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

MALAWI

Malawi Government

STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

COUNTRY REPORT

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PREFACE

The report has been produced after comprehensive consultations at both local and international level. Plant genetic resources (PGR) experts were consulted through a series of workshops and an interactive National Information Sharing Mechanism (NISM). The process started in August 2007 with support from Bioversity International and Food and Agriculture Organization (FAO). NISM provided for maximum participation of stakeholders through exchange of information on conservation and utilization of plant genetic resources for food and agriculture and Malawi Plant Genetic Resources Centre was designated as National Focal Point.

The process started with a policy maker's workshop that identified possible stakeholders to be involved in the project implementation. A total of 18 stakeholders from government departments, NGOs, and Parastatals were identified. The identified stakeholders together with the National Focal Point were trained NISM software installation, data entry and data analysis.

Information provide by all stakeholders was used by a drafting team to produce this report based on guidelines provided by FAO. Therefore this report presents a true reflection of state of plant genetic resources in Malawi.

EXECUTIVE SUMMARY

Agriculture is the mainstay of the economy in Malawi. The sector contributes about 36% of the Gross Domestic Product (GDP), 87% of the total employment, supplies more than 65% of the manufacturing sector's raw materials, provides 64% of the total income of the rural people, and contributes more than 90% of the foreign exchange earnings. It is the main livelihood of the majority of rural people, who account for more than 85% of the current, estimated 12-14 million people. In the past decade the agricultural productivity has been far from satisfactory due to erratic climatic conditions as well as lack of conducive policies for agricultural expansion. Development of agriculture in the country and the entire global depends on continuous availability plant genetic resources. Plant genetic resources form act as building blocks for crop improvement, help to regulate environmental conditions, also locally adapted plant genetic resources are easy to produce and also they provide cheap source of nutrient requirements. Factors leading to imbalance of these resources will jeopardize development of agricultural sector.

Malawi has a rich plant diversity contributed by a range of ecosystems. According to International Union for Conservation of Nature (IUCN), there is an estimated total of 6 000 species in the country. Of these, about 122 are endemics while 5 are extinct. 555 species have been reported as food. Principal food crops in Malawi are maize, rice, sorghum, cassava, potatoes, beans and bananas. Maize is the major staple food crop with 60% of the total cropped land devoted to its production. Common bean is the most important legume in Malawi. It is grown as both food and cash crop. Tobacco is the major export earner for Malawi contributing over 65 percent of the foreign exchange earnings. Other important export commodities include tea and sugar, which respectively contribute about 10 and 11 percent. Information on released varieties indicates that maize has the highest diversity of released varieties followed by beans, groundnuts, cassava, rice sorghum and pearl millet.

Mushrooming of improved varieties has contributed to loss of local crop varieties from farming communities. Comprehensive surveys conducted on maize, sorghum and finger millet has shown that most of local varieties for these crops have been lost. Fortunately some of the lost varieties from the communities have been conserved in the Genebank and efforts are underway to reintroduce the lost germplasm. Other factors that have led to loss of local crop landraces include: habitat loss and fragmentation, human population increase, deforestation, lack of policy on conservation and sustainable utilization of plant genetic resources. Some of the varieties that have been lost include: kanjerenjere (early maturing maize variety) kamchiputu (aromatic sweet potato), saopaalendo (fast cooking bean variety) and most of indigenous vegetables have disappeared from their habitats. Considering production trend and research activities the following crops have been identified as neglected and underutilized: *Eleusine coracana* subsp. *Coracana, Vigna subterranean, Sorghum bicolo,r Pennisetum glaucum, Vigna radiata, Amaranthus hybridus, Cleome gynandra, Dioscorea bulbifera, Dioscorea rotundata, Plectranthus esculentus, Moringa oleifera, Cicer arietinum, Sesamum indicum and Cucurbita maxima.* Diversity of these underutilised crops is decreasing considering that their production is out competed by selected few major crops. Though the production of these species is declining, importance of such crops still remain high.

Ex situ activities are mainly conducted by Malawi Plant Genetic Resources Centre. Other institutions involved in *ex situ* conservation on a small scale include: Forestry Research Institute, National Herbarium and Botanic Gardens. Conservation is carried in either specialised facilities such as deep freezers for seed samples or in the field for vegetatively propagated materials. Malawi Plant Genetic Resources Centre (MPGRC) is the only long-term conservation facility. Currently MPGRC is holding 3 527 accessions in both long and short term. Maintenance of *ex situ* materials is hampered by:

- Inadequate capacity in terms of staff and facilities to regenerate or rejuvenate germplasm hence limiting their availability for use in research programmes,
- Unknown viability status of the conserved germplasm due to limited capacity to conduct viability tests more especially wild plant species,
- Limited information on seed storage behaviour of some species especially the wild ones,
- Lack of capacity to conduct molecular characterisation which leads to inadequate information on the diversity of the conserved germplasm,
- Lack of information on the potential value of the conserved germplasm hence limiting its use by interested users such as plant breeders,
- Lack of information on appropriate seed testing protocols especially for wild species,
- Limited financial commitment that hampers systematic research work on germplasm.

MPGRC is working in collaboration with Seed Services Unit to overcome problem of viability testing. Plans are underway to establish a stand alone seed viability testing laboratory to avoid interfering with activities of Seed Services Unit. Government in collaboration with donors is planning for capacity building in terms of training in specialized fields that have proven to have negative impact on sustainability of *ex situ* collections.

In total MPGRC has distributed 1 272 samples to users in the last 16 years. 8% of was distributed from 1992 to 1996 and 92 % has been distributed from 1996 to present. A lot of samples were distributed in 2007 representing 26%. This increase in utilization came about because of deliberate effort by MPGRC to sensitize the public on existence of Genebank in Malawi. Beneficiaries of the Genebank materials include breeders, NGOs, universities, communities, and other research institutes. Major limitation to utilization of conserved materials is inadequate information describing accessions. In order to promote utilization of germplasm, it is important that systematic characterization is conducted and information properly packaged. As of now only 5 crop species have been characterised representing 10.4 percent.

A total of 394 samples from 5 crop species have been fully characterized. This represents 10.4% of the total collection. This clearly indicates that a lot of samples have not been characterized. The following crops have been characterized: sorghum, finger millet, cowpeas, pumpkins, and sweet potato.

The Malawi Plant Genetic Resources Centre (MPGRC) was established n 1992 at Chitedze Research Station as member of the SADC regional project on plant genetic resources. The SADC Plant Genetic Resources Centre (SPGRC) was established in Lusaka, Zambia in 1989. MPGRC operates with guidance from National Plant Genetic Resources Committee (NPGRC) which was established in 1992. The functions of the NPGRC are to advise on plant genetic resource activities to be carried out by the MPGRC. Though the MPGRC is a major player in plant genetic resources other institutions like University of Malawi, Forestry Research Institute of Malawi (FRIM), National Herbarium and Botanic Gardens of Malawi, FAIR, Mzuzu University, and Centre for Environmental Policy and Advocacy (CEPA) play a critical role in conservation and utilization of plant genetic resources for food and agriculture.

Plant genetic resources research programmes are coordinated by the Department of Agricultural Research Services (DARS). The work involves plant breeding, agronomic evaluation and characterisation. Most of the work is done in collaboration with both national and international partners. Strong collaboration exists between the national program and CGIAR (ICRISAT, IITA, CIAT, CIMMYT, and World Agroforestry Centre). However, lack of emphasis on conservation of plant genetic resources from partners has led to loss of some landraces in the country.

Malawi is a signatory to international agreements that are relevant to plant genetic resources. These include Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture and NEPAD. Though Malawi is a party to these international agreements, she has no comprehensive structural and legal framework specifically for the conservation of plant genetic resources and Access and Benefit Sharing but rather follows a sectoral approach where there is a policy and a legal instrument for a particular component of diversity governed by a particular government institution. The Sectoral legal frameworks include: National Environmental Policy (NEP, 1996), Environment Management Act (EMA, 1996), National Biodiversity Strategy and Action Plan (NBSAP, 2006), National Forestry Policy 1(996), Forestry Act (1997), Wildlife Policy (2000). Need for developing a stand alone policy on conservation and utilization of Plant Genetic Resources (PGR) for food and agriculture still remains a priority so that pgr issues are coordinated and implemented by the Ministry of Agriculture and Food Security.

In order to strengthen conservation and utilization of PGR in Malawi, there is a strong need to strengthen collaboration among key stakeholders in the following areas: collection, evaluation and characterization, training, public awareness, research and networking. Capacity building in terms of infrastructure improvement and human resources needs to be emphasized as well. For easy implementation of PGR activities conducive policy environment is required.

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ABBREVIATIONS

ASSMAG	Association of Smallholder Seed Marketing Action Group
AVRDC	World Vegetable Centre
CBD	Convention on Biological Diversity
CBO	Community Based Organisation
CEPA	Centre for Environmental Policy and Advocacy
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de AgriculturaTropical
CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Center
DARS	Department of Agricultural Research Services
DNPW	Department of National Parks and Wildlife
EAD	Environmental Affairs Department
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EU	European Union
FAO	Food and Agricultural Organisation
FRIM	Forestry Research Institute
FUM	Farmers Union of Malawi
GDP	Gross Domestic Product
GMO	Genetically Modified Organism
GRBC	Genetic Resources and Biotechnology Committee
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
ICRISAT	International Centre for Research in Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
IPGRI	International Plant Genetic Resources Institute
IPR	Intelectual Property Rights
IRRI	International Rice Research Institute
ISTA	International Seed Testing Association
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for Conservation of Nature
MDG	Millennium Development Goals
MGDS	Malawi Growth and Development Strategy
MPGRC	Malawi Plant Genetic Resources Centre
NASFAM	National Smallholder Farmers' Association of Malawi
NBSAP	National Biodiversity Strategy and Action Plan
NEP	National Environment Policy
NEPAD	The New Partnership for Africa's Development
NGO	Non Governmental Organisation
NHBGM	National Herbarium and Botanic Gardens of Malawi
NISM	National Information Sharing Mechanism
NPGRC	National Plant Genetic Resources Centre
NRCM	National Research Council of Malawi
NSOER	National State of the Environment Reports
NSSD	National Strategy for Sustainable Development
OAU	Organisation of African Union
OPV	Open Pollinated Variety
PBR	Plant Breeders Rights
PGRFA	Plant Genetic Resources for Food and Agriculture

PROTA	Plant Resources of Tropical Africa
PVP	Plant Variety Protection
SABONET	Southern African Botanical Diversity Network
SADC	Southern Africa Development community
SDIS	SPGRC Documentation and Information System
SIDA	Swedish International Development Agency
SLU	Swedish University of Agricultural Sciences
STAM	Seed Traders Association of Malawi
TRIP	Trade Related Intellectual Property
USAID	United States Agency for International Development
WESM	Wild Life Society of Malawi

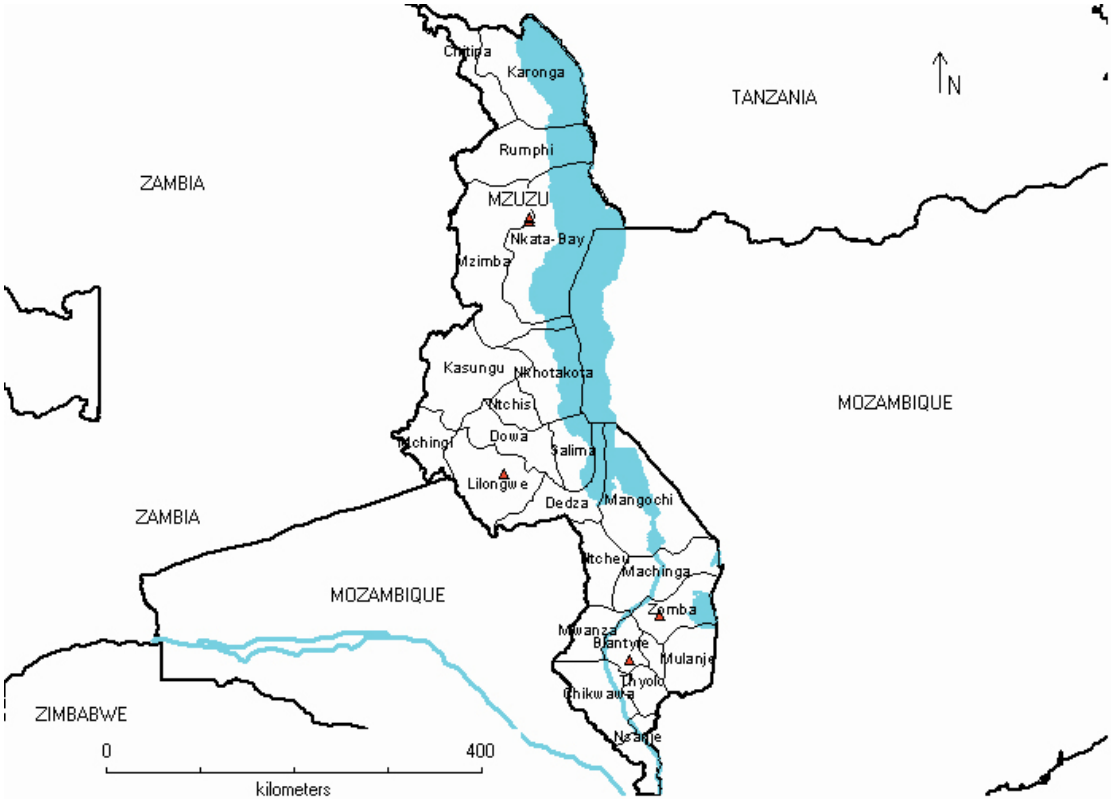
INTRODUCTION

1. Background information

1.1 Topography

Malawi has a total area of 119 140 km^2 of which 20 902 km^2 (20%) is made up of inland waters dominated by Lake Malawi. Mozambique borders it to the south, east and west, Tanzania to the north and Zambia to the west (Figure 1).

FIGURE 1
Map of Malawi



Malawi lies between latitudes 9^{0}22′ and 17^{0}03′ S and longitude 33^{0}40′ and 35^{0}55′ E. The topography varies from near sea level in the lower Shire (i.e. 50 m above sea level) to about 3 000 m on high mountains e.g. Mulanje.

1.2 Climate

The climate is continental with two distinct seasons – the dry and wet seasons, which are characterized by large seasonal variations in temperature and rainfall. The rainy season runs from November to April and the dry season from May to October. The average rainfall is about 1 200 mm per annum with the highest rainfall being recorded in Nkhata Bay and Mulanje. Shire valley receives the lowest rainfall (below 900 mm per annum). The mean annual temperatures range from 12^{0}C to 32^{0}C. Temperatures are highest in the rift valley and along the lakeshore and could be as high as 38^{0}C. The highest

temperatures occur at the end of October, but thereafter the rains usher in cool weather. The lowest temperatures are experienced in high altitude areas, particularly the Viphya and Nyika plateaux, and the Dedza, Zomba and Mulanje mountains.

1.3 Soils

Malawi's soils are dominated by three major soil types: the Eutric leptisols (also known as lithosols), the Chromic levisols (latosols), and the Haplic lixisols. The most widespread of the group are the shallow stony soils associated with steep slopes. These red-yellow soils include the ferruginous soils of the Lilongwe Plain and some parts of the Southern Region and the weathered ferrallitic soils, some with a high lateritic content, which are of low fertility and easily exhausted. The Haplic lixisols include the alluvial soils of the lacustrine and riverine plains; the vertisols of the Lower Shire Valley and the Phalombe plains; and the mopanosols of Liwonde and Balaka areas.

1.4 Vegetation

As a result of its varied topography and rainfall regimes, Malawi presents a rich mosaic of different habitats. Several attempts to classify the vegetation of Malawi have been made, but according to the classification by White, vegetation in Malawi is represented by three regional centres of endemism: the Zambezian regional centre of endemism, the Afromontane Archipelago-like regional centre of endemism, the Eastern (Forest) regional mosaic. This classification as modified by Dowsett-Lemaire identifies nine major vegetation types. The most extensive of these are: the miombo woodland, deciduous forests and thickets, evergreen and semi-evergreen forests, and Afromontane grassland.

1.5 Population

The population currently estimated at 12 million people and growing at 2%, down from 3.2% in 1994, has a density of 105 persons per sq. km. This decline in population growth is due to the repatriation of Mozambique refugees and the impact of HIV/AIDS related diseases. The last census in 1998 showed that the population distribution by region was 46.5% (south), 41.4% centre and 12.1% (north). The Southern Region has the highest density of 162 persons per square kilometre, followed by the Central and Northern Regions with 113 and 44 persons per square kilometre, respectively. Blantyre District has the highest density at 389/km^2 while Chitipa has the lowest density at 29/km^2.

1.6 Economy

Agriculture continues to be the mainstay of the country's economy. The sector accounts for about 36% of the Gross Domestic Product (GDP), 87% of the total employment, and supplies more than 65% of the manufacturing sector's raw materials. Agriculture is also the main livelihood of the majority of rural people.

Malawi's agriculture is characterized by a dual system consisting of the smallholder sub-sector and the estate sub-sector. The smallholder sub-sector operates on 4.8 million ha of customary land and contributes 80% of Malawi's food and 10% of exports. The estate sub-sector concentrates on tobacco, tea and sugar, which accounts for 80% of all agricultural exports.

For the past 10 years there have been varying trends in terms of food production. The first five years production was poor due to erratic climatic conditions as well as lack of commitment to implement policies for boosting crop production. Fertilizer prices were high such that farmers could not afford to buy. The last five years Malawi has been realising food surplus due to subsidy programme the Government put in place. The increased production was mainly on maize unlike other crops. This contributed to low production of other crops and in the long run narrowing down diversity of other crops.

Seed production in Malawi is mainly done by companies. Largely seed companies are producing and selling maize hybrids. Small scale farmers are also involved in seed production of maize (OPVs) and other crops. Seed industry is seemingly expanding as compared to the past ten years. Increase in seed production of improved is posing a threat to survival of local landraces as exchange of improved seed is high among farming communities.

1.7 Land Tenure

The Land Act (2002) recognizes three land tenure categories: customary, private and public. Customary land is land that is held, occupied or used under customary laws but excludes public land. It constitutes about 65% of the land in

Malawi. Public land is the land which is occupied, used or acquired by the government, and any other land which reverts to government on termination, surrender or fall-in of freehold or leaseholds. It constitutes 21% of the land in Malawi. Private land is land owned, held or occupied under freehold title, or a certificate of claim or which is registered as private under the Land Act and it constitutes 14% of the land in Malawi.

A Land Policy approved and adopted by the Malawi Government in 2001 aims at ensuring tenure security and equitable access to land. Following the adoption of this policy, the current Land Act is being reviewed. The revised Act will classify land into three categories: government, public and private land. Government land will comprise land owned by the government and put to specific national use. Public land will be managed by the government or traditional authority, but exclusively for the public whilst private land will include freehold and customary land allocated exclusively to families or individuals and leaseholds. Private land will be subject to common residual rights of the state such as compulsory acquisition.

Under the new land law, customary tenure will be codified and granted full statutory recognition as free simple customary estate, registered and available for disposition under market conditions. Customary land will be demarcated and district/village registries set up and maintained throughout the country.

1.8 Threats to biodiversity

Malawi's efforts to halt the current rate of biodiversity loss can be achieved if factors that contribute to habitat loss, population growth and poverty are also reduced. These factors are perceived here as major challenges to biodiversity conservation in Malawi.

1.9 Habitat loss and fragmentation

The greatest threat to biodiversity in Malawi is the dramatic loss of habitats, fragmentation of species and habitats and isolation of remaining communities due to unsustainable land use practices. In Malawi agriculture, urbanization, infrastructure development and human settlements are the major uses of land.

The agriculture sector comprises small, medium and large-scale farmers. Small-scale farming is largely practiced by smallholder farmers whose land holding ranges from 0.5 to 1.5 ha. The small-scale farming is characterized by continuous cultivation on the same piece of land, cultivation in wetlands and riverbanks, encroachment into protected areas and cultivation on mountain slopes. This practice has contributed to soils degradation and has subsequently resulted in low productivity. The estate sector is dominated by tobacco, tea, and coffee and sugarcane production. Estates are required by law to set aside 10% of their land for forests. Despite this requirement deforestation is widespread in forests within and outside the estates while enforcement of the 10% is weak.

Developmental activities contribute to habitat loss through conversion of arable land, wetlands and forests for road construction, urbanization and human settlements. In addition, damming of rivers for irrigation and water supply lead to changes in ecosystems downstream and also impede migration of aquatic organisms upstream and hence cut off species access to spawning areas.

1.10 Invasive alien species

Invasive alien species have either been intentionally or accidentally introduced into Malawi and threaten indigenous biodiversity through consuming and preying on them, competing with indigenous species. The major threats to biodiversity are from invasive plants. e.g. *Eucalyptus* sp., *Prosopis* sp., *Fruticosus sp* also affect biodiversity in similar manner. *Eucalyptus* is well known for draining water hence making habitats for other plants unfavourable.

1.11 Population pressure

High population and density are considered the greatest causes of biodiversity degradation since more land is cleared for settlement and in search of fertile areas to increase food production. These activities have directly contributed to the reduction in forest cover from 45% in 1975 to 28% in the early 2000s. Of the 28% forest cover, 21% are forest reserves, national parks and wildlife reserves, and 7% are customary land forests. Deforestation has resulted in soil erosion and reduction in species composition and abundance and has increased sedimentation and siltation of many rivers and lakes.

The high population and density has also resulted in increased demand for indigenous plant resources for food, medicine, fodder, and fuelwood and construction material and has led to scarcity of these resources. This coupled with unsustainable harvesting methods of plant resources, such as uprooting, tree felling and debarking have reduced populations of these medicinal, food and folder plants to non-sustainable levels.

As long as the population growth rate remains high, pressure on land for settlements, agriculture and resource use will remain the biggest challenge to achieving sustainable biodiversity conservation.

1.12 Policy issues affecting plant genetic resources

Currently policies affecting pgr are fragmented. Considering the need for legal framework of Plant Genetic Resources (PGR) issues, Malawi requires a stand alone policy on conservation and utilization of plant genetic resources. PGR issues are mentioned in Environment Policy, Forestry Policy, and Wildlife Policy. The problem with these fragmented policies is that implementation becomes a problem as far conservation of plant genetic resources for food and agriculture is concerned. Implementing institution happens to be in the Ministry of Agriculture yet these policies fall under totally different ministries and Departments. It is suggested that the stand alone PGR policy should be coordinated by the Ministry of Agriculture, Food Security for easy implementation.

CHAPTER 1

THE STATE OF DIVERSITY

Malawi has a rich plant diversity contributed by a range of habitats. According to International Union for Conservation of Nature (IUCN), there is an estimated total of 6 000 species in the country. Of these, about 122 are endemics while 5 are extinct. 555 species have been reported as food. Comprehensive, studies on finger millet, sorghum wild rice have been conducted to quantify the level of genetic erosion that has taken place; it is indicated that in the last decade a lot of diversity has been lost in the country. Efforts are currently underway to conserve plant genetic resources in the country. Several institutions are implementing conservation activities as indicated in the table 1 below:

TABLE 1
Key Institutions responsible for conservation of Plant Genetic Resources in Malawi

Institution	Responsibility
Malawi Plant Genetic Resources Centre	Conservation of agrobiodiversity (*Ex situ* & On-farm conservation)
Department of Forestry	*In situ* conservation of wild plants for food and crop wild relative in forest reserves
Department of National Parks & Wild life	*In situ* conservation of wild plants for food and crop wild relatives
National Herbarium & Botanic Gardens of Malawi	*Ex situ* conservation of vegatatively wild plant species
Tradition Healers Association of Malawi	*Ex situ* conservation of medicinal plant species
FAIR	On-farm conservation of agrobiodiversity
Wild Life Society of Malawi (WESM)	Community participation in natural resources management.
Centre for Environmental Policy & Advocacy (CEPA)	Public awareness on conservation, farmers' rights and sustainable utilisation of agrobiodiversity
Forestry Research Institute of Malawi (FRIM)	*Ex situ* conservation of forestry species

Malawi's efforts to halt the current rate of plant genetic resources loss can be achieved if factors that contribute to habitat loss, population growth and poverty are also reduced. These factors are perceived here as major challenges to biodiversity conservation in Malawi. The greatest threats to biodiversity in Malawi is the dramatic loss of habitats, fragmentation of species and habitats and isolation of remaining communities due to unsustainable land use practices and of late climate change, high population and density.

1.1 Important crops

The main food crops in Malawi are maize (*Zea mays* L.), Cassava (*Manihot esculentum)*, Sorghum *(Sorghum bicolor*), Sweet potato (*Ipomea batatas),* rice (*Oryza sativa)* beans (*Phaseolus vulgaris*), bananas (*Musa* sp.) and potatoes (*Solanum tuberosum*). Maize is the staple food of Malawi and it is grown in 80 per cent of all Malawian farms. Maize is a strategic food security crop and poor yields almost inevitably result in food shortage and famine in the country. It is also an income generating crop and accounts for about 25 per cent of agricultural employment. Rice is another important food security and cash crop in Malawi. Common bean is the most important legume in Malawi. The main agricultural export crops from Malawi are tobacco, cotton, sugar, coffee groundnuts. Other crops that are gaining popularity due to their nutritional value and adaptability to marginal environments include indigenous vegetables like *Amaranthus*, cat whiskers etc, bambara nuts and millets and cassava. Table 2 summarises important crops in Malawi.

TABLE 2
Major crops in Malawi

Crop	Importance (Region)
Maize	Staple food whole country
Cassava	Whole country
Sorghum	Shire Valley, Eastern Region,
Banana	Thyolo, Mulanje, Nkhatabay, Karonga
Finger millet	Mzimba, Dedza, Chitipa, Karonga
Rice	Lakeshore, Shire valley
Ground nuts	Whole country depending on varieties
Beans	Dedza, Ntcheu, Salima, Phlombe, Ntchisi, Chitipa, Karonga
Cotton	Lake shore, Shire valley
Sweet potato	Whole country
Potato	Dedza, Ntcheu, Ntchisi
Tea	Mulanje & Thyolo
Sugar	Nkhotakota & Chikwaw
Coffee	Chitipa, Zomba
Cowpeas	Whole country
Pigeon peas	Southern region
Pearl millet	Southern region
Bambara	Central
Sesame	Southern region
Tobacco	Whole country

1.2 Diversity within and between crops and plants

Based on the number of released varieties, maize (*Zea mays* L) has the highest diversity of modern varieties. Other crops that have registered increase in number of released varieties include: groundnuts, rice, common beans, tobacco, cassava, pigeon peas, sweet potato, and cowpeas. Table 3 below summarises information on released varieties of different crops.

TABLE 3
Number of released crop varieties

Crop	Number of released varieties
Maize (Hybrid)	29
OPV	10
Rice	6
Pearl millet	2
Sorghum	2
Ground nuts	10
Beans	15
Cassava	6
Sweet potato	9
Pigeon peas	2
Soya bean	12
Cow peas	3

1.3 Diversity within and between major crops

1.3.1 Cereals

Malawi has very important local maize genetic diversity. Local maize show a colourful display of black, purple, red, yellow, white and mixed colour ears, of varying lengths and circumferences. The trend of maize landraces in Malawi is decreasing. This is indicated by availability of hybrids in farming communities as compared to previous findings. The country has a diverse wealth of rice germplasm. The most common cultivated species is *Oryza sativa*. Other species of wild rice include *Oryza punctata, Oryza longistaminata* and *Oryza barthii*. These landraces carry traits such disease & pest resistance, and drought tolerance that breeders and future generations may find extremely useful.

1.3.2 Pulses

Malawi has a very rich diversity of pulses that include beans, cowpeas, and pigeon peas. The diversity is mainly represented by one species namely *Phaseolus vulgaris*. Common beans exhibit a wide range of phenotypic variation including growth habit (determinate and indeterminate), seed size, seed shape and days to maturity. Based on seed colour over 200 cultivars have been identified. Other species in the genera include *P. lunatus* which grow in coll hilly regions of Malawi. Soya bean is the second most important grain legume. This is basically an exotic crop therefore its diversity is still limited. Another important grain legume is cowpea which has various subspecies both cultivated and wild. The cultivated species is *Vigna unguiculata*.

1.4 Diversity within and between minor crops

1.4.1 Cereals

Sorghum and finger millet show wide range of diversity as evidenced from the Genebank collection. Sorghum diversity ranges from seed colour, seed size, plant height, maturity period, taste, use, etc while finger millet diversity is based on different morphological characteristics as indicated by characterisation results. Pearl millet is also one of the important cereals cultivated in Malawi and its diversity is limited as evidenced from presence of limited number of farmers' varieties.

1.4.2 Pulses

Bambara groundnuts (V*igna subterranea*) is one of the neglected and underutilised grain legumes which has wide diversity of landraces. The crop is grown across the country. Major distinguishing factors between cultivars of bambara nuts include: seed colour, seed size, growth, leaf colour, flower colour, maturity period etc.

1.5 Root and tuber crops

The sweet potato occurs both as wild and cultivated species. A wide diversity of *Ipomoea batatas* which is the cultivated species has been reported in several parts of the country. Most of these cultivars have been assembled in a sweet potato field Genebank and the main distinguishing factors are colour of leaves, flowers and leaf shape. Currently there is no record on wild relatives of sweet potato in Genebank collection.

1.6 Grasses and forage species

Malawi is rich in various grasses and other forage species. Most common grasses include Star grass (*Cynodon* spp.): Guinea grass (*Panicum* spp.): Setaria grass (*Setaria* spp.) Rhodes grass (Chloris gayana), and elephant grass *Pennisetum* sp. Among legumes the following species are commonly found *Neonotonia wightii Macrotyloma* spp *Sesbania* spp. High diversity is found in *Centrosema* spp. with 6 species *(Centrosema brislianum, Centrosema haitiense, Centrosema plumier,i*

Centrosema pascuorum Centrosema plumieri Centrosema pubescens, Centrosema viginianum). Another species with wide range of diversity is *Stylo* spp. Diversity of stylo is represented by *Stylosanthes fruticosa, S. hamata, S. guianensis, S. mucronata, S. hamata* and *S.viscosa.* Other important forage species include: *Acacia anguistissima, Cajanus cajan, Calliandra callothyrsus, Critoria tenatea, Desmodium entotum, Desmodium uncinatum, Gliricidia sepium, Sesbania* spp. *Leucaena* spp.

1.7 Minor crops and underutilized/underexploited species

Gathered information on the current status of the neglected and underutilized crop species indicate that 14 crops are regarded as underutilised or neglected. These include *Eleusine coracana* subsp. *Coracana, Vigna subterranean, Sorghum bicolo,r Pennisetum glaucum, Vigna radiata, Amaranthus hybridus, Cleome gynandra, Dioscorea bulbifera, Dioscorea rotundata, Plectranthus esculentus, Moringa oleifera, Cicer arietinum, Sesamum indicum and Cucurbita maxima.* Diversity of these underutilised crops is decreasing considering that their production is out competed by selected few major crops. Though the production of these species is declining, importance of such crops still remain high.

1.8 Medicinal and wild food plant species

It is reported that in Malawi about 131 plant species are used as medicinal plants Most of these medicinal plants are herbs as such to certain extent contribute to food and agriculture. Most of these plant species grow as wild plants. Even though there is a vast amount of indigenous knowledge about the use of these plant species for medicinal purposes, very few species have been tested in the laboratory to ascertain their use and as of now, no active attention has been given to monitoring the survival of these species and to institute conservation measures. Availability of such species is decreasing due to land pressure which is leading to cultivation of virgin lands. Malawi Plant Genetic Resources Centre is planning to conduct detailed survey in collaboration with National Herbarium and Botanic Gardens to document wild species that are contributing to food security as well as plants used as medicine. Traditional Healers Association has established gardens for medicinal plants.

1.9 Factors influencing the state of plant genetic diversity

Current Government policy is promoting production of improved varieties. This has resulted in a boom of newly released varieties (Table 2 above). This means that diversity of improved varieties is increasing. Crops that have seen tremendous change in terms of varieties include: maize, rice, groundnuts, beans, soyabeans, cassava, sweet potato, bananas, sorghum, and cowpeas. Emphasis on modern varieties has contributed to loss of most indigenous crops and landraces. Though there has been recognised loss of local crops, some varieties have been maintained due to specific attributes that farmers regard as important. Some of the crops have their landraces in abundance include: sorghum, finger millet, bambara groundnuts, maize, cowpeas etc.

The major factors that have led to decrease in availability of crop landraces and wild plant species include: adoption of new varieties, policy and legislation, urbanisation and human population pressure, droughts, floods, overexploitation (overgrazing, land clearing and deforestation).

1.10 Future needs

Considering the rate at which genetic erosion is occurring it is important to strengthen proper monitoring mechanism in the country. Need for establishing a National Early Warning System to monitor changes in diversity ranks high. Capacity building is highly needed for proper establishment of such initiative. Relevant institutions such as Malawi Plant Genetic Resources, Forestry Research Institute, National Herbarium and Botanic Gardens, Wildlife and Parks and other relevant institutions need to be trained in monitoring of genetic erosion.

Institutionalising genetic erosion monitoring activities is a big challenge as it does not fall under priority areas. External support is required to establish ground work so that proper monitoring mechanisms are put in place to safeguard plant genetic resources for food and agriculture in Malawi.

CHAPTER 2

THE STATE OF *IN SITU* MANAGEMENT

2.1 Introduction

The Malawi Plant Genetic Resources Centre (MPGRC) is the lead institution in the *In Situ* management of plant genetic resources (PGR) for food and agriculture (FA) in Malawi. A number of *in situ* surveys, inventories, programmes have been implemented in the country since 1996. However, due to lack of coordination, line institutions involved in the *in situ* management of PGRFA have been working in unsystematic manner. Each institution works within its mandate, needs and priorities. There is urgent need for the *in situ* management activities to be coordinated. This chapter summarises *in situ* programmes/activities that have been implemented in the country since 1996.

2.2 Surveys and inventories

Malawi as a developing country realizes the need for inventories of indigenous and adapted crop species, crop wild relatives and wild plant species used for FA by local communities. Although not all the crop landraces and their wild relatives, including wild plant species, used for FA have been covered, a number of surveys some of which have produced inventories have been carried out by different Govt and non-governmental/private institutions since 1995. A summary of surveys/inventories that have been carried out in the country are summarized below.

FAIR implemented a biodiversity conservation programme with the objectives of identifying and assessing the status of maize landraces in Ntchisi and Dowa. The survey's findings indicate loss of maize (10), ground nuts (6), beans (10) and other crop landraces as indicated in table 4 below. The loss is due to displacement caused by the introduction of modern varieties in areas previously grown to landraces.

TABLE 4
Lost landraces in Dowa and Ntchisi

Crop	Lost landraces
	Kanjelenjele
	Bantam
Maize	Kachamsana
	Mtsakinya
	Mtumayani
	Kachiswe
	Mtukwa
	Mkangala
	Nyani
	Kambili
	Chalimbana
	Kalisele
Groundnuts	Makumba
	Kabayaya
	Msalatsonga
	Katambalala
	Salima
	Chimbonga

Crop	Lost landraces
	Nanyati
	Msinkha
	Napilira
Beans	Chitsika
	Saopa alendo
	Nkhalatsonga
	Kholombe
	Mazira ampheta
	Naligonkho
	Chizama
Cow peas	Chiphonongo
Sorghum	A white
Pumpkin	Mwangasira
	Tanje
Sweet potatoes	Kamchiputu,
	joni
Cassava	Gwalangwa
	Mawaya

A bean germplasm survey conducted by Centro International de Agricultural Tropical (CIAT) resulted in the identification of threatened or endangered bean landraces used for Food and agriculture. Assessment of threat to genetic diversity in bean landraces was done through farmer interviews on the number of landraces they used to keep and the number they were currently keeping. Data generated through the survey was entered into a Geographical Information System (GIS) for spatial distribution of materials.

An ecogeographic survey of rice and its wild crop relatives was conducted by the Malawi Plant genetic Resources (MPGRC) in 1997 with the objective of filling the taxonomic and ecogeographic gaps of wild and the cultivated species of rice. The survey was part of a regional project implemented in SADC and East Africa with final and technical support from the Internal Rice Research Institute (IRRI). In Malawi the survey was undertaken in three of the four agroecological zones of the country namely; Lower Shire Valley (< 200 m), Low altitude (200 - 760 m) and middle altitude (760-1300m)...

The survey's findings revealed the occurrence of three species of wild relatives of the cultivated rice namely, *Oryza barthii*, *O.longistaminata,* and *O. punctata* distributed in a broad range of ecological habitats in throughout the targeted areas.

All the wild rice species surveyed showed more variation in terms of habitat types compared to *O. sativa.* However, *Oryza punctata* was found to be restrictively distributed (only found in Lengwe and one place in Salima) compared with the other two species. Serious genetic erosion in terms of ecological habitat destruction was observed in most of the sites explored and that rice cultivation was the major cause of genetic erosion observed besides grazing by cattle and goats. In view of the results obtained from this mission, future conservation priorities are reviewed.

A cassava and sweet potato field survey covering all districts of the country was carried out by MPGRC in 1997/98 followed by another survey in 2007 with the objective of identifying local varieties of the two crop species and assessing their status. Farmer interviews using structured questionnaire and key informant interviews with the agricultural extension workers reviewed a range of cassava and sweet potato landraces. Mbundumali, Tebula, Manyokola, etc were among the cassava landraces. In the case of sweet potato they included such landraces as Bele la Mai (meaning mother's breasts – indicative of sweetness), Overall, there were more landraces of sweet potato compared with cassava (39 sweet potato and 12 cassava).

Field surveys on on-farm maintenance of sorghum, finger millet and cowpeas have been implemented by MPGRC in collaboration with Bunda College of Agriculture. Surveys of sorghum and cowpea have mainly covered the Lower Shire valley, Phalombe, Zomba and Balaka. In the case of finger millet, only Mzimba District has been covered. The main objectives of these surveys have been to identify and assess the status of landraces of the target crop species through farmer interviews using structured questionnaires and key informants with agricultural extension workers. While a number of landraces have been found in all the crop species, genetic erosion was serious due to decrease in number of landraces cultivated present as compared to the past 10 years. Major causes to genetic erosion included displacement by improved crop varieties, change in rainfall patterns – more erratic rains compared with say 20 or so years ago.

A field survey on the inventory of fruit trees by Forestry & Horticulture in the Dzalanyama area indicate the occurrence of various tree species that are used as fruit trees by local communities. The major fruit tree species include *Uapaca kirkiana* (Masuku), *Parinari curatefolia* (Muwula), *Annona senegalensis* (Mpoza), *Azanza guirkiana* (Matowo), etc. However, occurrence of the wild species is sparse as compared to what it used to be in the past. This is caused by agricultural expansion and deforestation. As the population is growing virgin lands are being opened for farming. And deforestation is on the increase as people are cutting down trees for firewood and charcoal.

2.3 Supporting on-farm management and improvement of plant genetic resources for food and agriculture

On-farm conservation/management is an *in situ* conservation technique which aims at maintaining plant genetic diversity of crops and their wild relatives in farmers' fields where they occur and as such it is an important component of agrobiodiversity effort (FAO, 1996; Maxted *et al*, 1997). However unlike the *in situ* genetic reserve conservation, there is currently limited scientific methodology/strategy for implementing on-farm conservation of plant genetic resources in the country. It is for this reason most of the activities that are geared towards supporting on-farm management in the country have generally involved pilot studies. Following below is a summary of pilot studies that have been implemented in various parts of the country targeting landraces of some crop species.

2.3.1 A study of on-farm conservation of farmers' varieties of sorghum in Malawi

On-farm conservation pilot study of sorghum and its associated crop species that included pearl millet, cow peas and maize was carried out in the Lower Shire Valley, of the country from May - July, 1999. The study objectives were to assess the status of associated farmers' varieties of the target crop species; investigate methods used by farming families in the maintenance process; determine key factors that affect farmers' decision on the maintenance process and finally determine impacts of farmers' practices on crop diversity in the target area. Participatory rural appraisal (PRA) guided by a structured questionnaire; was administered to 100 farm families that were randomly selected from various agroecological units of the Lower Shire valley

The results of the study showed that fewer sorghum varieties were being currently grown in the Lower Shire Valley compared to 30 or so years ago. Of the existing sorghum varieties, Wayawaya and Kawaladzuwa were found to be dominant whereas Zambia, Masotong'o, Bandela and Kapsyabanda no longer existed in the selected agroecological units; Seed selection process was found to be dominated by women across the target area; food security, grain hardiness and inability to purchase seed of improved varieties were identified as key responsible factors for influencing farming families to continue with the maintenance process whereas The persistent erratic rains were responsible for influencing farmers to preferring early maturing landraces. Out of the 100 farmers interviewed, 84 farmers showed interest in continuing with the maintenance of sorghum landraces.

Promotion of on-farm maintenance of finger millet. The project is being implemented by MPGR in Mzimba District. The project has established pilot sites and has involved 120 farmers. The objectives of this project are:

- to determine the extent of finger diversity millet
- to conduct diversity fairs in all the impact areas,
- to mount on-farm demonstration plots for displaying environment friendly production methods and verifying different attributes of all varieties,
- to carry out on-farm seed multiplication of varieties variety not readily available to farmers,
- to facilitate community seed banks across the study area, and
- to hold discussions with agro processing companies, NGOs and other institutions for marketing linkages and developing other possibilities

The pilot project also involves the assessment of improved varieties utilisation and management.

Evaluation of Best Practices for the conservation of sorghum (*Sorghum bicolor*) and Cowpea (*Vigna unguiculata*) in the Lower Shire. The study took an approach that evaluates a practice's importance for rare landraces and the practice's contribution to the main farmer livelihood strategies: in other words, the study tried to find out if the practice helped rare landraces to survive, and whether the practice was sustainable. It was concluded that most practices that contribute to food availability help in maintenance of landraces in the communities. The study involved 200 farmers who keep sorghum landraces. The evaluation process used was participatory in that it involved the farmers, not just in an extractive information gathering process, but also in a larger part of the analytical process. The process aimed at providing farmers as well as development agents and researchers with new insights into what keeps landraces on-farms. In addition, the process attempted to be sufficiently objective to convincingly communicate this information to a broader audience of researchers and development workers.

2.4 Promoting *in situ* conservation of crop wild relatives and wild plants for food production

In Malawi, most of the "active" *in situ* conservation for the crop wild relatives and wild plant species used for food production still relies heavily in the country's protected areas (National Parks, Wildlife reserves and Forest reserves) in which they are normally conserved. However, due to the fact that reasons for establishing the country's protected areas were not necessarily for the conservation of wild crop relatives and those plant species used for food production, their continued survival is seriously threatened with genetic erosion caused by overgrazing (in case of national parks and wildlife reserves) and bush fires.

Apart from protected areas, patches of crop wild relatives and wild plant species occur though on small scale in Dambos, community forests, etc. However, crop wild relatives and other wild food plants are more susceptible to genetic erosion than those residing in Government protected areas due to lack of ownership (communal) as well as lack of enabling policies and laws for their effective protection.

CHAPTER 3

THE STATE OF *EX SITU* MANAGEMENT

Ex situ conservation activities and initiatives are conducted in the country mainly by three major institutions namely: Malawi Plant Genetic Resources Centre, Forestry Research Institute of Malawi and National Herbarium and Botanic Gardens of Malawi. The main methods employed in *ex situ* conservation are carried out in freezers, coldrooms fields and glass houses. Materials are maintained in form of seeds and live plants.

3.1 Germplasm conservation facilities

There are 2 Genebank (seed storage) facilities in the country. One keeps seeds for long term and one for short term. Malawi Plant Genetic Resources centre keeps samples for both long and short term while Forestry Research Institute maintains its materials for short term mainly for research. National Herbarium and Botanic Garden also contributes to *ex situ* conservation of vegetatively propagated materials. Below are institutions that participate in *ex situ* conservation.

3.1.1 Malawi Plant Genetic Resources Centre

Considering the importance of plant genetic resources and the rate of species' disappearance, Malawi government established a centre of excellence responsible for conservation and sustainable utilisation of these resources. Malawi Plant Genetic Resources Centre (MPGRC) commonly known as Genebank is the only long term conservation facility in the country. It was established with financial and technical support from the Nordic Countries in 1992 through a network of plant genetic resources in SADC region. During the initial phase, MPGRC targeted crops germplasm but now the mandate has expanded to other economically important species as it is the only institution handling long term conservation.

The main objective of MPGRC is to enhance conservation and sustainable utilization of plant genetic resources in Malawi. It therefore strives to conserve plant genetic resources using appropriate and improved approaches for the benefit of present and future generations. Specifically the institution aims to:

- Collect and conserve threatened plant species
- Characterise, evaluate and document plant genetic resources
- Sensitize general public on conservation of plant genetic resources
- Handle the *in situ* conservation of crop, forestry, pasture, ornamental, medicinal and other indigenous plants
- Evaluate, review problems and recommend to the government, preventive measures to be taken against genetic erosion of plant genetic resources

The Genebank currently has 20 deep freezers and each has a storage capacity of 120 accessions. The deep freezers run at -18^{0}C and 12-15% RH. It also has two drier dehumidified incubator drying unit which runs at 18^{o}C and 12% relative humidity. It has a handling capacity of about 20-50 seed accessions and is capable of drying the seeds to below 5% moisture content. Besides seed collection the Genebank is maintaining vegatatively propagated crops in field genebanks at three sites (Chitedze, Bvumbwe and Kasinthula Research Stations. Since the genebank became operational in 1992 a total of 3 527 accessions of plant germplasm representing at least 900 species have been assembled through in-country collections missions. Out of 3 527 accessions 3 011 are seeds while 516 are vegetative materials.

3.1.2 Forestry Research Institute of Malawi (FRIM)

Forestry Research Institute of Malawi (FRIM) operates a seed centre which was established with support from German Technical Co-operation Agency (GTZ) on behalf of the Republic of Germany. The overall goal of the Centre has been the provision of high quality tree seed in sufficient quantities. The Centre therefore collects or produces, processes and freely distributes tree seeds. These are mostly indigenous species but in some cases also include other commercially useful species. FRIM has also undertaken significant activities involving medicinal plants.

3.1.3 Constraints to sustaining *ex situ* collections

Maintenance of the existing *ex situ* collections has been affected by several constraints. The major constraints include

- Inadequate capacity in terms of staff and facilities to regenerate or rejuvenate germplasm hence limiting their availability for use in research programmes
- Unknown viability status of the conserved germplasm due to limited capacity to conduct viability tests more especially wild plant species
- Limited information on seed storage behaviour of some species especially the wild ones
- Lack of capacity to conduct molecular characterisation which leads to inadequate information on the diversity of the conserved germplasm
- Lack of information on the potential value of the conserved germplasm hence limiting its use by interested users such as plant breeders
- Lack of information on appropriate seed testing protocols especially for wild species
- Limited financial commitment hampers systematic research work on germplasm.

In order to overcome these constraints, there is strong need to build both human and infrastructural capacity. Human capacity building should concentrate in the following areas: seed technology (viability testing, seed dormancy and storage) studies. At the moment viability testing is done at Seed Services Unit (ISTA accredited lab). MPGRC needs to establish a laboratory for viability testing to overcome the limitations caused by depending on the Seed Services Laboratory. Therefore, need for seed germination incubator. Provision of enough resources to conduct research on difficult species will enhance utilisation of maintained germplasm.

3.2 Expanding *ex situ* collections

3.2.1 Documentation

At MPGRC, two documentation modes are used. Manual and computer data handling techniques are employed in documenting *ex situ* germplasm. The manual system consists of a set of data books which are used to organize and record raw data for eventual input into a computer system. Computerised system, uses Microsoft Access Database Management System has been designed to hold the data that includes passport data, seed testing data, storage data and distribution. The system is standardised for SADC region as such it is called SADC Documentation & Information System (SDIS). All the collected and characterised germplasm has been documented into the system. The Documentation System will be upgraded to a web based system so that it is accessed on line.

3.2.2 Research

In its conservation efforts, to enhance utilisation of germplasm and improve efficiency of conservation efforts applied and strategic research is conducted. This research has been in areas of germplasm evaluation, characterization, diversity studies, and spatial analysis. Germplasm evaluation and characterisation has led to development and release of varieties of Sorghum and bambara groundnuts. Characterisation has been done on maize, sorghum, finger millet, bambara groundnuts and cowpeas. These studies have also improved utilisation through increased demand of fully understood germplasm. Spatial analysis has also been conducted on all the germplasm under conservation to understand geographic distribution of the samples. More efforts are required to improve research in seed dormancy, seed storage and molecular characterisation. This has led to identity areas that have been undercollected. More collaboration and funding are required in order to further these studies nationally and regionally as they are a research priority.

3.2.3 Botanical and home gardens

Malawi has three major botanical gardens in three major cities (Zomba, Lilongwe and Mzuzu). These gardens are geared towards of forest genetic resources. Besides conservation, botanic gardens are also involved in restoration programs of depleted natural resources providing planting materials to communities. They also conduct research on propagation of plants that are difficult to propagate.

(Get additional information from National Herbarium)

3.3 International arrangements and networks in PGR collection

Malawi is a member to several international arrangements involved in the conservation of PGR. Some of these include SADC Plant Genetic Resources Network which is a Southern African network working on conservation and utilisation of plant genetic resources, Millenium Seedbank Project, which is a Seed Conservation undertaking that has grown out of the Royal Botanic Garden, Kew global initiative. SPGRC acts as a duplicate site for germplasm. Four institutions (MPGRC, FRIM, NHBGM, and NRCM) are parties to the Millenium Seedbank initiative. The aims of the Project are:

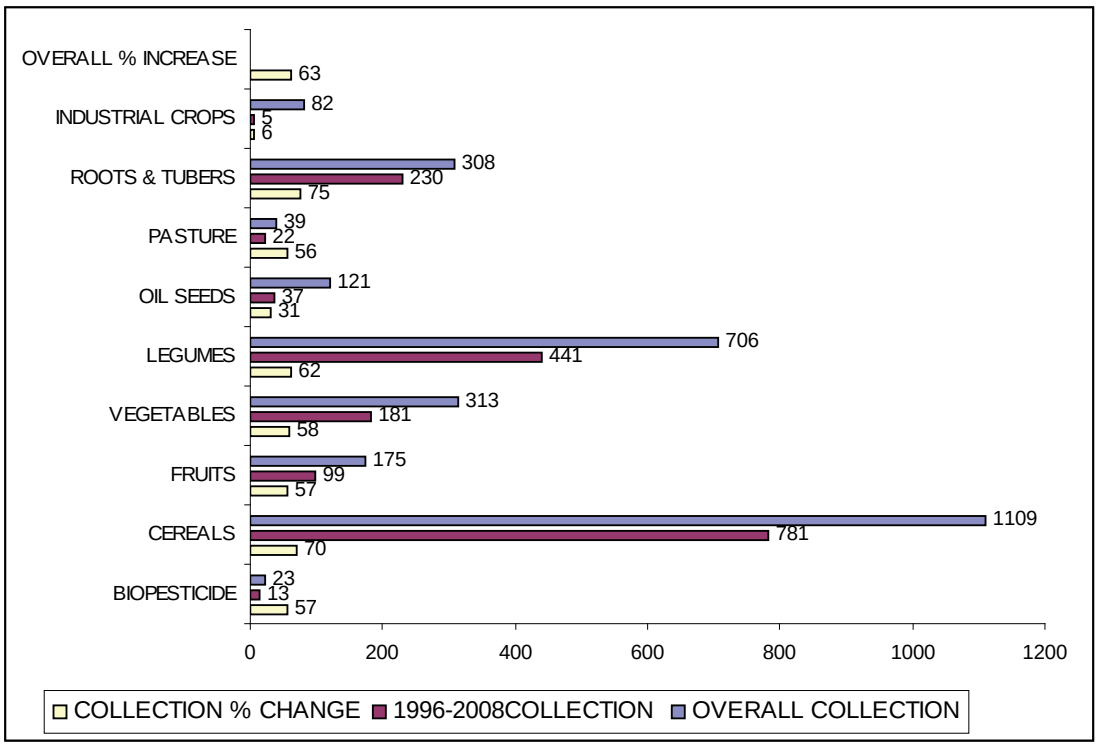
- Collect and conserve 10% of the world's seed bearing flora which partly include threatened edible wild plant species from drylands by year 2010
- Develop bilateral research, training and capacity building in order to support and advance the seed conservation effort.

Malawi also participates in an initiative of Plant Resources for Tropical Africa (PROTA). This is an initiative which aims at documenting plant genetic resources and in the process identifies gaps for research purposes. It also aims at promoting utilisation of plants that have been neglected for quite a period of time through dissemination of use attributes of such plants.

3.4 Planned and targeted collection

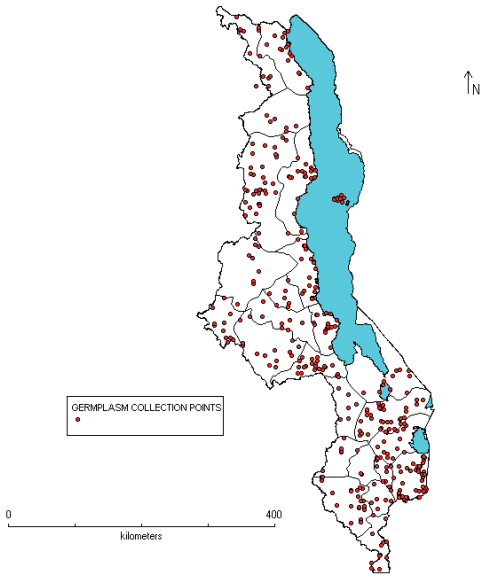
At present MPGRC holds 3 527 germplasm accessions belonging to about 900 species. This germplasm has been assembled through crop specific or opportunistic collection countrywide from farms or targeted ecosystems. Targeted and planned collections are being conducted specifically in these areas of the country. Cereals and legumes represent with cereal and legume germplasm forming the bulk as indicated in figure 2 There has been an overall increase of 63% of germplasm in the genebank with roots and tubers recording highest percentage increase of 75 followed by cereals (70). Unique categories such as traditional vegetables, pasture, biopesticide and medicinal plants are underrepresented.

FIGURE 2
Germplasm collection in the genebank according to crop groups



In terms of geographic coverage MPGRC holds materials all over the country as indicated in figure 3 below.

FIGURE 3
Spatial distribution of collected materials



However, despite the urgency to preserve our biodiversity, conservation efforts have largely been restricted to species and provenances of proven value thus neglecting some species and ecosystems. From spatial analysis conducted on the collected germplasm it has been observed that some areas have not been collected implying that some unique genetic resources have been neglected. Such areas need immediate collection. In terms of species collection, MPGRC has concentrated on cultivated species. Currently we are planning to embark on mass collection of crop wild relatives as sources of useful genes in crop improvement. Also we are targeting neglected and underutilised crops.

Priority for collection has been identified for crop wild relatives of crops, underutilized crops and species. Priorities for germplasm collection will also focus on regions with high rate of genetic erosion and degradations. With global threat of climate change, prone areas need to be surveyed for unique germplasm

Genetic diversity studies using different markers are essential to undertake germplasm collection for *ex situ* conservation and to identify sites with high genetic diversity for *in situ* conservation. However, such studies have not been carried out in the country thus hindering a rational collecting strategy. Genetic diversity studies therefore remain a priority research need to define important characters' variability and their patterns of distribution, and hence generate information for further germplasm collection.

3.5 Assessment of major *ex situ* needs

Conservation of plant genetic resources in Malawi is activity which is recognised by few institutions as such the few institutions need to have full operational programs so that their programs address the needs for the whole country. Therefore it is urgent for Malawi to strengthen its technical capacity for *ex situ* conservation and utilization of plant genetic resources at the sub-regional and national levels, with a special focus on:

- Strengthening of human resource capacity in areas of taxonomy, pathology, GIS, molecular techniques, database management and inventory.
- Strengthening infrastructures. At the national level there is need for strengthening the seed handling and storage capacity of the Genebank to meet national needs through provision of equipment. Equipment includes: germination incubators, Zigzag seed blower and oven. Modern purposefully built genebank is required for Malawi as currently the Genebank is housed in a very dilapidated building.

- Establishment of *In vitro* conservation facility for vegetatively propagated materials that are difficult to maintain due to pests and disease problems
- Value addition and enhancement of conserved materials through characterization, evaluation and pre-breeding.
- Increasing the infrastructural capacity to do regeneration, characterization and multiplication of germplasm.
- Providing adequate financial resources for conservation activities

3.6 Regeneration

To overcome genetic erosion in the process of regeneration, germplasm is strategically multiplied and rejuvenated in sites that have similar environmental conditions as collection sites. This is done in Research Stations located across the country. To preserve the genetic integrity of each population, pollination of each accession is controlled by isolation in time and space or by the use of pollination bags. Care is taken to maintain high effective population of each accession during regeneration and multiplication in order to preserve the genetic composition of the accession. Malawi is planning to do regeneration program as part of a major regional effort coordinated by SPGRC with support from Global Crop Diversity Trust . It plans to regenerate crops that are important to the region as stipulated in the regional strategy. These crops include: Sorghum, millets, maize, and cowpeas.

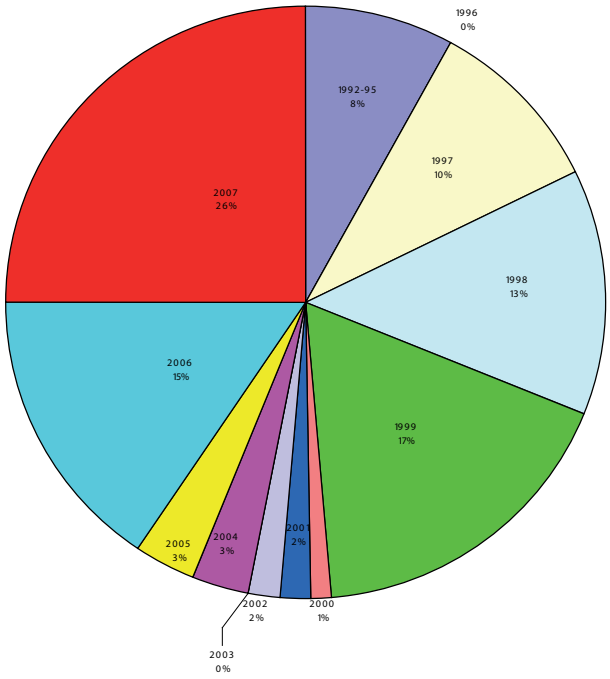
CHAPTER 4

THE STATE OF USE

4.1 State of plant genetic resources utilization

Collection of germplasm is done for various reasons including serving current and future breeding work. In addition germplasm is collected with intention of direct distribution to other farmers after multiplication. MPGRC is managing both accessions for long-term use and immediate use. Utilization of plant genetic resources held *ex situ* picked up in the last few years after introduction of awareness program. This program has revealed that many people, including farmers, were not aware of the availability of germplasm that Malawi Plant Genetic Resources Centre (MPGRC) keeps (refer figure 4 for samples distributed from 1996).

FIGURE 4
Annual sample distribution to users



MPGRC has 3 527 accessions in ex *situ* collections of which 1 272 have been distributed. 27% was distributed in 2007, and in 2003 no sample was distributed. Samples distributed from 1992-1996 represent 8% of the total distribution. A deliberate program has been running for the past four years to multiply roots and tuber crops, for example *Plectranthus esculentus* and *Dioscorea bulbifera,* for distribution mainly to farmers. Different scientists have requested and taken materials from NPGRC. While many scientists, who have accessed the plant genetic resources, are from Department of Agricultural Research Services the other group is mainly from the universities. Materials are distributed together with passport data particularly to scientists. Materials are collected for various reasons including enhancement of pest and disease tolerance, and yield improvement. Notable, is the development of two varieties of sorghum (Pilira 1 and Pilira 2) from genebank collections.

Participatory variety development through selection has been carried out on bambara groundnuts. Three varieties have been approved and released.

4.2 Characterisation

Most of the crops have not yet been characterized. Six crop species out of forty two have been characterized representing 14.2%. The low number of characterized crops is largely due to inadequate staff to carry out this activity. In addition there is a great need to train more people to carry out characterization. MPGRC needs to collaborate with other institutions like the university where some of the characterization could be carried out.

Characterization has mainly targeted morphological traits (refer Table 5). Characterization data is being handled manually and it is only cowpea data that is in electronic database called SADC Documentation and Information System.

TABLE 5
Characterized Crops

Crop	Overall percentage	% within species
Finger millet	2	76
Cowpeas	2	76
Sorghum	4	90
Pumpkins	0.4	50
Sweet potatoes	2	92
Total % of characterised germplasm	**10.4**	

A total of 36 sorghum accessions have been characterized at molecular level. Evaluation work for agronomic and biochemical traits is yet to be done and so too are biotic and abiotic stresses.

4.3 Seed supply systems and the role of markets

Seed supply systems are divided into formal and informal. Production of seed for the formal sector is regulated by government through Seed Services Unit which was established in 1976. It involves production of hybrid and open pollinated varieties. In Malawi the seed industry has been liberalized to enhance seed production; the formal seed sector is dominated by the multinational companies like Monsanto, SeedCo, Pioneer and Pannar Seeds among others. In the main these companies are producing and selling maize seed. All Seed Companies in Malawi have formed an umbrella body called Seed Traders Association of Malawi (STAM).

The Seed Services Unit deals mainly with issues of quality control through seed certification and random checks. Contravention of seed production regulations entails penalties determined by courts. The Government through the Department of Agricultural Research Services is involved in the production and selling of open pollinated varieties of maize as well as seed of other crops like groundnuts, soya bean and pigeon peas.

There are many non governmental organizations dealing with smallholder farmers involved in the seed multiplication. They include World Vision, Care International, Action Aid, FAIR, Oxfam, and National Smallholder Farmers Association of Malawi. Whereas, the range of operations of these NGOs extends to the remotest areas, often not reached by private seed companies, the number of rural farmers reached still remains low.

Informally, seed is sourced through various ways including free exchange, buying from local markets, exchange for labour and gifts. The Department of Nutrition is promoting utilization of indigenous vegetables. Dietary diversity is being increasingly recognized in the face of HIV and AIDS pandemic. Two projects conducted in collaboration with by Bioversity International and the AVRDC-The World Vegetables Centre – Regional Centre for Africa are also promoting use indigenous vegetables for nutrition, health and livelihoods. Similarly, universities and horticultural organizations are doing the same.

4.4 Constraints to increase markets local varieties and diversity-rich products

Some of the constraints thwarting markets for local varieties are:

- Lack of policy to promote production local varieties
- Inadequate awareness of the nutritional values of local varieties
- Stigma of local varieties – they meant for the poor and famine conditions

4.5 Underutilized crops

Activities were carried to collect some underutilized crops (refer Table 6). To date, NPGRC has 30 accessions of air yams, Livingstone potato and ground yams. The scope of their use has now widened based on the number of farmers who have requested and received these crops. There are two non governmental organizations, FAIR and Care International, whose program subcomponents are to enhance utilization of traditional crops through groups of farmers who have shown interest.

TABLE 6

Crop	No of accessions
Air yams *(Dioscorea bulbifera)*	8
Livingstone potato (*Plectranthus esculentus*)	12
Ground yams (*Dioscorea odoratisima* and *Dioscorea* spp)	10

4.6 Future needs

There is need to strengthen and create more linkages with different institutions in a bid to increase utilization of plant genetic resources. Promotion of indigenous foods through establishment of stable markets for such plants and also integration of indigenous food consumption with HIV/AIDS. In order to promote utilisation of the conserved materials, characterisation should be emphasised through collaboration with other research institutions.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

5.1 National programmes

The Malawi Plant Genetic Resources Centre (MPGRC) was established n 1992 at Chitedze Research Station as member of the SADC regional project on plant genetic resources. The SADC Plant Genetic Resources Centre (SPGRC) was established in Lusaka, Zambia in 1989 with the following objectives:

- to conserve indigenous plant genetic resources and the natural crop heritage of the SADC region;
- to establish over 20-year period a SADC Plant Genetic Resources Centre and network of local germplasm programme to support plant research in the region;
- to train plant genetic resources personnel for the region;

The MPGRC is a section in the Department of Agricultural Research and Technical Services of the Ministry of Agriculture, Food Security and Fisheries. The mandates of the MPGRC are to:

- collect endemic and indigenous germplasm;
- characterise, evaluate, rejuvenate, multiply and document all endemic, and indigenous germplasm;
- hold short term and active collections;
- handle "*Ex Situ*" conservation programmes;
- handle "*In Situ*" and "On-farm" conservation programmes;
- serve plant breeding and plant research in Malawi with indigenous and/or adapted germplasm from the SPGRC and active collections of the MPGRC; and
- work in close collaboration with national plant breeding institutions, non-governmental organisations (NGOs) and the farming community.

The MPGRC staff team has grown from 3 (1 MSc. 1 diploma and 1 certificate holders) in 1996 to nine (9) in 2008. Currently, there are two MSc degree holders at Principal Research Scientist level; one technical staff member at Chief Technical Officer level; two technical staff at Senior Technical Officer level; and three at Technical Staff level. A large number of staff have been trained (under the SPGRC programme) at certificate and MSc degree level at the University of Birmingham in the UK, Swedish University of Agricultural Sciences (SLU) in Sweden, Danish University in Copenhagen, Nordic Gene Bank in Sweden and SPGRC in Lusaka, Zambia. Although, xx are not working at the MPGRC, most of them have significant contribution to plant genetic resources conservation and use within Malawi.

A National Plant Genetic Resources Committee (NPGRC) is in place since 1992. The functions of the NPGRC are to advise on plant genetic resource activities to be carried out by the MPGRC and to scrutinise the budget. The NPGRC comprise of members from government departments, parastatals and NGOs. In future, there will be need for incorporating representation from the farming community through the Farmers' Union of Malawi (FUM) as they have direct link with farmers and it will be easy to involve farmers on issues of conservation and sustainable utilisation of plant genetic resources for food and agriculture.

The MPGRC also has three Crop Working Groups: the Food Crops Group; the Industrial and Horticultural Group; and the *In Situ* and Forestry Group. Crop working groups are advisory committees for the MPGRC. Their role is to develop strategies for collecting, characterisation, multiplication and conservation of plant genetic resources *in situ*, on-farm and *ex situ*.

The approved SPGRC programme has 12 crop working groups. In Malawi only three crop working groups were formed and operationalised before 1996 and remained so due to inadequate staff at the MPGRC. It is unfortunate that medicinal plants, ornamentals and underutilised plants were not included in the three crop working groups. In Malawi there are

many vibrant associations of traditional healers who could be co-opted in a working group on medicinal plants. The group would prepare an inventory of medicinal plants in Malawi and the accompanying indigenous knowledge. Lastly, there is a lot of work done in agriculture and forestry on underutilised plants. Just like vegetable crops, all scientists working on underutilised plants should be grouped together to form a working group on underutilised plants. Therefore, the challenge is to form several local/national networks to work on the various categories of germplasm in Malawi.

The Malawi government has shown commitment in providing funding for both the MPGRC at Chitedze Research Station in Malawi and the SGPRC in Lusaka, Zambia. As is the case with any other Malawi government department, funding for the MPGRC is done through the government treasury allocation through the Ministry of Agriculture, Food Security and Fisheries and the Department of Agricultural Research and Technical Services. The limited funds mostly cover personnel emoluments, overhead costs, and partly support to implement technical activities. The MPGRC has had difficulties to procure basic equipment for seed processing, storage drying and motor vehicles. Fortunately, most of the currently available equipment has been provided under the bilateral arrangement with SIDA and SPGRC. The MPGRC legal committees do not meet as required due to lack of funding. It would be appreciated if international organisations responsible for the conservation of plant genetic resources could fund the committee meetings and the approved annual activities.

The Convention on Biological Diversity has its desk officer in the Ministry of Research and Environmental Affairs and an all embracing legal framework for the conservation of biological resources has been developed and it is hoped to fulfil implementation of all its provisions. Plant genetic resources for food and agriculture are not fully covered in the CBD, but are focussed in the International Treaty for Plant Genetic Resources for Food and Agriculture. Till now, there is still no national legislation on plant genetic resources for food and agriculture in Malawi. The MPGRC relies on the National Plant Genetic Resources and Biotechnology Committee of the Ministry Education, Science and Technology which is responsible for protecting plant genetic resources from biopiracy. Currently efforts are underway to solicit views from the public on how best PGR legislation can be formulated and implemented so that conservation and utilisation of pgr is done in coordinated way under one specific law which will help in internalising the International Treaty for Plant Genetic Resources for Food and Agriculture that came into force in 2004 and the other conventions to which Malawi is party.

The ultimate goal of plant genetic resources conservation activities is to ensure continued availability of plant genetic diversity which will help future breeding work to produce new adaptable crop varieties. Food security can only be realised if there is enough diversity in terms of the number of different types of crop types under production as well as the variation in the genetic make up which will be versatile enough to cope with the continuously changing environment.

5.2 Education and training

At the inception of the SPGRC in Lusaka, Zambia and the MPGRC, there were very few people trained at both certificate and BSc or MSc degree level with specialisation in conservation and sustainable use of plant genetic resources. SADC, through the SPGRC implementing agent, the Nordic Gene Bank, in collaboration with Bioversity International (IPGRI at that time) organised short courses in plant genetic resources at Danish University in Copenhagen, at the Nordic Gene Bank and in various countries in the SADC region for the both staff based at SPGRC and the NPGRCs. The Nordic donors, further sponsored several staff members based at the MPGRC on an MSc degree in Conservation of Plant Genetic Resources. The staff trained on the short courses and the MSc degree course in conservation of plant genetic resources by 1991 started the work on plant genetic resources in SADC.

By the year 2008, (26) staff had undergone training on the short course (5) staff had gone through the one-year MSc degree on conservation of Plant Genetic Resources at Birmingham University and 2 had gone through the two year MSc degree on biodiversity management in Sweden. Although a large number were trained, it has proved very difficult to retain staff at the MPGRC because of staff transfers, lack of staff promotion and attrition due to death and resignations. Staff that moved out of the MPGRC to other departments have helped to establish plant genetic resources activities at Bunda College of Agriculture, the Forestry Research Institute of Malawi and Mzuzu University. The MPGRC also benefited from the existence of a well equipped Seed Technology Laboratory with competent staff at Chitedze Research Station.

5.2.1 Challenges

At the moment, the most limiting factor to support the sustainable use, development and conservation of plant genetic resources is shortage of full time qualified staff in plant genetic resources management. Most NGOs, civic society organisations and CBOs that are working with local communities in agriculture and food security do not have sufficient

trained staff to handle conservation and sustainable utilisation of plant genetic resources. More staff at all the agricultural research stations, Natural Resources College, Bunda College of Agriculture, Mzuzu University, National Herbarium and Botanic Gardens, extension and crop specialists at all the eight Agricultural Development Divisions in the country should go through a 1 to 2 months course in plant genetic resources. Given the current demand for awareness on genetic resources conservation and use, there is need to introduce crop plant genetic resource management in the primary and secondary school curricula. It is also recommended that crop plant genetic resource should also be introduced in either "environmental science courses" offered in the departments of Chemistry, Biology or Physics at university level. The purpose for introducing the course at primary, secondary and tertiary education level is to mainstreaming the importance of crop plant genetic resources in food production and food security in Malawi.

In order to enhance capacity in Malawi there is need for SADC region to initiate training. Universities in the region should have fully fledged plant genetic resources courses in addition to continuing training staff in the plant genetic resources abroad at the long established universities such as Birmingham, Swedish University of Agricultural Sciences, Universities in Israel, China, USA and India. The major advantage for training abroad is that most of the universities abroad will have better equipped laboratories and on going advanced research in areas of characterisation and biotechnology applications. Regional and local training would be cheaper and include many more staff.

5.2.2 Education and training proposals

Short Courses

- Data and information management (2)
- Germplasm collection and GIS (2)
- 2-3 weeks introduction course in gene bank management (3)
- Advanced documentation training (2)
- *In situ* training (1)
- Study tours to UK, Nordic, Germany, USA and Chinese gene banks (2)
- Study tours to visit countries with functioning *In Situ* and On-Farm conservation programmes (2)
- Attachment to AVDRC: to study the handling of vegetable seeds (3)
- Attachment to Biodiversity International and Kew Botanical Gardens to equip MPGRC staff with modern and robust techniques for handling germplasm. (4)

The short courses will strengthen capacity in Malawi since most officers working on PGR do not have specialised training. Mostly staff have general agriculture knowledge.

Academic training

- 5 MSc in conservation and utilisation of plant genetic resources
- 5 MSc in biological diversity management
- 2 PhD in conservation and utilisation of plant genetic resources
- 2 PhD in biological diversity management

5.3 National legislation

Since the late 1990s, the subject of Intellectual Property Rights (IPRs) in biological materials has become very important in all kinds of bilateral and multilateral negotiations. This is so because biotechnology had become very prominent. As a result, the Trade Related Intellectual Property Rights (TRIPs) regime of WTO required member-nations to allow patent protection to plants and animals. The agreement allowed for exemptions (but not micro-organisms) in coutries where patents were not accepted for life forms provided an effective *sui generis* system was in place. The Organisation of African Unity (OAU), Council of Ministers recommended that African countries should develop national laws, as well as regional and common negotiating positions in international law and related issues to protect Africa's common biological diversity and livelihood systems dependent on it with a common tool. This *sui generis* law was developed and is called The African Model Law: The Protection of the Rights of Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources.

Malawi after acceding to WTO and CBD (1994)has developed several laws/policies regarding the two conventions. The laws or policies are:

- The Plant Protection Act (1969)
- The Environmental Management Act (1996)
- The National Decentralisation Policy (1998)
- The National Forestry Policy (2003)
- The National Parks and Wildlife Act (2004)
- The Wildlife Policy (2000)
- The National Herbarium and Botanic Gardens Act (1987)
- The Seed Act (1994)
- The Farmers Rights (Draft)
- The National Biotechnology Policy (2007)
- The Guidelines for Development of GMOs in contained facilities (2004)
- The National Strategy and Action Plan (2006)
- National Environment Policy (2004)

Most of the laws/policies listed above are largely in response to the adoption of the Convention on Biological Diversity in 1992. Malawi had to have new laws in order to internalise CBD. However, there is still need to establish ownership rights over biological resources found in Malawi; formulate guidelines for "Prior Informed Consent" according to CBD and set conditions for Material and Information Transfer Agreement according to CBD.

The question of IPR in case of new or old plant varieties will now be addressed through the Plant Breeders Rights, whereas those of local farmers and communities will be addressed through the Farmers' Rights. New plant varieties that are produced by plant breeders and seed produced by seed companies will go through Plant Breeders Rights. In Malawi, most of the certified seed will be hybrid maize. The majority of seed in Malawi is produced by smallholder farmers; as a result, there is no compulsion and need for Plant Breeder Rights. It is the opinion of some sectors that seed produced by farmers should be dealt with under Farmers' Rights. PBR should provide room for implementation of Farmers' Rights. Royalties from PBR should also be channelled to Farmers Rights in recognition of roles farmers have played in maintaining germplasm that breeders are using.

Currently, there is no specific policy on plant genetic resources. Issues of plant genetic resources are fragmented and need for one guiding policy ranks high. Therefore development of such policy will be a big achievement towards harmonising conservation and utilisation of plant genetic resources for food and agriculture in Malawi. This policy should most appropriately be under the Ministry of Agriculture, Food Security and Fisheries for easy implementation.

5.4 Information system

As pointed out in the introduction the MPGRC is situated at Chitedze Research Station as one of the research programmes of the Department of Agricultural Research Services in the Ministry of Agriculture, Food Security and Fisheries. At the moment, the MPGRC uses a well developed computer based documentation system (SPGRC Documentation & Information System - SDIS) that was developed at SPGRC in Lusaka, Zambia and is used by all the SADC national plant genetic resources centres. The main challenges are the maintenance of hardware (computers, printers and photocopiers) and connectivity to internet. Information on the MPGRC is also posted on the SPGRC and the Department of Agricultural Research and Technical Services websites. Ideally, the MPGRC should have its own website for publicity and for wider sharing of information on plant genetic resources. The MPGRC therefore needs a wide band e-mail and internet installation, high capacity computers and reliable electricity.

5.5 Public awareness

At the moment, the public has very limited awareness of the role and value of plant genetic resources. Some initiatives have been taken by MPGRC to sensitise the public. These initiatives include: participation in agricultural shows, organising seed fairs, organising talks to key institutions etc. The main reasons for limited awareness are due to the fact that plant genetic resources are discussed or handled under the Environmental Management Act under which there is more emphasis on issues such as climate change, environmental pollution and deforestation. Plant genetic resources are rarely highlighted. Plant genetic resources are really supposed to be highlighted under agriculture and food security.

Unfortunately, in agriculture and food security emphasis is on hybrid maize and fertilizers. The fact that plant genetic resources are used in developing the so called improved high yield varieties is not highlighted.

5.6 Trade, commercial and other international agreements

During the past decade, four important conventions/treaties/protocols have been adopted and signed by Malawi. These documents are the Convention on Biological Diversity (CBD) of 1992; the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs Agreement of 1994); the International Treaty on Plant Genetic Resources for Food and Agriculture of 2001; and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity of 2000.

The Convention on Biological Diversity rectified a historical wrong, i.e. it reversed the principle of "Common Heritage of Mankind", according to which genetic resources of the world belonged to everyone and not particularly to the nation where they were found. Now the CBD has acknowledged the "Principle of Ownership" and lays down conditions for countries where germplasm is found: "prior informed consent" and "material and international agreements" with respect to the transfer of germplasm from owner countries to companies or individuals that want to use these resources. Malawi through the Genetic Resources and Biotechnology Committee (GRBC) has formulated guidelines for users to follow in requesting germplasm. Ed The guidelines are acquired upon request GRBC.

Incidentally, Malawi is also a member of the World Trade Organisation (WTO). As a result, the Trade Related Intellectual Property Rights (TRIPs) regime of WTO required member-nations to allow patent protection to plants and animals. Therefore, Malawi opted to develop an effective *sui generis* system for protecting farmer crop varieties as provided for in Article 27.3(b). This *sui generis* protection system is known as Farmers' Rights. However, the conventional plant breeders will protect their new plant varieties with Plant Breeders Rights. Plant Breeders Rights will be administered by the Ministry of Agriculture, Food Security and Fisheries; where as Farmers' Rights will be administered by the Ministry of Research and Environment. Discussions are under way to have both Acts administered by the Ministry of Agriculture, Food Security and Fisheries.

5.7 Biotechnology

While debate on CBD, TRIPs Agreement and WTO agreement were going on, genetic engineering (the genetic modification of living materials) had ignited heated debates over trade policy. This debate has influenced the debate on plant genetic resources and new plant varieties. Innovations in the manipulation of microbes, plants and animals raises serious ethical questions related to the commoditisation and exchange of living organisms. Fortunately for Malawi, guidelines for the development of GMOs in contained facilities were published in 2004. The guidelines have set out procedures to be followed before GMOs are commercialised and released in the environment, risk assessment factors and risk control measures, and containment specifications for micro-organisms, plants, animals and recombinant DNA procedures. A national Biotechnology Act has not been formulated, but the Biosafety Act was published in 2007.

5.8 Challenges in biotechnology

Although guidelines for the development and testing of GMOs and national biotechnology policy are in place, there is limited public awareness of the value of biotechnology and its products in Malawi. There is also a limited number of laboratories that undertake traditional biotechnology research, let alone, a laboratory that can identify GMOs. There is, therefore a strong need to train staff in traditional and modern biotechnologies and establish laboratories that can identify materials that have GMO compounds and carry out research in biotechnology.

As pointed out earlier on, developed countries such as USA, and those in the EU plus developing countries such as Brazil and China have recognised the potential of biotechnology to contribute towards agricultural development. Both the USA and EU have provisions for supporting biotechnology and biosafety capacity building in the SADC region. For Malawi, there are challenges with regard to getting access to biotechnolgy because it is expensive and IPRs will increase the cost of GM crop varieties to farmers. Biotechnology will also strengthen conservation of plant genetic resources for food and agriculture by developing DNA banking, *in vitro* conservation as well as molecular characterisation of the conserved materials.

5.9 GM Food and Hunger

Producers of GM crops argue that biotechnology could be the world's cure for hunger. They cite the technology's ability to produce high yields, resist natural disasters such as drought and certain viruses, and be enriched with vital nutrients that starving people are likely to lack. However, aid agencies and anti-GM countries argue that in eliminating world hunger, GM crops have not been sufficiently researched. In fact, they note that many countries where hunger is a major problem do produce adequate amounts of food to feed their population. Hunger, they argue, is not a function of agricultural yield; it is also a function of mismanaged government and a series of other factors, which technology cannot solve. At present, there is international law dealing with aid shipment of GM crops to needy countries. However, debates over a country's right to refuse GM food aid during famine are bringing this issue to the forefront of biotechnology concerns. Malawi requires that all the food coming into the country be milled at the port of entry to avoid contamination.

5.10 Capacity building in biotechnology

In order for Malawi to benefit from biotechnology, there is need to develop capacity at national level through:

- Training of a critical mass of scientists and technicians in different areas of biotechnology, biosafety, risk assessment and management
- Promoting the participation of local biotechnologists and breeders in the development of GM crop plant varieties and products to satisfy local and regional needs
- Institutional support to establish and/or upgrade national research and testing facilities to meet appropriate quality standards
- Development of partnerships at international level to promote all areas of biotechnology research and application, taking advantage of NEPAD, the CGIAR, USAID and EU support.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 Regional collaboration

Malawi is a member of the SADC Plant Genetic Resources Centre (SPGRC) that is in Lusaka, Zambia. The main functions of the SPGRC are to: hold the base collection of the SADC member states; develop, maintain and manage the SADC accession databases for *in situ* and *ex sit*u germplasm; develop, maintain and manage the SADC inventory database of both *ex situ* and *in situ* germplasm; coordinate the inventorying, collection, characterisation, evaluation, rejuvenation and multiplication of germplasm in the SADC region; publish an SPGRC Newsletter; issue catalogues of plant genetic resources available in the SADC genebank; organise plant genetic resources annual planning meetings; and organise planning for human resources development.

During the 20 years of the SPGRC's existence, MPGRC has had: (33) people trained in germplasm conservation and sustainable utilisation; received three (3) motor vehicles for germplasm collection; a seed drier, seed germinator and ten (10) freezers for seed storage; has received five (5) computers; has received MK() for collection missions, workshops and maintenance of equipment.

Malawians working at the MPGRC have also benefited from the SPGRC through sponsorship to regional meetings set for preparing for country reports to the FAO Technical Conference that led to the adoption of the GPA for Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture and the Leipzig Declaration. Participation in SPGRC meetings has sharpened the MPGRC staffs' negotiating skills and advocacy. MPGRC also participated in the SADC Tree Seed Centre project and Southern African Botanical Diversity Network (SABONET).

Currently, the MPGRC is participating in the Millennium Seed Bank Project which is coordinated by the Kew Botanic Gardens at Kew in the UK. The participants in this project come from the Forestry Research Institute of Malawi, MPGRC, National Research Council of Malawi and National Herbarium and Botanic Gardens and Mzuzu University.

6.1.1 Challenges

Malawi's participation in regional networks has helped in building a strong national programme on conservation and sustainable use of plant genetic resources. However, more needs to be done in order to develop and operationalise *in situ* and on-farm conservation of plant genetic resources. It is believed that work on *in situ* and on-farm conservation will help in promoting underutilised plants, restoration, crop diversification and food security.

6.2 International Agricultural Research Centres

The Consultative Group on International Agricultural Research (CGIAR) has been supportive to national agricultural research, collection of plant genetic resources and training for a long time.

Most early collections were made out of the CGIAR scientists' initiative. The collections were split into two. One lot was taken and stored at the CGIAR's genebanks, where as the other half was left in the country. Material that was left in the country in many cases was lost due lack of good storage, but material that was taken to the CGIAR banks is still there and the MPGRC would like to embark on systematic repatriation of materials while ensuring that the collected materials are conserved properly.

Most of the CGIAR institutions have established their satellite research stations in Malawi. Centres such as ICRISAT, IITA, CIAT and CIMMYT have operated in Malawi over the past 20 years or so and the country has benefited from them through human resource development, provision of equipment and advanced breeding lines.

The most important field crops in Malawi are maize, rice, sorghum, pearl millet, groundnuts, beans and cowpeas. To date, large collections have been made but the MPGRC has not been able to characterise and evaluate all the accessions. It would be appreciated if collaborative programmes involving the CGIAR centres staff based in Malawi and MPGRC staff could be developed so that all the accessions in the MPGRC genebank could be characterised and evaluated so that materials with good traits could be identified and used in breeding projects. The collaborative projects could be extended to seed multiplication for sale/or issue to farmers in disaster situations or in crop restoration programmes to ensure food security.

Certain international research institutions e.g. Kew Garden and some other botanic gardens are storing some underutilised plants collected from Malawi. These plants may not be covered under the multilateral system, but are important for farmers' food security. Here, again, it would be good to have collaborative projects with institutions like Kew Gardens on plants such as edible orchids, melons, Livingstone potato and Zulu round potato following mutually agreed standards

Lastly, Malawi now has a Farmers' Union known as the Farmers' Union of Malawi (FUM). The organisation's role is to ensure that its members have adequate capacity to lobby for conducive policy and legal framework for increased agricultural production, marketing and fair trade agreements. FUM has a large membership which includes smallholder seed growers. Smallholder seed growers would be the best farmers for multiplying open pollinated crop varieties and seed for underutilised crops such as finger millet, Bambara groundnuts, Cowpeas and sesame.

CHAPTER 7

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

7.1 International instruments on access to plant genetic resources

After the earth summit in 1992 in Brazil countries agreed on a comprehensive strategy for sustainable development, which is meant to meet the needs of humans by ensuring that a healthy and viable world is left for future generations. One of the key agreements adopted at Rio was the Convention on Biological Diversity (CBD). Having signed the convention, Malawi has been participating as a member during the Conference of Parties (COP) meetings. The challenge for the national legal framework is to provide a workable framework that promotes fair and equitable sharing with various stakeholders identified as having contributed to the management of the resource, or the scientific or commercial process. Such beneficiaries may be governmental, non-governmental or academic institutions and indigenous and local communities.

Apart from the CBD, Malawi is also a party to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) which is another main international instrument regulation access and benefit sharing. The treaty was ratified in 2002. Unlike the CBD, the treaty comprehensively outlines matters relating to farmers rights and ABS. The first step therefore is to recognize the role of agro-biodiversity it plays in national development especially in relation to food security. The challenge is how to protect the existing plant genetic resources in Malawi while also ensuring that improvements are being made for food security. Some techniques and practices employed in crop improvement may have negative effects such as genetic pollution, monoculture and corporate monopoly promoted by IPRs.

In addition to the above, Malawi also ratified the WTO/TRIPs agreement which calls for parties to come up with sui generis regime in regulating and protecting plant genetic resources. Apart from the multilateral agreements and conventions, Malawi has also signed several regional protocols in management of trans-boundary genetic resources within the SADC region.

7.2 Policies and legislation relating to ABS in Malawi

Malawi has no comprehensive structural and legal framework specifically for the conservation of biodiversity and ABS but rather follows a sectoral approach where there is a policy and a legal instrument for a particular component of diversity governed by a particular government institution. However the National Environmental Policy (NEP) revised in 2004 and the Environment Management Act (E.M.A) 1996 currently under revision provide a coordinating framework though they have serious limitations. This part examines various pieces of legislation to determine the extent to which they address ABS issue.

7.2.1 Environmental management

A National Environmental Policy (NEP) was approved in 1996 and revised in 2004. The NEP was perhaps the first ever clear statement from Government of Malawi of its principles for environment and natural resources management in the country.

The Environment Management Act (EMA) was enacted in 1996. Amendments were drafted in 2006[1]. The main reason for these amendments is to eliminate gaps, overlaps, areas of contradiction, account for emerging issues and address

[1] Awaiting enactment by the Malawi National Assembly

inconsistencies in the existing environment and natural resources legislation. All this is being done in an attempt to harmonize environment and natural resources management legislation. The other key problem that the review of EMA will seek to address is ineffective implementation and enforcement of environmental legislation. The amendments also provide for farmers' rights and access and benefit sharing.

In addition, the Environmental Affairs Department (EAD) also developed a number of strategies. These include the National Strategy for Sustainable Development (NSSD), 2004; NEAP (1994, 2002); National Biodiversity Strategy and Action Plan (NBSAP), 2006; National State of the Environment Reports (NSOER), 1998, 2001, and 2002; Decentralized Environmental Management Manual (2002) and Guidelines for Environmental Impact Assessment (EIA) in a number of sectors in 2002. These strategies have significant impact in the implementation of ABS in the country.

7.2.2 Forestry

A National Forestry Policy was approved in 1996, followed by a Community Based Forest Management – A Supplement to the National Forestry Policy in 2003. The Forestry Act was passed in 1997. There are also Forestry (Community Participation) Rules, 2001 and Forestry (Amendment) Rules 2003. Progressive steps have been undertaken within the Forestry Department; currently there are drafts of Forestry (Community Participation) Rules 2008 being considered.

The Forestry Department also developed the National Forestry Programme in 2000. The Programme was developed as a means to put the 1996 Forestry Policy and the Forestry Act (1997) into practice. It provides a framework of priorities and actions for improving the management of forest goods and services and for strengthening their contribution to livelihoods and ABS for rural communities.

7.2.3 Wildlife

The most recent Wildlife Policy is dated 2000. In 2004, a National Parks and Wildlife (Amendment) Act was passed by the National Assembly. This amended the previous Act dated 1992. Although the latter was relatively modern it did not provide for community participation in wildlife management. In 2007, the Department of National Parks and Wildlife (DNPW) finalized the preparation of Access and Benefit Sharing Guidelines.

DNPW would like to amend the National Parks and Wildlife regulations to reflect the amended National Parks and Wildlife Act (2004). This will ease implementation of the current Act and enable the department to apply new fees. Considering that the Act was amended in 2004, the department seems to be moving at a very slow pace in coping up with policy and legislative reforms.

7.3 Fair and equitable sharing of the benefits of the use of plant genetic resources

7.3.1 Access and Benefit Sharing

Local farmers have been saving local plant genetic resources over the years. Yet these important resources are necessary for research and a number of breeders have used these to develop new varieties. Farmers who contribute to the conservation and protection of plant genetic resources which is eventually used by breeders must receive benefits. However the challenge is on the negotiations of such benefits to ensure that there is fairness. Breeders often argue that they can not identify beneficiaries and entities to transact with since these are community rights. Clearly this is lame as there are traditional, community and government organizations which can represent local communities.

Under the revised EMA which is under consideration by parliament, issues of ABS and equitable sharing have been ably highlighted. This includes recognition of local communities in conservation of agro-biodiversity for food, as such the need for access and benefit sharing. Processes are under way to develop the agro-biodiversity policy that would encompass farmer's rights and equitable sharing of benefits arising from use plant genetic resource. However, the development of policy and legislation in Malawi takes too long to be finalized, adopted and enacted.

7.4 Implementation of Farmers' rights

7.4.1 International Conventions and Treaties

Malawi has ratified the CBD, TRIPS and ITPGRFA. These three instruments are the responsibility of different government departments with often diverging interests and priorities. The CBD is implemented by the Environmental Affairs Department (EAD) which has developed the National Strategy on Sustainable Development (2004), the National Biodiversity Strategy and Action Plan (2006), the National Environmental Policy (revised 2004) and the Environmental Management Act, 1996 (under revision). These address biodiversity and agro-biodiversity in general and specifically call for protection of farmers' rights.

7.4.2 National policy and legislation

The Ministry of Agriculture implements the ITPGRFA and is therefore responsible for farmers' rights issues. There is no legislation dealing with either plant breeders' rights or farmers' rights. A Plant Breeders Rights Bill has been in draft for over five (**5**) years or so. With technical and financial support from Centre for Environmental Policy and Advocacy (CEPA), the Department of Agriculture Research Services (DARS) undertook a review of the draft bill and stakeholder consultation which culminated into the incorporation of farmers' rights. A new draft was developed entitled Plant Variety Protection Bill, 2007. However after internal consultations within Ministry of Agriculture, DARS removed the farmers' rights chapter from the PVP Bill and incorporate it into a revised EMA. This certainly brought more confusion about the implementation of farmers' rights and signalled the level of commitment to farmers' rights within the Ministry of Agriculture. CEPA on the other hand has continued to lobby the Ministry to ensure that farmers' rights are accepted at official level. A subsequent stakeholder consultation has however recommended that farmers' rights be brought back into the PVP bill.

The Ministry of Trade and Industry is responsible for the implementation of TRIPS. To date, no significant steps have been undertaken to revise the intellectual property legislation such as the Patents Act, the Copyright Act, and the Trademarks Act, among others which are old pieces of legislation mostly enacted during the colonial period. Malawi is however involved in trade negotiations with, among others, the European Union which will lead to the signing of Economic Partnership Agreements sometime in 2009. These affect agriculture products and therefore farmers' rights; hence the need for the country to be clear about its policy direction in these discussions.

7.4.3 Obstacles for achieving or enhancing implementation of Farmers' rights

Several factors are limiting the attainment of farmers' rights in Malawi. These include:

Absence of policy and legislation

Malawi does not have a policy and legal framework dealing with farmers' rights. The initiation of development of legislation pertaining to farmers' rights together with the plant breeders' rights has created uncertainties amongst the breeders. The plant breeders would like to maintain a critical role and do not seem to be willing to give support to community technology through farmers' rights. As such they have proceeded cautiously in dealing with the farmer's part which they have little knowledge of and confidence with.

Then too it is important to note that although most of the local farmers and breeders have the technical capability on seed multiplication or breeding of new varieties there is little knowledge on policies and legislation related to agro biodiversity conservation and protection in general.

Limited awareness and vision

Most of the farmers and institutions providing services on agro biodiversity do not have a reasonable understanding of farmers' rights and its ultimate goals. The awareness and vision of the end results of attaining farmers' rights are vague and the application of its principles is weak. Opinions and levels of belief amongst stakeholders in rural communities' ability are extremely varied. There is no institution within the public sector and civil society whose core business is dissemination of policies and legislation related to farmers' rights. The Government having ratified the ITPGRFA, appears ambivalent about the implementation of this instrument, especially with regards to farmers' rights.

Civil society role in Farmers' rights implementation

There are just a few NGOs engaged in work related to farmers' rights. These, however are not involved in the core farmers' rights activities or application of its principles but address farmers activities more as a part of general food security support. Rights based approaches are only taken on board as add on issues.

Uncoordinated smallholder farmers' activities

Two institutions are driving most of the smallholder farmer activities in Malawi. These are National Smallholder Farmers' Association of Malawi (NASFAM) and Farmers' Union of Malawi (FUM). However, their coverage in terms of focus and geography are limited and require expansion. There is little organization amongst smallholder farmers rendering them unable to approach issues as a united front. This limits their potential to challenge plant breeders and also participate in the general campaign for recognition on their rights.

Capacity of local level farmers' institutions

Institutions dealing with seed at local level such as Association of Smallholder Seed Marketing Action Group (ASSMAG) have inadequate capacity to effectively coordinate seed production for smallholder farmers. Many smallholder seed producers complain of frustration with delays in getting payment after seed sales. Most of the seed farmers interviewed in central Malawi indicated that they had not yet been paid for the seed they supplied both in 2005 and 2006. Private seed traders have also taken ASSMAG for a ride by collecting seed and return it after failing to sell it, yet by then most of the seed will have gone bad.

Emphasis on research

Plant breeders in Malawi have focused their research on hybrid varieties, particularly maize. Little is done on local land races. Local varieties are lacking institutional attention. This has resulted in farmers lacking seed for some of the important local land races such as finger millet. However it is ironical that although they have ignored development of local land races, the development of improved varieties such as hybrids has relied on the strengths existing in local varieties. Certain crops such as finger millet, sorghum have been ignored in terms of research because of their perceived low economic value. Yet it is recognized that these crops provide farmers with the much needed buffer in terms of droughts.

Privatization of the seed industry

With the coming in of private companies and other factors there has been a dramatic shift into hybrid varieties as they are perceived to be highly productive, modern and demand shorter rainfall seasons. This has led to gradual disappearance of local varieties. However, hybrid varieties demand high levels of chemical fertilizer inputs and a lot of investment in post harvest chemicals as they get easily attacked by weevils. In addition the hybrid seed is also very expensive and most of the local farmers cannot afford this.

7.5 Future needs

As highlighted Malawi has uncoordinated legal instruments affecting plant genetic resources and farmers access and benefit sharing regimes. Immediate action to address this challenge is to develop a stand alone policy on plant genetic resources and also to incorporate Farmers' Rights Bill into Plant Breeders' Bill so that they are implemented and coordinated by one institution. Public awareness on importance of developing a policy on plant genetic resources ranks high as most policy and decision makers are not very much conversant with issues of plant genetic resources conservation and utilisation.

CHAPTER 8

THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

Plant genetic resources are the basis of food security and sustainable agricultural development as they comprise diversity of genetic material contained in traditional varieties, modern cultivars, wild and weedy relatives of crop plants. The importance of biological diversity and increasing threat of genetic erosion was internationally acknowledged at the United Nations Earth Summit at Rio de Janeiro in 1992 when majority of the world's governments signed the Convention on Biological Diversity (CBD) which came into force in 1993. Improvement in livelihoods security has been registered and social and cultural integrity have been maintained.

The economy of Malawi is heavily dependent on agriculture. Agriculture is significantly emphasized in Malawi Growth and Development Strategy (MGDS), a blue print for development orientation, as sector that is important for Malawi to achieve food security and economic development. The MGDS is well connected to Millennium Development Goals (MDG). MDGs deal with poverty elimination and environment, among others.

Proper management of plant genetic resources ensures less environmental degradation. One of the good initiatives is an on-farm project that is promoting production of finger millet on ridges as opposed to clearing forests every year. Plant genetic resources also serve other functions of checking run off to minimize soil erosion.

Plant genetic resources are an insurance against hunger and malnutrition. They provide much needed dietary diversity which avails both macro and micro nutrients which necessary for good health. Health people contribute to economic development. Malawi is faced with problem of HIV and AIDS. Consumption of diverse diets to boost immunity as well for provision of nutrients is being encouraged by government and non governmental organizations.

Plant genetic resources have been used in breeding varieties for better resistance and tolerance to pests and diseases. Sorghum varieties have been developed in Malawi which tolerate moisture stresses created by droughts. Bambara nut germplasm has been selected in participatory manner and has led to improvement yield. Local bean varieties have been screened for micro nutrients and pest and disease resistance.

Farmers have a choice of growing different crop species and varieties in a mix that best suits their goals and aspirations. Different communities use plant genetic resources for various cultural functions, for example weddings, chief ascension and funeral ceremonies. Therefore plant genetic resources also help in maintaining social fabrics.