be part of CORAF/WECARD's core function:

1. Enhancing agricultural productivity, with a component on crop improvement based on the use of crop germplasm collections
2. Enhancing the use of agricultural inputs, with a component on seed multiplication and dissemination
3. Promoting post-harvest technologies
4. Strengthening the capacities of value-chain actors
5. Accelerating the promotion of regional integration systems
6. Strengthening subregional agricultural research systems as a CORAF/WECARD core function, to include the following:

a) Creating stakeholders consultative platforms for planning, reviewing, and sharing information on project outcomes and experiences
b) Coordinating programmes and creating a networking mechanism to link stakeholders

These projects will be implemented in all of the 22 CORAF/WECARD member countries. The exchange of germplasm will be based on the SMTA for countries that have ratified the International Treaty. CORAF/WECARD will agree on appropriate mechanisms for exchanging germplasm with any countries that are not party to the International Treaty.

5.2 Regional agricultural research bodies and economic groupings

The creation of CORAF in 1987 represented a significant regional collaborative research effort. Following institutional reforms in 1999, CORAF/WECARD covered all West and Central African countries and included germplasm testing among its objectives right from the inception of its activities. CORAF/WECARD's recently adopted Strategic Plan (2007–2016) and Operational Plan (2008–2013) respond to the objectives of the Comprehensive Africa Agricultural Development Programme (CAADP) of the New Partnership for Africa's Development (NEPAD). They also respond to the Framework for African Agricultural Productivity (FAAP) of the Forum for Agricultural Research in Africa (FARA) and the agricultural policies of the regional economic communities of CEDEAO/ECOWAS, the West African Economic and Monetary Union (WAEMU), CEMAC and the Economic Community of Central African States/Communauté Économique des États d'Afrique Centrale (CEEAC) to harness research efforts toward contributing to achieving 6% annual growth in agricultural productivity by 2016. CORAF/WECARD is the implementing agent of the fourth pillar of CAADP in West and Central Africa, in partnership with FARA. It is also mandated by the subregional economic organizations (CEDEAO/ECOWAS and CEMAC) to oversee agricultural research and development in WCA.

CEDEAO/ECOWAS and CEMAC have clear commitments to sustainable agricultural development in WCA, including integrated natural resource management where plant genetic resources play a key role. The importance given to the exchange of planting materials in CEDEAO/ECOWAS's regional seed regulation and forest policy clearly indicate its commitment to the issue.

5.3 Regional cooperation and representation at intergovernmental negotiations

There was a lack of internal, national institutional processes in lead government agencies prior to their participation at international negotiations around the conservation and use of genetic resources. As a result, national representation at international meetings and negotiations on PGR has been weak, with a lack of concerted subregional engagement and clearly defined common positions to

articulate at such meetings. Although the signing or ratification of international agreements constitutes an important first step in a country's adherence to new international standards and plans, it is not sufficient. A stronger gauge of political commitment would be the effective implementation of agreements nationally and regionally. To that end, an essential task for most WCA countries is the development and implementation of national enabling laws, institutions and policies that properly internalize the key elements of the international agreements that they have signed. Most countries lack capacity in this respect and would benefit from support from CORAF/WECARD, CEDEAO/ECOWAS and CEMAC to stimulate and support the implementation of international agreements in the subregion.

Nevertheless, there are successful examples of collaboration in the subregion. In the late 1980s and early 1990s, there was a realization that seed-borne diseases were being transferred across countries. Consequently, at the level of the African Union (then, the Organization for African Unity), there was a recommendation to set up quarantine systems to control the introduction of seed-borne diseases. Moor Plantation in Nigeria was selected as the quarantine centre for West Africa. Its operation has been a notable success in subregional collaboration.

Further, CEDEAO/ECOWAS, the Permanent Interstate Committee for Drought Control in the Sahel/Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS) and WAEMU have collaborated to make significant advances in the harmonization of seed certification, quality control and variety registration. At a regional workshop held in Accra, Ghana, in 2007, 66 participants representing private and public seed-sector actors from 17 states belonging to these three organizations agreed on measures that rectified differences in standards and harmonized them for eleven crops.[7] This led to the adoption of a harmonized regulatory framework by the CEDEAO/ECOWAS Council of Ministers on 18 May 2008 in Abuja. This framework, the "West African Seed Regulation Harmonization", led to the establishment of the West African Catalogue of Plant Species and Varieties (COAfEV), a list of varieties whose seeds can be produced and commercialized in the member states without restriction (FAO 2008). The objective of the initiative is to facilitate the access of West African farmers to a greater variety of seeds and to foster cross-border seed trade.

At the level of CEDEAO/ECOWAS, regional legislation has been developed for forestry, livestock and fisheries. However, not unexpectedly, regional collaboration across differing institutions and legal systems (mostly inherited from colonial cultures) has not been without difficulty. A notable institutional failure, due principally to lack of funding and constraints in scheduling meetings, is manifested in the inability of the WCA Council of Ministers of Agriculture (CMA-AOC), as a subregional policymaking body on agriculture, to convene regularly, resulting in inactivity.

The action plan developed at a NEPAD ministerial conference, held in Johannesburg, 6–7 November 2003, invited countries to create appropriate mechanisms, such as databases on African traditional knowledge, as well as protecting and promoting the intellectual and economic value of the traditional knowledge and technologies of African communities.

[7] Cassava, cowpea, Irish potato, maize, millet, onion, peanut, rice, sorghum, tomato and yam.

With Annex 10 of the "Bangui Agreement Establishing an African Intellectual Property Organization" (OAPI)[8] coming into effect on January 2006, it became possible for member states[9] to protect their new plant varieties. The OAPI member states signed texts relative to the protection of traditional knowledge and cultural expressions/expressions of folklore, during an OAPI diplomatic conference, held in Niamey, Niger, 25 July 2007. These texts constitute the "Legal Instrument on the Protection of Traditional Knowledge" and the "Legal Instrument on the Protection of Expressions of Folklore". The regional legal instruments involve the implementation of the following:

1. Article 8(j)[10] of the CBD regarding knowledge, innovations and practices, with encouragement of the equitable sharing of benefits from the use thereof
2. CBD article 10(c)[11]
3. Article 9 of the International Treaty regarding the protection of farmers' rights, including the protection of traditional knowledge of interest to plant genetic resources for food and agriculture

In the instrument on traditional knowledge, the intangible yet integral parts of genetic resources and indigenous technologies (that knowledge found in a way of life and individual memory and within local communities and indigenous populations), have become objects of property rights. The instrument on the expression of folklore provides protection against the illicit appropriation and use of traditional cultural expressions. Together, the two instruments ensure the concept of equitable benefit sharing and effective application.

Within the framework of the African Regional Intellectual Property Organization (ARIPO), a single text deals with both traditional knowledge and expression of folklore, addressed in separate chapters. ARIPO member states[12] adopted the "Swakopmund Protocol on the Protection of Traditional Knowledge and Expressions of Folklore" at the ARIPO diplomatic conference of at Swakopmund, Namibia, on 9 August 2010 (ARIPO 2010).

The substance of the ARIPO and the OAPI texts is similar, as they emanate from the same core texts developed at a first meeting of ARIPO and OAPI experts in Kampala in November 2005 and a second ARIPO and OAPI experts' meeting in Dakar in October 2006. The ARIPO text contains some additional formal provisions usually included in ARIPO protocols.

With this African initiative of a collective *sui generis* system of intellectual property rights for the protection of traditional knowledge and cultural expression, WCA countries possess a legally binding instrument linking community development, *in*

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8 The OAPI regional system came into force as a result of the Libreville Accord of 13 September 1962, effective 1 January 1964, as revised by the Bangui Accord of 2 March 1977, with regulations effective 8 February 1982.

9 West and Central African members of OAPI currently include Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Chad, Côte d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Senegal and Togo.

10 CBD article 8(j) concerns the respect, preservation and maintenance of knowledge, innovations and practices of indigenous and local communities that reflect traditional ways of life in relation to the conservation and sustainable use of biological diversity.

11 CBD article 10(c) concerns the protection and encouragement of traditional uses of biological resources in conformity with traditional cultural practices compatible with imperatives for their conservation or of their sustainable utilization.

12 West and Central African members of ARIPO currently include Gambia, Ghana, and Sierra Leone.

situ conservation and equitable sharing of benefits. Two follow-up international workshops were organized to address the development of databases on African traditional knowledge for patent research. One workshop for ARIPO member states was held in Harare in December 2006, and the other, for OAPI member states, was held in Yaounde in August 2007.

There are still potential threats to PGRFA conservation and use in the subregion, due in part to the non-implementation of the regulations, to the absence of national or regional organs to oversee and control the implementation of ratified treaties and conventions, and to a lack of financial, physical and human resources to monitor international undertakings.

Countries in WCA have taken different actions in regard to biosafety. In 2002, some countries constituted national committees to bring biosafety frameworks to the point of legislation. The most advanced were said to be Cameroon, Côte d'Ivoire and Nigeria (Alhassan 2003), all of which have drafted laws in harmony with the Cartagena Protocol on Biosafety, although by 2002, only Cameroon had ratified the Cartagena Protocol. Since then, CEDEAO/ECOWAS has established a biosafety advisory group to assist countries in the development of appropriate national regulations.

Ministerial-level discussions on policy toward genetically modified organisms (GMOs) have taken place in WCA but countries have not yet agreed on a common policy. In the absence of which, each country is proceeding as it wishes. For example, Burkina Faso authorized trials on *Bacillus thuringiensis* (Bt) and vegetative insecticidal protein (VIP) varieties of cotton in 2003 (Mayet and Williams 2007). Neighbouring Ghana drafted biosafety legislation in 2005, with officials keen to pursue research on genetically modified (GM) crops. In contrast, some countries in the subregion are taking more cautious approaches. Choike[13] reports that Benin introduced a moratorium on GMOs in 2002, while in February 2006, Mali stopped plans to produce a law permitting GMO trials, under pressure from civil and consumer groups (Choike 2007). Internally, leaders of WCA countries are confronted by resistance from sections of civil society. The leaders increasingly favour the use of biotechnology in agriculture, seeing it as a vital tool for increasing crop yields and thereby helping to achieve food security and lift farmers out of poverty. Yet sections of civil society argue vehemently against the introduction of GMOs on the basis of health and environmental concerns, as well as cautioning about the dearth of knowledge on GMOs. Few governments in the subregion are actually engaging in the public debate or carrying out wide consultations, as recommended by the CBD, or allowing the public to be fully involved in discussions prior to the introduction of GMOs, as required by Article 5 of the "African Model Law on Safety in Biotechnology" (African Union 2002).

5.4 Regional nodal centres of excellence

In 2004, the CGIAR centers operating in WCA, the Technical Centre for Agricultural and Rural Cooperation/Centre Technique de Coopération Agricole et Rurale (CTA) and CORAF/WECARD funded a workshop on genetic resources, held in Ibadan. The workshop recommended establishing selected NCEs as a mechanism for subregional management of genetic resources, and for sharing the responsibilities and benefits.

[13] Choike is a portal dedicated to improving the visibility of the work done by NGOs and social movements from the South (see www.choike.org/nuevo_eng/).

In pursuit of this recommendation, CORAF/WECARD hired a consultant, using funds provided by the Trust, to assess the physical and human resource capacities, legal framework, compliance with international conventions and treaties, and status of research infrastructure in selected WCA countries. The consultant visited nine of the countries in the subregion,[14] and a report (see chapter 4) was presented to the CORAF/WECARD Annual General Assembly in the Gambia in 2006. As a follow-up on the General Assembly's recommendations, urging the CORAF/WECARD Secretariat to pursue the development of the NCEs further, the Trust, in collaboration with the Genetic Resources Policy Initiative (GRPI), Bioversity and CORAF/WECARD organized a subregional conference in Ouagadougou in September 2006 to discuss cooperation for effective and efficient *ex situ* conservation of PGRFA in WCA.

Leaders of national agricultural research institutions who participated in the conference endorsed the establishment of the NCEs as collaborative regional mechanisms and agreed to the Ouagadougou Declaration (see chapter 3), which, among other things, defined the functions and modalities (criteria and process) for setting up the NCEs, the crops/crop groups proposed for conservation at each NCE, policies for exchange of materials, information requirements for supporting the regional conservation strategy, and a strategy for funding. A major recommendation of the conference was that the development of a regional strategy for management and conservation of PGRFA should be included in the overall CORAF/WECARD strategic plan to be completed in May 2007. Thus, WCA countries under the auspices of CORAF/WECARD have worked closely with Bioversity, FAO, GRPI and the Trust to move forward on a shared agenda to adopt a regional approach to germplasm conservation, exchange and use.

6. Awareness of PGR issues at the subregional level

Awareness of PGR issues in the subregion has largely been achieved by the participation of WCA countries in international processes such as the CBD, the GPA, the FAO Commission on Genetic Resources for Food and Agriculture, the International Treaty, and the Intergovernmental Committee on Intellectual Property Related to Genetic Resources, Traditional Knowledge and Folklore (IGC-GRTKF) of the World Intellectual Property Organization (WIPO). For example, CBD discussions created an awareness of bio-piracy and brought to the fore a realization that individual countries were powerless to deal with offending parties. Therefore, there was the need for a common subregional approach to monitor PGR movement. This awareness led to substantive changes in political discourse and policy on genetic resources in the subregion.

It is important to acknowledge the contributions of non-governmental organizations (NGOs) and other actors urging alternatives to globalization during international negotiations, to the creation of public awareness of issues on plant genetic resources. This heightened awareness was made concrete by follow-up discussions at the national level that focused on transforming selection programmes and creating truly national management programmes for genetic resources that would be open to all stakeholders, in order to fulfil the important mission of conserving, managing and facilitating access to genetic resources by breeders and farmers.

[14] Countries visited by the consultant were Cameroon, Congo-Brazzaville and Gabon (in Central Africa) and Benin, Burkina Faso, Ghana, Mali, Nigeria and Senegal (in West Africa).

Houssou (chapter 4) points to the signature, and ratification in some cases, of principal international agreements on biological diversity, environmental protection and PGR by most WCA countries as evidence of the high level of political awareness and engagement in the subregion. However, Houssou also points to an inadequate understanding and engagement on PGR issues at the national, subregional and international levels as a matter of concern that needs to be addressed.

In an analysis of biosafety policy issues in the subregion, Alhassan (2003) noted that there was a low level of awareness about issues concerning intellectual property rights (IPR). Therefore, he advocated raising awareness of these issues in view of their importance for benefit sharing. More recently, debates and concerns about the effects of GMOs on the environment have raised awareness of the need for regional collaboration through CORAF/WECARD and CILSS, WAEMU and CEDEAO/ECOWAS.

7. Global market influences on genetic resources in WCA

Global market forces exert considerable influence on agriculture in the WCA countries. The upward spiral in global food prices since the beginning of 2008 has had serious consequences for social stability (with resulting food riots or tensions) across almost all countries in the subregion. The food crisis reveals a strong interdependence between WCA countries and the global food market and is forcing governments to adopt a more aggressive focus on farming, with a view to boosting food production and controlling threats from world-wide food scarcity. There is a renewed focus on supporting research to find higher yielding varieties/cultivars, among other strategies to boost food production. This has brought into sharp focus the question of how best to harness the potential of genetic resources, both from within and outside the subregion. For example, the Alliance for a Green Revolution in Africa (AGRA) is sponsoring further breeding work on rice to develop new NERICA varieties in Mali and other WCA countries. The Japanese government has committed itself to supporting these efforts. The increasing interest is also facilitating formal and informal seed systems that would allow greater farmer access to a diversity of highly productive seeds.

The influence of the global market is also evident in the non-food agricultural sector. For example, it is reported that about 10 million people in WCA depend on cotton production for revenues (UNCTAD, undated). In addition to providing natural fibre, cotton also provides edible oil and seed by-products for livestock feed. Cotton occupies a strategic position in the development policies and poverty-reduction programmes in Benin, Burkina Faso, Chad, Mali and Togo. It accounts for 5%–10% of the gross domestic product (GDP) and about 30% of total export earnings (WTO 2003). It has been observed that the impact of production and market reforms undertaken by WCA countries in the cotton sector have been virtually nullified by the farmer-support measures applied by some WTO states, which contrary to the basic objectives of the WTO (WTO 2003), distort global market prices. To counter negative distortions of subsidies to cotton farmers in the United States and, in particular, the lack of competitiveness of local cotton varieties in the face of increasing adoption of much more highly productive Bt cotton cultivars outside the region, Burkina Faso has adopted Bt cotton. However, under pressure from a vocal civil society, Mali is resisting the introduction of GMOs until biosafety regulations are in place.

8. Concluding comments

The WCA subregion constitutes an important gene reservoir for native food crops as well as introduced crops that have developed substantial diversity in the region over time. Facilitating the conservation of PGRFA and their exchange with the global community will enhance the subregion's capacity to tap the potential contributions of the global genepool in the struggle against poverty and food insecurity. As one example, the production of NERICA varieties from *O. sativa* and *O. glaberima* shows that great benefits can be derived from linking genetic resources in WCA to those from other global collections. There are strong reasons for WCA countries to actively engage in and, more importantly, implement the International Treaty and processes that would facilitate the worldwide conservation, exchange and use of PGRFA for food security. This is based on the general mutually beneficial interdependence among countries globally, supported by facilitated access to genetic resources among regions, and the specific dependence of WCA on the high level of genetic diversity of food crops originating from outside the subregion. In 2009, the governing body of the International Treaty adopted, by resolution 3/2009, Annex 4 of the funding strategy, which includes a list of projects to be funded under the first project cycle of the benefit-sharing fund. The list includes funding Senegal's Institut Sénégalais de Recherches Agricoles (ISRA) for preserving the diversity of local cultivars of millet, maize and sorghum through participatory crop improvement.[15]

Although awareness of the importance of genetic resources has resulted in political endorsement of international agreements by countries in WCA, there is a need for strong financial investment in and strengthening of common institutions to foster regional collaboration. The signing of the International Treaty is not enough. The political will of governments has to be manifested in the implementation of policies, legal regimes and institutions that give real authority to the instruments that have been signed. Despite political will, formidable challenges to meaningful regional collaboration in the management of genetic resources for the benefit of all remain and are compounded by the varied linguistic, legal and economic regimes in place in the different countries. Thus, regional economic groupings (e.g., CEDEAO/ECOWAS, CEMAC) have a key role to play in helping countries in WCA to overcome the challenges to regional collaboration and to foster investment in regional facilities and networking mechanisms to support the effective conservation, exchange and use of genetic resources for the improvement of people's well-being.

A consensus has emerged among leaders of national research institutions on the building of NCEs under the auspices of CORAF/WECARD; on the conservation of plant genetic resources in the subregion; on the adoption of legislation for forest, animal and fish resources by CEDEAO/ECOWAS; and on the development of a regional biotechnology action plan together with a framework for regulating biosafety. These represent new areas that will result in common regional actions or approaches to enhance the conservation and use of genetic resources in WCA.

CORAF/WECARD, as the technical arm of CEDEAO/ECOWAS and CEMAC, is well placed to play a critical role in bringing about an effective mechanism for networking activities concerning genetic resources in the subregion. Through its network, GRENEWECA, it is playing a key role in assisting selected WCA countries in regenerating priority at-risk accessions, with financial support from the Trust and

[15] For the list of projects to be funded, see (accessed 4 October 2013) ftp://ftp.fao.org/ag/agp/planttreaty/funding/pro_list09_01_en.pdf.

technical backing from Bioversity. It could complement this effort with initiatives to stimulate and guide region-wide debates and advocacy on key policy and technical issues, with a view to facilitating the exchange of genetic resources within WCA as well as with the global community. This could build on past experience and initiatives, such as when CORAF/WECARD partnered with other organizations to moderate an electronic conference in 2001 to discuss regulating plant genetic resources in WCA (Nnadozie and Fondoun 2002) or when it organized the workshop leading to the Ouagadougou Declaration, charting the way forward for the establishment of NCEs (see chapter 2).

The time is ripe for action, with CORAF/WECARD as the key institution to champion and provide strategic leadership in regional collaboration in PGR conservation and use, and linkage to global initiatives.

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Chapter 2: Developing a subregional strategy for plant genetic resources management in West and Central Africa

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1 Introduction

The West and Central Africa (WCA) subregion covers a total area of over 11.5 million km^2 with a population of over 318 million people. About 70% of the population in the subregion depend on agriculture, which accounts for over 35% of GDP and over 40% of exports. The WCA subregion consists of diverse environments that host a great variety of indigenous crops, wild relatives and forest species that are important in farming and nutrition, medicine and local cultural practices. WCA is also the centre of diversity for a range of crops such as pearl millet, sorghum, African rice, fonio, cowpea, Bambara groundnut, African oil palm, coffee and African yams. For the foreseeable future, agriculture in WCA will continue to be closely associated with the natural environment, where plant genetic resources are prominently featured and play important roles. Resource-poor farmers in WCA have benefitted from biodiversity in several ways, including optimizing productivity in heterogeneous environments, pest and disease resistance, the stability of outputs and resilience to external shocks, dietary diversity and nutrition as well as improved incomes through new markets.

Despite their great importance for nutrition, household economy, health and cultural practices for local communities in WCA, some of these crops have been neglected by science and development, and are badly managed. Their diversity is becoming eroded for a number of reasons, including changes in land use, farming systems and dietary habits. Biodiversity in WCA is also seriously threatened by unsustainable farming practices, particularly the shifting cultivation that is practiced in the forest and savannah regions, coupled with reckless exploitation of certain plant species. Climate change is increasingly becoming a major threat to the very existence of biodiversity and the livelihoods of the people. The challenges arising from the prevailing and anticipated changes in the climate are enormous and are fast overrunning the indigenous knowledge and coping mechanisms of farmers to effectively protect and conserve plant genetic resources and become less vulnerable to the effects of the changing climate. Unfortunately, for most countries in WCA, the national research and development systems that have the responsibility to support farmers with much-needed technologies and innovations lack the requisite material and human resources, as well as the appropriate institutional framework to meet the demands of farmers and challenges of the environment. The efforts of earlier national initiatives to conserve plant genetic

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resources in collaboration with several international organizations in the region have not been sustained because of inadequate facilities and resources. Consequently, most of the materials conserved at the national level have been lost.

Currently, there is no effective collaborative mechanism across countries in the subregion for the conservation, improvement and use of plant genetic resources. A regional effort is, therefore, required to provide the framework for a policy environment that will support country efforts and capitalize on synergies in the region, to effectively conserve and protect valuable PGR and benefit from them. In this regard, CORAF/WECARD, which is responsible for coordinating agricultural research in WCA, has been spearheading and fostering the development and implementation of a framework that will guide and ensure the conservation and appropriate utilization of plant genetic resources in the region. This paper traces the trend of collaborative efforts in developing a regional strategy for plant genetic resources in WCA.

2 Factors affecting conservation and use of genetic diversity in WCA

2.1 Rapid population growth

The West and Central Africa subregion is blessed with a wide range of agroecosystems rich in biodiversity. The rapid increase in population in the region is, however, threatening the sustainable conservation of plant genetic resources, particularly against the background of unimproved traditional farming practices, which are inimical to biodiversity conservation. This situation is particularly critical since *in situ* conservation, particularly in natural environments, demands relatively less financial inputs and ensures natural environmental conditions that are beneficial for the plants. According to estimates, the population in WCA will almost triple in the first half of the 21st century (see Figure 1). Nigeria stands out with a population of about 120 million, occupying an area of 900,000 km². The rate of population growth is 2% to 3% per year for countries in this subregion. This high rate is likely to continue and will be accompanied by increased pressure on agriculture and natural resources.

Loss of biodiversity is principally related to human activities, including agriculture (especially shifting cultivation, based on slash-and-burn methods), collection of wood for fuel, logging and grazing. Between 1990 and 2000, the annual deforestation rate in West Africa averaged 2.8%, which is very high compared with the average rates for African countries (at 0.8%) and all low-income countries (at 0.7% (World Bank, 2009). It is estimated that between 1990 and 2005, forest cover in West Africa diminished at a rate of 1.2 million hectares per year, which is far higher than the average for the continent. According to FAO estimations, over 10% of closed forests were transformed into open forests between 1980 and 2000 and between 3% and 7% of fragmented forests became woodland during the same period. These changes are linked to extensive agriculture (cacao, coffee, etc.), forestry (wood energy and log exports), mining activities, the development of infrastructure and fires (ECOWAS-SWAC/OECD, 2007). At the regional level, cultivated areas grew from 8.4% to 11.8% of all land between 1961 and 2002. This could lead to increased land clearance and deforestation that could threaten genetic diversity and result in species loss.

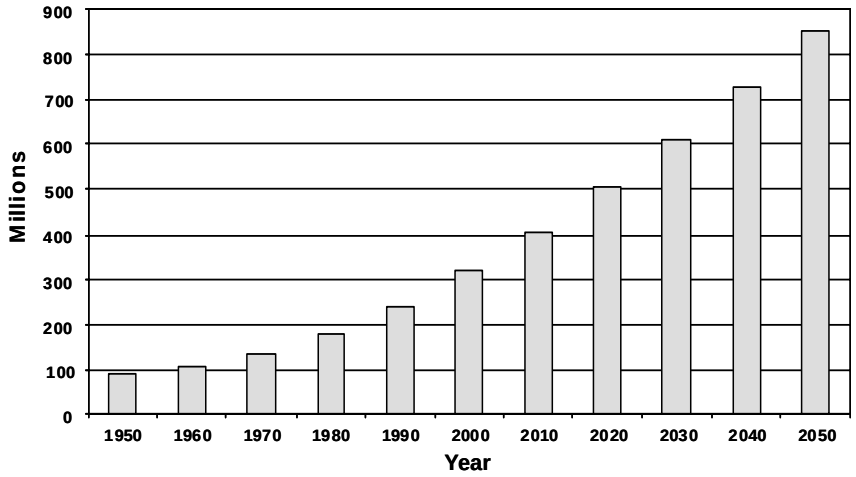

Figure 1. Predicted trends in population growth in West Africa

Hunger and malnutrition threaten millions of people in WCA. In many countries in this subregion, about 20% or more of their people are food-insecure. The problem is most crucial in arid areas such as the Sahel, where drought threatens most rain-fed agriculture. This situation is partly responsible for the increasing focus on high-yielding crops and the abandonment of lower-yielding indigenous crops, resulting in a narrowing of the genetic resource base for agriculture. The food shortage and the growing pandemic of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) in the subregion will have a negative impact on human health and the availability of labour for agriculture and other work. The search for treatments for conditions related to HIV/AIDS will continue and the exploitation of PGR will be an integral part of this search. Emphasis on plants to solve other health problems will also continue and will include:

- Promotion of indigenous plant species with high nutritional value, e.g., African leafy vegetables, fruits, fonio, etc.
- Increased use of medicinal plants

2.2 Effects of climate change

Climate projections for Africa presented in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) include a likely average temperature increase of 1.5°C to 4°C in this century, which is higher than the global average. It is estimated that about 10% – 15% of species will likely be lost in an Africa that is 2°C warmer than pre-industrial levels (Parry et al., 2007). Many studies have shown that the average precipitation in WCA underwent major fluctuations in the 20th century, with a marked resurgence of extensive droughts in the 1970s and 1980s, particularly in the Sahel, and highly deficit periods in 1972–73, 1982–84 and 1997. This trend has taken the form of a 200km downward shift in rainfall towards the South and a historic aridification process in the area's climate (SWAC 2006). A growing concern in the region, particularly in the Sahelian countries as well as the adjacent parts of coastal countries, is the increasing uncertainty as to the beginning of the rains, coupled with shortening of the growing season related, which has the potential to adversely affect genetic diversity in species and genepools, with some species disappearing completely.

There is, therefore, a growing threat to biodiversity in the region with a potential negative impact on local agriculture and, therefore, the region's food supply.

2.3 Scientific and technical environment

For most countries in WCA, the national agricultural research and development systems are in an early stage of evolution and have limited human and financial resources. If the PGR conservation component within these systems exists at all, it is at an embryonic stage. National PGR programmes in most countries in the subregion are weak and lack basic facilities for conservation and evaluation, as well as skilled human resources. Therefore, networking is recognized as an essential mechanism for supporting a country's efforts for better management of its genetic resources. Networking has the advantage of bringing members together in such a way that all partners contribute to and benefit from the network, with gains in efficiency through members striving for common goals rather than attempting to reach them individually.

Several international research institutions are working on PGR management in collaboration with countries in WCA to overcome food insecurity and to achieve the well-being of local communities. The headquarters of IITA and WARDA are located in the subregion. The ICRISAT Sahelian Centre and regional programmes and offices of Bioversity, the International Potato Center (CIP) and the International Livestock Research Institute (ILRI) are also present and very active. Linkages with these organizations strengthen the subregion's research capacities through training of scientists and development of research tools and technologies. Additionally, these relationships facilitate access to the germplasm conserved in international and regional collections. However, most international institutions generally focus their activities on major commodities, such as their mandate crops, and many other species of importance to local communities are left out. Therefore, it is only through strong national PGR programmes that will take care of this wide diversity.

2.4 International and political factors

At the global level, the adoption of the CBD and the GPA, the entry into force of the International Treaty, and the creation of the Trust provide a technical and political environment that is conducive to the preservation of PGR. In Africa, the challenge of conservation and use of PGR is crucial. The growing interest of the African Union (AU) in this is clearly stated in its Model Law for the Protection of the Rights of Local Communities, Farmers and Breeders and for the Regulation of Access to Biological Resources, which was initiated to provide a framework to guide African countries in the development of national policies.

In spite of all this, Africa in general and WCA in particular are still lagging behind in agrobiodiversity management. The efforts of individual countries to achieve progress are limited. Therefore, a variety of regional initiatives are calling for appropriate mechanisms for collaboration and cooperation among countries to support concerted action to boost agricultural development in the subregion:

- NEPAD's natural resources management strategy
- FARA's vision on agricultural biodiversity management
- Adoption of CAADP
- Adoption of the West Africa Agricultural Productivity Programme (WAAP)

- Adoption of the Common African Agricultural Programme (CAAP)
- Development of policies for various sectors (forests, fisheries, fertilizers, etc.) by CEDEAO/ECOWAS
- Development of regional agricultural investment programmes (RAIPs) by CEDEAO/ECOWAS
- Development of the new CORAF/WECARD Strategic Plan

All of these organizations and initiatives recognize the importance of the promotion, conservation and sustainable use of existing PGR for agricultural development in support of the well-being of present and future generations.

3. Initiatives towards a regional strategy for conserving plant genetic resources in West and central Africa

Since the early 1970s, numerous prospecting and plant-collecting missions have been organized by international organizations, such as FAO, IBPGR/IPGRI (now Bioversity International) and other international and regional research organizations, such as CIRAD, ICRISAT, IITA, ILRI, the Royal Tropical Institute in the Netherlands (KIT), ORSTOM and WARDA, in collaboration with national programmes in the subregion. Collected samples were generally shared among the countries visited and the international partner institutions. A number of countries have also undertaken additional collecting missions and established national genebanks for conserving the material collected. Unfortunately, most of the material conserved at the national level has been lost as a result of poor genebanking capacity in terms of both physical and human resources in most countries of the subregion.

The tasks of promoting the conservation and use of PGR in WCA, as well as enhancing awareness of their importance and value, are major ones. This continues to be a core preoccupation of CORAF/WECARD. In line with frameworks for agricultural policy at the continental and subregional levels, CORAF/WECARD has developed a revised Strategic Plan, 2007–2016, and a five-year medium-term operational plan for the period 2008–2013, for implementing the first phase of the Strategic Plan. This plan supports CAADP's highest level objective by sustainably improving broad-based agricultural productivity, competitiveness and markets. Twenty out of 22 countries in West and Central Africa, where CORAF/WECARD has the mandate to coordinate agricultural research and development are signatories to the International Treaty.

3.1 GRENEWECA

In chapter 1, Baidu-Forson et al. have noted that, as a further step to overcome the dispersal of germplasm-conservation efforts, several regional consultations were organized by NARS with assistance from FAO, Bioversity, CORAF/WECARD and other regional and international organizations. These took place during the period 1990–1998. At all the consultations, participants stressed the need for collaborative efforts on conservation and development of the rich genetic diversity of the subregion. These consultations culminated in a recommendation made in 1998 to establish one non-crop-specific regional plant genetic resources network: GRENEWECA. This network covers 24 countries with diverse languages: French (15 countries), English (four), Portuguese (four) and Spanish (one). The objective of this initiative is to provide a framework for the

efficient and effective *ex situ* conservation of the most important collections of crop diversity in the subregion, and to promote their availability.

To encourage, support and undertake activities to improve the management of genetic resources in WCA so as to help eradicate poverty, increase food security and protect the environment, GRENEWECA focuses on the conservation and use of the genetic resources important to countries in the subregion. GRENEWECA's mission is also to assist national programmes on PGR to be actively engaged in the adoption and implementation of international conventions and laws, including the CBD, the GPA and the International Treaty.

3.2 Regional consultations: Ibadan and Ouagadougou conferences

A regional conference on "Plant Genetic Resources Management and Food Security in West and Central Africa" was held at IITA, Ibadan, Nigeria (26–30 April 2004), under the auspices of CORAF/WECARD (Vodouhe et al., 2007). Participants noted that the capacity for PGRFA conservation and gene banking, in terms of both physical and human resources, is generally weak in various WCA countries, and that only a few countries in the region are able to make moderate commitments towards supporting research, conservation and the use of the rich and diverse genetic resources of the region.

Subsequently, the Ibadan Conference called upon CORAF/WECARD to initiate a process to develop a regional approach to PGRFA conservation, including exploring possibilities for establishing NCEs[6] for gene banking priority species and collections in WCA. The approach was endorsed by CORAF/WECARD's executive council, which recommended that the CORAF/WECARD secretariat develop the concept further. A consultant commissioned by CORAF/WECARD and the Trust surveyed existing national capacities in WCA and proposed major actions to be taken to establish effective cooperation on PGR management in the subregion (see chapter 4).

At a second regional conference, held in Ouagadougou, Burkina Faso (11–15 September 2006), the NCE approach was adopted. The Ouagadougou conference ("Towards Regional Cooperation for Effective and Efficient *ex situ* Conservation of PGRFA in West and Central Africa") was a direct response to the CORAF/WECARD recommendation. The Ouagadougou declaration captures the shared agreements and recommendations from the conference (see chapter 3).

3.3 Nodal centres of excellence to conserve and enhance West and Central Africa's plant genetic resources collections

This subregional mechanism brings together NARS, CGIAR centers and other partners to share responsibilities in PGR conservation and enhancement. NCEs are created under CORAF/WECARD and collaborate with the CGIAR centers, the genetic-resource units of advanced research institutes (ARIs), the private sector and NGOs, as shown graphically in Figure 2. The NCEs are located in countries but could also be based in

[6] The NCE is a regional mechanism that brings together NARS, CGIAR centers, the genetic units of advanced research institutes, the private sector and NGOs to share responsibilities in PGR conservation and enhancement.

regional or international research centres on the basis of comparative advantage. The following four NCEs have been approved:

1. NCE on cereal crops (pearl millet, African rice, sorghum, fonio, etc.) in the Sahelian zone
2. NCE on root and tuber crops (African yams, frafra potato, cocoyam) in Coastal West Africa
3. NCE on coconut collections and other industrial crop species in Coastal West Africa
4. NCE on banana and plantain in Central Africa

NCE Goals

Ensuring that the PGR of WCA are effectively collected, characterized, conserved and sustainably used for the well-being of the people of the subregion through a network of strong national programmes

NCE Objectives

- Taking responsibility on behalf of countries for effective *ex situ* conservation of the subregion's PGR
- Developing/strengthening national capacities in PGR development
- Promoting awareness on policy issues of relevance to PGR management and developing/strengthening national capacities in laws and legislation
- Developing a subregional PGR documentation system and information-sharing mechanism

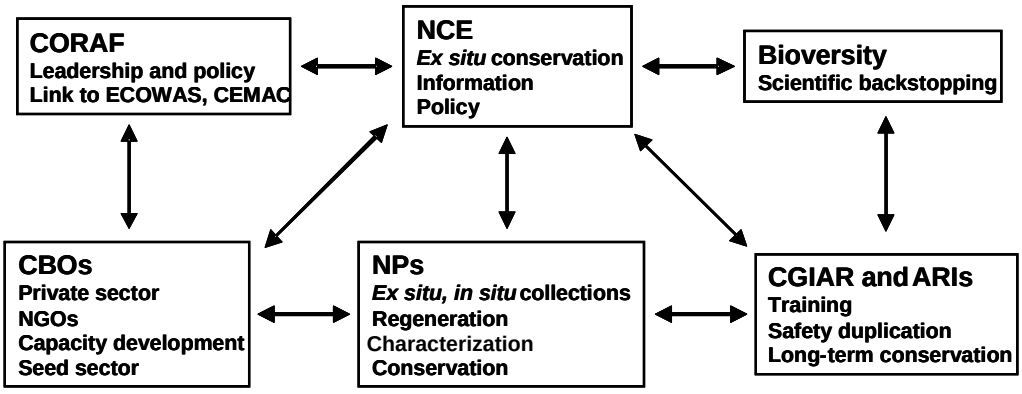

Figure 2. NCE links to partners

3.3.1 Activities of NCEs associated with the above objectives

Objective 1: Taking responsibility on behalf of the countries in WCA for effective conservation of the subregion's PGR

This includes the following:

1. Conducting the medium-term *ex situ* conservation of specifically mandated crops on behalf of all the countries in the subregion and ensuring their safe duplication in an international centre (ARI or CGIAR center)
2. Developing standards for conservation management, including a system for monitoring seed health to detect pathogens and address germplasm sanitation

Objective 2. Strengthening national capacities in PGR development

The main activities for this objective will include the following:

1. Assisting countries in managing their *in situ* collections and enhancing complementarities between *ex situ* and *in situ* collections
2. Understanding genetic diversity in *in situ* conservation systems
3. Investigating gene flow between cultivated species and their wild relatives
4. Undertaking collecting for additional accessions to fill gaps in collections and for preserving threatened species
5. Training national scientists and technicians in *ex situ* genebank management
6. Promoting the publication of PGR research and development activities and results

Objective 3. Promoting awareness on policy issues of relevance to PGR management, and developing/strengthening national capacities in laws and legislation

The following activities will be undertaken:

1. Training of national programmes on law and policies related to PGR
2. Promoting and facilitating PGR policy development and analysis

Objective 4. Developing a subregional PGR documentation system and information-sharing mechanism

This will be achieved by

1. Developing a subregional information system providing access to information on material conserved at the NCEs
2. Promoting the use of appropriate software and data-management systems for PGR in national programmes
3. Sharing information among members through newsletters and other media

3.3.2. Coordination of NCEs

Each NCE has a coordinator, assisted by the administrative staff of the hosting institution.

3.3.3 Modus operandi of NCEs

The operational strategy of the NCEs is based on partnership. All their activities are implemented in collaboration with national, regional and international partners.

Partnership with national programmes

It is recognized worldwide that every country has a sovereign right to regulate access to genetic resources within its borders. National genetic-resource programmes are responsible for ensuring that the country's genetic resources are well preserved and sustainably used.

A national programme is a type of network at the national level that includes all stakeholders involved in the conservation and use of the genetic resources. It comprises national agricultural research institutions; universities; forestry departments; livestock departments; educational institutions; the various ministries responsible for

environmental management, agriculture, trade, legislation, health, etc.; healers, NGOs and the private sector. Generally, the members of this large group are very active individually but do not always take into account what others are doing. This situation inevitably leads to a waste of effort, waste of limited resources (human and financial) and inefficiency. When no clear mandate is given to any institution for conserving specific germplasm collections on behalf of others , many collections are simply lost or abandoned if the holding institutions lack resources or change mandate. There is an urgent need to establish—at the national level—an appropriate mechanism for the exchange of ideas and experience for better management of genetic resources. This calls for a forum where all stakeholders can meet and evaluate the country's potential in genetic resources, the activities undertaken by various institutions and existing gaps, and can plan urgent actions.

To be strong enough, a national programme should have a clear mandate, recognized by all partners and policy/decision makers. It should develop and adopt its strategic and action plans to be compatible with and linked to national policy (for natural resource management) and national development plans. Within a subregional collaboration mechanism, it should also maintain good working relationships with all other institutions contributing to the development of the sector, especially the CGIAR centers, FAO and various international commissions, conventions and treaties: CBD, the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD), the International Treaty, etc.).

In this context, a national PGR programme will duplicate its collections to the NCE for medium- to long-term conservation. Responsibilities for characterization and evaluation of the collections will rest with the national PGR programme unless a special arrangement is made for the NCE to assist in these tasks. The materials conserved belong to the country and can be retrieved at any moment, provided a request is sent to the NCE in advance. The NCE can provide samples of species listed in Annex 1 of the International Treaty with other partners that are signatories of the Treaty. Appropriate mechanisms developed and adopted by the countries will be used to exchange non-Annex 1 species.

Partnership with networks

The NCE will collaborate with all networks (crop, regional and thematic) involved in PGR management. The collaboration can be based on exchange of material, training of researchers, joint exploration, collecting of germplasm, maintenance of collections or characterization of germplasm.

Partnership with CGIAR centers

CGIAR centers operating in WCA (Bioversity, ICRAF, ICRISAT, IITA, ILRI and WARDA) play significant roles in exploring, collecting, conserving and characterizing the germplasm of important plant species in the subregion. The genebanks at IITA and WARDA provide crucial security storage, close at hand, for some of the subregion's major crops. ICRISAT also provides valuable services to the subregion's sorghum, millet and groundnut breeders by holding duplicate samples and data on the collection and characterization of their varieties in its global collections at the Sahelian Center at Sadore

in Niger. Bioversity's global expertise on agrobiodiversity will benefit the NCE in the following areas:

- Investigation, documentation and promotion of traditional plant species
- Development of best practices for genebank management
- Information-sharing and documentation systems
- Implementation of the GPA, the CGIAR Challenge Programme for Sub-Saharan Africa and CGIAR systemwide and ecoregional programmes
- Policy analysis and development

The NCE will play a facilitating role in assisting national programmes in keeping their germplasm collections in the CGIAR genebanks using black-box arrangements.

A thorough characterization of the germplasm collections is needed in order to benefit fully from the genetic resources available in the subregion. NCEs will benefit from the biotechnology facilities available in the CGIAR centers to undertake genetic characterization and to enhance the genetic diversity of their collections.

The recent survey conducted by the CORAF/WECARD consultant has indicated that fairly well-structured tissue-culture laboratories exist in most of the countries. However, these laboratories generally lack the basic equipment, well-trained scientists and consumables needed to become operational. ARIs, the CGIAR centers and donors will assist in strengthening some of these laboratories to enable them to play subregional roles in the context of the NCE approach and to the benefit of other countries in the subregion.

Partnership with research institutions in developed countries

Developed-country research institutions such as CIRAD, Deutsche Gesellschaft für Internationale Technische Zusammenarbeit (GIZ, formerly GTZ), IRD, KIT, etc., have greatly contributed to exploration, collecting, characterization, evaluation, conservation and the use of PGR for the benefit of people in the subregion. The NCEs will maintain and develop strong relationships with these partners, on a case-by-case basis, through joint research and training programmes.

Partnership with international NGOs and the private sector

NGOs such as Genetic Resources Action International (GRAIN) in WCA are very active in assisting farmers in developing and sustainably using their genetic resources. This valuable assistance will be developed further in various domains such as *in situ* and on-farm conservation, training and utilization of genetic resources. Many international private-sector companies are also very active in the use of genetic resources through biotechnology. Specific agreements involving these partners, national programmes and GRENEWECA will be negotiated based on existing legislation at the national, regional and international levels.

3.4 The CORAF/WECARD Strategic Plan (2007 – 2016)

CORAF/WECARD is playing a leadership role in coordinating research and development related to agriculture in the WCA region. Moreover, the two regional economic communities (CEDEAO/ECOWAS for West Africa and ECCAS for Central

Africa) have mandated CORAF/WECARD to implement their agricultural policies. CORAF/WECARD has succeeded in establishing a multi-donor trust fund with key development partners, including the World Bank, European Union (EU), Department for International Development (DFID) in the UK and the Canadian International Development Agency (CIDA). These activities demonstrate the respect commanded by CORAF/WECARD and its will to ensure the sustainability of its actions.

The new Strategic Plan addresses prioritized issues and makes a clear commitment to delivering a series of four results, which encompass a new paradigm for agricultural research and development—Integrated Agricultural Research for Development (IAR4D):

1. Appropriate technologies and innovations developed
2. Strategic decision-making options for policy institutions and markets developed
3. Subregional agricultural research system strengthened and coordinated
4. Demands for agricultural information from target groups facilitated and met

These results are to be delivered through a portfolio of eight programmes based on technical and policy research and core functions. It should be noted that the four result areas listed above are either directly or indirectly linked to the development of a regional policy framework for plant genetic resources, its operationalization and eventually its output and impact.

By aligning its plan with CAADP and FAAP, CORAF/WECARD has provided coherence, not only with regional concerns but also with other subregional organizations. The Strategic Plan is intended to coordinate and harmonize fragmented support across WCA, involving a wide range of stakeholders such as farmers' organizations, NGOs, policymakers, private-sector agri-businesses (processors, marketers and transporters), agricultural research institutes and universities. The 2007–2016 Strategic Plan seeks to achieve agricultural-led economic growth. More specifically, the strategy is to achieve sustainable improvements to the competitiveness, productivity and markets of the agricultural system in West and Central Africa by meeting the demand from target groups for technology, innovation, policy options, knowledge, and enhanced capacity and coordination of the subregional research system. In achieving these specific objectives, CORAF/WECARD would contribute to high broad-based agricultural growth in WCA. By the end of its implementation period, the Strategic Plan would also have contributed significantly to the achievement of the 6% target growth in the agricultural sector, as well as to poverty reduction and food security in WCA.

3.4.1 Strategic transition: Programme approach vs network approach

The CORAF/WECARD Strategic Plan is the strategic choice of a programme approach with a more general and global approach to implementing its operational plan at the expense of networks. The shift to a programme-based approach requires significant changes in organizational and institutional systems and structures (in terms of management and formal/informal rules) that are being integrated into the programmes. This approach will be applied throughout the subregion and will need to receive specific and carefully planned management. Networking is the mechanism for ensuring subregional collaboration and delivery of results. Network structures permanently financed by CORAF/WECARD are no longer a feature of the revised Strategic Plan (CORAF/WECARD 2007). Nevertheless, the networking component is fully recognized

and is being fully taken on board by the Natural Resources Management Programme of CORAF/WECARD, which has the mandate for research and development activities related to PGR conservation.

The CORAF/WECARD Strategic plan also states that base centres, centres of excellence and poles play an important role in implementation, but are no longer responsible for overall management of a CORAF/WECARD programme. Instead, they form the nucleus of the networking processes that address specific problems or sets of problems through a project or projects. Access to resources and reporting is done through the programme management structure based at the CORAF/WECARD Secretariat (CORAF/WECARD, 2007). In view of this, it is therefore important to note that the new CORAF/WECARD programme approach incorporates two key components of the former GRENEWECA, namely NCEs. Consequently, the goals, objectives and activities of the former GRENEWECA are now within the CORAF/WECARD Natural Resources Management Programme.

3.4.2 CORAF/WECARD Natural Resources Management Programme, scoping study

The Natural Resources Management Programme of CORAF/WECARD deals with a range of priority issues, including soil and water management, biodiversity, forestry and agroforestry, that are linked to Pillar 1 of CAADP (Extending the Area under Sustainable Land Management and Reliable Water Control Systems) and Pillar IV (Agricultural Research, Technology Dissemination and Adoption). After the manager for the Natural Resources Management Programme was recruited in 2009, one of the first major activities was the coordination of a scoping study for the Programme. Analysis of the strategic statements of the Strategic Plan and the constraints and opportunities identified by stakeholders in natural resources management resulted in the formulation of an overarching strategy, two major themes in the area of soil and water management, one theme each in biodiversity and socioeconomics, and several subthemes related to each of the major themes.

Strategy

A three-pronged overarching strategy, underpinned by social and economic considerations (including the need for producers to break out of the vicious circle of poverty leading to degradation of natural resources leading to poverty), has been proposed. CORAF/WECARD should backstop research and development activities conducted by NARS in West and Central Africa, within the framework of its Natural Resources Management Programme, aimed at

1. Preventing the degradation of natural resources
2. Preserving and improving the productivity of natural resources
3. Rehabilitating degraded resources

The four major themes are as follows:

1. Sustainable management of land and water and adaptation to climate change
2. Sustainable intensification and diversification of agriculture
3. Conservation and improvement of biodiversity (animals, plants, fisheries)
4. Socioeconomics and policy research on natural resource management

The subthemes under theme 3, relating to the conservation and improvement of biodiversity are as follows:

Subtheme 1. Knowledge and conservation of genetic resources

i. Inventory of genetic resources
ii. Collection, *in situ*, in the fields and *ex situ* conservation and expansion of the genetic base of priority endangered, not well known, hardly used and/or neglected species
iii. Ethnobiological studies and development of indigenous knowledge in terms of biodiversity conservation and management
iv. Monitoring of biodiversity indicators for endemic, endangered and endemic species and invasive or pervasive species
v. Characterization of genetic resources
vi. Research on techniques of conservation of genes, genotypes, and gene complexes of endangered species
vii. Study of gene flows
viii. Knowledge of the biological diversity of certain specific domains: micro-organisms and their functional relations with other components, marine and animal resources

Subtheme 2. Use and improvement of species

i. Breeding of efficient varieties that are adapted to producers' needs and means
ii. Technology and physiology of seeds and techniques of multiplication of species
iii. Domestication and development through the local processing of forestry and agroforestry wild species
iv. Study of diseases and pests of the species and definition of coping mechanisms
v. Development of biotechnological tools in terms of the conservation of germplasm and evaluation of biodiversity
vi. Tests and trials on genetically modified local plants
vii. Development of genetic diversity
viii. Study and development of bioenergy

Subtheme 3. Rehabilitation of the productivity of agricultural and forestry ecosystems

i. Composition, functioning and dynamics of ecosystems
ii. Contribution of research to the elaboration of multi-resource land-management plans
iii. Techniques of improvement of natural formations with special emphasis on endangered ecosystems
iv. Impact of deforestation, bushfires and grazing areas on habitat and the environment

Subtheme 4. Climate change and environmental services

i. Evaluation of impact of climate change on biodiversity
ii. Setting up methods and strategies of adaptation to climate change
iii. Study of indicators of carbon sequestration of fruit and forest species

3.4.3 More recent developments towards a regional strategy

Like previous studies and workshops, the scoping study for the CORAF/WECARD Natural Resource Management Programme clearly recognized the growing threat to the survival of plant genetic resources, and recommended the need for appropriate actions that would ensure sustainable conservation of plant genetic resources in WCA. It is worth noting that the goals, objectives and associated activities of GRENEWECA are consistent with the CORAF/WECARD result areas, particularly those of the Natural Resources Management Programme. Specifically, efforts are being made to build on the achievements towards a regional policy for PGR conservation. Recent developments in this regard include the following:

1. The theme "Biodiversity Conservation and Improvement" was one of the first two themes on which the call for concept notes for the CORAF/WECARD competitive grant scheme under the Natural Resources Management Programme was based.
2. A growing number of partners, including researchers, producers, processors, civil society activists and a range of policymakers, are being contacted and linked on various innovation platforms with an emerging network of key stakeholders in PGR conservation under the Natural Resources Management Programme.
3. In early 2011, on behalf of the NARS in WCA, the Natural Resources Management Programme submitted a proposal titled "Strategic Action Plan for Plant Genetic Resources Conservation and Use in the Face of Climate Change in West and Central Africa" under the call for the 2010 proposals of the benefit-sharing fund of the International Treaty. The major objective of the proposal was the development of a regional strategy and an appropriate action plan for the conservation and use of the subregion's agricultural biodiversity.
4. A subcommittee of the CORAF/WECARD Scientific and Technical Committee was appointed in 2010 to evaluate the two existing base centres and give recommendations for appropriate actions related to improved performance of their designated responsibilities. At the same time, another subcommittee was appointed to suggest modalities for operationalizing the NCEs, as recommended in the Ouagadougou Declaration. Final reports of these two committees are being awaited.

Disclaimer

The Global Crop Diversity Trust provided support towards the development of the 2007 regional strategy. The Trust expects the strategy to continue to evolve, as appropriate. The Trust is not responsible for the contents of the strategy or for the accuracy or completeness of the information contained within it.

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Chapter 3. The Ouagadougou Declaration: countries of West and Central Africa join forces for action on crop diversity

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1. Introduction

In September 2006, representatives of national PGR programmes in West and Central Africa met in Ouagadougou and took a crucial step forward in agreeing on a framework for the creation of a regional *ex situ* conservation system for priority plant genetic resources for food and agriculture. Along with partners in regional and international organizations, the WCA countries designed the concrete steps that would turn the objective of a regional system into reality. This paper underlines the driving force for action—the crucial role that PGRFA play in the economies of the WCA countries and the health and well-being of their people. It then describes the history of collaboration on genetic resources in the subregion, which provided a foundation of knowledge and goodwill, and a clear understanding of the challenges ahead that enabled the 2006 landmark conference to crystallize the countries' goals into the Ouagadougou Declaration, which provides the blueprint for action.

2. West and Central Africa's rich crop diversity

PGRFA are the raw materials of agricultural production, contributing towards food and nutritional security, environmental health and ecosystem maintenance. WCA owes its particular wealth of diversity to the interaction of smallholder farmers with introduced and locally domesticated crops over long periods of time in a range of very different agroecosystems. Among the important staple food crops with a primary centre of diversity in WCA are millet, cowpea, fonio, several types of yam, African rice, Bambara groundnut and oil palm. WCA is the secondary centre of diversity for sorghum and robusta coffee, and a significant number of introduced staple food crops and commodities have developed genetic complexes and wild relatives adapted to environmental conditions in WCA.

The prominence of introduced crops in markets and on food tables in the subregion reflects WCA's involvement in the centuries-long practice of germplasm exchange between countries and continents. Exchange continues to be very important as a source of genetic diversity to support crop improvement and combat diseases. Likewise, the subregion contributes to global food security through being an important reservoir of genetic diversity for its native crops and for introduced crops that, over time, have evolved local types with traits that are potentially useful elsewhere.

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Thus, as well as the need for a solid infrastructural base to manage and safeguard PGRFA for farmers today and in the future, appropriate policies are required that enable WCA countries to participate fully in, and benefit from, a global system of conservation and exchange of genetic resources. In concrete terms, it is in the strategic interests of WCA countries to support and implement the International Treaty, which is reflected in the widespread membership of WCA countries in the Treaty, signalling a common desire to move forward with concerted action as described in the following section.

3. The Ouagadougou Conference

3.1 History

In recognition of a need for increased, long-term, cooperation in WCA in support of the conservation and use of the subregion's PGRFA, a regional conference was convened in Ouagadougou, Burkina Faso, 12–15 September 2006. Entitled "Towards Regional Cooperation for Effective and Efficient *Ex Situ* Conservation of Plant Genetic Resources for Food and Agriculture in West and Central Africa", the conference was organized under the auspices of CORAF/WECARD and cosponsored by Bioversity International (formerly IBPGR and IPGRI), GRPI and the Trust.

The conference itself was a seminal event in the evolution of subregional collaboration, and followed a history of some four decades of build-up during which studies were carried out and various collaborative mechanisms were explored in WCA. Since the early 1970s, prospecting and collecting missions were undertaken by national programmes in collaboration with international partners, including FAO, CGIAR centers and other advanced research institutes. These activities and the creation of crop networks gave impetus to the collection and conservation of crop gene pools in national genebanks.

Such efforts all had a positive effect on the level of PGR conservation and use in WCA. Nevertheless, there was a risk that their overall impact was too dispersed, as highlighted in consultations conducted at the national and subregional level between 1990 and 1994 in the context of preparing FAO's Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. As a result, CORAF/WECARD member countries recommended the establishment of a non-crop-specific network, and in 1998, GRENEWECA was created. Important players during this period were national PGR programmes, FAO, the CGIAR centers represented in the subregion, and regional bodies with research and/or development mandates (e.g., CORAF/WECARD, FARA, NEPAD).

GRENEWECA, on its own, was unable to address all of the outstanding challenges associated with the management of PGRFA in the region, so CORAF/WECARD, FAO and several CGIAR centers (Bioversity, IITA, ICRAF, ICRISAT, WARDA) convened a regional conference on "Plant Genetic Resources and Food Security in West and Central Africa", which was held at IITA, Ibadan, Nigeria, from 26–30 April 2004.[5]

[5] The conference report is available at http://www.bioversityinternational.org/e-library/publications/detail/plant-genetic-resources-and-food-security-in-west-and-central-africa/

The conference acknowledged that genebanking capacities in WCA were generally low in terms of both physical and human resources, with very few countries being able to make significant commitments towards supporting research, conservation and the use of genetic resources. Deficiencies were identified in the availability of information on local crop diversity as well as in mechanisms for sharing information, in the number of people trained in the conservation of genetic diversity and in appropriate policies, regulatory instruments and funds. Together, these factors prevented countries from benefiting optimally from their rich and diverse genetic resources, and put those resources at risk. Indeed, much of the material deposited in national genebanks from early collecting activities has been lost. Deficiencies at the national level were compounded by weak collaboration among countries in the subregion, so there was clear scope for enhancing conservation and sustainable use of PGRFA through regional collaboration, as called for in the CBD and the International Treaty.

Drawing upon all of these factors, the Ibadan conference strongly recommended the implementation of a mechanism for sharing responsibilities in PGR management among countries in order to arrest the genetic erosion in WCA. The conference went further by recommending a specific collaborative mechanism, namely, the establishment of nodal centres of excellence for the conservation and development of WCA's genetic resources, as described below.

3.2 The NCE concept

An NCE was foreseen as a set of national facilities, selected and upgraded to play a regional role. It would comprise well-developed and well-equipped genebanks and laboratories, having trained personnel and adequate budgets, and would network with national genebanks and CGIAR center genetic resource units. An NCE would undertake the following tasks:

- Receiving and conserving genetic resources for all national programmes of WCA
- Carrying out appropriate cleaning and seed-health testing
- Carrying out, if deemed necessary, specific characterizations in collaboration with countries
- Giving back germplasm to countries on request
- Developing effective and easily accessible documentation systems for the collections
- Training national partners in conservation, characterization and documentation

The objective was not to start from scratch and build new infrastructures; rather, existing facilities in selected countries would be upgraded to play regional roles. Also, the principles of management for NCEs could benefit from the recent positive experiences in intra-regional collaboration gained by CILSS, the West African Economic and Monetary Union (UEMOA) and CEDEAO/ECOWAS. Countries would agree to put together their PGR, and share responsibilities and costs related to the maintenance and development of the PGR. They would also share the benefits from the use of the PGR, based on an agreed legal framework, for which there is already a firm foundation based upon the fact that CORAF/WECARD member counties in WCA are signatories to the CBD and the International Treaty, as well as to many other relevant regional and international conventions, legislations, treaties and protocols. Thus, the principle of a country's sovereignty over its genetic resources, as recognized by the CBD and the International Treaty, would apply in the context of NCEs.

The Ibadan conference proposed the following steps for establishing NCEs:

1. Assess existing national capacities (infrastructure, equipment, personnel, legislations, government goodwill)
2. Assess the importance and state of existing national germplasm collections
3. Assess each country's commitment to international conventions/legislation and commitment to development and enforcement of national legislation
4. Draft guidelines for operating NCEs.
5. Develop and apply criteria for selecting host countries and institutions
6. Develop a memorandum of understanding between CEDEAO/ECOWAS-CEMAC-CORAF and each NCE host country/institution and send to countries for adoption and ratification

By the time of the Ouagadougou conference in September 2006, significant progress had been made on this action list. A concept note for establishing NCEs for conserving WCA's priority species (i.e., the species listed in Annex 1 of the International Treaty) had been funded by the Trust, and the process was launched in 2005. A consultant was hired to assess and produce a report on national capacities and capabilities in three countries in each of the three WCA zones (Sahelian Zone, Coastal West Africa and Central Africa). Two other important studies were also commissioned to address the legal framework for regional collaboration and a mechanism for sharing information and documentation. The Ouagadougou Conference would examine the consultant's report and the latter studies and would take the process to a point where countries could apply to host the NCEs. CORAF/WECARD would select the host countries and sign binding agreements with the countries under the auspices of CEDEAO/ECOWAS and CEMAC. Specific project proposals would then be developed to strengthen the capacities of the selected countries.

3.3 Conference objectives

The broad goal of the Ouagadougou Conference was to build upon the previous outputs to finally establish a mechanism and framework for regional cooperation in the conservation and use of the subregion's PGRFA. Specifically, it aimed to develop an implementation plan for the creation of an *ex situ* conservation system for priority PGRFA in WCA, the components of the system envisaged being a mix of existing organizations and collections, such as those hosted by CGIAR centers, and newly established NCEs. The conference sought to establish the roles, responsibilities and requisite capacities of the NCEs. It also sought to chart the means by which NCEs would relate to other organizations that would play important roles in the regional conservation strategy. Finally, the conference examined the international legal framework and considered policy options for the most effective positioning of the regional conservation strategy in general, and the NCE's in particular, to operate within that framework.

The conference was attended by leading stakeholders in WCA, comprising 50 participants from 18 countries and 28 international and regional institutions/organizations.6 The conference programme was divided between plenary presentations and discussions and

[6] The list of participants, final programme and presentations made at the Ouagadougou conference are available on request from Bioversity International.

working group discussions, the latter allowing in-depth examination of pertinent issues and the development of conclusions and recommendations for consideration back in plenary. After an introduction on the history of regional collaboration on PGRFA leading up to the conference, the programme proceeded to an examination of national capacities and of relevant activities by CGIAR centers and ARIs in WCA, to gain an understanding of the context within which NCEs could emerge.

3.4 Study of national programmes

The study of national capacities and capabilities in WCA was carried out by a consultant, Dr Moïse Houssou (see chapter 4). Following a preparatory phase of interaction with CORAF/WECARD and Bioversity to develop the approach to the report, Dr Houssou conducted fact-finding missions in nine countries. In the Sahel, he visited Burkina Faso, Mali and Senegal; in coastal West Africa, Benin, Ghana and Nigeria; and in Central Africa, Cameroon, Congo and Gabon. Interviews were conducted with a range of stakeholders to gather information on available infrastructure, human resource capacity and funding, the institutional and political environment, and the genetic resources currently conserved. At the workshop, Dr Houssou presented the key findings of his report.

While there was a high degree of interest in activities on PGRFA, with a core human resource capacity and a strong commitment to international conventions, the fact that few genebanks were fully functional confirmed the overall need to enhance the effectiveness of PGR conservation in WCA. The approach of creating regional NCEs was supported with due regard to ensuring their effectiveness and sustainability. Thus, there would be a need for careful definition of the scope, responsibility and legal status of the NCEs, for strategic priority setting and due attention to the organization of cooperation among the main actors. Criteria for selecting the host countries would need to be defined carefully, taking into account genebank infrastructure, human resources, the number of species and accessions held, and the status of national legislation and adherence to international agreements. The identification of sustainable financing would be fundamental, and implementation of NCEs would require a legal framework for collaboration, with clear definition of roles and adequate funding for recurrent costs.

3.5 Developing NCEs

Conference participants deliberated on the scope, number and boundaries of NCEs, and identified key outstanding questions and issues requiring resolution. Against that brief, the conference observed that it was necessary to clearly define the following:

- What an NCE actually was
- The scope and boundaries of NCEs, noting that there were at least two ways to define clusters of NCEs: according to plant species and agroecological zones
- The relationship of NCEs to CGIAR genebanks and their collections
- The political basis upon which an NCE would operate
- The legal status of the collections vis-à-vis the countries in which they were located and the region as a whole

Relating to legal status, the conference noted that, since most countries in the region are members of the International Treaty, they are legally obliged to use the SMTA to transfer

materials included in Annex 1 of the International Treaty that are in their management and control and in the public domain. However, it would still be necessary to decide which material transfer agreement to use for transfer of non-Annex 1 materials.

3.5.1 Criteria for establishing NCEs

The conference discussed processes and criteria for establishing NCEs and suggested elements of an application procedure with all countries being able to apply. CORAF/WECARD would launch a call for applications, providing clear information on the requirements and conditions to host an NCE and with details of specific criteria. A mechanism would be developed to assess applications and select the strongest candidates to host NCEs; to be selected, countries had to have a comparative advantage.

Selection criteria were identified that would apply to all countries in WCA. Applications had to be submitted by the respective government to demonstrate the country's political and financial commitment. The government had to be committed to maintaining its financial support to its national institution at least at the current level, although there was no need for a commitment to contribute to support additional costs incurred by the regional responsibilities. In addition, the International Treaty should have been ratified by the country or the ratification process should have been in progress.

Furthermore, countries had to have a suitable operational infrastructure consistent with international standards for conserving the PGR of the selected species: there should be a guaranteed regular supply of electricity and water, adequate communication facilities and space for extending the infrastructure to conserve more material. Well-trained human resources should have the necessary range of skills, noting that the capacity to train personnel locally would be an additional advantage, although not an absolute criterion for selection. A sound record of collaboration with and support from plant pathology services for testing seed health and with quarantine services for imported material was also required.

Consideration had to be given to the PGR conservation activities carried out by the country, the number of species (interspecific diversity) and the number of accessions per species (genetic diversity) conserved. Also important were the quality of the collections (viability and health of materials) and the importance for the region of the species conserved. Finally, there had to be evidence of good management practices and adequate funding for the respective genebank, as well as a sound record of participation in regional integration processes (e.g., CORAF/WECARD).

3.5.2 Physical institutional resources

The conference then examined physical institutional structures in more detail and the conditions that an NCE should meet in order to be operational. It was concluded that, ideally, an NCE should have conservation facilities (see below), basic genebank activities (multiplication, cleaning, diagnosis, sanitation, etc.) and research activities (biological, biotechnological, social sciences, etc.). Noting that information sharing is necessary for proper decision making and collaborative action within a regional partnership, an information and documentation system with data-sharing packages (e.g., digital libraries) would be essential. The NCE should also fulfil a support and advisory (consultation) role, provide legal expertise (to harmonize legislation and manage

conflicts), communication services and training services, as well as a strong capacity for negotiation and mobilization of resources. The conservation facilities should support both seed conservation (rooms for conservation in the more or less long term and equipment for handling, storage and distribution of germplasm) and conservation of the germplasm of vegetatively propagated species (culture rooms, conservation rooms, cryopreservation equipment, etc.). To complement these, there should be facilities for molecular biology and for characterization and diagnosis, etc., plus an experimental unit (field/farm) for germplasm regeneration. Other requirements would include a regular power supply and a standby generator (with the suggestion to explore solar energy), as well as accessibility and availability of services to enable distribution (e.g., post office).

3.5.3 Requisite skills

To provide the necessary skills, the NCE should have a complement of personnel that includes genebank curators, seed technicians and *in vitro* culture specialists supported by a maintenance team (e.g., refrigeration engineers). In addition, there should be biological scientists (molecular biologists, biostatisticians, population geneticists, agronomists, botanists, taxonomists, ecologists), social scientists (ethnobotanists/anthropologists, economists), lawyers and information specialists (expertise in databases and geographic information systems), communications services and training/teaching/technology-transfer services. In relation to communications, NCEs should play a role in informing other organizations in the region, for example, by updating information on genetically modified organisms.

3.5.4 Relationship with CGIAR centers, ARIs and NARS

There is clear scope for exploiting synergies and complementarities among the CGIAR centers, ARIs, NARS and NCEs, all of them being components of the regional conservation strategy. It is important to establish strong links between the excellent genebank facilities within the CGIAR and ARIs in the region and the NCEs. The CGIAR centers conserve important collections of major crop and agroforestry species from WCA under secure medium- and/or long-term conditions in seed banks, field genebanks and *in vitro*, and make material from the collections available on request. The centres could backstop the NCEs by providing training in genebank management, molecular and phenotypic characterization, seed health, information management, IPR issues and international conventions. They could also assist in duplication of accessions held in the NCE collections.

ARIs such as CIRAD and IRD are well established in WCA and have long-standing relationships with NARS in the region. As well as holding important collections of crop species relevant to the region and offering training capacity, they have significant research activities on germplasm management *ex situ* and *in situ*, and on diversity analysis. Their involvement in the OECD's "centres de ressources biologiques" (CRBs), (e.g., for rice in Guadeloupe) is relevant to the creation of NCEs.

While it is not impossible that a CGIAR center could come to play the role of an NCE within the regional conservation strategy, it should be noted that the main objective of the creation of the NCEs is to bolster the participation of NARS. In any case, close support from CGIAR centers must be assured. NCEs would have a wider mandate than the CGIAR centers and should be adding value to the CGIAR system. They would give

first priority to orphan crops/CGIAR non-mandate crops and then extend, progressively including CGIAR mandate crops. It is possible that certain CGIAR activities could be outsourced to NARS.

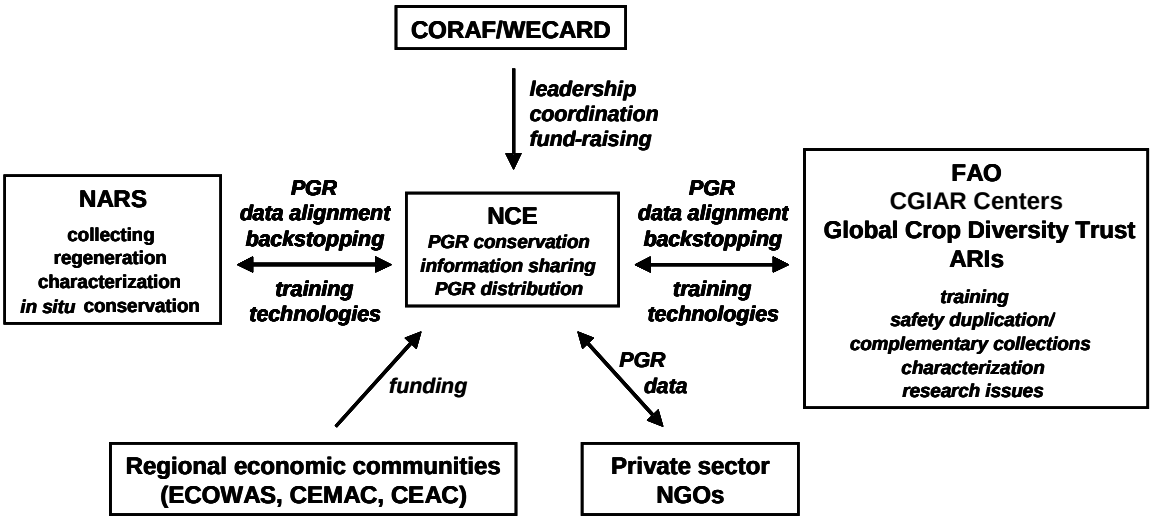

Figure 1. Schematic model of linkages between nodal centres of excellence and other players

A range of potential linkage arrangements among CGIAR centers, ARIs and the NCEs were identified (see Figure 1) including exchange of germplasm and of information/databases, as well as standardization and harmonization of documentation, capacity building and joint research projects. These arrangements would require a memorandum of understanding between the CGIAR-ARIs and NARS-NCEs-CORAF/WECARD, as would linkages between NCEs and national genebanks. The latter linkages would add value to national activities, reinforcing NARS capacity and assisting in specific areas such as the harmonization of databases. The system of NCEs could take particular care of material from countries experiencing armed conflict, potentially arranging safety duplication, including duplication in another NCE. National genebanks might also be in a good position to help NCEs by offering regular regeneration of their own genetic resources in the proper environment to maintain specific adaptation, collecting in their own country and sharing materials with NCEs, as well as providing support on characterization, *in situ* conservation, and collation of indigenous knowledge related to PGR documentation.

Regarding wider linkages, including links with initiatives or genebanks outside the region, the CRBs initiated by OECD were brought up as a good example. Linkages with the private sector would also be possible, noting though that this could introduce particular IPR/benefit-sharing considerations. The importance of staying in the public domain was emphasized, as would also be the case in possible collaboration with NGOs.

3.5.5 Areas of research

The conference next considered the research and scientific dimensions of NCE operation. It was concluded that NCEs should engage in active research since this would strengthen germplasm management and increase the value and use of PGR collections as well as generate regional public goods. It was also observed that significant advances made during the last 40 years in the development of tools and methods would need to be integrated into PGR science and research within the NCEs.

A number of focal research areas that needed to be addressed within the NCEs were identified:

- Conservation quality standards, cryopreservation techniques for recalcitrant seeds, and germplasm health issues
- Diversity of both major crops (on core collections and heterotic/manageable gene pools for breeding) and neglected crops (on taxonomy, genetic structure, reproductive biology and species complexes)
- Biotic and abiotic stress tolerance and genotype by environmental interactions, genomic research and allele mining for useful traits, and development of post-harvest processing techniques
- Management and advanced use of information generated from *in situ* conservation projects, including geographic distribution of landraces (virtual collections); building synergies between *ex situ* and *in situ* conservation to add value to collections through a better understanding of germplasm and in the flow of information, including indigenous knowledge and farmers' preferences; and linking PGR and society including issues on gender and networks
- Storage of valuable and endangered germplasm, restoration and reintroduction of local germplasm, and facilitation of germplasm exchange between communities
- Development and sharing of protocols for improved germplasm exchange, curation of field collections and management of endemic pesticides and diseases
- Impact of global climate changes and genetic erosion, and the role of PGR diversity in agroecosystem sustainability
- Promoting use of diversity and access to germplasm for national agriculture, and strengthening capacities in PGR legislation

Conference participants stressed that to achieve progress in all of these areas, NCEs would need to build partnerships with ARIs, CGIAR centers and biotechnology laboratories. NCEs should also engage and raise awareness among decision makers and promising young scientists in order to promote research activities.

3.5.6 Legal status of NCEs

A key objective of NCEs is to establish a legal framework that enables the exchange of plant genetic materials in WCA to be regulated in the context of a regional strategy and the legal status of the NCEs. More specifically, the objective is to identify areas of research for the NCEs and set the basis for the legal status of *ex situ* collections similar to the situation that already exists in the CGIAR centers. The International Treaty creates an appropriate multilateral system of access and benefit sharing. Since most countries in WCA have ratified the International Treaty, any exchange of Annex 1 materials among the members of an NCE should be governed by the SMTA, with the time saving,

transparency and equity that it brings. Furthermore, the participants agreed that it would be a good idea, in support of the proper functioning of the NCEs, for a harmonized approach to be adopted within the region to use the SMTA or a slightly revised version thereof for exchange of non-Annex 1 materials. It was recommended that CORAF/WECARD, with the assistance from a lawyer, should lead in the development of a policy concerning movement of non-Annex 1 materials. It was also recommended that CORAF/WECARD should encourage countries in WCA to nominate more species to the list in Annex 1. CORAF/WECARD should also encourage countries that have not ratified the International Treaty to do so.

There is a range of options for the legal status of the collections that will be held by NCEs on behalf of WCA. The choice among these should take into account the ease of collecting and sharing materials, the investment required and the availability of human resources with the required skills and capacities for the management and coordination of the NCEs. It should also take into account the possibility of the NCEs to be taken over eventually by a regional economic commission, such as CEMAC or CEDEAO/ECOWAS.

Issues related to the ownership of NCE collections and the question as to who should be able to influence or control how an NCE executes its duties vis-à-vis the regional conservation strategy were addressed. It was foreseen that an NCE should be built using the existing infrastructures of selected countries. These infrastructures should be upgraded to play regional roles. NCEs would belong to the regional economic commissions (CEMAC, CEEAC and CEDEAO/ECOWAS) with CORAF/WECARD as the technical implementing body. However, in the long term, NCEs could develop more facilities and acquire more autonomy and independence. While host countries should provide the minimum staffing required to start with, additional expertise from other countries within or outside of the subregion could be needed to strengthen the capacities of the NCE.

The conference also examined how materials should be exchanged with states that are not party to the International Treaty, using the SMTA or some other specified instrument. The conference proposed that, when WCA countries are sending materials, the SMTA will apply regardless of whether or not the recipient is located in a state that is party to the International Treaty. The conference also recommended that when WCA countries receive materials from states that are not signatories of the International Treaty, they should ask the supplier to send the material under the SMTA. Otherwise, both parties should agree to use another tool.

3.5.7 Funding mechanisms and sustainability

Participants discussed the critical issue of ensuring sustainable funding for NCEs. A number of key points emerged. Sustainability of subregional cooperation and collaboration will depend greatly on institutionalization of the system at the national, regional and international levels. Nationally, this should be with direct and firm commitments of countries at a ministerial or head-of-state level. CORAF/WECARD should further develop the idea of the NCE and take it to various partners at the regional and international level (CEDEAO/ECOWAS, CEMAC or CEAC, NEPAD, FARA, etc.), encouraging these partners to place NCEs in their programmes for the development of the subregion. Funding strategies should include a commitment from hosting countries to

support the functioning of the NCE with secure funding for NCE operations, increased annual contributions to CORAF/WECARD from member countries, support to specific project proposals from donors, and provisions made by CEDEAO/ECOWAS, CEMAC and CEAC to support the system. Effective communication of results was identified as a factor in sustainability through raising awareness. The possibility of creating commercial activities that generate financial resources was also noted.

Participants in the conference expressed their support for the NCE initiative and their willingness to support efforts on PGR management in the subregion, with a number of specific comments and commitments:

- The Trust is interested in a long-term conservation strategy and advised CORAF/WECARD to clearly indicate the link between regional and the global systems while developing its programme, and to indicate the specificity of the regional collections.
- IRD confirmed its availability to provide technical support through training of national scientists and collaboration in regional and international projects.
- CIRAD added its availability to contribute in the development of activities related to *in situ* conservation to complement *ex situ* conservation.
- A number of CGIAR centers are already supporting the initiative and have aligned their medium-term plans with the regional medium-term plan for WCA.
- FAO is eager to continue working with CORAF/WECARD, the CGIAR centers and all national partners to make NCEs a reality.

3.6 Conference conclusions and recommendations

The plenary presentations and working group discussions provided a wealth of material that was incorporated into a draft document—the "Ouagadougou Declaration"—that identifies the shared agreements that were reached at the conference and sets out recommendations for action. During the final working session of the conference, participants reviewed, refined, amended and adopted the document as reflected in the consensus form presented in the following section.

The Ouagadougou Declaration: Towards Regional Cooperation for Effective and Efficient *Ex Situ* Conservation of Plant Genetic Resources for Food and Agriculture in West and Central Africa

Preamble and Background:

A regional conference entitled: "Towards Regional Cooperation for Effective and Efficient *Ex Situ* Conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) in West and Central Africa (WCA)" was organized in Ouagadougou, Burkina Faso, 12–15 September 2006, under the auspices of CORAF/WECARD. The conference was organized with the collaboration of IPGRI (now Bioversity International), the Trust, GRPI and GRENEWECA.

The overall goal of the conference was the establishment of a mechanism and framework for regional cooperation and collaboration, including establishment of Nodal Centres of Excellence for conservation of the region's plant genetic resources (PGR). Specifically the aim was to develop an implementation plan for the creation of a regional *ex situ* conservation system for priority plant genetic resources for food and agriculture (PGRFA) in WCA.

Participants at the conference came from a broad range of institutions and organizations with programmes and responsibility for PGRFA conservation and use in WCA, including senior representatives from:

- The national agricultural or PGR programmes of 14 countries in WCA
- The regional organizations CORAF/WECARD, NEPAD Science and Technology; FARA, and INSAH/CILSS
- CGIAR centers (IITA, ICRISAT, ICRAF, WARDA, IPGRI, ILRI), the CGIAR System-wide Genetic Resources Programme (SGRP), IRD, CIRAD, the Trust, and FAO

The Ouagadougou conference was organized as a direct follow-up to an earlier initiative, the "Regional Conference on Plant Genetic Resources Management and Food Security in West and Central Africa", that was held at IITA Ibadan, Nigeria (26–30 April 2004), under the auspices of CORAF/WECARD. The Ibadan conference noted that PGRFA conservation and genebanking capacity, in terms of both physical and human resources, is generally weak in various countries in WCA. It also noted that only a few countries in the region are able to make moderate commitments towards supporting research, conservation and use of the region's rich and diverse genetic resources.

The Ibadan conference called upon CORAF/WECARD to initiate a process to develop a regional approach to conservation of PGRFA, including exploring possibilities for establishing Nodal Centres of Excellence (NCEs) for genebanking of priority species and collections in WCA.

In response to this recommendation, CORAF/WECARD commissioned a consultant study in 2005 to assess existing plant genetic resources conservation facilities and capacities in WCA countries, and to initiate development of a framework for a strategy for PGRFA conservation in the region.

The conclusions of the study were presented to the CORAF/WECARD Annual General Assembly held in The Gambia in 2006. The General Assembly endorsed the concept of the regional conservation strategy including the establishment of NCEs and requested CORAF/WECARD to develop the proposal further.

The Ouagadougou conference is in direct response to the CORAF/WECARD General Assembly recommendation. The conference reviewed the CORAF/WECARD-commissioned study, addressed outstanding issues, and worked towards the development of a strategy for cooperation within the region for the conservation and use of PGRFA.

In consequence, the conference, after four days of deliberation, arrived at conclusions and recommendations, set out in this Ouagadougou Declaration. The declaration captures the shared agreements and recommendations from the conference.

Shared agreements

NCE functions and modalities

- NCEs provide the basis for creating *ex situ* collections in WCA with long-term conservation objectives.
- NCEs are not just dedicated to conservation; they also should have research and training components.
- Research at NCEs should add value to what is ongoing at national genebanks; NCE research should focus on the development of regional public goods.
- Responsibilities for multiplication, evaluation, characterization, and other research should be spread among a range of partners located in countries in WCA, including those that are not hosting NCEs and, in some cases, outside WCA.
- The NCEs will be located in selected countries/organizations but will hold collections on behalf of the regional partners.
- WCA countries and CORAF/WECARD should facilitate the movement of experts to work at the NCEs.
- CGIAR institutions and ARIs, both inside and outside WCA, are critical partners in the WCA regional conservation strategy.
- To get started, the NCE will build on existing functional national or international facilities and networks of partners (providing conservation and use services such as regeneration, safety duplication, etc.).
- The regional economic community organizations: ECOWAS, CEEAC and CEMAC should be involved in oversight of the NCEs.
- Over time, the NCEs will increase in size and capacity, and will gain financial support from the regional economic organizations to establish their own facilities to function on a sustainable basis.

Criteria and process for establishing NCEs

- Eligibility criteria for a country to host an NCE include: ratification of the International Treaty; membership in good standing of CORAF/WECARD; submission of a hosting request by government; and a good track record of the national institution in PGR conservation and management, and in financial management.

- To host an NCE, countries are expected, at the minimum, to ensure current levels of funding for the national organization.
- CORAF/WECARD should organize a competitive bidding process for countries that want to host NCEs.
- CORAF/WECARD should develop host country agreements/guidelines with well-defined responsibilities.

Scope of plants conserved in the NCE

- A list of priority crops (see below) was agreed to by the conference participants as entry points for further discussion and elaboration. Additional crops could be considered in the future.

Policies for exchange of materials and information in support of the regional conservation strategy

- Materials listed in Annex 1 of the International Treaty and associated non-confidential information will be exchanged using the SMTA under the International Treaty since most countries in WCA have ratified the International Treaty.
- There needs to be a harmonized approach for the exchange of non-Annex 1 material and associated information within the region (e.g., fonio, frafra potato, forest species). The policy should follow the logic of the International Treaty and the SMTA adopted by the Governing Body of the International Treaty in June, 2006. Perhaps the SMTA would need to be adapted to respond to the specific conditions of the region.
- CORAF/WECARD should promote the inclusion of additional crops of importance to WCA in Annex 1 of the International Treaty. Using the SMTA for those materials would represent a proactive move to get them eventually included in Annex 1.
- CORAF/WECARD is invited to advise the few countries in the region which have not ratified the International Treaty to ratify it as quickly as possible. Meanwhile, the SMTA should be used when sending Annex 1 materials to non-parties. Non-parties should be asked to supply materials using the SMTA. If they refuse, a new agreement will need to be developed.

Funding strategy

- Countries hosting an NCE must secure long-term commitment of financial support for their portion of the cost of operating the NCE.
- CORAF/WECARD member countries should make special contributions to the regional conservation system, including the NCEs, by increasing their annual contributions to CORAF/WECARD.
- ECOWAS, CEMAC and CEAC should make provisions in their budgets to support the regional conservation system.
- Donor organizations should also be invited to provide financial support for the conservation strategy to be developed.

Recommendations

The conference accepts NCEs as an important instrument for enhancing cooperation within the region to manage and conserve PGR. The outcome of this conference should culminate in the development of a regional strategy for management and conservation

of PGRFA, which should be included in the CORAF/WECARD overall strategic plan to be completed by May 2007. In this regard, the conference recommends the following:

1. In general, CORAF/WECARD should take full ownership of the process of developing the regional strategy which includes NCEs. More particularly, CORAF/WECARD should:
    - Create links with relevant regional economic community bodies to ensure that the conservation strategy is included in their respective strategic plans for implementation
    - Create, to start with, four NCEs based on plant species and agroecological zones:
        - cereals and related plant species in the Sahelian zone
        - root and tuber crop species in the Coastal West African zone
        - coconut collections and other industrial crop species in the Coastal West African zone
        - banana and plantain collections in the Central African zone
    - Implement the process for the initiation and implementation of the regional strategy, including the process of countries' bidding to host NCEs, and developing host country agreements
    - Coordinate efforts among countries from WCA to expand the list of materials included in Annex 1 of the International Treaty to include more crops of regional importance
    - Lead the process to develop a WCA policy for exchange of non-Annex 1 materials
2. Country representatives should take steps to ensure the internalization of the concept of the regional PGRFA conservation strategy to be developed, including the creation of NCEs, within their planning processes, and to ensure the involvement of relevant Ministries to obtain strategic recognition.
3. Countries within the region that have not already done so should ratify or accede to the International Treaty and effectively implement it in national laws, policies and or practices.
4. The CGIAR centers and ARIs should embed the regional conservation strategy to be developed in their own implementation plans, acting as key partners in the strategy.

List of priority crops in the region

1. Cereals:
Rice, maize, sorghum, pearl millet and fonio

2. Grain legumes:
Cowpea, bean, groundnut (peanut), Bambara groundnut, pigeon pea, groundbean or Kersting's groundnut

3. Horticultural crops:
Tomato, onion, okra, pepper, eggplant, roselle, cucurbit

4. Root and tuber crops:
Yam, cassava, taro, sweet potato, Irish potato, Hausa potato

5. Forest genetic resources:
Timber (ronier palm or African palmyra palm, raphia palm), food tree species (fruit trees, leafy vegetables), medicinal

6. Fodder species :
Poaceae, leguminous, tree forages/tree fodder

7. Banana and plantain

Priorities per agroecological zone:

Species	Sahel	Coastal	Forest
Rice, maize	X	X	X
Sorghum, pearl millet and fonio	X		
Kersting's groundnut	X	X	
Okra	X	X	X
Eggplant	X	X	X
Cucurbit	X	X	
Yam		X	X
Taro		X	X
Hausa potato	X		
Forest genetic resources	X	X	X
Oleaginous plants			
Oil palm		X	X
Coconut		X	
Shea butter	X	X	
Sesame	X		
Peanut	X	X	
Banana and plantain		X	X

Chapter 4. Assessment of means and facilities for plant genetic resource management and development in West and Central Africa

Moïse Houssou[1]

Executive summary

At the request of CORAF/WECARD, a consultant mission on the evaluation of capacities for PGR conservation in West and Central Africa was carried out between 8 October and 30 November 2005. It covered nine countries, including three in Central Africa (Cameroon, Congo and Gabon), three in the Sahelian zone (Burkina Faso, Mali and Senegal) and three in the West African Coastal zone (Benin, Ghana and Nigeria).

The objective of this mission was to establish the state of the subregion in terms of *ex situ* conservation of PGR, in order to:

1. Identify countries with a certain comparative advantage to host the nodal centres of excellence for PGR conservation and management
2. Propose a mechanism of regional cooperation that can enable the concerned countries to contribute to the supply of genebanks, have easy access to resources and equitably share profits from the eventual use of these resources

The observations made in the field, discussions held with stakeholders at different levels (policymakers, researchers from national and international centres, senior officers from various departments, etc.) and responses to a questionnaire developed for this purpose make it possible to draw the following conclusions:

1. Countries and institutions dealing with PGR in WCA have truly become aware of the great biological diversity of the subregion and have initiated actions for the conservation and exchange of PGRFA. These actions were particularly visible during the 1970s and 1980s, following on from the twelfth FAO conference, which set up a panel of experts in 1963. During this period, FAO, IPGRI (now Bioversity International) and other organizations added to the national efforts through significant support for the collection, introduction of new genetic material, establishment of genebanks and *ex situ* conservation of PGRFA.
2. The countries visited are not at the same level of experience in terms of PGR management. Generally, efforts made nationally are not at a significant level. In terms of the structure of institutions, activities are undertaken in two ways:
   - within an autonomous national structure whose specific mandate concerns PGR conservation, management and availability to users
   - through breeding programmes carried out in research institutions and coordinated at the national level
3. PGR management in the subregion is faced with a number of difficulties:
   - lack of adequate infrastructure and functional equipment for long-term PGR conservation (most often acquired through international cooperation and now out of order due to a lack of technical support and/or funds for maintenance

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- limited human resources trained in PGR management
- lack of funding for countries to ensure sustainable use of services

4. Apart from a few exceptions, these difficulties have, as a direct consequence, led to the loss of PGR collected or provided through the support of partners. Only working and field collections can be found.
5. These difficulties reflect the economic gloom in the countries, which forces governments to give a low priority to the issue of PGR conservation, even though it is often displayed as a priority in speeches or in strategy papers. In these circumstances, the idea of combining efforts throughout the CORAF/WECARD subregion and creating NCEs is more than beneficial.

After analysing the situation, the consultant mission makes the following proposals for the creation of NCEs:

1. As a prerequisite, CORAF/WECARD should agree with its partners and the government authorities of member countries on modalities to enable NCEs to be fully functional. A workshop is recommended for this purpose.
2. NCEs should be given a mandate for the conservation of all resources, but to avoid excessive specialization, some PGR would be first priority and others, second and third priority.
3. A selection committee of the host countries should be established. A selection grid has been proposed to facilitate the work of the committee.
4. A memorandum of understanding (as per a proposed draft) should be used to highlight the obligations of various actors and serve as a basis for the mechanism of subregional cooperation on PGR.

1. Introduction

The regional conference on the contribution of PGR to food security in WCA, held at IITA, Ibadan, Nigeria, 26–30 April 2004 and organized by CORAF/WECARD, emphasized the importance of strong subregional mechanisms for collaboration and cooperation in conservation, management and sustainable use of PGR. Moreover, it highlighted the fact that national programmes were faced with various problems related to the lack of appropriate infrastructure, limited personnel, limited financial resources and inappropriate research capacity.

At the end of the conference, the participants recommended that CORAF/WECARD:

1. Be more active in demanding that subregional political structures in WCA hold the management, conservation and sustainable use of PGR in high regard as a national priority.
2. Put in place appropriate mechanisms for collaboration and cooperation among countries for concerted efforts and actions in the management of PGR, in order to put an end to genetic erosion in the subregion. Thus, the concept of "Nodal Centres of Excellence (NCEs) for the management of PGR" was proposed.

An NCE is supposed to have an infrastructure endowed with the required characteristics, good-quality equipment, and competent and well-experienced personnel in order for it to be beneficial to the subregion. It will be located in a national institution on the basis of its comparative advantage in PGR management, readiness to share resources with other countries and willingness to make its conserved PGR available. It could also be located in an international institution for respective mandate crops.

CORAF/WECARD opted for the creation of three NCEs in three agroecological zones in the subregion of WCA. However, the establishment of these NCEs needs a prior investigation that will not only survey the existing national capacities for PGR conservation, but will also gather information from concerned parties on the NCE activities and sharing of benefits that might stem from the eventual exploitation of shared resources.

2. Background to the study

2.1 CORAF/WECARD and the problem of PGR conservation

CORAF/WECARD was created in 1987 under the name "Conférence des responsables de Recherche Agronomique Africains et Français" but after a series of mutations followed by an in-depth process of institutional reforms and strategic planning, it was to be known from July 1999 as CORAF/WECARD (Conseil ouest et centre Africain pour la recherche et le développement agricole/West and Central African Council for Agricultural Research and Development. CORAF/WECARD, as opposed to other subregional African organizations (such as the Association for Strengthening Agricultural Research in Eastern and Central Africa [ASARECA] in East Africa and the Southern African Development Community-Sub Regional Coordinating Unit for Agricultural Research and Training [SADC-SRCU] in Southern Africa) focuses on the promotion of agricultural research and development. It covers the entire WCA subregion and is made of the national agricultural research systems

of 22 countries (anglophone, lusophone and francophone) of WCA, which are roughly divided into three agroecological zones as follows:

- The Humid Equatorial Zone includes most countries of Central Africa: Cameroon, Central African Republic, Congo, Gabon, Democratic Republic of Congo.
- The Humid Savannah Zone is made of many countries on the West African Coast: Benin, Ghana, Guinea, Côte d'Ivoire, Liberia, Nigeria, Sierra Leone, Togo.
- The Sahelian Zone includes Burkina Faso, Cape Verde, Chad, Gambia, Guinea Bissau, Mali, Mauritania, Niger, Senegal.

Box 1 provides information on the climate and vegetation in the three zones. Figure 1 provides a map of the countries.

Box 1. Climatic characteristics and vegetation grown in the three zones of WCA

The Sahelian zone: This is a relatively dry area, characterized by annual rainfall ranging from 300mm to 700mm. The vegetation consists largely of grass dotted with shrubs, especially thorny types. But an important part of some countries in this area such as Burkina Faso, Mali and Chad is made up of more or less humid savannah. It is rich in livestock and mainly cereals (sorghum, millet, maize, rice, fonio), legume forages (cowpea, bean, groundnut), vegetables (potato, onion, green bean), horticultural crops (mango, citrus) and cotton, etc., are grown there and contribute substantially to the economy of some of these countries.

T**he Central African zone:** This is the equatorial zone, which is highly humid. It is characterized by rainfall generally ranging between 1,600mm and 2,500mm per year, but it can be as high as 4,000mm, as is the case in the provinces of Littoral and Southwest Cameroon. The vegetation consists of forests, which are more or less dense. But an important part of the territory of certain countries (Cameroon and the Central African Republic) lies in the savannah zone and even in the Sahel (in northern Cameroon). The forest is the greatest resource of this area and is the preferred area for growing perennial crops (palm oil, cocoa, rubber and various fruits), banana and plantain. Root and tuber crops (cassava, taro, sweet potato) are also cultivated.

The West African Coastal zone: In this transitional zone between the Sahel and the forest area, annual rainfall is usually between 700mm and 1,600mm. The vegetation consists of savannahs with large shrubs and sparse forests. Most countries have great climatic diversity, which allows them to cultivate the same crops as the other two zones. Although not to the extent of Central Africa, the forest is also a significant resource, where the perennial plants mentioned above are grown, as well as coffee. The same is true of the cereals and legume forages cultivated in the Sahelian zone. The cotton grown in the savannah is important but it should also be noted that the largest producers of the two most important root and tuber crops (cassava and yam) are in this area.

The diversified environment of WCA is known for its similarly diverse biological resources. It is home to a great variety of indigenous crops that are important in farming, nutrition and medicine. Unfortunately, despite their great importance, these resources are subject to genetic erosion caused by a mixture of uncontrolled exploitation of the resources and natural factors such as desertification. Concerning PGRFA, the number of these plant species is not only considerably reduced but their genetic base is also being progressively reduced by selection and genetic manipulation. This has increased the focus on high-yielding crops and led to the abandonment of lower-yielding indigenous crops, narrowing the genetic resource base for agriculture as a consequence.

Forest resources are particularly at risk because commercial products are collected at a faster rate than they can naturally regenerate. This not only leads to a drastic

reduction of forest cover but also to destruction of ecosystems that are very difficult to reconstitute. The main consequence is the loss of endemic species, particularly non-timber forest resources.

Figure 2. The three CORAF/WECARD subregional zones of WCA

Though the problem of genetic erosion was first invoked in the 1940, it was in the 1970s that the international community took it up, with the creation of IBPGR in 1974. The strengthening of short- and long-term conservation capacity in the subregion will undoubtedly help to curb this genetic erosion and will also provide a safety valve to African agriculture (mostly rain-fed) which is often hit by long spells of drought and other threats such as locusts.

The task of conserving and managing natural resources has always been the core priority of CORAF/WECARD and has always been achieved through setting up regional research projects. It is worth mentioning that, in 1997, to support national efforts, CORAF/WECARD, in collaboration with IPGRI submitted a proposal to the African Development Bank for funding. This proposal stipulated the need for regional collaboration in the conservation and sustainable use of PGR in WCA. The creation of GRENEWECA in 1998 is a clear indication of the willingness of CORAF/WECARD to give the issue of PGR a high priority, even appearing in its strategic plan, which was developed in 1999.

2.2 Strategic partners

In the field of PGR conservation and management, CORAF/WECARD collaborates with a number of strategic partners. These include FAO, Bioversity International (formerly IBPGR and then IPGRI) and other international research centers belonging to the CGIAR and operating in Africa: ICRISAT, IITA and WARDA.

2.2.1 FAO

The Food and Agriculture Organisation of the United Nations was established in 1945 and aims to improve the nutritional status, agricultural productivity and living standards of rural people. As part of its mission, FAO has been involved in various PGR projects. In its organizational structure, FAO has a Commission on Genetic Resources for Food and Agriculture (CGRFA). For almost two decades, FAO hosted and administered IBPGR. FAO has carried out several activities and initiated a number of agreements, including the International Plant Protection Convention (1951), the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (1996) and, in 2001, the International Treaty.

FAO and CORAF/WECARD are privileged partners in terms of PGR. FAO participates in several agricultural projects in its member countries by providing considerable help, which takes the form of providing technical support on collecting, evaluating and conserving PGR so as to reinforce national capacities. FAO also helps its member countries by providing them with financial support to strengthen their local institutions, where they exist, or to meet the cost of building infrastructure and installing equipment for PGR conservation, as well as assisting in research and the training of personnel.

2.2.2 Bioversity International

In 1991, IBPGR evolved into IPGRI, taking the name Bioversity International in 2006. Bioversity's mandate is to advance the conservation and use of genetic diversity for the well-being of present and future generations. It places particular emphasis on developing countries, and its activities are conducted according to the following six focus areas:

1. Managing agricultural biodiversity for nutrition, improved livelihoods and sustainable production systems for the poor
2. Conserving and promoting the use of biodiversity in selected commodity crops of special importance to the poor
3. Enhancing the *ex situ* conservation and use of diversity
4. Conservation and sustainable use of important wild species
5. International collaboration on conservation and use of genetic resources
6. Monitoring the status and trends of useful diversity and valuation of agrobiodiversity

As IPGRI, Bioversity contributed to several international initiatives for promoting the conservation and use of PGR, including the Earth Summit, held in Rio de Janeiro (1992); the International Technical Conference on Plant Genetic Resources, held in Leipzig (1996), which led to the development of the GPA; and the WCA Sub-Regional Technical Conference, held in Dakar in 1995 to prepare for the Leipzig conference.

Like FAO, Bioversity is a privileged partner to CORAF/WECARD in terms of PGR in WCA, operating through its office in Cotonou, Benin. Bioversity has contributed to the development of human resources through short-term training offered to researchers and technicians, as well as through postgraduate courses organized in various European universities. Strengthening the conservation capacities in countries of the subregion is one of Bioversity's priorities in WCA. In addition, Bioversity has contributed significantly to the organization of national workshops that have brought together all stakeholders to reflect on the problems of PGR management, to

set up national committees to coordinate activities in the PGR sector and, in some cases, to develop national programmes on PGRFA, as recommended by the GPA.

2.2.3 Other international CGIAR centers

The CGIAR centers operating in WCA (WARDA, ICRISAT and IITA) are heavily involved in projects and programmes in collaboration with the subregion's NARS. Training for management as well as exploration and collecting of PGR done in collaboration with NARS scientists are prominent in these programmes. It is important to mention the crucial role played by such centres in conserving duplicate collections from national exploration activities in their genebanks. They are equipped with modern infrastructures and high-performance equipment for conservation. Most of the materials conserved at the national level are lost because of poor genebanking capacity in terms of both physical and human resources.

2.2.4 ARIs and universities in developed countries

Many advanced research institutes and universities in developed countries cooperate with CORAF/WECARD member countries in the field of PGR, either directly or through regional projects. They participate particularly in exploration (in some cases carrying out characterization) and in long-term conservation. Relevant institutes include IRD and CIRAD in France, the Kiev Botanical Garden and some British and American universities.

2.2.5 The Global Crop Diversity Trust

The Trust is an international organization initially located at the headquarters of FAO, but now based in Bonn, Germany. Its mission is to promote:

1. Long-term conservation and availability of PGR, in order to achieve food security
2. A global system that is efficient, effective, viable and sustainable in accordance with the International Treaty and the GPA

To achieve this, the Trust provides financial support for the conservation of crop diversity through the interest generated from financial resources that it mobilizes and places in banks. According to its statutes, which stipulate that it must operate within the framework of the International Treaty, the Trust is a privileged instrument in the funding strategy of the Treaty. This explains the emerging partnership between CORAF/WECARD and the Trust, within their respective missions, to further their commitment towards promotion of medium- and long-term conservation of PGR in the WCA subregion.

3. Objectives and conduct of the mission

3.1 Objectives of the mission

To follow up on the recommendations made at the regional conference on the contribution of PGR to food security, CORAF/WECARD and the Trust commissioned a consultant to survey existing national capacities on PGR management in the subregion, propose actions to be taken to establish effective cooperation on PGR and identify the countries that possess a comparative advantage to handle regional capacities in this domain. The objectives of the mission were as follows:

1. To visit countries in the subregion so as to assess the following:
   - existing national capacities for conservation and development of PGR in terms of infrastructure, equipment and human resources
   - the importance and status of existing national collections
   - countries' commitment to international conventions and treaties
   - development and enforcement of national legislation
2. To draft a regional collaborative mechanism for conservation of PGR using the NCE concept
3. To develop a list of criteria for selecting hosting countries and institutions
4. To develop a draft memorandum of understanding to be signed between stakeholders

The terms of reference are given in annex 1.

3.2 Conduct of the mission

The mission was carried out in two stages, which consisted of country visits and the drafting of the evaluation report and various documents. Nine countries were selected for the visits, taking into account the three agroecological zones of the subregion. They were Cameroon, Congo and Gabon in Central Africa; Benin, Ghana and Nigeria in the West African Coastal zone; Burkina Faso, Mali and Senegal in the Sahelian zone. These countries were visited between 8 October and 31 November 2005. The detailed schedule of visits is given in annex 2.

During this phase, the consultant met with researchers from agricultural research institutes and universities, and with senior officers from relevant ministries (science and technology, agriculture, environment) and technical departments in charge of PGR management. The consultant visited PGR conservation facilities, where they existed, as well as other facilities that could contribute to PGR management, such as biotechnology laboratories and quarantine facilities. Living crop collections, parks and botanical gardens were also visited.

4. Results

4.1 Political and institutional environment

A country's political commitment to PGR can be seen at two levels: (1) the adoption of international accords[2] and (2) a national institutional and regulatory environment that facilitates PGR conservation, management and use.

4.1.2 Regarding international agreements

Most countries have signed and, in most cases, ratified agreements on biodiversity, environmental protection and PGRFA. Box 2 presents the main agreements by area of interest.

CORAF/WECARD member countries that have already ratified the International Treaty to date are Benin, Cameroon, Central African Republic, Chad, Republic of Congo, Côte d'Ivoire, Democratic Republic of Congo, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Sierra Leone. Countries that have signed are Burkina Faso, Cape Verde, Gabon, Nigeria, Senegal.

[2] The term "international accords" used in this document includes conventions, treaties, memoranda that were established at the sub-regional, continental and global levels.

Box 2: Major international conventions

PGRFA

- International Undertaking on Plant Genetic Resources for Food and Agriculture (1983)
- Action Plan for the World Food Summit (1996)
- Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture (1996)
- International Treaty on Plant Genetic Resources for Food and Agriculture (2001)

Biological Resources

- Convention to the Preservation of Fauna and Flora in Their Natural State (1933)
- International Plant Protection Convention (1951)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)
- Ramsar Convention on Wetlands of International Importance (1971, 1982)
- International Agreement on Tropical Timber (1983)
- Agenda 21: Programme for Sustainable Development (1992)
- Convention on Biological Diversity (1992)
- Rio Declaration on Environment and Development (1992)
- Rio Declaration on Forest Principles (1992)
- African Model Legislation for the Protection of the Rights of Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources (1998)
- Cartagena Protocol on Biosafety Relative to the Convention on Biological Diversity (2000)

Trade and intellectual property rights

- General Agreement on Tariffs and Trade (GATT) Final Act of the Uruguay Round of Multilateral Trade Negotiations (1994) including:
  - Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (1994)
  - GATT agreement on the Application of Sanitary and Phytosanitary Measures (1994)
- International Convention for the Protection of New Varieties (UPOV) (1978, 1991)
- The Bangui Agreement (African Intellectual Property Organisation (1997, 1999)

Source: Spillane et al. (1999).

4.1.2 Regarding national regulatory and institutional frameworks

Countries, for the most part, have made a great effort in the field of environmental protection, particularly in the wake of the Rio Convention. They have often defined policies and put in place institutional arrangements, among which are the following:

1. Reforms for better actions in regard to biodiversity by creating a ministry of environment, where none existed
2. Elaboration of a monograph and a national report on biodiversity
3. Definition of a national strategy and a plan of action for the environment or the conservation of biodiversity and promulgation of subsequent laws (environmental law, forest code, biosafety law, etc.)
4. Establishment of coordination mechanisms (e.g., national committee for the management of the Biodiversity Convention) and structures to implement policies and actions envisaged in the environmental field

Nevertheless, the situation is rather different for PGRFA:

- Some countries, such as Ghana, Mali and Nigeria have shown an understanding of the need for PGR conservation and have so far created an autonomous unit, centre or institute. They have put in place functioning and well-equipped infrastructures. However, unfortunately, the genetic resources unit established in Mali doesn't have adequate equipment.
- Cameroon, without a structure dedicated to PGR, managed to develop a PGR management programme within IRAD in 1982. In 1996, the mandate of this programme was expanded to all the country's biodiversity.

- Other countries have put different coordination mechanisms in their national plans. All activities related to PGR are carried out in centres, research institutes and departments under various ministries. This is the case in countries such as Benin, Congo and Senegal, which have empowered a researcher or a senior officer at the Ministry of the Environment to serve as a PGR focal point (as in Congo).
- In Senegal, in addition to the researcher in charge of the national programme, a formal working group was created at ISRA to serve as an interface between all PGR actors within the institute.

In almost all countries visited, to support national efforts, IPGRI initiated the creation and implementation of a national committee on PGR to act as an interface between all actors at the national level, and to also coordinate all activities related to PGR. Three situations of national committees were observed in the countries visited:

- A committee duly established by a text of law signed by political authorities (Benin, Ghana, Nigeria, Senegal)
- A process stalled at an advanced stage due to lack of political will, although one can talk of the existence of an informal committee (Burkina Faso, Cameroon, Mali)
- No visible initiative (Congo, Gabon)

For many reasons, and especially lack of funds, none of the established committees fully plays its role.

Generally speaking, the political and/or administrative authorities met with at various levels showed great enthusiasm for the installation of NCEs for the management of PGR in the subregion. They declared their willingness to host such a centre and share their resources with other countries in the subregion. Cameroon, in particular, has in the past shown its commitment by transforming its research centre in Njombé into an "African Research Centre on Banana and Plantain".

4.2 Infrastructure and equipment for plant genetic resources conservation

There are two types of infrastructure for conservation.

First, there are cold rooms used for the conservation of seeds. This study does not take into account air-conditioned rooms, which are usually used for the conservation of working collections, but only conservation rooms used for medium- and long-term conservation. Thus, the case of conservation of palm oil seeds, which is the subject of intense demand by users in WCA, is not discussed. Second, there are *in vitro* laboratories used to conserve root crops, tuber crops and grain species. In addition to these two types of infrastructure for conservation, one needs to add the support infrastructure used in the management of PGR

4.2.1 Cold rooms

One can generally say that the subregion is still poor in facilities of this type. It is not that they don't exist, but most are worn out or there is no adequate supply of electricity.

Central African zone

- The mission did not see any cold rooms on the ground.
- According to information gathered from the questionnaires, IRAD in Cameroon has many cold rooms in its stations (Nkolbisson, Garoua, Maroua and Bambui) and a small cold room in Dschang for the conservation of rice, maize and grain

legumes. In most stations, particularly those located in the northern areas, such as Garoua and Maroua, IRAD has freezers that are also used to conserve genetic material outside the cold rooms. Most equipment and facilities no longer function due to lack of financial resources. Currently a rehabilitation process has begun.
- The centres in Loudima and Pointe Noire in Congo have cold rooms, but they have not been functional for years.

Sahelian zone

- The situation seems a bit better, although the majority of cold rooms in the institutions visited are not functional.
- In Burkina Faso, the National Center for Forest Seeds has two cold rooms (temperature of conservation between 4° and 6° Centigrade) with a capacity of two to three tons of seed. Two other newly acquired cold rooms (including one whose temperature goes to –20°) increase the capacity of conservation to more than 10 tons. Three freezers and a ventilated room are also available. The Environmental and Agricultural Research Institute (INERA) has functional freezers used for long-term conservation at Farako-Ba and Bobo-Dioulasso stations.
- In Mali, the Institute of Rural Economy (IER) has three non-functioning cold rooms with two at Sotuba and one at Cinzana. The Genetic Resources Unit (URG), based at Bamako, also has freezers used for long-term conservation.
- Senegal has a functional cold room (temperature of conservation of 0° to 4°) with a capacity of 25m^3 at the National Research Laboratory on Plant Production (LNRPV) and two at the Centre for Horticulture Development (CDH) in Dakar, plus freezers for long-term conservation at LNRPV and at the Bambey station. In the country, there are four other cold rooms, including two non-functional cold rooms at Bambey, one at Ziguinchor and another one at the National Center for Forestry Research (CNRF) in Dakar.

West African Coastal zone

- This zone seems generally more advanced because of NACGRAB in Nigeria and PGRRI in Ghana, which have adequate infrastructure and equipment.
- In Benin, the National Agricultural Research Institute (INRAB) has a functional cold room with a capacity of 40m^3 at the Niaouli research centre and another non-functional cold room at the Ina centre. Long-term preservation is ensured by freezers.
- In Nigeria, NACGRAB is equipped with a functional large-capacity cold room (560m^3) for long-term conservation of all PGR available in the country. Apart from this, there are cold rooms in other research institutes that are used for the conservation of their mandate crops.
- In Ghana, PGRRI opted for the use of freezers for long-term conservation; it has a dozen. The Savanna Agriculture Research Institute (SARI), IRC and the Forestry Research Institute of Ghana (FORIG) also have facilities for PGR conservation.

Table 1 shows the situation in all the countries visited.

Table 1. Cold Rooms and Freezers by Zone and Country

Zone	Country	Cold rooms			Energy		Freezers	
		Number	Location	Capacity (m^3)	Source*	Power generator functionality	Existence	No. functional
Central African	Cameroon	1	Nkolbisson	120	E		—	—
	Congo	2	Loudima	21	E and G	No	—	—
			Pointe Noire	—	E and G	Yes	—	
	Gabon	—	—	—		—	Yes	?
Sahelian	Burkina Faso	7	Farako-Bâ (2)	120 & 18	E and G	—	Yes	?
			C NSF(4)	62	E and G	Yes	Yes	5
			Kamboisé (1)	5	E and G	Yes	Yes	5
	Mali	3	Sotuba (2)	—	E and G	No	Yes	5
			Cinzana (1)	—	—	Yes		
			URG		E and G			
	Senegal	7	CDH Dakar (2)	200	E and G	Yes	No	
			LNRPV Dakar (1)	25	E and G	Yes	Yes	3
			CNRA Bambey (2)	—	E and G	No	Yes	1
			CRA Ziguinchor (1)	Large capacity		No (station closed)	No	
			CNRF Dakar (1)	30	E and G	No	Yes	3
	Benin	2	Niaouli (1)	40	E and G	Yes	Yes	?
			Ina (1)	—	E and G	No		
West African Coastal	Ghana	?	PGRRI		E and G	Yes	Yes	10+
			Other centres					
	Nigeria	?	NACGRAB	560	E and G			
			Other centres					

* E = mains electricity; G = Generator.

4.2.2 *In vitro* laboratories

All countries visited have, within their research institutes and universities, biotechnology laboratories for vegetable crops, which are more or less well equipped and functional. None of these laboratories, apart from those of NACGRAB in Nigeria and PGRRI in Ghana, has the conservation of PGR as its initial mandate. Even in these two cases, these laboratories do not perform this function yet. It is obvious that a spatial rearrangement and the judicious use of these laboratories can enable them to effectively contribute to the conservation of PGR, as well as carrying out isozyme and molecular characterization. Unfortunately, the mission was only able to obtain precise information about the current capabilities and potential in a few cases. For illustrative purpose, the mission observed the following:

- **Burkina Faso:** There is a biotechnology laboratory at the Biological Sciences Research Centre, which focuses on several themes, including environment and medicinal plants. Also seen at INERA in Kamboinsé, was an important amount of equipment purchased with funds from the National Programme for the Development of Agricultural Services (PNDSA) and the Francophone Agency, which are still waiting to be installed in the building that was renovated to serve as a genetic and biotechnology laboratory.
- **Mali:** The Institute for Training and Applied Research has a functional agro-physio-genetic and biotechnology laboratory that is endowed with qualified personnel. The laboratory is in charge of, among other work, developing genotypes with strong drought resistance in collaboration with the Regional Center for Studies on the Improvement of Plant Adaptation to Drought (CERAAS) Senegal, which hosts the molecular biotechnology unit.
- **Senegal:** The ISRA Plant Production Laboratory, created in 1992 for the fight against drought in the Sahel, has an important section on *in vitro* culture (called URCI), which contains two rooms for experimentation with four compartments each; four rooms for acclimatizing *in vitro* plant crops, with a capacity of 80,000 *in vitro* plants; and four phytotrons of 600 litres each (or capacity for 366 jars). This laboratory is functional despite some maintenance difficulties. The Faculty of Science and Technology at the University of Cheikh Anta Diop in Dakar also has a molecular biotechnology laboratory, which is working on several themes including biological diversity. Though not equipped for cryogenic preservation, this laboratory has staff with expertise in this area.
- **Gabon:** Apart from the universities that it was not possible to visit, IRAF has a laboratory of *in vitro* crops with a storage capacity of 12,000 to 15,000 *in vitro* plants, which was installed four years ago. This laboratory is functioning and properly maintained.
- **Cameroon:** The universities (Yaounde, Dschang, Buea), IRAD's specialized centres, the African Research Centre on Bananas and Plantains (CARBAP) in Djombé and the Ekona centre all have biotechnology laboratories.
- **Congo:** Through international cooperation, the Centre for Research on Genetic Improvements of Plants (CERAG) has a laboratory for *in vitro* culture, which, despite the damage caused by social and political unrest from 1993 to 2000, is still operational and focuses on the following crops: cassava, yam, banana and plantain, potato, taro, citrus and sweetleaf (*Stevia*). The laboratory has a conservation capacity of 12,000 test tubes.
- **Benin:** The mission visited a genetics and biotechnology laboratory at the University of Abomey-Calavi, which has a functional *in vitro* culture unit that focuses on root and tuber crops (yam and cassava).
- **Ghana:** PGRRI is poised to establish a major biotechnology laboratory for the

management and conservation of PGR, especially root and tuber crops. The project is relatively well advanced, the building is already constructed, and the equipment has already been purchased. The Biotechnology and Nuclear Agriculture Research Institute (BNARI), whose mission is to promote agricultural development through the efficient application of nuclear technology and biotechnology, has a particularly impressive tissue-culture unit with great capacity, proper infrastructure and equipment. Installed in 2003, this unit has six crop rooms and six storage rooms with two-thirds currently in use. So far, the *in vitro* culture unit focuses on the production and supply of seedlings to large-scale pineapple producers, but it is also interested in other crops, such as yam, cassava, sweet potato, banana and plantain, and orchids. The Faculty of Sciences of the University of Ghana in Accra also has a functional tissue-culture laboratory. Oriented towards training students and producers, this laboratory also has a section for cryogenic preservation, which was set up three years ago.

- **Nigeria:** Apart from the existing units at the specialized agricultural research centres of which only the National Root Crops Research Institute (NRCRI) was visited, NACGRAB has a tissue-culture unit whose mandate is the conservation of PGR. However, it is not yet fully used for conservation.

4.2.3 Support infrastructure for PGR management

Among these facilities, there are quarantine services, laboratories for plant health control and certification of seeds. The latter exist in all countries visited and are more or less functional. The role of quarantine services is much more important in the transfer of material. Unfortunately, in many cases these services, which are usually located in ports and at the borders, are not always functional. Where they exist, they mainly focus on foodstuffs. The mission visited the Nigerian quarantine service located at the same site as NACGRAB. Although the infrastructure and equipment for quarantine services are in a state of dilapidation, its proximity to NACGRAB is a great advantage for managing PGR transfers.

At the National Centre for Forest Seed (NCFS) in Burkina Faso, it was reported that in 2005 there was an acquisition of equipment for analysis of the environment, measurement of carbon and nitrogen, and recording of photosynthetic activity. This can be considered as a supporting infrastructure and equipment for conservation.

4.3 Plant genetic resources conserved in the subregion

Over 90% of all activities related to PGR (exploration, collecting, conservation and use) are conducted by agricultural research institutes and universities. They include:

- indigenous crops of the subregion: cereals, grain legumes, root and tuber crops, horticultural crops, banana and plantain
- other forage plants
- forest species and vegetative cover
- medicinal plants

With the support of partners such as FAO and IPGRI, these institutions have conducted prospecting activities and introduced PGR into their countries and have attempted to implement *ex situ* collections in various forms, as summarized below (sections 4.3.1–4.3.4). Updates on medium- and long-term PGR conservation in the countries visited is shown in tables 2.1 (cereals), 2.2 (grain legumes) and 2.3 (root and tuber crops).

4.3.1 Medium- and long-term conservation of seeds in cold rooms and/or freezers

Included in this type of conservation are cereals, grain legumes and a few vegetable and tree species. Unfortunately, with the exception of a few countries with functional cold rooms (Nigeria) and freezers in sufficient numbers (Ghana, Senegal, Burkina-Faso) and due to funding reasons (difficulty in ensuring sustainable expenditure and maintenance of infrastructure and preservation equipment), most conserved collections have generally disappeared. At present there are mostly collections of material conserved in air-conditioned rooms. Thanks to regional and international cooperation, duplicates are kept in the genebanks of partner institutions in Africa (IITA, WARDA and ICRISAT) and elsewhere in the world (IRD and CIRAD in France, the Kiev botanical garden, European and American universities and IRRI). The number of accessions conserved by the international centres involved in the subregion is summarized in table 3. The figures contained in this table clearly show the important role played by these centres in the preservation of WCA's germplasm.

4.3.2 Living collections conserved in indigenous crop or wild-relative plantings

This type of collection is most common in the subregion. It consists of collecting and periodically replanting collected samples. Ironically, the cost of long-term conservation is relatively high because of the labour involved in planting, harvesting, drying and follow-up (see table 5). Furthermore, this method leads to great risks of genetic erosion as it exposes collections to the uncertainty of the environment, notably drought and pests, with consequent loss of accessions. Note that CARBAP in Djombé, Cameroon, is home to one of the largest collections of banana and plantain (nearly 700 accessions) in the world (although the mission was not able to obtain more data). The plantain cultivars (154 accessions) were collected mostly in WCA, the only area of plantain diversification.

4.3.3 *In vitro* living collections

As previously reported, although there are *in vitro* culture laboratories throughout the subregion, the mission did not see this type of conservation (which is not yet commonly practiced). IITA has just installed one such a laboratory at its Cotonou station and it is currently conserving 1,000 accessions (500 accessions of cassava and 500 accessions of yam). It has a conservation capacity of 2,000 accessions.

4.3.4 Botanical gardens

For forest resources, botanical gardens are the preferred form of *ex situ* conservation in the subregion. All countries visited have one or more botanical gardens of varied wealth. However, it would be tedious to list the species that are conserved. The few cold rooms devoted to the conservation of forest seeds in the subregion are found in the Sahelian zone, in CNRF in Senegal and in NCFS in Burkina Faso. Although NCFS has the potential for long-term conservation, its infrastructure is used instead for short-term conservation in order to facilitate diffusion of seeds. Note that, apart from the botanical gardens, there are large areas of forest reserves that are used to conserve valuable *in situ* PGR.

Table 2.1. Cereals

Crop	Benin	Ghana	Nigeria	Burkina Faso	Mali	Senegal	Cameroon
Maize	NNA	545	800	12,953		NNA	158*
Rice	NNA	564	1,355	802	NNA	NNA	725*
Sorghum	NNA	65	1,000	1,051	NNA	NNA	3,216*
Millet	NNA	5	1,110	333	NNA	NNA	
Fonio	NNA			743		NNA	
Other			1,095	46			

Note: NNA = numbers not available at time of writing report.
*Seeds conserved at ambient temperature.

Table 2.2. Grain Legumes

Crop	Benin	Ghana	Nigeria	Burkina Faso	Mali	Senegal	Cameroon
Cowpea	NNA	609	1,500	835	NNA	NNA	198*
Groundnut	NNA	171		1,150	NNA	NNA	534**
Voandzou	NNA	204	20	200	NNA	NNA	238**
Sesame				180			
Soya	NNA	NNA		250			342***
Bean		74					108*
Other			1,054				

Note: NNA = numbers not available at time of writing report.
*Seeds conserved under ambient temperature.
**Seeds conserved in refrigerators.
***Seeds conserved in cold rooms at 3°–5°C.

Table 2.3. Root and Tuber Crops

Crop	Benin	Ghana	Nigeria	Burkina Faso	Mali	Senegal	Cameroon	Congo
Cassava	180		1,202	NNA	NNA	NNA	120	300
Yam		852	132	NNA	NNA		97	3
Macabo, taro		262	9	NNA	NNA		141	2
Sweet potato		178	50	NNA	NNA	NNA	126	NNA
Other		102	311				50	3

Note: NNA = no numbers available.

Table 3. PGR of Visited Countries Already Conserved in Genebanks at ICRISAT Sadoré and IITA Ibadan

Country	ICRISAT Sadoré		IITA Ibadan									
	Ground-nut	Millet	Cowpea	Rice	Wild *Vigna*	Soya	Maize	Yam	Banana & plantain	Voandzou	Cassava	Total
SAHELIAN ZONE												
Burkina Faso	47	81	291	1,044	1	16	23	12		97	6	1,490
Mali	183	119	292	197	5					37	1	532
Senegal	247	34	281	640	5	1				36		963
Total	477	234	864	1,881	11	17	23	12	0	170	7	2,985
WEST AFRICAN COASTAL ZONE												
Benin	12	6	357	92	25		234	261		27	412	1,408
Ghana	48	39	321	207	81		15	273	6	120	338	1,361
Nigeria	298	511	3,793	2,438	184	78	197	1,067	42	310	1,687	9,796
Total	358	556	4,471	2,737	290	78	446	1,601	48	457	2,437	12,565
CENTRAL AFRICAN ZONE												
Cameroon	24	99	620	158	101	1	31		23	205	219	1,358
Congo			46	10	109		41	31	3	40	77	357
Gabon			6		72		12	21	16			127
Total	24	99	672	168	282	1	84	52	42	245	296	1,842
Total all zones	859	889	6,007	4,786	583	96	553	1,665	90	872	2,740	17,392

4.4 Human resources

According to officials from research institutions and university departments in charge of PGR, the subregion has an important human resource potential that is unfortunately difficult to assess. Indeed, apart from Ghana, Nigeria and, to a lesser extent, Mali, which have an entity specifically devoted to PGR activities, researchers are usually involved in breeding programmes, management of botanical gardens, national parks, medicinal plant collections, etc., where they spend part of their time on PGR activities. This point is emphasized in table 4 using data collected from questionnaires.

Table 4. Human Resources Working in PGR Management

Country	PhD/Doctorate	MSc/DEA	Other higher diploma	Technicians	Total
Burkina Faso	20	6	3	2	31
Mali	?	3	2	3	8
Senegal		3	2	2	25
	5	4		9	
Benin	?	?	1	1	2
Ghana	2	7	22	?	31
Nigeria	4*	2	12	10	28
Cameroon	?	?	?	?	5
Congo	5	2	3	5	15
Gabon	4	1	4	3	12

Note: Clear cells indicate full-time staff; shaded cells indicate part-time staff.
* Three staff members still in training.

4.5 Funding of activities related to management, conservation and use of plant genetic resources

Few countries realize their political commitment to the funding of activities related to PGR management, conservation and use. Apart from Nigeria and Ghana, whose specialized institutions have financial autonomy and benefit from national funding, other countries do not finance PGR activities directly, but do it through breeding programmes. Even Mali, which had shown some political will through the creation of a genetic resources unit, does not fund it as it should. Funding of PGR activities is a reflection of agricultural research funding, to which it is closely linked. However, it is noted that the institutions in charge of PGR management have been able to mobilize external resources through projects supported by various partners, as indicated in table 5.

4.6 Means of communication

Most of the focal points have means of communication (telephone, fax and e-mail), as shown in table 6.

Table 5. External Financial Resources Mobilized Through Projects in the Past Five Years

Country	Amount	Currency	Observation
Benin	2,000,000	FCFA	
Burkina Faso	705,000,000	FCFA	
Cameroon	?		No available data
Congo	30,000,000	FCFA	
Gabon	40,000,000	FCFA	
Ghana	871,000,000	Cedi	
Mali	390,000 70,000,000	US Dollar CFA	
Nigeria	9,500 107,800,000	US Dollar Naira	
Senegal	130,500,000	CFA	

Table 6. Means of Communication

Countries	Telephone	Fax	E-mail
Benin	✓		✓
Burkina Faso	✓	✓	✓
Cameroon			
Congo	✓		✓
Gabon	✓	✓	✓
Ghana	✓		✓
Mali	✓	✓	✓
Nigeria	✓	✓	✓
Senegal	✓	✓	✓

5. Conclusions

5.1 Major findings

The observations made on the ground confirm the conclusions of the Regional Conference on the Contribution of Plant Genetic Resources on Food Security, which was organized by CORAF/WECARD in Ibadan, 26–30 April 2004. In particular, it confirms that:

- Since the early 1970s, and after the FAO Twelfth Conference, which established a panel of experts in 1963, countries and institutions responsible for PGR in WCA have become aware of the great biological diversity of the subregion and have initiated actions for the conservation and exchange of PGRFA. International organizations, such as FAO, IPGRI/Bioversity and others, have significantly supported national programmes in the collection and introduction of new genetic materials, and the establishment of genebanks and *ex situ* conservation of PGR.
- The countries visited are not at the same level of experience in terms of conservation and management of PGR, and the national programmes differ significantly in terms of human resources, structuring of institutions and funding. For some countries, political commitment has been establish by setting up

autonomous structures. For others, PGR management activities are simply carried out as part of a project or operation within a research programme. There are also various structures for coordination.

- There are few functional genebanks in the subregion. This is due to the fact that concerted efforts are always faced with problems related to lack of sustainability in terms of the operation and maintenance of infrastructure and equipment.
- The idea of combining efforts throughout the subregion in order to conserve resources in centres of excellence on the basis of comparative advantage should be developed and implemented.

5.2 Analysis of the situation and recommendations

The creation and development of an NCE would have a greater chance of success if a number of particularly important points were clarified. These include:

- project sustainability, in terms of the operation of the centres, after installation of infrastructures
- NCE specialization in terms of resources to conserve
- criteria for selecting host countries and/or institutions
- a mechanism for subregional cooperation

5.2.1 Project sustainability

The sustainability of the project remains, in the mission's view, the crucial question. With few exceptions, the general view is that genebanks, as well as research programmes and projects that host them, are poorly funded. Conservation infrastructure and equipment are not well maintained or repaired because of the lack of financial resources. What would be the point of building or strengthening regional capacities if they are not provided with financial resources to carry out their various operations, the cost of which is not insignificant? Under the conditions of this mission, it was impossible to estimate the cost of PGR conservation in NARS. But for illustration purposes, table 7 presents the assessment made at the level of the genebanks of CGIAR centers, in early 2000 (Koo et al. 2004). This table indicates the operational costs of conservation of some accessions and takes into account the acquisition of plant material, conservation (electricity, personnel), viability testing, regeneration, characterization, duplication and dissemination. It is noted that the costs vary: it was more than US$ 280 per accession per year for maize in the CIMMYT genebank and wild peanut in the ICRISAT genebank, and less than US$ 30 for cereals in the ICARDA genebank. This is equivalent to a range of more than 140,000 CFA francs and less than 15,000 CFA francs (at a rate of 500 CFA francs to the US$). A sharp difference was also noted from one species to another, as well as from one centre to another. Even if they were to be put under NARS conditions, these costs should be reviewed because people working in international centres are well paid and, thus, they represent a considerable burden in comparison with the budgets of NARS.

The question that arises is whether the support that CORAF/WECARD will receive for the creation of NCEs will include a contribution to cover recurrent expenses. If so, for how long will such contributions be maintained? Whatever the case, it is essential to know what the contribution of countries of the subregion would be and what mechanism should be put in place so as to ensure its sustainability and survival, since the number of inter-governmental organizations that suffer badly from non-compliance by member states is already known.

The answer to these questions is undoubtedly a prerequisite for resolution before the start of the project. Accordingly, the mission proposes the following:

- CORAF/WECARD should negotiate with its financial partners for their commitment to contribute towards servicing recurrent expenses and providing for the depreciation of investments over a fairly long period of time, if possible.
- Invite influential government authorities of the countries concerned to a consultative workshop in order to discuss and obtain from them guarantees regarding sustainability of the project, progressively taking responsibilities related to the activities of the NCEs.
- Establish a timetable for financing recurrent operational costs, including a gradual withdrawal of partners, so that member countries of CORAF/WECARD can increasingly take up their responsibilities.
- In the event that this prerequisite is not properly resolved, CORAF/WECARD should consider the option of setting up NCEs in CGIAR centers (IITA and ICRISAT).

5.2.2 Specialization of nodal centres of excellence

Regarding the specialization of NCEs, it should be remembered that this consultation was carried out based on the assumption that three NCEs were to be installed in the subregion (one per zone). The Sahelian zone is specialized in cereals and grain legumes; the West African Coastal zone is known for its root and tuber crops; and the Central African zone is known for its forest resources, banana and plantain. But when the number of accessions by species currently conserved (based on data from international centres, as shown in annex 7) is observed, with regard to cereals and grain legumes, it is evident that there is more or less the same diversity in the countries of the West African Coastal zone, which is more than the diversity found in the Sahelian zone, particularly because of Nigeria. In addition, the West African Coastal zone undoubtedly has great potential in the number of root and tuber crops.

Central Africa is not to be overlooked, especially if the importance of cassava is taken into account, and also the fact that, so far, it has been difficult to know the real potential of such diversity in the Democratic Republic of Congo, where the security situation does not allow prospecting activities to be undertaken of in all parts of the country. In terms of forest resources, it was only in the Sahelian zone (Burkina Faso and Senegal) that the mission witnessed the existence of cold rooms for the conservation and use of forest seeds. This probably means that, in this region, the need for forest seeds is so important that it is essential to ensure their conservation in order to meet demand.

The importance of PGR in any given area is defined by both: (1) the genetic diversity available in the area and (2) the need for this resource. Considering the findings of the mission, these two arguments do not, in the consultant's opinion, call for strict specialization.
Therefore, the mission proposes to give the three NCEs the responsibility of conserving all the genetic resources of the subregion, with particular emphasis on specific resources considered as having a high priority for the area. However, caution demands that all eggs should not be put in one basket. Therefore, there will always be duplicated accessions in case of trouble or disaster at one NCE. Table 8 shows an example of the distribution of mandates.

Table 7. Operational Costs of PGR Conservation (in US$)

Centre	Crop	Acquisitions	Medium-term storage	Long-term storage	Viability testing	Regeneration	Characterization	Duplication	Dissemination
CIAT	Cassava								
	- In vitro[a]	68.19	3.09			20.87			13.07
	- Cryo-conservation			1.23	8.13	33.70			
	- Field genebank[b]			7.28					
	Common bean		0.44	0.92	4.22	35.71		4.24	26.95
	Forages		0.65	1.12	15.08	51.91		4.24	51.21
CIMMYT	Wheat	3.30	0.37	0.48	1.36	6.63		0.44	4.20
	Maize	9.47	3.04	2.16	4.79	221.02		5.53	35.45
ICARDA	Cereals	6.10	0.55	0.47	2.70	10.09	1.55	2.51	3.71
	Forages	6.10	0.55	0.47	2.70	12.78	1.46	2.51	3.71
	Chickpea	6.10	0.55	0.47	2.70	13.88	2.00	2.51	3.71
	Lentil	6.10	0.55	0.47	2.70	17.85	2.22	2.51	3.71
	Faba bean	6.10	0.55	0.47	2.70	17.59	2.65	2.51	3.71
ICRISAT	Sorghum	5.27	1.51	1.32	1.26	19.88	11.10	4.39	2.58
	Pearl millet	5.27	1.51	1.32	1.26	51.05	12.67	4.39	2.58
	Pigeon pea	5.27	1.51	1.32	1.26	60.31	6.38	4.39	2.58
	Chickpea	5.27	1.51	1.32	1.26	21.51	5.11	4.39	2.58
	Groundnut	5.27	1.51	1.32	1.26	28.18	18.34	4.39	2.58
	Wild groundnut	5.27	1.51	1.32	1.26	249.00	26.36	4.39	2.58
IRRI	Cultivated rice	6.51	0.87	0.47	1.54	33.90	10.15	1.74	9.75
	Wild rice	6.51	0.87	0.47	1.54	114.74	7.62	1.74	9.75

Source: Koo et al. (2004).

a. The acquisition costs for material to be held *in vitro* represent the costs of screening the health of the sample by disease-indexing methods. Regeneration costs for material held *in vitro* represent the costs of sub-culturing the accession. Most cassava is distributed in the form of *in vitro* samples.

b. As a practical matter, conserving cassava in a field genebank is more properly thought of as a medium-term undertaking, but we included it here under long-term storage to reflect its conservation intent.

Table 8. Example of Mandate for Each NCE

Order of priority	Zone		
	Sahelian	**West African Coastal**	**Central African**
First priority	Cereals, grain legumes, horticultural crops	Roots and tubers	Forest resources, banana and plantains
Second priority	Forage crops, forest resources	Cereals, grain legumes, forage crops	Horticultural crops, roots and tubers
Third priority		Forest resources, banana and plantain	Cereals, grain legumes, forage crops

5.2.3 Criteria for the selection of host countries

The 16 elements stipulated in the terms of reference for inclusion in the criteria for selection are all important. However, considering the situation of the subregion described in section 4 of this report, not all these elements are used to the same degree, because of their direct or indirect relationship with the existence and functionality of NCEs, and this could be discriminatory.

The proposition of the mission is, first, to consider measurable elements from observations made, establish selection criteria and retain the element of "political goodwill" for the development of the host-country responsibilities. Two sets of criteria and sub-criteria may be used, among which is a very discriminatory set of criteria, which is assigned a high ratio, while the other one is not (see box 3).

Box 3. Selection criteria

Key selection criteria (80 points)

1. Genebank infrastructure
   a) Existence of appropriate physical infrastructure equipped with cold rooms and/or freezers
   b) Functionality
   c) Capacity and possibility for expansion
   d) Electrical supply source
   e) Means of communication
2. Human resources: number and qualifications
3. Number of species and accessions conserved

Secondary criteria (20 points)

1. Support infrastructure
   a) Seed control service
   b) Quarantine services
2. National legislation and commitment to international conventions and agreements

Accordingly, the mission suggests the selection grid and ratings shown in table 9.

Table 9. Selection Grid

Selection criteria	Number of points	
Genebank infrastructure		
• Existence of appropriate physical infrastructure	10	50
• Functionality	10	
• Capacity and possibility for expansion	10	
• Sources of electrical supply	10	
• Means of communication	10	
Human resources		20
Number of species and accessions already conserved		
Support infrastructure		10
• Seed-control services	5	10
• Quarantine services	5	
National legislation and commitment to international conventions and agreements		10
Total		**100**

5.2.4 Mechanism of regional collaboration in plant genetic resources

Elements to consider in the development of regional collaboration

There are two main options to consider in the subregion: (1) let NARS be directly responsible for the management of NCEs or (2) entrust this responsibility to the international CGIAR centers for a term yet to be determined. The choice will depend on the results of the validation workshop, as well as the commitment of countries and partners in contributing towards the sustainable funding of recurrent expenditures.

Whatever option is chosen, it is important to identify key elements to be included in the regional cooperation mechanism. The GRENEWECA working paper already indicates some of these elements, namely:

- The legal framework for collaboration
  - national legislation, CBD, the International Treaty, the Cartagena Protocol, the AU Model Law
  - preparation of an interim agreement on the transfer of material
  - preparation of a memorandum of understanding for conservation
- Activities of NCEs
  - collect germplasm from national programmes
  - ensure collection and appropriate monitoring system for seed health
  - ensure, if necessary, specific characterization in collaboration with countries
  - return germplasm at the request of countries
  - provide documentation on received accessions
  - conserve accessions
  - train national partners in conservation and characterization
  - ensure distribution to users
- Stakeholders
  - CORAF/WECARD
  - countries (NARS)
  - CORAF/WECARD network (GRENAWECA)
  - CGIAR centers

The following should also be added:

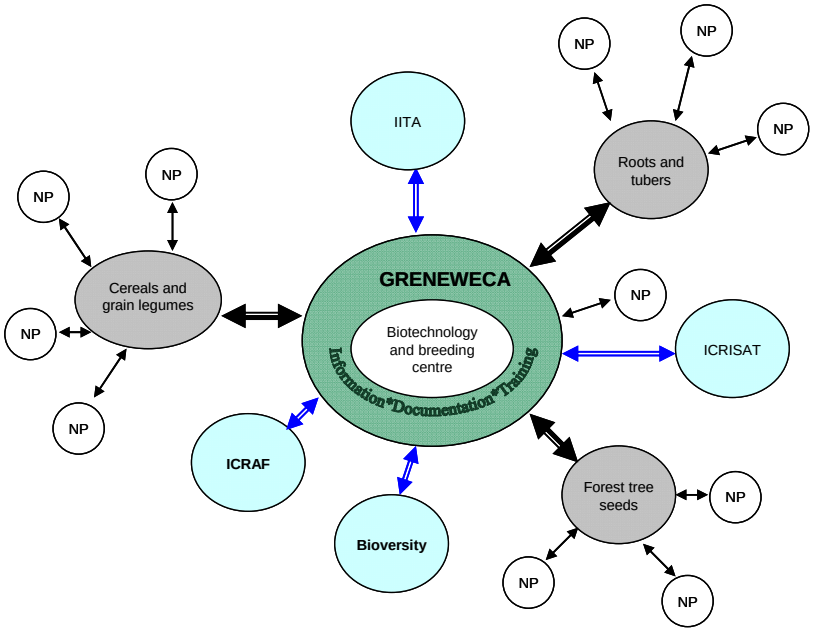
- The legal status of centres and/or conserved germplasm

Given the challenge and the regional mission of the NCEs, it is imperative to give them a status that confers autonomy and freedom of action in relation to the host country. In addition, the decision-making body of an NCE (steering committee) will play an important role not only in decision making and management, but also in fund raising. That is why it should have a good representation of stakeholders, including policymakers and partners.

All these elements must be conceptualized in a formal document—a memorandum of understanding—that will be signed by all stakeholders. The memorandum of understanding is a constituent of the legal framework for collaboration and will help codify the duties of stakeholders, which include: CORAF/WECARD, the CORAF/WECARD network, the CGIAR centers, host countries and CORAF/WECARD member countries. A draft memorandum is proposed in annex 5

Model diagram of NCEs

The diagram below is a proposal for a model contained in the working paper prepared by the GRENEWECA network, which embodies the interactions between the various technical components of the complex comprising NCEs, national programmes, CGIAR centers and the CORAF/WECARD network. It provides for the support of the three NCEs and a central unit of biotechnology and selection, under the control of the CORAF/WECARD network. However, we can consider other options, for example, to make use of national biotechnology laboratories and limit the role of the network to coordinating and enhancing capacities (training, information and documentation, etc.). This diagram provides a good basis for discussion at the validation workshop.



Source: Development of Nodal Centres of Excellence for Genetic Resources Management in West and Central Africa. GRENEWECA working paper.

Figure 2. Model diagram

6. Recommendations

Three questions are crucial for the implementation of the project:

1. **The prerequisite of the sustainability of funding**
   To address this, the mission recommends
   - inviting government authorities of all CORAF/WECARD member countries and partners involved in the conservation of PGR to the validation workshop
   - organizing a round table, outside the workshop, to discuss the issue of sustainability of the project, particularly how to take charge of recurring costs concerning the operation of the NCEs
2. **The selection of host countries**
   The mission recommends
   - reviewing and finalizing the selection grid proposed in this report during the validation workshop
   - establishing a selection committee that will use the data of this report and other additional data (the Scientific and Technical Committee of CORAF/WECARD might well play this role); this committee should be supported by the consultant
3. **Draft a memorandum of understanding**
   This should also be scrutinized during the workshop so as to obtain the consensus of all stakeholders

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Annexes

1. Terms of reference of the consultant
2. Institutions and persons contacted
3. Research priorities developed by CORAF/WECARD
4. Draft memorandum of understanding
5. West and Central African plant genetic resources conserved in IITA genebanks
6. Collection of living forest genetic resources in conservation at PGRRI Ghana

Annex 1. Terms of reference

Assessment of existing conservation facilities for germplasm management and development in West and Central Africa

The West and Central Africa Council for Agricultural Research and Development (CORAF/WECARD) is a scientific subregional African organization specialized in agriculture. It was founded in 1987 and is made of the national agricultural research systems (NARS) of twenty-one countries of West and Central Africa. It is headquartered in Dakar, Senegal. To strengthen regional collaboration in conservation and sustainable use of plant genetic resources in the subregion, CORAF/WECARD has decided to establish key specialized Nodal Centres of Excellence for root and tuber crops in Coastal West Africa, cereals and grain legume species in the Sahelian zone, and forest tree seeds and banana in Central Africa. In order to select countries to host the various centres, CORAF/WECARD is seeking applications from appropriately qualified consultants to undertake an assessment of conservation and development facilities of key West and Central African countries, namely Benin, Ghana, and Nigeria in coastal West Africa; Cameroon, Gabon and Congo in Central Africa; and Mali, Niger and Senegal for the Sahelian zone of West Africa. The Consultant will be a senior and renowned scientist, with sound knowledge of plant genetic resources management and very familiar with African national agricultural research systems.

Under the supervision of the Executive Secretary of CORAF/WECARD, the Consultant will:

1. Assess existing national capacities (infrastructure, equipment, personnel) for conservation and development of PGR (See observations)
2. Assess importance and status of existing national collections
3. Survey countries' commitments to international conventions and legislations
4. Assess national legislation development and empowerment
5. Draft a regional collaboration mechanism for conservation of plant genetic resources using the Nodal Centre of Excellence concept
6. Develop a list of criteria for selecting the hosting countries and the hosting institutions
7. Draft a memorandum of understanding to be signed between CORAF/WECARD and the hosting countries and institutions

NB1: Duration of the consultation: 30 days with 26 days for visit to countries.

Observations: Elements to be taken into consideration in the list of criteria for selecting hosting countries

The following domains could form part of the criteria (but not exclusively):

1. Genebank infrastructures with required characteristics and in appropriate environment
2. Genebank capacity: enough space to host additional accessions and offering expansion possibilities
3. Capacity currently used by the national programme (is it effectively used on a regular basis?)
4. Equipment (does it have required equipment? list)
5. Status of equipment (age and maintenance)
6. Electricity + water supply sources
7. Seed health unit (is the genebank supported by a plant health unit and staff?)

8. Personnel (number and qualifications of regular permanent staff)
9. Documentation (software or systems used to document PGR)
10. Communication facilities (telephone, fax, e-mail, etc.)
11. Funding situation (number of projects funded in past five years)
12. National legislation and commitment to international conventions and agreements
13. Quarantine measures (do they meet the standard?)
14. Space for experimentation and regeneration (plots/greenhouse size)
15. Political goodwill (does the country show goodwill to share facilities and responsibilities? How?)
16. Species presently conserved
17. Other

Annex 2. Institutions and persons contacted

Institution	Name	Position
Cameroon		
Ministry of Environment and Protection of Nature	Saïdou Adamou	Under Director of Sensitization and CHN Focal Point
Ministry of Forest and Fauna	Dr Emmanuel Pouna	Director: Promotion and transformation of forestry produce
Ministry of Agriculture and Rural Environment	Claude Tite Tekel Tekel	Representative of the Under Secretary: Seeds regulation and vegetable quarantine
Ministry of Science and Innovation	Dr David A Mbah	Representative: the Biosafety Project and the Academy of Sciences of Cameroon
Ministry of Science and Innovation/Research Institute of Agricultural Development	Dr Jacob Ayuk Takem	Director General
	Dr Jean Daniel Ngou	Deputy Director General
	Dr Vincent N Tanya	Interim Scientific Director
	Dr Bernard Foahom	Scientific Coordinator of Forest and Environment
	Dr Grégoire Ngono	Nkolbisson Researcher and CORAF/WECARD Focal Point
	Dr Jean Michel Onana	Director of the National Herbarium and Head of Biodiversity Programme
	Dr Joseph Kengue	PGR Programme Coordinator and GRENWECA network focal point
University of Yaoundé	Mme Laurette Ekoue	From Douala University but presently undergoing training in the biotechnology laboratory at the University of Yaoundé
Congo		
DGRST/CRAL	Grégoire Bani	Director of the Centre
	Fernand Mouketo	Researcher: Banana and plantain
DGRST	Joseph Mabamza	
DGRST/CERVE	Dr Antoine Ouabonzi	
DGRST/CRFL	Dr Maurice Diabangouaya	CRLF Department Director
Ministry of Agriculture, Livestock and Fisheries	Mme Georgette Bamana-Dandou	Director General: Agriculture
Ministry of Environment and Forestry Management	Benjamin Dzaba-Boungou	Director General: Environment
	Jean Colin Namadoum	Director: Conservation of Natural Ecosystems, Biodiversity and Biosafety focal point
	Antoine Mountanda	Director of National Forestation Service
Gabon		
CENAREST	Samuel Mbadinga	General Commissioner
	Dr Lucien E. Obame	Scientific Coordinator
	Dr François Ndjelassi	IRAF Director
	Mesmin Ndong Biyo'o	Deputy Director of IRAF and Biotechnology Laboratory
	Delphin Mapaga	Head of the Silviculture and Genetic Improvement Unit at IRAF
	Dr Henri Paul Bourobou Bourobou	IPHAMETRA Director
	Dr Ludovic Ngok Banak	IRET Deputy Director and Head of the National Herbarium

Ministry of Agriculture, Livestock and Rural Development	Luc Bézas Saba Okouyi	Director General
	Dr Dénis Nzogue	Deputy Director General, Agriculture
Ministry of Environment	Emmanuel Bayani Ngoyi	Head of Urban and Rural Environment Service and Assistant to the Biodiversity Focal Point
PRGIE/ADIE Gabon Unit	Jean Christophe Igaboughi	Head of Follow-up and Evaluation Unit
Burkina Faso		
CNRST	Tiéba Traore	Secretary General
INERA	Prof. Hamidou Boly	Director
	Dr Didier Balma	Director, Scientific Research; Coordinator, PGR interim Committee, Focal point/FAO on PGR
INERA/CREAF Kamboisé	Dr Jérémy T. Ouedraogo	CREAF Director and Head of the Genetic and Biotechnology Laboratory
	Gabriel Diasso	Phytopathology Laboratory
	Dr Bertin Zagre	Annual oilseed breeder
	Mahamadi Ouedraogo	Millet breeder
	Amos Miningou	Peanut breeder
University	Prof. Jean Didier Zongo	Head of the Genetic Resources and Plant Improvement Laboratory
	Prof. Gérard Zombre	Chief, Crop Physiology
	Prof. Aboubakar Ouattara	UFR/SVT, Research Centre of Biological Sciences
MECV	Soumaïla Banse	Head of the Biological Diversity Programme at the CONEDD Permanent Secretariat
	Moussa Ouédraogo	Director General, National Centre for Forestry Seeds
MAHRH	Alain Kabore	Director General, Vegetable Crop Production
	Apollinaire Zongo	Director, National Seed Services
	Mme Mini Dah/Pale	Chief of Control and Certification Laboratory at the National Seed Service
Mali		
Ministry of Agriculture	Daniel Siméon Kelema	National Deputy Director, Agriculture
	Abdramane Sidibe	Head of Division, Legislation and Phytosanitary Control
IER	Dr Amadou B. Cisse	Deputy Director General
	Dr Ibrahima N'diaye	Interim Scientific Director
	Dr Doré Guindo	CRRA Director/SOTOBU
	Dr Aboubacar Toure	Chief of Sorghum Programme, CRRA/ Sotuba
	Amadou Sidibe	Head of Unit, Genetic Resources
	Brahima Dembele	Genetic Resources Unit
Ministry of Environment	Moussa Dembele	Deputy Director, Permanent Technical Secretariat of the Management Institutional Cadre on Environmental Questions (STP-CIGQE)
	Bather Kone	Project Coordinator, elaboration of national strategic framework on biosafety
	Bakari Toure	CAT Chief of bureau at STP-CIGQE CAT
	Mouhamadou Traore	Chief communication bureau, Training and research at STP-CIGQE
	Toumani Dembele	Head, Natural Resources Management Bureau at STP-CIGQE
	Lt Colonel Baïkoro Fofana	National Deputy Director, Conservation of Nature (DNCN)

University: Rural Polytechnic Institute for Training and Applied Research (IPR/IFRA)	Bakary M.Traore	Interim Laboratory Chief
	Dr Abdoulaye Sidibe	Lecturer- banana researcher
Senegal		
CORAF/WECARD	Paco Sereme	Executive Secretary
	Dr Marcel Nwalozi	Scientific Coordinator
	Cheik Alassan Fall	IPGR Programme Administrator for West Africa, National Programme Coordinator of Genetic Resources and Biotechnology
	Jean Rostand J. Kamga	Administrative and Finance Manager
ISRA	Papa Abdoulaye Seck	Director General
	Dr Taïb Diouf	Scientific Director
	Dr Mamadou Khouma	Chief of the National Research Laboratory on Vegetable Products
	Abidou Gaye	Chief of the National Forestry Research Centre
University	Prof. Amadou Tijan Ba	Professor at the Faculty of Science and Technology, Director of the Environmental Science Institute
Ministry of Scientific Research	Dr Ismaïla Diallo	Principal Technical Advisor to the minister, Secretary General of the PGR National Committee
MEPN	Dembe Mamadou Ba	Second Technical Advisor, Focal point on Diversity
Ministry of Agriculture	Abba Dieme	Head of Seeds Division at the Plant Protection Office
Benin		
INRAB	Dr David Arodokoun	Director General
	Dr Delphin Koudande	Scientific Director
	Ali Djima	Head of the Genetic Improvement Unit
University	Prof. Adam Ahanchede	Phytology Laboratory
	Dr Alexandre Dansi	Genetic and Biotechnology Laboratory, Head of Unit: Researcher on PGR
	Dr Corneille Ahanhanzo Glele	Genetics and Biotechnology Laboratory, Head of *In Vitro* Culture Unit
	Dr Aristide Adomou	Head of National Herbarium
IITA	Dr Dominique Dumet	Genetic Resources Unit Manager
WARDA	Dr Patrick M Kormawa	Focal point on property rights
	Dr Ousmane Youm	Programme Director: Integrated System for the Production of Rice
Ministry of Agriculture, Livestock and Fisheries (MAEP)/HQ agriculture/DPQC	Maurice Noudofinin	Head of Department: Promotion and Enhancement of Agricultural Production
	Emmanuel Lougbegnon	Head of Unit, Analysis of Products
Ministry of Environment, Housing and Urbanization (MEHU)	Raphaël JM Ogounchi	Environment Deputy Director

Nigeria		
NACGRAB	Mondiu B Sarumi and his collaborators: • - SE Aladele • - JK Adedayo • - Dr S Adesola Ajayi • - Mme MN Olayode	Director of the Centre and his collaborators: Geneticist Biochemist Consultant (Obafemi Awolowo University) Seed Specialist Specialist consultant on tissue culture
NRCRI	Dr KI Nwosu and his collaborators: • - Dr ENA Mbanaso • - Dr ON Ekeokoro	Director and his collaborators: Specialist researcher on tissue culture Head of PGR unit and cassava specialist
Federal Ministry of Agriculture and Rural Development/Department of Agricultural Development	• - Dr AM Ataja • - Dr PM Nyandai • - Yarama D Ndirpaya	Deputy Director Assistant Director Chief Scientific Officer
Department of Agriculture	PO Agboade	Chief of Quarantine Services
IITA	Stanford Blade Dr Viswanathan Mahalakshmi	Director of Research and Development Head of Genebank
Ghana		
CSIR	Prof. Owusu Vivian Oduro Godwin Amenorpe Lawrence Aboagye and collaborators	Director Researcher at BNARI, Chief of Tissue Culture Laboratory Cassava collector at BNARI IPGR Interim Director
University of Ghana	Dr Elizabeth Acheampong	Head of Tissue Culture Laboratory

Annex 3. Research priorities developed by CORAF/WECARD

Regional research priorities have been established by CORAF/WECARD, using the national strategic plans of each country in the region. Given the wide range of agroecological conditions, the region has been divided into three zones: West African Sahelian zone, West African Coastal zone and Central African zone. Working groups for each of the three zones, identified on the basis of national plans for the development objectives for the specific zone, established a list of priority research programs for collaboration at the zonal level. Following this, a figure was given reflecting the degree of priority of each of the research programmes. The totals of these for the countries in the zone give an initial score for the priority. Next, each research programme is classified according to its contribution to the development objectives. This gives a weighted score that is multiplied by the initial score to give the final score, the latter being transformed to a common denominator of 20 for easier comparison. The results are presented in the following table. Figures in brackets give ranking in the three different zones.

Zone:	West African Sahelian	West African Coastal	Central African
Plant production			
Vegetable crops	17.62 (1)	13.19 (4)	12.14 (3)
Rice	13.15 (2)	14.94 (1)	6.28 (12)
Cowpea	12.19 (3)	10.97 (7)	1.40 (22)
Fruit crops	12.14 (4)		
Groundnuts	11.53 (5)	8.25 (11)	8.64 (9)
Millet	10.36 (6)	6.94 (13)	1.84 (19)
Maize	9.64 (7)	14.00 (3)	12.08 (4)
Root crops	9.64 (8)		
Forage crops	8.82 (9)		
Sorghum	7.89 (10)	10.22 (9)	4.09 (16)
Cassava		14.17 (2)	17.00 (1)
Yam		13.14 (5)	5.51 (14)
Cotton	7.60 (11)	12.19 (6)	4.78 (15)
Plantain		10.67 (8)	
Pineapple		10.11 (10)	10.31 (6)
Banana		7.64 (12)	
Soybean		5.67 (16)	2.60 (18)
Plantain/banana			13.91 (2)

Zone:	West African Sahelian	West African Coastal	Central African
Natural resource management and production systems			
Soil fertility	18.25 (1)	16.19 (1)	12.05 (6)
Intensification/ diversification	17.75 (2)		
Irrigation systems management	16.67 (3)		
Crop/livestock int.	16.51 (4)	16.06 (2)	15.21 (1)
Land ownership	16.43 (5)		
Biodiversity	15.75 (6)		14.04 (2)
Agroforestry	15.00 (7)	14.33 (3)	13.03 (4)
Impact of agricultural practices	14.25 (8)		
Water management		13.89 (4)	
Land management		11.42 (5)	
Soil acidity			13.59 (3)
Water and soil pollution			8.96 (7)
Soil erosion			8.79 (8)

Annex 4. Draft memorandum of understanding

Among the signatories of the memorandum, it is agreed as follows:

Subject

It is to be created in the subregion of West and Central Africa and under the auspices of CORAF/WECARD, three (3) Nodal Centres of Excellence for the conservation and sustainable use of plant genetic resources. This MOU aims to establish the obligations of each of the stakeholders, to ensure smooth and sustainable operations of the centres and easy access to conserved resources in order to ensure their effective use for agricultural development, reduction of food insecurity and poverty in the subregion.

A. Stakeholders

The following are designated as stakeholders:

- The countries hosting the Nodal Centres of Excellence (CGIAR hosting centres)
- The CORAF/WECARD member countries that have agreed to support genebanks
- The International Research Centres whose mandates cover PGR of the subregion (IITA, ICRISAT, WARDA, ICRAF)
- The executive secretariat of CORAF/WECARD
- The GRENEWACA network of CORAF/WECARD
- The Scientific and Technical partners who are committed to the creation and support of the Centres.

B. Composition of the Regional Complex for the conservation and development of PGR

The complex is composed of:

- Three centres of excellence based in national institutions dealing with *in vivo* PGR conservation, *in vitro* (optional) and in cold rooms
- A coordination unit located at the network level and committed to providing coordination between stakeholders and enhancing capacities

C. Activities of NCEs

NCEs for the conservation and use of PGR have the following as essential functions:

- Collecting germplasm of national programmes
- Ensuring the collection and appropriate sanitary tests
- If necessary, ensuring specific characterization in collaboration with national programmes
- Documenting received accessions
- Returning germplasm at the request of countries
- Conserving accessions
- Ensuring distribution to users under consensual conditions established by stakeholders and, in any case, after the permission of the owner of the material
- Training national partners in conservation and characterization
- Collaborating and cooperating with other genebanks throughout Africa and the world

D. Stakeholders' obligations

Each stakeholder must play its role and fulfil its obligations for the proper functioning of the centres. Their obligations include the following:

1. Host countries

- To make available to the subregion, by a regulatory act all or part of the infrastructure and equipment of the national genebank
- To guarantee regular supply of water and electricity to the best possible conditions
- To contribute to the remuneration of national regular staff through payment of a salary to which a regular staff member is entitled in the national system
- To recognize that GR conserved in the genebank constitute a collective asset (property) and ensure free access by all stakeholders
- To provide the CORAF/WECARD network with all information related to the genebank

2. CORAF/WECARD member countries, signatories of the memorandum

- To contribute to the supply of regional genebanks by sending duplicates of accessions from exploration and/or accessions represented in the national collections
- To provide the centres with qualified personnel and ensure their basic wage in accordance with the national grid
- To contribute to the sustainable operation of the centres on the basis of an agreement based on the CORAF/WECARD initiative

3. The CORAF/WECARD network

- To ensure coordination between stakeholders, including countries, NCEs, CGIAR centers
- To train more personnel
- To research, produce and disseminate appropriate documentation
- To ensure that all players have the same information in good time
- To pay the wages of casual staff recruited for specific tasks
- To pay, in addition to basic salaries of regular staff, accessories related to their activities
- If necessary, to recruit and pay consultants for regional activities
- To assist countries in the transfer of germplasm between donors and the NCE
- To help NCEs in raising funds for enhancing institutional capacities (infrastructure, equipment and training)
- To establish or prepare a draft agreement for the exploitation of PGR and sharing of benefits arising from such exploitation

4. CGIAR centers

- To provide the NCEs with scientific and technical support
- To supply centres with germplasm
- To train researchers and technicians
- To cooperate with the NCEs in other areas identified as important to the centres
- To assist national programmes in exploring, collecting and evaluating the germplasm

5. CORAF/WECARD

- To effectively play its role as an umbrella institution
- To facilitate interactions between NCEs and hosting countries
- To ensure the funding of NCEs

- To monitor NCE activities via the network and inform the national programmes
- To chair all the meetings of the NCE steering committee
- To ensure that actors respect their obligations, especially those related to ownership of resources conserved in the NCE
- To ensure compliance with the charter on the use of PGR and equitable sharing of benefits

E. Benefits to the countries

The creation and normal operation of the NCEs give a considerable number of benefits to the signatory countries of this memorandum.

1. Host Countries

- Strengthening of the capacities of the national institution put at the service of the region; this national institution gains more experience and gets to be well funded
- Creation of jobs, especially through the recruitment of local staff

2. Each signatory country

- Safety of all PGR germplasm available in the country
- Privileged access to the entire germplasm of the subregion
- Other benefits from new and dynamic regional cooperation related to PGR (capacity enhancement, information)

Annex 5. West and Central African plant genetic resources conserved in IITA genebank

Zones/Countries	Maize	Rice	Wild *Vigna*	Soybean	Cowpea	Bambara groundnut	Banana and plantain	Yam	Cassava
Sahelian zone	**101**	**2,509**	**114**	**17**	**1,944**	**216**		**44**	**107**
Burkina Faso	23	1044	1	16	291	97		12	6
Cape Verde									13
Chad	76	92	25		134				3
Gambia	2	387	2		4	11			5
Guinea Bissau		85				22		32	69
Mali		197	5		292	37			1
Mauritania		11			2				
Niger		53	76		940	13			10
Senegal		640	5	1	281	36			
West African Coastal zone	**547**	**5,795**	**296**	**79**	**4,732**	**595**	**63**	**3,093**	**2,839**
Benin	234	92	25		357	27		261	412
Côte d'Ivoire		998	3		136	4	15	165	23
Ghana	15	207	81		321	120	6	273	338
Guinea Conakry									87
Liberia		1652	2	1	9				6
Nigeria	197	2438	184	78	3793	310	42	1067	1687
Sierra Leone		388	1		13			34	110
Togo	101	20			103	134		1293	176

Zones/Countries	Maize	Rice	Wild *Vigna*	Soybean	Cowpea	Bambara groundnut	Banana and plantain	Yam	Cassava
Central African zone	**84**	**843**	**365**	**7**	**983**	**348**	**42**	**58**	**320**
Cameroon	31	158	101	1	620	205	23		219
Central African Republic		69	43	1	183	103			2
Congo	41	10	109		46	40	3	31	77
Democratic Republic of Congo		28	36	5	15				22
Gabon	12		72		6		16	21	
Equatorial Guinea		578	4		113			6	
Total	**732**	**9,147**	**775**	**103**		**1,159**	**105**	**3,195**	**3,266**
TOTAL (all countries/crops)	**26,141**								

Annex 6. Collection of living forest genetic resources in conservation at PGRI Ghana

1.	Acacia albida	1	41.	Cola acuminata	2
2.	Acacia auriculaeformis	3	42.	Cola gigantea	4
3.	Adansonia digitata	4	43.	Cola millenii	4
4.	Afzelia africana	2	44.	Cola nitida	1
5.	Agave spp.	5	45.	Cordea alliodora	4
6.	Albizia odorantissima	36	46.	Croton zambesicus	3
7.	Albizia saman	3	47.	Dacryodes edulis	15
8.	Albizia spp.	16	48.	Dalbergia sisso	7
9.	Aloe barbadense	100	49.	Deinbollia pinnata	2
10.	Alstonia boonei	2	50.	Delonix regia	6
11.	Anacardium occidentale	7	51.	Dialum guineense	7
12.	Anogeissus leiocarpus	2	52.	Elaes guineensis	25
13.	Anthonotha macrophylla	6	53.	Enterolobium cyclocarpum	13
14.	Artocarpus altilis	6	54.	Erythrina senegalensis	1
15.	Artocarpus heterophyllus	5	55.	Erythrophleum suaveolens	1
16.	Azadiracthta indica	37	56.	Eucalyptus camaldulensis	7
17.	Bauhinia rufescens	3	57.	Eugenia jambos	1
18.	Bixa orellana	5	58.	Euginia vitiflora	1
19.	Blighia unijugata	2	59.	Ficus exasperata	4
20.	Bombacorpsis glabra	2	60.	Ficus mucoso	2
21.	Bombax glabra	5	61.	Ficus sur	1
22.	Caesalpinia pulcherima	4	62.	Ficus thonningii	2
23.	Callophyllum innophyllum	7	63.	Gliricidia sepium	50
24.	Cassia fistula	2	64.	Gmelina arborea	23
25.	Casuarina equisetifolia	1	65.	Gossypium arboreum	1
26.	Cederela odorata	2	66.	Griffonia simplicifolia	80
27.	Ceiba glabra	4	67.	Holarrhena floribunda	2
28.	Ceiba petandra	3	68.	Hura crepitens	10
29.	Chasmanthera dependes	1	69.	Jatropha curcas	4
30.	Chrysophyllum albidum	235	70.	Jatropha multifida	1
31.	Citrus aurantium	2000	71.	Khaya grandifoliola	2
32.	Citrus grandis	3	72.	Kigelia africana	9
33.	Citrus limon	9	73.	Largestroemia speciosa	2
34.	Citrus paradisi	5	74.	Lecaniodiscus cupanioides	1
35.	Citrus reticulata	1	75.	Leucaena leucocephala	1
36.	Citrus sinensis	50	76.	Mangifera indica	13
37.	Citrus tangelo	3	77.	Margritaria discoidea	2
38.	Cleistopholis patens	5	78.	Megaphrynium macrostachyum	20
39.	Cnidoscotus stimulus	5	79.	Milicia excelsa	8
40.	Cocos nucifera	1	80.	Milletia griffoniana	2

81.	Morinda lucida	6	106.	Tecoma stans	1
82.	Moringa oleifera	3	107.	Tectona grandis	1
83.	Napoleonaea imperialis	13	108.	Terbebuia rosea	2
84.	Nauclea diderrichii	2	109.	Terminalia catappa	3
85.	Neathe elegans	1	110.	Blighia sapida	7
86.	Newbouldia laevis	13	111.	Terminalia glaucescens	3
87.	Parkia biglobosa	11	112.	Terminalia ivorensis	4
88.	Pelthophorum pterocarpum	4	113.	Terminalia superba	11
89.	Pentaclethra macrophylla	17	114.	Tetrapleura tetraptera	12
90.	Persea americana	1	115.	Thaumatococcus danielli	1000
91.	Phoenix dactylifera	1	116.	Theobroma cacao	63
92.	Piper guineense	1	117.	Thevetia neriifolia	7
93.	Pithecellobium dulce	1	118.	Treculia africana	18
94.	Polyalthia longifolia	40	119.	Triplochyton scleroxylon	2
95.	Pouteria campechiana	15	120.	Vernonia amygdalina	168
96.	Psidium guajava	7	121.	Voacanga africana	10
97.	Pterocarpus santalinoides	16	122.	Zizipus spino-christii	1
98.	Pterygota macrocarpum	1	123.	Draceana spp.	1
99.	Ravenala madagascarienis	3	124.	Glyphea braevis	24
100.	Ravoulvia vomitoria	1	125.	Monodora myristica	1
101.	Spondias mombim	9	126.	*Cassava* wild variety	1
102.	Sterculia tragacantha	5	127.	Irvingia wombulu	413
103.	Synsepalum dulcificum	7	128.	Irvingia gabonensis	414
104.	Syzygium zamaragensis	5	129.	Chrysophyllum albidum	68
105.	Tamarindus indica	2	130.	Citrus aurantium	10

Chapter 5. The International Treaty on Plant Genetic Resources for Food and Agriculture: A brief on Benin's treaty ratification and implementation process

Georges A. Agbahungba[1]

1. Introduction

The Republic of Benin has ratified the International Treaty on Plant Genetic Resources for Food and Agriculture. The date of deposit of instruments was 24 February 2006 (FAO 2006). The process to ratify any treaty in Benin involves several steps, including the sharing of information among practitioners, approval by the Council of Ministers, authorization by the National Assembly—i.e., the Parliament—and, finally, the ratification decision by the Head of State.

2. Ratification

2.1 Why Benin ratified the International Treaty

Several issues motivated Benin to ratify the International Treaty. First, the country is home to significant PGRFA diversity (Yallou and Adjakidjè 1995), which represents tools that can help to improve agricultural productivity and contribute to ensuring food security for the country's population.

Second, the International Treaty is in accordance with the internal agricultural policy of Benin. The national framework that supports Benin's agricultural policy (République du Bénin 2007) considers sustainable management of natural resources, including plant genetic resources, to be the basis for agricultural and livestock development. At the first national workshop on PGR management, held in 1995, a strong recommendation was made regarding the necessity to adopt national and international legal instruments to regulate the exchange and use of PGR. Benin's national committee on PGR was then created in March 2002 with the aim of coordinating PGR activities in the country.

Third, Benin took an active part in the various stages in the negotiation of the International Undertaking on Plant Genetic Resources that led to the International Treaty. It is a member of the Commission on Genetic Resources for Food and Agriculture, thereby serving as a member of the Interim Committee of the International Treaty (FAO 2002) and wished to be a member of the governing body of the International Treaty in order to have an opportunity to voice its concerns. INRAB, under the Ministry of Agriculture, represented the country at Treaty meetings and drew attention to the anticipated benefits from the International Treaty as part of a strategy used to sensitize policymakers to the importance of ratification.

[1] CIPMA UNESCO/UAC, Cotonou, Bénin.

During the same period, Benin also participated in a very closely related international process, also coordinated under the auspices of FAO—the International Technical Conference on Plant Genetic Resources, held in Leipzig, Germany, in June 1996—which adopted the GPA. Benin had previously attended the United Nations Conference on the Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in 1992, a meeting that dominated the international stage at the time. Following UNCED, Benin ratified the CBD in June 1994 and all other conventions emerging from the Rio conference.

The International Treaty was adopted at the FAO conference held in Rome on 3 November 2001 (FAO 2001) and entered into force on 29 June 2004, 90 days after 40 member countries had ratified, accepted, approved or acceded to it. Member countries responding to the invitation of the Director General of FAO to ratify the International Treaty have the benefit of being Members of the Governing Body of the International Treaty, and participating in its examination of all important questions related to PGR, as well as participating in decision-making and follow-up actions relating to the implementation of the International Treaty.

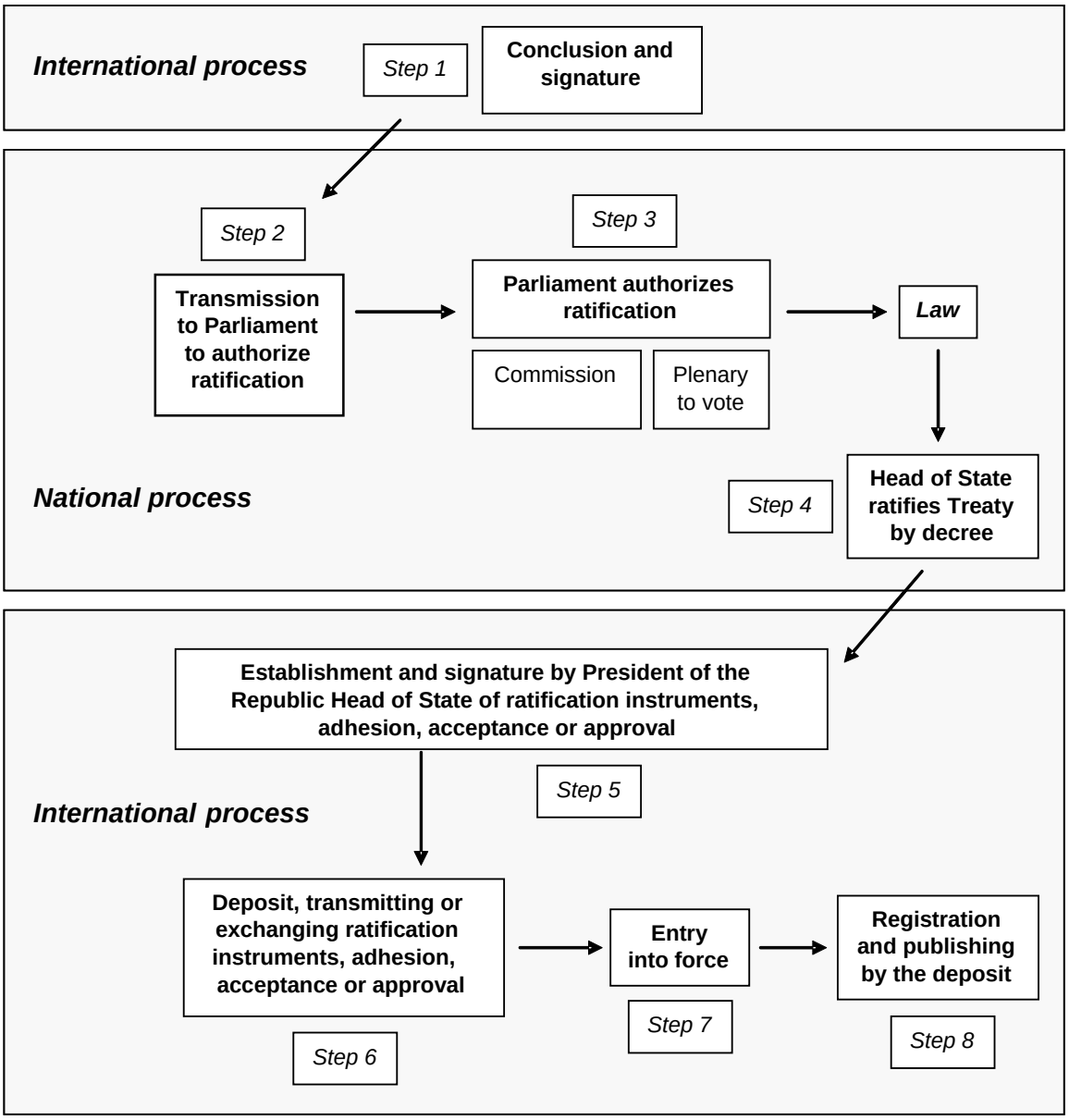
2.2 The process of ratification of the International Treaty in Benin

The process of ratifying the International Treaty followed several steps. First, a joint report from both MAEP and the Ministry of Foreign Affairs and African Integration (MAEIA) was presented to the Council of Ministers following Benin's participation in relevant meetings at FAO in October 2002.

The Council approved the report and recommended the organization of a national forum to share views on the issue and prepare appropriate documents to be submitted to Parliament. A report was prepared for this one-day national forum (see Aly 2002), following which, other technical meetings—not reported in detail here—were held to prepare the documents for official use.

The next step was for a request for authorization to ratify the International Treaty to be sent to the Parliament by the Government. A specialized parliamentary commission examined the Government request and listed points of concern and questions for clarification by the Government, placing ratification of the International Treaty on the agenda of a plenary session of Parliament. Interested ministers (of agriculture and international affairs) were invited to this plenary session. The commission presented its report to Parliament and discussions took place, with the ministers providing clarification and additional information on the International Treaty.

Following Parliament's approval of the International Treaty and the vote to authorize its ratification, the Head of State duly signed the ratification document, which was then forwarded to and placed on record by FAO.



Source: Based on MAEIA (2007); Steps 2–4: Article 145 of the Constitution, 11 December 1990.

Figure 1. Diagram setting out the process for ratification and the organizations involved

2.3 Early champions of the International Treaty in Benin

INRAB, under the Ministry of Agriculture, was the major actor in the ratification process for the International Treaty. The institute contacted and informed other technical departments of the Ministries of Agriculture, Environment, Education, Trade, Legislation and Laws. It also contacted NGOs and the private sector, prepared basic information and decision-making documents, and organized a national forum to share views on the International Treaty.

Other important actors that contributed to the process at later stages were:

- MAEIA
- MEHU
- Ministry of Industry and Trade (MICPE), which hosts the National Industrial Property Centre (CENAPI)
- Universities (particularly the University of Abomey–Calavi)
- Centre for Scientific and Technical Research of Benin (CBRST)
- NGOs: GRAIN, Tropical Nature, the Medicinal Plant Biodiversity Research and Development Institute (IRDCAM) and the Benin Organization for the Promotion of Biological Agriculture (OBEPAB)

Together with INRAB, representatives from these institutions and organizations sensitized their respective authorities, contributed to the production of national position papers and participated actively in national fora dealing with the issue of the International Treaty.

2.4 Expression of concerns by stakeholders

NGOs expressed concerns about the possibility of patenting living organisms. They also expressed concerns about farmers' rights that they felt were not dealt with clearly under the International Treaty, since it does not specify how benefits arising from the use of cultivars will be shared with farmers. The organizers of the national forum and representatives from the National Intellectual Property Rights Office clarified the fact that the Governing Body of the International Treaty was in charge of developing modalities for the practical implementation of the International Treaty, including aspects related to benefit sharing. Farmers did not participate in the national technical fora because they were not sufficiently well organized at the time to play such a role.

2.5 Public discussions and consultations

Several consultations took place at various levels, as indicated above— both within and among institutions—during the awareness-raising period from June to September 2002. The meetings within institutions were organized to share stakeholders' views to develop an institutional vision. Such meetings were convened by INRAB, acting as focal point for PGR management in the country and hosting the National Committee on Plant Genetic Resources.[2] The meetings included participants from the University of Abomey-Calavi, GRAIN and CENAPI.

INRAB organized a one-day national "Workshop to Internalise the International Treaty on PGRFA" (*Atelier d'internalisation du Traité International sur les Ressources Phytogénétiques pour l'Alimentation et l'Agriculture*) that brought together all national stakeholders. Participating institutions included the following:

- **MAEP:** INRAB (six research centres), Direction de l'Agriculture (DAGRI) and a representative of the Cabinet of the Minister
- **MEHU:** Focal Points for Biodiversity, Climate Change, Desertification
- **MAEIA:** Department of International Relations and Department of Ratification and Human Rights

[2] Decree 2002-099 of 4 March 2002 and Minister's order 2004-089/MAEP.

- **Ministry of Education:** the University of Abomey–Calavi (three faculties)
- **Ministry of Law and Legislation:** CENAPI and a representative of the Cabinet of the Minister
- **International organisations:** IPGRI (now Bioversity International) and FAO
- **NGOs:** Nature Tropicale and GRAIN

Four papers were commissioned by INRAB in preparation for the workshop:

1. Plant genetic resources management in Benin (by the National PGR Programme Coordinator)
2. Participation of Benin in various international PGR related fora: major recommendations and actions taken
3. The International Treaty on Plant Genetic Resources for Food and Agriculture (by IPGRI)
4. Why Benin should ratify the International Treaty on PGRFA

The main objective of the meeting was to bring all national stakeholders to the same level of understanding about PGR management in the country and to build consensus on reasons for Benin to adhere to the International Treaty.

During the discussions that followed the presentations, several questions for clarification were brought up about links between the CBD, the GPA and the International Treaty, and how the International Treaty would benefit farmers. As noted above, NGO representatives (from Nature Tropicale and GRAIN) raised concerns about farmers' rights and intellectual property rights. A long debate took place on the issue of the Union for the Protection of New Varieties of Plants (UPOV) system and the Bangui Agreement. Representatives of civil society were concerned about patenting living organisms and suggested that the national delegation should voice that position at relevant international meetings.

The representative of CENAPI indicated that tangible and effective progress would not be possible if plant breeders' rights were not recognized. Other participants raised concerns about the model law of the Organization of African Unity, which is no longer considered in international debates; such a model, if adopted, could help African countries develop national legislation (GRENEWECA 2001).

The participants in the forum found the International Treaty broadly satisfactory and endorsed the paper prepared for the Government to request authorization from the Parliament to ratify.

2.6 Discussions in Parliament concerning ratification of the International Treaty

As noted above, the request sent to Parliament by the government was examined by a specialized commission, which made a report at a plenary session where members of the government were invited. Discussions focused mainly on the seed-storage capacity and the PGR conservation facilities available in the country that could guarantee the availability of and user access to quality seed. Questions and requests for clarification were raised in relation to advantages and disadvantages for the country. Some parliamentarians were concerned about the effective implementation of ratified laws.

The ministers representing the government replied and assured Parliament that efforts would be made for better follow-up of national legislation. The parliamentarians then voted unanimously in favour of the law authorizing the government to ratify the International Treaty.

3. Implementation

Very little has been done so far in relation to implementing the International Treaty in Benin. The second national report on PGRFA, sponsored by the FAO, has been available in draft form since 2007 (Aly et al. 2007).

3.1 Progress to date

INRAB is the lead agency for implementing the International Treaty. It has not, to date, developed any concrete activities for implementation, but the plan is to organize a series of national stakeholder meetings to share views on the recent situation after the International Treaty's entry into force and to sensitize the government and other institutions on ways in which implementation could be carried out. These plans were discussed at meetings that were held by FAO to build a national information-sharing mechanism in Benin.

Benin is planning to develop legislation to implement the International Treaty. Two CGIAR centers based in the country—IITA and WARDA—are using the SMTA adopted for use in the multilateral system when they distribute germplasm. In addition, one national institution has used the SMTA when transferring Annex 1 materials to IITA. Beyond this, there is still no further experience in organizations or individuals using the SMTA.

3.2 Materials within Benin that are included in the multilateral system of access and benefit sharing

Annex I crops of importance in Benin include yam, African rice, sorghum, millet, maize, cassava, coconut, and banana and plantain. According to Article 11.2 of the International Treaty, Benin will need to make all Annex 1 materials that are under the management and control of the government and in the public domain available in the multilateral system.

3.3 Legal or administrative challenges to implementing the International Treaty

There are no domestic laws in Benin that might be in conflict in any way with the implementation of the International Treaty.

4. Conclusion

The Republic of Benin ratified the International Treaty in 2006. The main objective in so doing was to provide a legal framework for the management of the country's important PGRFA. Through the availability of good seeds for farmers, this will contribute to sustaining Benin's agricultural productivity and the quality of crops, thereby enhancing national food security. However, to date, implementation efforts have been slow to get off the ground.

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Chapter 6. The International Treaty on Plant Genetic Resources for Food and Agriculture: A brief on Ghana's treaty ratification and implementation process

Samuel Kwarteng Nyamekye[1]

1. Introduction

The Government of the Republic of Ghana was among the earliest countries in the world to ratify the International Treaty, in October 2002 (FAO 2002). This paper describes the process within Ghana leading up to its decision to ratify. The paper also includes information on Ghana's early efforts to address the implementation of the International Treaty.

Ghana is a democratic country, with a parliamentary government. Administratively, it is divided into 10 regions. The population of the country was about 18.9 million in 2000, with an average growth rate of 2.7% per annum. About 56.2% of the population live in rural areas and derive their income from agriculture and related activities (MOFA 2006).

There are five main agroecological zones, defined on the basis of climate, and reflected in the natural vegetation, which is also influenced by the soils. The zones are presented in table 1, along with the main crops produced in each.

In Ghana, agriculture involves the crops, livestock, fisheries, cocoa, forestry and logging sectors. Agriculture is vital to the overall economic growth and development of the country and, at about 55%, is the largest contributor to the national GDP. Cocoa accounts for 13% of agricultural GDP, other crops 64%, livestock/poultry about 7%, fisheries about 5%, and forestry about 11%. The principal food crops are maize, cassava, plantain, yam, cocoyam, rice, sorghum and millet. Between 50% and 60% of total cereal production is maize. Vegetables include pepper, eggplant, tomato, okra and bean. The country's important cash crops are cocoa, oil palm, cotton, coconut, rubber, pineapple and groundnut.

About half of Ghana's total cultivated land area is under cocoa, followed by cereals (25%) and roots and tubers (20%). The majority of farmers are small holders, with an average holding of less than two hectares. They contribute about 85% of agricultural production. Shifting cultivation is widely practised, and subsistence farming is common in rural areas. Productivity is low, mainly because of low fertility of the land and limited use of available technical packages (good agricultural practices delivered by the agricultural extension services), late delivery of inputs (especially fertilizers) and inadequate availability of credit.

[1] Directorate of Crop Services, Ministry of Food and Agriculture, Accra, Ghana.

Table 1. Ghana's Agroecological Zones, Their Climate, Soils and Agricultural Production

Agroecological zones	Mean annual rainfall (mm)	Soil	Crops
High Rain Forest	2,200	Heavily leached; Fertility relatively low	Oil palm, rubber, coconut, rice, banana, plantain and cocoyam
Semi-deciduous Forest	1,500	More fertile than High Rainfall Forest	Cocoa, coffee, oil palm, maize, plantain, cocoyam, cassava and rice, plus vegetables, including eggplant, bean, pepper and okra
Forest-Savannah Transition	1,300	Soil fertility fairly high but soil liable to erosion	Maize, plantain, cassava, yam, cocoyam, cotton, tobacco, groundnut, tomato, pepper, eggplant, cowpea and bean
Coastal Savannah	800	Land gently sloping; Soils either heavy clay or light textured and underlain by clay	Cassava and maize, plus vegetables on lighter soils, and rice, cotton and sugarcane on heavier soils; Coconut found on the coastal fringe
Sudan and Guinea Savannah Zones (sometimes called the "Interior Savannah")	1,100	Soils generally poor	Millet, sorghum, maize, rice, yam, peanut and tomato; Trees of shea nut—an important cash crop—grow wild (More than 70% of Ghana's livestock—cattle, sheep and goats—are also raised in these zones)

2. Ratification

2.1 Why Ghana ratified the International Treaty

Ghana's decision to ratify the International Treaty was in recognition of the important role that PGRFA play in the country's socioeconomic development (FAO 1996). The objective of the International Treaty is the conservation and sustainable use of PGRFA and the fair and equitable sharing of the benefits arising out of their use. This is in harmony with Ghana's agricultural development agenda as articulated in the Food and Agriculture Sector Development Policy and in the Growth and Poverty Reduction Strategy documents (MOFA 2002; NDPC 2003, 2005).

These documents recognize that agriculture is the highest contributor to GDP and that it provides employment for over 60% of the population. Consequently, sustainable growth in the agricultural sector will have a direct impact on employment and on the growth of the economy as a whole. The majority of the poor, especially women, are engaged in agriculture. Therefore, accelerated development in agriculture will directly benefit poverty reduction in villages and will help to slow down rural-urban drift.

The following factors contributed, directly or indirectly, to Ghana's decision to ratify the International Treaty:

- Agriculture is seen as the lead sector of the Ghanaian economy, and issues of sustainable agricultural production and food security receive special attention in the Ministry of Food and Agriculture's policies. Since the development of PGRFA is essential to the attainment of higher productivity and food security, it was not difficult to convince policymakers to throw their full weight behind ratification.
- The Directorate of Crop Services (DCS), which is one of the technical wings of Ghana's Ministry of Food and Agriculture responsible for issues concerning the crop subsector, was convinced very early on of the relevance of such an international mechanism as the

International Treaty to facilitate the transfer of genetic material and ensure equitable sharing of benefits. The DCS was, therefore, instrumental in the preparation of briefs on the International Treaty for consideration by policymakers and parliamentarians.

- Prior to the actual ratification of the International Treaty on 28 October 2002, IPGRI (now Bioversity International) held its management committee meeting in Ghana (in June 2001). During this period, an awareness-raising forum on plant genetic resources was organized for stakeholders, including farmers, researchers, policymakers and parliamentarians. Presentations at the forum highlighted a number of issues relating to the important role played by PGR in the development of agriculture. Some specific stakeholder concerns were also addressed.

2.2 Processes to be followed in Ghana to ratify an international agreement

The constitution of Ghana provides that any treaty, agreement or convention executed by, or under the authority of, the President in the name of Ghana must be ratified either by an Act of Parliament or by a Resolution of Parliament, supported by the votes of more than one-half of all Members of Parliament. (Republic of Ghana 1992)

Hence, it is incumbent upon the lead ministry to ensure that all treaties, agreements or conventions pass through Parliament, whether there are financial implications to the state or not. The process that needs to be followed is not complicated (see figure 1).

First, the lead ministry responsible for ensuring that the agreement is ratified prepares briefs and seeks a legal opinion from the Attorney General's department. If the department expresses reservations, any queries must be resolved before proceeding. Once the department indicates that it has no reservations to the government's signing the agreement, a cabinet memorandum and briefs are then presented before the cabinet and defended by the responsible minister. Depending on the nature of the agreement, both the request for the legal opinion and the cabinet memorandum may be submitted concurrently. As far as the International Treaty is concerned, the lead ministry—the Ministry of Food and Agriculture—undertook this first step in July 2002. The Attorney General's department did not have any reservations, so the presentation to the cabinet could proceed.

Second, the cabinet considers the issue. In the case of the International Treaty, consideration by the cabinet, again in July 2002, resulted in approval, conveyed to the DCS by the sector minister.

Third, when cabinet approval has been received, a parliamentary memorandum and briefs on the agreement are prepared and sent for Parliament's consideration. A parliamentary select committee then receives the proposal and a date is set for the responsible minister and his/her technical staff to defend the proposal before the committee. In the case of the International Treaty, the main question asked by the chair of the select committee related to the benefit of the International Treaty to the nation. The minister responded by explaining the importance of PGR to agriculture and the consequent need to conserve and ensure their sustainable use with the support of an instrument such as the International Treaty. The committee then gave its approval. After approval by the select committee, its chair presents the proposal and defends it in Parliament. Accordingly, Ghana's parliamentarians discussed ratification of the International Treaty on the floor of

Parliament. With the required support of more than one half of all the Members of Parliament, it was resolved to ratify the International Treaty.

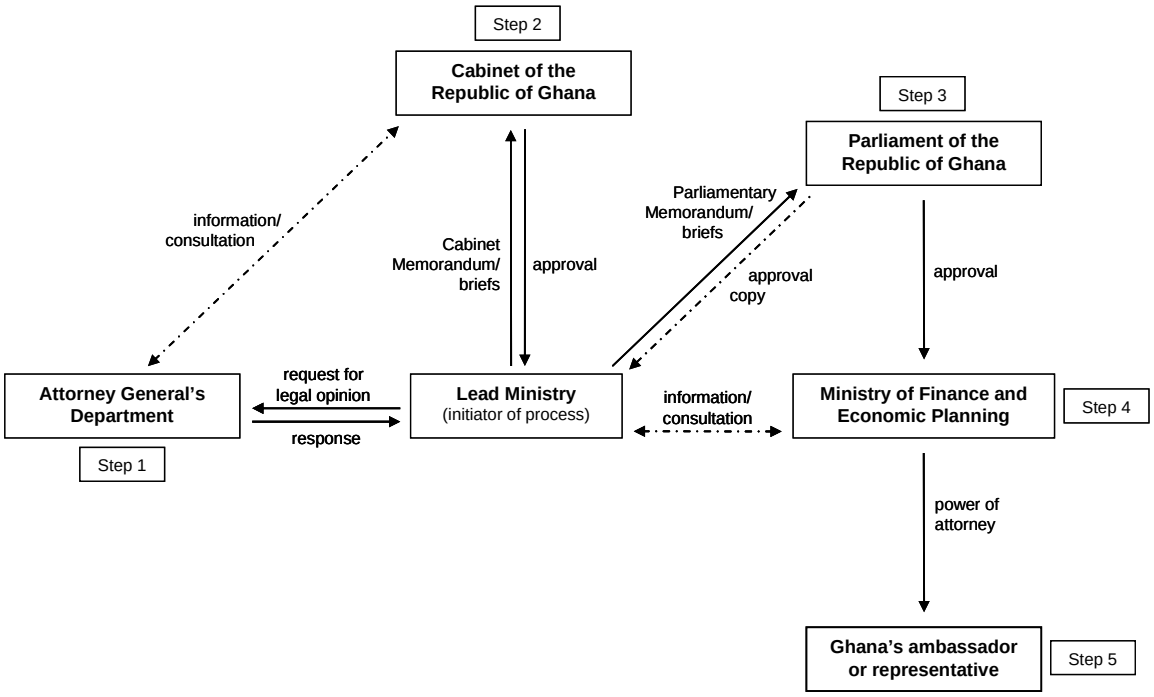

Figure 1 Flowchart showing the organizations, chronology and processes for ratification of a treaty in Ghana

Fourth, when the proposal is approved following debate on the issue, Parliament then communicates its approval by a resolution to the Minister for Finance and Economic Planning (with copies to the lead ministry, the Attorney General, the Ministry of Justice, and the Ministry of Foreign Affairs, Regional Integration and NEPAD). In some cases, depending on the proposal and especially if there are no financial obligations on the part of the State, Parliament may communicate its approval directly to the responsible ministry (copied to the other ministries mentioned above) to take appropriate action.

Fifth and last, the Minister for Finance and Economic Planning authorizes (or gives power of attorney to) the ambassador or representative of Ghana in the country where the documents are deposited to sign on behalf of the people of Ghana. In the case of the International Treaty, as noted earlier, this occurred on 28 October 2002, with the Ambassador to Italy representing Ghana.

2.3 Institutional involvement in the ratification process

Initially, it was the DCS, under the Ministry of Food and Agriculture, that initiated and encouraged the process of ratifying the International Treaty in Ghana. As the process continued, the Plant Protection and Regulatory Services Directorate (also under the Ministry of Food and Agriculture), the Plant Genetic Resources Centre (now PGRRI)

under CSIR (in the Ministry of Environment, Science and Technology) and the Ministry of Lands, Forestry and Mines became involved.

All of the ministries participated and conveyed their views through written communications, one-on-one consultations and discussions. There was general agreement among stakeholder institutions on the need for Ghana to ratify the International Treaty, and no one expressed any concerns against it. However, the government did not sponsor any open public meetings or consultations in the period leading up to or during the ratification process described above.

3. Implementation

3.1 National Focal Point and lead institution

In 2004, the Minister for Food and Agriculture, through CSIR, designated PGRRI as the National Focal Point and the agency responsible for the implementation of the International Treaty. PGRRI's nomination reflects its status as a research institution specialising in PGR, and it is well placed to play the role of focal point.

3.2 National consultation workshop

Implementation of the International Treaty has been rather slow, mainly due to financial constraints on the part of PGRRI. However, the Ministry of Lands, Forestry and Mines organized a national consultation workshop for all major stakeholders in Ghana, 4 and 5 December 2006. The workshop aimed to develop a national policy framework on biodiversity, to provide adequate recognition and protection of traditional knowledge or intellectual property rights. It also sought to support the conservation of biodiversity and indigenous knowledge, and create options for adequate and fair schemes of access and benefit sharing. Participants from a broad spectrum of stakeholders attended, including five ministries, three departments, various national Boards, councils and commissions, universities, healers' and farmers' associations, and civil organizations.

As a result of this process, the Ministry of Lands, Forestry and Mines, through the World Bank-funded Northern Savannah Biodiversity Conservation Project, has produced a draft national policy on traditional knowledge related to PGR (MLFM 2007). The relevance of this initiative in the present context is that it is conceptually linked to the implementation of Article 9 of the International Treaty, on farmers' rights, and Article 9.2(a), in particular, concerning the "protection of traditional knowledge relevant to PGRFA".

As an attempt towards implementing the International Treaty, in 2009, PGRRI organized a workshop on a "National Information Sharing Mechanism on Plant Genetic Resources".

3.3 Processes to be followed for groups interested in the International Treaty

For target groups in Ghana to take advantage of the International Treaty's provisions, it may require the national lead institution to constitute a National Committee of Experts on PGR, including legal persons to conduct surveys on the current status of PGR and on existing legislation that might hinder or promote implementation of the International Treaty. It would also be useful to organize a national stakeholders' workshop to clarify

the way forward, as well as organize awareness-raising and training workshops to build the capacity of target groups.

FAO supported PGRRI in the development of Ghana's report on the implementation of the GPA. The meeting that was convened in July 2007 to develop the report resulted in the formation of a national committee of experts, the membership of which could potentially be expanded to include legal expertise. The national information-sharing mechanism noted above is another relevant development.

3.4 Standard material transfer agreement

Currently, there are no organizations within Ghana using the International Treaty's SMTA when transferring material under the multilateral system of access and benefit sharing created by the International Treaty. It will require a considerable level of sensitization of all relevant stakeholder institutions on this requirement and the benefits to be derived therefrom. PGRRI took advantage of the FAO-supported meeting of July 2007 (mentioned above) to sensitize researchers from other institutions on information sharing and to raise awareness about the SMTA.

3.5 Materials within Ghana in the multilateral system of access and benefit sharing

So far, no consultation process has taken place to determine which materials within Ghana are included in the multilateral system and which are not. This is clearly an area with which the national focal point should be concerned, and for action, e.g., through consultation with researchers to identify PGR collections and their contents that could be included in the multilateral system (also see below).

3.6 Existing laws in Ghana

There are no existing laws or policy frameworks in Ghana that are, in any way, in direct conflict with the implementation of the International Treaty. Nevertheless, there is a need for a coherent legal and policy framework for implementing its provisions, especially those relating to access and benefit sharing. Fortunately, however, all of the materials likely to be included in the multilateral system are in the public domain and under the control of the contracting party—the Republic of Ghana. Therefore, the issue of legal difficulties does not arise.

4. Conclusions

The Government of the Republic of Ghana demonstrated its commitment to the International Treaty and its aims by ratifying the Treaty in 2002. The significance of the International Treaty to Ghana is a reflection of the country's varied ecological zones, which support diverse forms of PGRFA; the important contribution of farmers, local communities and researchers in the sustainable management of these resources; and the fact that the economy of Ghana relies heavily on the contribution of agriculture.

However, Ghana is lagging behind in the implementation of the International Treaty because of inadequate budgetary support to the lead institution to enable it to develop an appropriate institutional framework, draft appropriate laws and regulations, and

sensitize and build capacity among interest groups to take advantage of the International Treaty's provisions.

Ghana may need technical and legal advice and assistance from FAO or Bioversity International, particularly in implementing certain elements of the International Treaty, such as farmer's rights, the multilateral system and IPR.

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