MALAWI:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCE

(Leipzig, 1996)

Compiled by:

Malawi Governament

Li Longwe, June 1995

Note by FAO

This Country Report has been prepared by the national authorities in the context of the preparatory process for the FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17-23 June 1996.

The Report is being made available by FAO as requested by the International Technical Conference. However, the report is solely the responsibility of the national authorities. The information in this report has not been verified by FAO, and the opinions expressed do not necessarily represent the views or policy of FAO.

The designations employed and the presentation of the material and maps in this document do not imply the expression of any option whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Table of Contents

CHAPTER 1
Introduction to Malawi and its Agricultural Sector

1.1 LOCATION

Malawi is a country in Southern Africa, south of equator, between latitude 9° 45' and 17° 16' South and between longitude 33° and 36° East. It is a landlocked country, bordered by Tanzania in the North and North-East, Mozambique in the East, South and South-West and Zambia in the West (Figure 1).

1.2 PHYSIOGRAPHIC AND CLIMATIC FEATURES

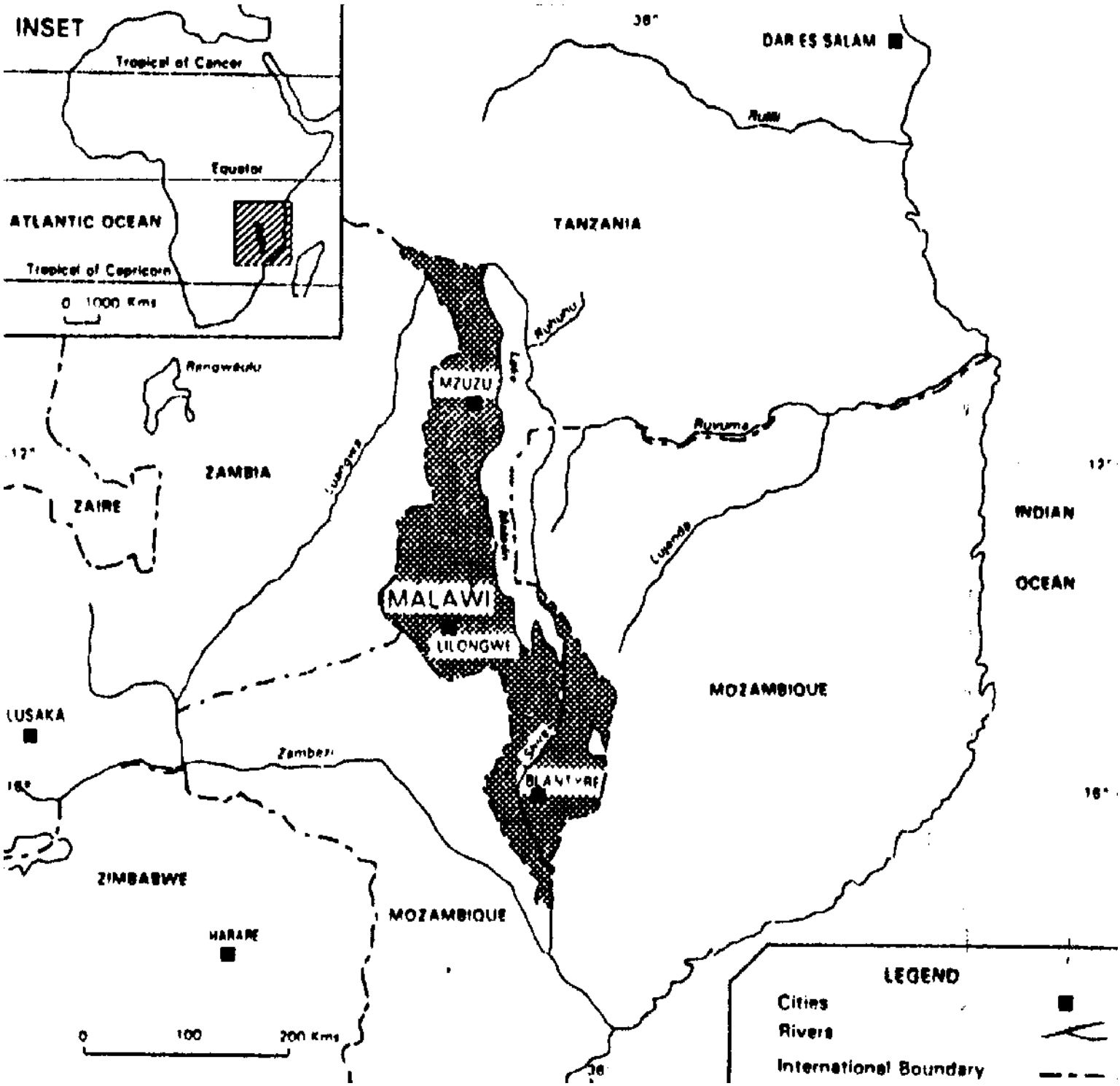
The country is 900 km long from South to North and has a width varying between 80 km and 160 km, covering 12.3 million ha. (118,484 sq km), out of which 2.4 million ha. is covered by lakes.

Malawi has topographical features which include low laying areas like Shire Valley and lake shore plains with an altitude of about 50 m, mid altitudes and plateau areas with altitude up to 1,100 m and high mountains with altitude of about 3000 m. The climate is sub-humid with temperatures mostly ranging from 14°C to 23°C on high elevation areas and 30°C to 37°C along lakeshore and the Shire Valley.

Malawi has two main seasons, the dry season, between May to October and wet season which is from November to April with rainfall between 635 mm to 3,050 mm with low rainfall in the low laying areas and high rainfall on high altitude and plateau areas.

Most soils in Malawi are leached and they are classified as ferralitic, ferruginous, ferisols and lithosols.

FIGURE 1: A MAP OF MALAWI



1.3 POPULATION AND AGRICULTURAL SYSTEMS

Malawi has a population of about 9 million, of which 9% lives in the rural areas. The average population growth rate is 3.3% per year and hence a very high population density of 74 persons per square kilometer with some districts like Thyolo having up to 275 people per square kilometer (6).

Agriculture is the main income and foreign exchange earner, contributing over 40% of the Gross Domestic Product (GDP) and accounting for about 80% of the foreign exchange.

The three main cash crops are tobacco, sugarcane and tea, which account for over 80% of the total exports. Maize is the most important staple food crop occupying 68% of the crop land. Other important staple food crops include sorghum, cassava, rice and millets.

There are two main systems of agriculture. The smallholder system occupies 70% of the cultivated area under customary land tenure with family land holdings ranging from 0.5 to 2.5 ha.

The estate sector under the leasehold land tenure utilises about 5% of the cultivated area. The smallholder sector produces about 80% of the total agricultural products most of which are for subsistence while the estates sector produces mostly cash crops like tobacco, sugar and tea.

In the country there are two seed companies mostly involved in production of certified seed of cross-pollinated crops like maize and tobacco. There is also a smallholder seed multiplication scheme organized by the government and it is aimed at production of seed of self-pollinated crops. Most of the certified vegetable seed is imported from other countries. Owing to financial constraints, most of the smallholder farmers use uncertified seed.

Recent trends in Malawi's agricultural sector have favoured early maturing varieties due to drought spells which the country has experienced. Drought tolerant crop types like cassava, sweet potato and sorghum have received encouragement in order to counter the very erratic rainfall which the country has been experiencing.

Current research and production policies are also aimed at encouraging use of improved seed and breeding of high yielding and disease resistant varieties.

1.4 MAIN VEGETATION TYPES

Malawi contains various vegetation types dependent on the varying altitude, rainfall pattern, soil types and locations on which they grow. Such vegetation types include lowland rain forests, montane and sub-montane rain forest, dry evergreen forests, wooded grasslands, wooded farmlands, and swamp forests.

Recent trends have shown that most of the main vegetation types are fragmented and small. The main contributing factor to the decrease in the vegetation areas is deforestation which is due to high population, overdependence on subsistence agriculture and fuelwood resource for energy and income. Most of the forest reserves, wildlife reserves and national parks are fairly protected but some do suffer heavy poaching for wood resources. However, there is a lot of deforestation in the customary land so that on average deforestation is estimated at 1.6% per annum (3).

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 FOREST GENETIC RESOURCES

About 30% of Malawi's land area is under forest cover and of this, ll% (1094000 ha) is under national parks and game reserves, 10% (721,000 ha) are gazetted forest reserves and the remaining 17% is natural woodland under customary land. There are 70 gazetted forest reserves and 80 more forest reserves are under consideration to be gazetted. Figure 2 shows a map of Malawi indicating locations of game reserves and national parks and figure 3 shows forest reserves.

In these forests there are many forest species which are economically important to man in provision of timber, firewood and construction poles. Some have ornamental value while others are used for medicinal purposes.

Effective management of these forests is achieved through collaborative efforts by both governmental and non-governmental organisations.

The Forestry Department is the main body which ensures that these forests, especially gazetted reserves are well managed. Control measures currently in force include regular patrols to prevent encroachment, theft of forest produce and protection of forests from fires.

Other control measures are licencing of procurement of forest produce such as timber and grazing, use of fixed fee for procurement of minor forest produce and non-timber forest produce. Forests on customary land are under the control of the traditional authorities and the Forestry Department plays an advisory role in the conservation, management and sustainable harvesting of forest produce.

Despite the control measures which are in place, the survival of some of the forest species is at risk because of over-exploitation, wild fires and expanding farm land. Consequently, the Forestry Department declared some species as "endangered" or "protected" and they are given statutory protection.

FIG 2. NATIONAL PARKS AND GAME RESERVES OF MALAWI

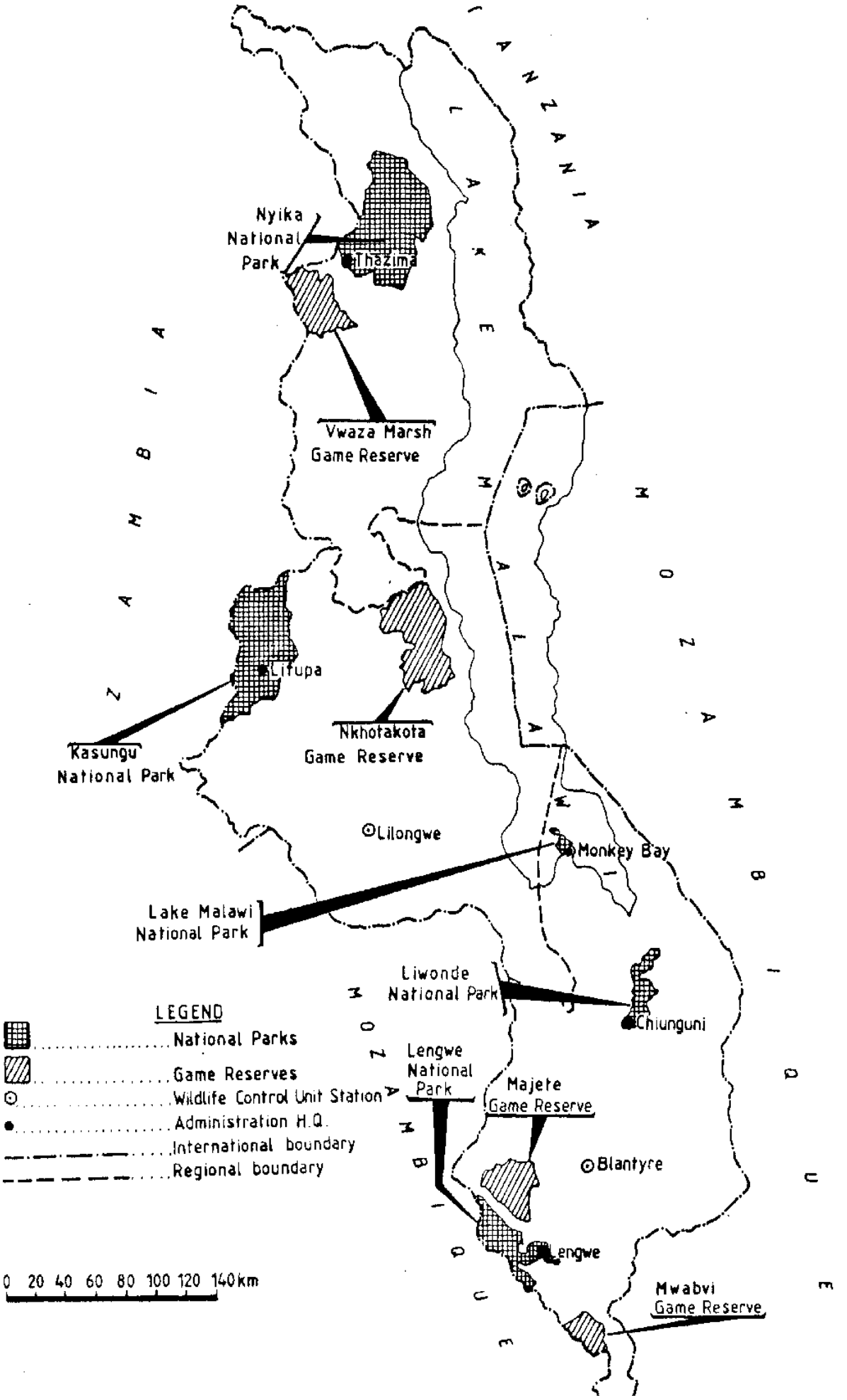
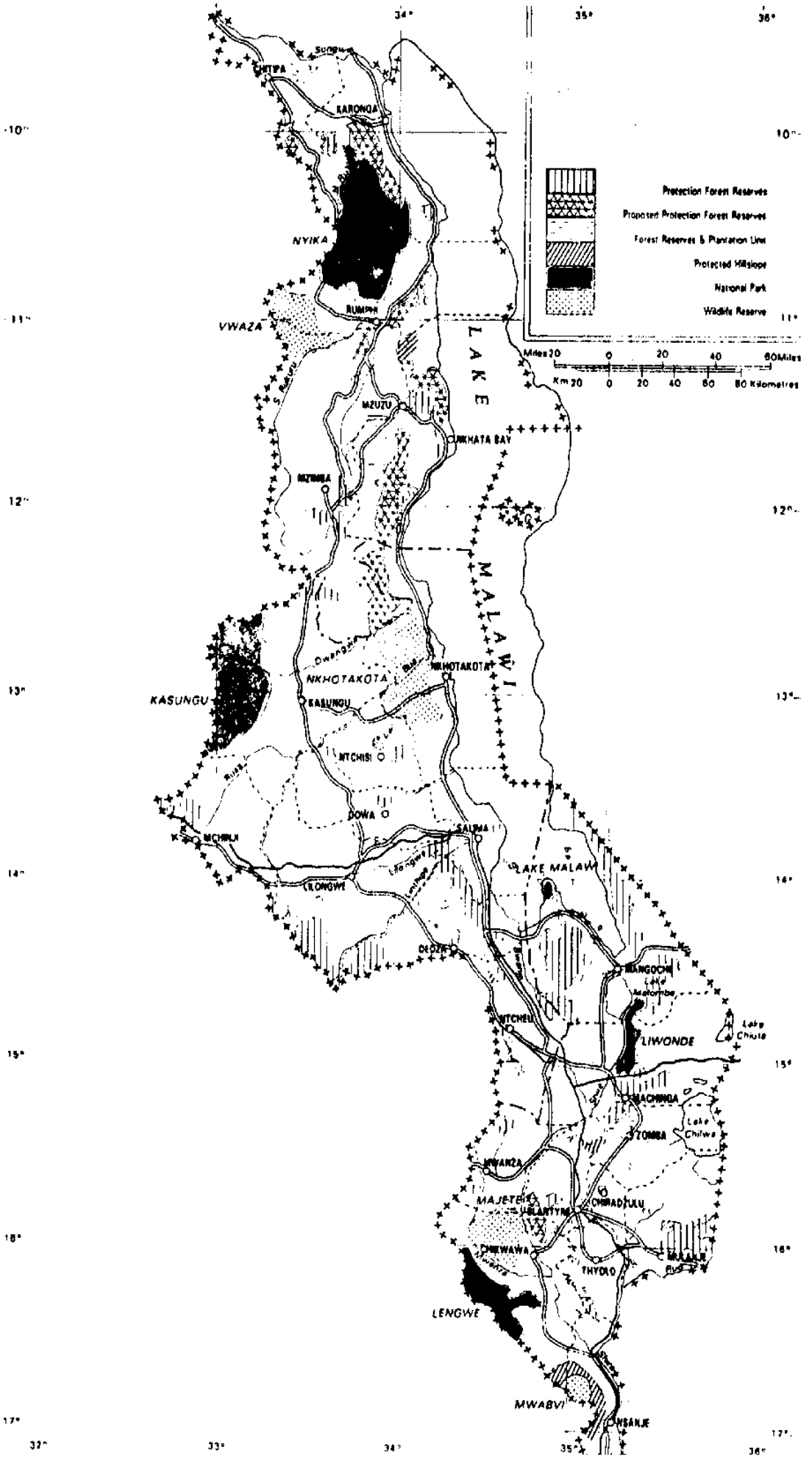


FIG 3. FOREST RESERVES AND WILDLIFE RESOURCES OF MALAWI



2.2 OTHER WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

Man utilises wild plant species for different purposes and the most notable uses have been in food supplement and provision of curative drugs.

The number of wild indigenous plants used by Malawians is quite high. For those plants that are cultivated there is a number of wild relatives which exist in the country.

For example, the cultivated cowpea *(Vigna unquiculata)* has several wild relatives, some of which are utilised as food plants and others are perennial in growth habit which might signify possession of unique survival characteristics. Sorghum, finger millet and rice are some of the cereal crops which are extensively used in Malawi and have some wild crop relatives present in the country. Appendix I gives a list of the crop plants of Malawi and their wild relatives.

It is reported that in Malawi about 109 plant species produce edible fruits and 79 of these are indigenous species (5). Most of these fruit species are very much liked by the people and are potential species for economic exploitation. Other species provide edible tubers, for instance, *Dioscorea odorantissima* (a wild yam), *Plectranthus esculentus* (buye), *Sphenostylis stenocarpa* (chinaka) and *Habenaria walleri*. There are also some edible wild cereals and those include *Panicum repens* (mphunga) and *Panicum miliaceum* (nkhwanje). Over 90 wild species have leaves which are edible as vegetables.

Some of the indigenous forest species have shown potential for utilization in timber plantations because of their fast growth and wood qualities.

A number of indigenous grass species have good qualities for inclusion in pasture establishments. Such species have high nutritive value and high resistance to grazing. Some of such species are as follows:

2.2.1 Grasses

- Star grass (*Cynodon spp.*): Have high dry matter (dm) ranging from 8 to 20 ton /ha. (1). Star grass can be used for permanent pastures for wet and dry season grazing and withstands heavy grazing (7).
- Guinea grass (*Panicum spp.*): Has broad dark leaves with dm yield average 17 ton / ha. and 12 % crude protein. It is suitable for stallfeeding, grazing and silage making.

- Setaria grass (*Setaria spp.*): The germplasm present shows a lot of variation in heading date, seed retention, plant height, tillering capacity, leaf hairiness, regrowth potential after cutting and ability to remain relatively green during the early dry season (7). The dm production ranges from 4 to 8 ton / ha with crude protein over ll%. Setaria grass is very acceptable to cattle and has high digestibility when fertilized with nitrogen.
- Rhodes grass *(Chloris gayana):* A perennial grass which performs well on a wide range of soils and climates. The grass forms the basis of improved pasture recommended for grazing, hay and silage making. The grass is also used to control nematodes in tobacco rotation.

2.2.2 Legumes

- *Neonotonia wightii:* It is a perennial creeper with a strong tap root and has the advantage of producing a steady supply of protein long into the dry season. The Australian variety "Malawi" is a successful cultivar developed from this species which was collected from Malawi (4) . The species has a potential to fix nitrogen up to 175 Kg N / ha per annum, producing dm yield of 4 ton / ha with 20% crude protein.
- *Macrotyloma spp.*: The species is fairly tolerant to poor soils and it combines well with tall grass forages like Napier grass.
- Sesbania *spp.*: A nitrogen fixing species with leaves having over 25% crude protein which can be used as both livestock feed and green manure.

These indigenous pasture species have potential to earn foreign exchange through grass seed exports. Since they are adapted to the local climatic conditions, they can have a significant contribution to the livestock industry if they are developed into pasture cultivars. However, the forage seed collection and productivity potential evaluation is limited by lack of trained personnel and funds to support the work.

It is reported that in Malawi about 131 plant species are used as medicinal plants (9). 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.

There are also many other useful wild species which have a variety of uses, for instance, insecticides, dyes, soap substitutes, spices, gum and latex (9). There is need for further investigation on the possible increased utilization of these species as well as instituting conservation measures for their continued survival.

2.3 LANDRACES (FARMERS, VARIETIES) AND OLD CULTIVARS

Most of the crops produced by farmers are from traditional varieties. While some of the improved varieties are getting popular, most of the farmers still keep seed of the traditional crops. These traditional varieties are kept because of their unique characteristics, such as flintness or hard endosperm in maize, sweetness in sorghum grains, cookability and colour in pulses, palatability in cassava and potatoes, flavour in rice and even survival ability to unfavourable environmental conditions.

For quite long, research has been geared towards the yielding potential and disease resistance of new varieties. Not much emphasis has been paid on the acceptability of such new varieties. Unique qualities preferred in the traditional varieties have not been investigated on. This in some instances has resulted in breeding varieties which though high yielding, have not been accepted by farmers. For example, breeding of high yielding dent maize varieties and soft endosperm sorghum which have very poor storability (due to weevil infestation) and poor processing capabilities have resulted in low adoption by farmers.

There are a lot of under-utilised plant species especially in fruit species, vegetable species and pulses. A lot more needs to be done in assessing the extent at which the under-utilised species are being exploited and find out their potentials in being used as food and cash crops. There is also much work that needs to be done in the evaluation of the traditional varieties in order to document the unique qualities they possess.

Although traditional varieties are conserved by farmers, recent trends show that these plant materials can easily disappear because of introduction of high yielding varieties and changing food consumption habits. The popular argument that on-farm conservation can be encouraged and be relied upon and that the traditional varieties will continue to be kept as they have been kept ever since is quite misleading. It must be pointed out that most of these traditional varieties did not survive on the farm by chance but out of necessity.

Therefore, if the present situations demand production of high yielding varieties or crops with high monetary value, there will be gradual replacement of the traditional varieties with those new profitable varieties. For example in Malawi, certain crops are becoming less common, like finger-millet, velvet beans, pearl-millet, groundbeans and yams. In many cases it is mostly elderly people who are so keen in the production of these crops. Since some of the underutilised species and traditional varieties are either grown by the farmers or they naturally grow on farmers' land, the survival of these species will demand systematic collection

and conservation. There is also need to undertake evaluation work to identify means to improve those varieties hence make them popular for utilisation by farmers.

With limited financial resources, attention of conservation and research work is paid to species which show present economic importance. No attempt is made to improve some of the traditional varieties. For example, most of Malawi's indigenous vegetables have a proven higher nutritive value than the exotic species. However, since most of the indigenous varieties have not been worked upon to improve yield potential, palatability, flavour and general attractiveness, despite their being highly nutritious they are still not widely exploited commercially.

While active collection and conservation is important, the utilisation of those collections will not be realised unless evaluation and pre-breeding work on those under-utilised species is undertaken.

Therefore in order to get the full benefit of these traditional varieties and under-utilised species, there is need to collect enough information on the merits of those varieties, characterise and evaluate them and where necessary pre-breeding and breeding work needs to be done. It will also call for the strengthening of the institutions involved in this work in both infrastructure and technical capabilities.

CHAPTER 3
Conservation Activities

3.1 *IN SITU* CONSERVATION ACTIVITIES

In Malawi, most of the "active" *in-situ* conservation programmes are on forest and wild species which are normally conserved in protected reserves. However, for some of the endangered species the Forestry Act of the Laws of Malawi designated eleven forest species as "protected". Therefore, some of these species are protected on farmers, land. *In situ* conservation of species which grow in forest reserves are managed by the Forest Department. Their protection and husbandry operations are done by the forestry personnel. However, for the species that are protected in national parks and wild reserves no husbandry work is done, apart from offering them protection from illegal exploitation.

For field crop species, though farmers are holding a vast diversity of the traditional varieties, no organised or active programme is in place for encouragement of the on-farmconservation.

The survival of the "protected" species on farmers' land is very unreliable because present conditions show that no natural regeneration is allowed to take place as the farmer feels he will not be able to use the trees when they grow. For example, most of the palm species (except coconut trees which are domesticated) are designated as protected by law. On most of the sites where such species exist a common sight is only that of very old trees and small regrowths. This shows that regeneration is deliberately prevented as the farmers cultivate their fields.

The threat to survival of the endangered species also exists even on species in forest reserves, for example, the Mulanje cedar, *Widringtonia nodiflora* (or W. whytei). Mulanje cedar, Malawi's National Tree, is a very unique tree in that except in Malawi and a patch in Mozambique, nowhere, world wide does it grow into a gigantic timber tree. In Malawi it grows up to 40m tall while in other countries, the average height is only 8m (2) . Mulanje cedar is mainly concentrated on Mulanje mountain, at about 48 different locations. Observations are showing that cedar populations are getting more disjointed (8) . Factors which pose a threat to the survival of the cedar species include illegal exploitation, frequent wildfires, invading plant species and the recently noticed phenomenon of death of both old and young trees, believed to be caused by an aphid, *Cinara cupressii*.

The Malawi Plant Genetic Resources Centre and the Forestry .Research Institute of Malawi proposed a conservation strategy which included seed collection from different cedar populations, establishment of 2 Cedar populations on Mulanje mountain (the natural locality where that cedar is growing) and another population to be established at a different plateau location about 400 km from Mulanje mountain. Unfortunately, while the threat on the survival of Mulanje cedar continues, no funding has yet been secured for the conservation project. Within the conservation project, it would be quite necessary to test the seed from the different locations, using electrophoresis or any other reliable procedure in order to establish the intra-specific variation which exists amongst the different populations. This would also help in the designing of a conservation project which will be able to capture much of the genetic diversity that exists.

With time the list of threatened species and group of species which need protection is increasing and as of now about 25 species fall under this list. Appendix II gives a list of Malawi's threatened species.

3.2 *EX SITU* COLLECTIONS

For a long time in Malawi, conservation was being undertaken by user-organisations and this has had a lot of negative repercussions. However, in 1992 the government established a plant genetic resources centre at Chitedze Research Station in Lilongwe, under the Department of Agricultural Research. Its main role is to undertake germplasm exploration, collection and conservation and to coordinate conservation activities between various organisations.

The Malawi Plant Genetic Resources Centre (MPGRC) works in close collaboration with the SADC Plant Genetic Resources Centre (SPGRC) in Lusaka, Zambia. Offices and seed store for the MPGRC are accommodated in an old building which was renovated to suit the gene bank requirements and the funds for the renovation work were provided by the SPGRC. The SPGRC also helped in the provision of some of the equipment used in the gene bank. Funds for everyday running of the centre and salaries for the MPGRC personnel are provided by Malawi government. However, some funding at times is secured from the SPGRC after submitting a project for a specific activity for instance seed collection, but this is on a non-regular basis.

Much as the government values the services provided by MPGRC, the establishment is not financially secure to undertake the most of the worthwhile projects as proposed. At the same time, it is quite difficult to secure bilateral funding for establishment of the basic infrastructural components and for undertaking other conservation activities. This makes it very imperative that the Global Action

Plan should make provisions whereby some of the issues left solely for national attention and bilateral arrangements should be dealt with at a global or multilateral level.

A number of crops grown in Malawi are indigenous to Africa and most of the introduced crops have been grown in the country long enough such that adaptation and naturalisation has occurred. In Malawi, out of about 561 species which give useful products, about 126 species are cultivated as field crops. Currently the MPGRC holds about 1,300 accessions from 36 species. Appendix III contains a list of those species held by the MPGRC and total number of accessions for each species.

Two major collection missions have been made in two of the three regions of the country and random sampling was followed. In order to ensure that a cross-section of most of the different crops are collected, the collection missions are aimed at collecting several crop species. Collections were made by visiting different remote locations of the country and samples were obtained from store houses and from fields. However, from the collection missions deficiencies in capturing the whole range of genetic variation was noted because during the time of undertaking the collection some of the crop species were not yet mature. Also, while fields and storehouses are a more reliable places where enough variability can be captured, it is quite necessary to supplement such collections with samples obtained from village markets. Further collection missions will need to be carried out on both crops and wild crop relatives.

Up to date 122 accessions from 3 different crop species have been supplied to researchers in Malawi for their further investigation work. As more information is provided on the inherent value of the germplasm held by the gene bank it is envisaged that more samples will be requested by other scientists.

3.3 STORAGE FACILITIES

The Malawi Plant Genetic Resources Centre seed store uses upright deep freezers and it is intended for long term storage of both base and active collections. Seed samples are dried between 5-6% moisture content (on dry weight basis) for oil seeds and between 6-7% mc for cereals and they are put in sealed aluminium foil bags and stored in deep freezers which are operated at -18% C. For species which cannot be kept as seed, field gene banks are established. Some indigenous species are conserved in botanic gardens, however, there is need to make maximum use of those gardens by introducing various species for conservation purposes.

The effective operation of the seed gene bank is affected by several problems. For example there is need to have a power back up electricity generator which will ensure continuous operation of the deep freezers at times of power failure, as this is a common occurrence. Secondly, due to lack of an appropriate equipment, seed drying is done by silica gel and this is a very slow process because the rate of moisture extraction is slow and the capacity of such seed driers is quite small.

On average, samples take about 4 to 5 weeks to be adequately dried and hence due to the small capacity the seed stays quite long at room temperature before it can be put in the long term storage environment. Thirdly, there is need to improve the general infrastructure of the gene bank for instance, to include construction of a coldroom, tissue culture facilities and adequate seed processing space.

While long term storage is being done at the MPGRC, arrangements are underway to have duplicate samples sent to SPGRC for long term storage.

3.4 DOCUMENTATION

The MPGRC had been using a manual system of documentation until 1993 when a computerised system was installed. Almost all the passport data for the accessions has been stored on diskettes using the Data Base IV programme developed by the SPGRC. However development of a programme which can handle characterisation and evaluation information is not yet completed. Skills in this documentation field are also lacking.

Documentation is considered one of the major sections within the gene bank because it holds information on the work which takes place in the bank. It will also serve a very significant role in making known to other scientists the value of the genetic material held by the gene bank through periodic publication of seed catalogues and other newsletters carrying information on characterisation and evaluation work.

Most of the information stored on diskettes is duplicated but both sets are kept within the same building. In future, attempts will be made to have the duplicates kept somewhere outside the gene bank, for instance the research station library.

Documentation in the Wildlife Department is mainly done through publication of booklets, for instance, plant check lists for various game reserves and national parks. The National Herbarium and Botanic Gardens of Malawi has a large amount of information on the flora of Malawi on voucher specimen labels as well as computer system. The Forestry Department is also undertaking computerised

documentation. Such exercises include, for example, the current project on documentation of all the village forest areas. These are woodlands (indigenous or exotic) on customary land owned by local communities and their traditional leaders.

3.5 EVALUATION AND CHARACTERIZATION

Characterisation of germplasm accessions largely concerns description of accession composition and morphological characteristics or phenotypic expressions while as germplasm evaluation involves closer observation on the agronomic performance, pathological reactions, chemical and genetic analysis and observable responses to stress factors. From the explanation given it can be seen that there is no clear demarcating line on the difference of the two terms except for the fact that things recorded under characterisation are more easily observable. In the work plan for the gene bank, only characterisation work and preliminary evaluation is being done in order to establish basic information on the accessions held. Further evaluation work will be conducted later.

Most of the characterisation and evaluation work will be done in collaboration with national scientists working with a particular crop type. This is important because such scientists are the ones who are more conversant with the crop and also, they are the ones who will be the main users of the plant accessions as well as the information generated.

Nevertheless gene bank personnel need to be quite competent to undertake the work on their own because of several reasons. To begin with, most of the crop specialists are busy with their own programmes therefore they may not have a lot of their time set aside for this collaborative work on characterisation and evaluation.

Secondly, the gene bank personnel need to be able to initiate work that will generate information on the accessions held if they are to arouse enough interest in the research personnel to take up further investigative work on those accessions. Thirdly, in the IPGRI descriptors some of the characters that need to be recorded are not normally included in the day to day work of the scientists and some of those characters are less apparent or not clear enough therefore there is need for the gene bank personnel to collaborate with the crop specialists in order to help each other in the recording of those various characters.

For characterisation and evaluation work, the MPGRC uses IBPGR/IPGRI descriptors booklets. To a larger extent, no modification is made except in some cases, for instance, where too much details are called for. At times there is need to

include certain features, like the presence or absence of large sepals on cotton balls as they have an implication on offering hiding place for larvae of insect pest. Also, IPGRI descriptor for cotton, petal colour is given in two different colours, pink and creamy white but this has not been usable because the creamy white colour changes to pink as the flower ages.

On the use of descriptor booklets, it is quite apparent that occasionally, it is necessary to have general discussions between crop specialists who took part in the writing of the booklets and gene bank scientists in order to offer explanations on certain characters demanded in the descriptor booklets and the general ease of use of such descriptors.

According to our work priorities in the gene bank, germplasm rejuvenation, seed multiplication and seed processing for storage in long-term environment is receiving a greater priority than characterisation and evaluation work. However, where possible, characterisation and evaluation work is being done on selected crops concurrently with the accession rejuvenation and seed multiplication work.

Most of this seed multiplication work and accession rejuvenation is done within the localities of the gene bank due to limitation in funding. It is very necessary that when much work will be initiated on characterisation and evaluation this work should take place as close as possible to the place of origin but this will depend on the amount of funding that is available.

Information from characterisation and evaluation work will be made available to users through periodical publications.

Information on germplasm will also be secured from the germplasm users who get material from the gene bank for their research programmes.

While it is known that characterisation and evaluation work is quite costly, it is one of the gene bank undertakings which are necessary if the stored germplasm is to be useful. Gene banks are not "museum" establishments because they hold material that has to be used in future breeding work and this can only be possible if there is active information generation on the accessions held. Gene banks have to be active establishments, capable of safe keeping of the plant accessions, capable of generating useful information on the accessions held and being able to share that useful information with other scientists in order to encourage utilisation of the germplasm under storage.

Most of the detailed evaluation work need resources in terms of trained personnel, advanced scientific equipment and adequate funding. All this shows a need for a global or at least regional approach to this work. For the evaluation work

which is done in order to provide specific information, say disease resistance, depending on the magnitude of the problem the work can be approached either globally or regionally.

However, for some of the evaluation work that is done in order to widen the information base on the accessions there is need for involvement of international organisations in the national programmes in order to get around the problems as encountered in undertaking this evaluation work. Therefore, at international (global) level, there is need to set up mechanisms that will help in this evaluation work and provide active communication channels for the needed collaborative work.

While very little is done on characterisation and evaluation of *in situ* species, the need for attention in these species cannot be over-emphasized. There is need to carry out performance test of indigenous forest species on growth rate and other useful characters. There is great need to carry out detailed evaluation work on the diverse wild fruit, tuber, and vegetable species as well as non-food plants in order to generate basic information that will help in the development of these species into useful food or cash crops.

3.6 REGENERATION

The present guidelines for the gene bank on regeneration stipulate that any accession having a viability of 84% or lower should be rejuvenated. However, in some species where low viability figures are anticipated, for example in grasses and some vegetables, lower figures will be accepted and the minimum figure will be taken as the minimum viability figure accepted by the national seed certification office.

From, the experience obtained within the two years of operation of our gene bank, problems have been encountered in undertaking seed multiplication of cross-pollinated species, especially sunflower (*Helianthus annuus*) . Use of pollination bags is not a good option because this will greatly encourage inbreeding depression. In sunflower, heads which were bagged had a big proportion of unfilled seeds (suggesting existence of a certain degree of self-incompatibility). In this area, there is great need for adequate training and exposure if competent work is to be achieved.

Practical information in form of written reference books is not available on how best to maintain the genetic characters of accessions. The information available on population size and isolation distances in certain cases has not been found to be practicable. For example, with field gene banks population size is rather limited because of the need to accommodate many samples.

Although increasing number of multiplication cycles is believed to decrease the genetic purity the need to have enough quantities for storage and distribution makes it imperative that this exercise cannot be entirely avoided. Care must just be taken to maintain the genetic purity of the accessions.

One of the instances where decision making has been difficult is on whether to mix samples from different regenerations. The indecision on this issue arises because of the prevailing merits and demerits for both. For example, the earlier regenerations are considered to be genetically like the original sample but yet because of their having been kept for a longer time, they might be poor in viability.

The genetic composition may also have been changed because of loss of the genotypes with shorter longevity. Where enough precautions were taken to maintain genetic composition during regeneration, discarding of the older material can be done since their longevity is quite reduced and there is not much genetic variability that will be lost which is not present in the new generation. However, backing guidelines derived from scientific investigation on this issue are not easy to come by, if they do exist.

3.7 FORESTRY GENETIC RESOURCES

In Malawi different forest species are confined in different ecogeographic zones making it imperative to undertake a systematic species distribution survey.

In an effort to determine Malawi's forest reserve cover, the Forestry Department in collaboration with the Swedish Space Corporation carried out a forest mapping exercise using satellite imagery in 1992. As a result of this exercise, Malawi's forest vegetation types were produced. This has been backed up by inventorying of various forest ecosystems in order to document the exact species composition and variation in the different forest types.

For example, from the inventories it became abundantly clear that Miombo woodlands are very variable in species composition, stocking and structure. Such information is important in identifying areas where genetic diversity conservation of specific species can be done *in situ*.

The inventorying and species distribution done so far has helped in having certain areas gazetted as forest reserves in order to conserve specific species. For example, Mulanje Mountain forest is mainly aimed at conservation of Mulanje cedar (*Widringtonia nodiflora*), Ngara (in Karonga) and Kuwirwe forest reserves were set up to protect the prime Mlombwa (*Pterocarpus angolensis*) which occurs there and it also occurs naturally in Nkhwazi Hill forest reserve.

Such information on species distribution has also helped the Forestry Research Institute of Malawi (FRIM) to identify seed collection and *in situ* conservation sites. For example, seed sources for *Pterocarpus angolensis* populations have been identified in Ngara forest reserve in Karonga and Liwonde forest in Machinga. Similarly, for *Acacia albida*, *Afzelia quanzensis* and *Khaya nyasica*, sites for seed collection, *in situ* conservation and selective breeding have been identified and marked.

In order to ease tree establishment and management work, the National Tree Seed Centre under FRIM is also involved in research work on trees and this includes sowing, vegetative propagation, field establishment and harvesting. However, the work is hampered by lack of proper laboratories.

The amount of inventory preparation and species distribution survey which was done, however, is very incomplete. There is still need to have detailed information on the distribution of the endangered species in order to adequately plan for *in situ* site demarcation.

There is also need for funds, equipment and trained manpower to immediately carry out inventory of all the Forests in Malawi from which gene pool diversity would be documented. Effective conservation of forest genetic diversity demands a knowledge of the exact species composition of the reserve woodlands. Not all species of Malawi forest have been documented. Most new studies and inventories reveal existence of new species endemic to Malawi.

Further studies need to be carried out to assess the effect of forest disturbance on species composition particularly on customary land as it is less well understood. The biology, ecology and silviculture of most indigenous tree species is not known. This complicates the process of making recommendations on how best to conserve, propagate and manage a given species especially the endangered ones.

CHAPTER 4
In-Country Use of Plant Genetic Resources

4.1 USE OF PLANT GENETIC RESOURCES

Since the National Gene Bank has been operational for only three years, not much plant genetic resources have so far been requested from the gene bank. However, as of now 30 samples of maize, 50 samples of sunflower and 42 samples of groundbeans have been supplied to various national scientists in Malawi for their research programmes. With more acquisition of germplasm samples and generation of information on those accessions, a lot more samples are likely to be requested.

Plant accessions are acquired by the Gene Bank mainly by asking for small samples from farmers. Farmers on the other hand get access to the products of the collected germplasm through utilisation of the improved varieties which are a product of those accessions collected from them.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

The main function of the national plant breeding programme is to improve the local varieties, screen introduced varieties and lines for adaptability and breeding for specific traits like disease resistance and drought tolerance. The ultimate aim of the breeding programme is to increase productivity and the main focus is on meeting national food needs and increased export opportunities.

Much of the breeding work is geared towards production of varieties which are genetically uniform. With this, it can be noted that most of the released varieties have a narrow genetic base as compared to the local land races which consist of various genotypes. Due to the threat posed by vulnerability of varieties with narrow genetic base, it is quite important that the need to expand this genetic base be impressed upon breeders in order to improve yield stability and tolerance to biotic and abiotic stress.

Since breeding programmes take quite a long time before coming up with tangible success, availability of financial and technical capabilities is usually limiting. Much of the breeding work in the country is done by government researchers. Some is also done by researchers from the national university, international organisations and the private seed companies. With the expanding number of breeders, demand for the locally adapted landraces from the Gene Bank is likely going to increase.

Most of the breeding programmes involve farmers in the production of new varieties by letting them make their opinion on palatability and cookability tests. The performance testing is also conducted at on-farm trial fields.

After varieties are released by breeders they are made available through seed market channels. Knowing financial limitations of the local farmers, other facilities like credit packages are used which facilitate the ease with which farmers get access to the new varieties. One of the commendable ways which have been used by some breeders to get their varieties to farmers is through provision of free seed to agricultural extension offices which in turn formulate mechanisms whereby the seed is multiplied and made available to farmers.

Getting new varieties to farmers sometimes meets some constraints for instance, lack of finances for purchase of such varieties. Usually the varieties are multiplied by private seed companies which in turn may offer the seed for sale at quite a high price. Seed production by the smallholder farmers was deemed to be an ideal solution to avoid the high seed prices. However, problems like lack of adequate isolation distance for cross-pollinated species affected the programme. Also, on several instances, seed producers have resorted to selling their produce to commercial crop traders where higher prices are normally offered.

4.3 USE OF FOREST GENETIC RESOURCES

The Forest Institute of Malawi (FRIM) is the main supplier of tree seed in the country. In 1993/94 financial year some 2.7 metric tonnes of seed, representing 70 species of pine, eucalyptus, multipurpose exotic and indigenous species were issued. Demand for seed is increasing and FRIM has experienced difficulties in procuring sufficient quantities, especially of indigenous species.

There is a SADC regional project on Tree Seed Centres (funded by CIDA) in which Malawi is participating. The National Tree Seed Centre (NTSC) is under FRIM in the Forestry Department and it is responsible for seed collection and sales.

Seed orchards have been established where improved seed of commonly grown timber, fuelwood and multipurpose species are obtained for sale to the public. Seed collection areas have also been identified where elite (mother) species of endangered fine hard woods from which tree seed can be collected.

To maintain genetic diversity and ensure availability of seed for sale and future establishment and enrichment planting, the NTSC stores seed of endangered fine woods such as *Pterocarpus angolensis* (mlombwa).

The storage is mainly for short term, up to five years. The seed is stored in a cold room at 4-8°C, usually in air tight glass or hard plastic containers. Viability test is conducted on seed lots sold to customers in order to furnish the buyers with information that can be used in determining seed rate and hence the total amount of seed required.

Local communities are now being engaged in seed collection on behalf of FRIM. They are trained in identifying elite tree provenances from which to collect seed and they are taught safe seed collection techniques. This not only provides a regular source of income for the rural communities but also reduces the temptation to cutting down well-formed (seed collection) indigenous trees and thus assist in preserving genetic diversity by actively discouraging others from cutting down mother trees.

4.4 BENEFITS DERIVED FROM THE USE OF PLANT GENETIC RESOURCES

For quite long, Malawi has cooperated with other international organisations on germplasm exchange. Many seed collection missions have been undertaken in Malawi previously, some of which never bothered to leave any duplicate samples, let alone sharing the benefits or at least reporting on the information derived from those germplasm.

Consequently, the policy of the country has been refocused on the modalities that have to govern germplasm exchange on the fact that proper consultation needs to be made before the material is exported from the country.

4.5 IMPROVING PLANT GENETIC RESOURCE UTILIZATION

Successful implementation of the plant genetic resources conservation programme in Malawi has great potential in having an impact on both subsistence and commercial agriculture. Due to increasing deforestation and changing food habits protection of the traditional crops and indigenous forest and medicinal plants will prove very important in protection of the plant resources.

Germplasm conservation and utilisation can only be realised through extensive collaboration between the institution involved in plant genetic resource conservation and other organisations dealing with plant materials. An elaborate organisational structure for plant genetic resource conservation exists in Malawi. However, its effectiveness is not as anticipated because of lack of commitment by some member organisations to such collaboration and also lack of financial resources to support the activities which were supposed to further inter-departmental interaction. Adequate germplasm utilisation cannot be realised unless there is enough information generated on the germplasm under conservation. This calls for extensive work on germplasm characterisation and evaluation work which demands financial resources and trained manpower.

Therefore, in order to improve plant genetic resource utilisation in the country, there is need for financial assistance for characterisation and evaluation activities, training of personnel and provision of equipment required for undertaking such work. The inherent qualities of the indigenous plant species in food, woodlot establishment and medicinal values can only be realised if conservation and evaluation activities receive the needed support. Such support can be in financial or material form on both bilateral as well as multilateral assistance programmes.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 NATIONAL PROGRAMMES

The Malawi Plant Genetic Resources Centre (MPGRC) was established in 1992 as a national germplasm conservation programme in the SADC regional project for plant genetic resources. Its mandates are to undertake specific conservation activities for instance, germplasm collection, conservation, documentation and promotion of utilisation through generation of useful information by characterisation, evaluation and germplasm enhancement activities. It is also supposed to maintain active collaboration with other organisations which deal with plant material.

The MPGRC is a section in the Ministry of Agriculture and Livestock Development under the Department of Agricultural Research and it is one of the sections in the Technical Services Commodity Group. It has services of 8 officers, two officers are M Sc degree holders (one trained in plant genetic resource conservation and the other in seed technology), two University Diploma holders and four officers with an Agriculture Certificate.

There is a national committee responsible for appraising the MPGRC work plan and budget. Members in this committee are from various government ministries and private organisations.

For the MPGRC to get ideas on conservation needs and to be able to provide conservation guidance to various specialist in various ministries and organisations 3 crop working groups were formed and these include Food crops group, Industrial and Horticultural group and *in situ* and Forestry group. Members in these respective groups meet to discuss issues concerning conservation and utilisation of plant genetic resources.

While the National Plant Genetic Resources Committee is responsible for appraisal of the MPGRC workplan and budget, elaborate discussion of the annual workplant and budget is also done at a different forum in the Research Department (during Annual Research Project Meetings).

Funding for the MPGRC is done through the government treasury allocation which is made to the Ministry of Agriculture and Livestock Development, which in turn is partitioned between various departments including the Agricultural Research Department. It is then from that portion that is received by the Agricultural Research which is further partitioned and allocated to the various commodity teams of which the MPGRC is one.

This lengthy chain has not been without its drawbacks. Much as it can be appreciated that other government departments and institutions are just as equally important, the conservation work would be better served if it could get a separate allocation from the government treasury. This would save it from the unavoidable budget allocation reduction which has to be done at various stages.

The fact that the MPGRC is funded through the Agricultural Research department means that it will be difficult to carry out work which belongs to other departments because of unresolved issues on who is to fund such activities. when considering the effect of the lengthy chain through which funds can be acquired from the government treasury to the MPGRC, it is also just as equally pertinent to think of the chain through which decisions are made on conservation activities. From experience, it has been quite evident that the programme needs a certain degree of semi-autonomy, whereby allowing ability in making certain decisions without having to go through the present long chain of administrative arrangements. The programme is responsible for conservation of useful, and more importantly, live material which need to receive a fair amount of speed in effecting certain decisions.

The conservation work is also actively being coordinated by the Ministry of Research and Environmental Affairs. There is quite a need for harmonising the activities of the MPGRC and those by the Ministry of Research and Environmental Affairs in order to avoid duplication of programmes hence allow maximum efficiency in use of resources available for the Plant Genetic Resources conservation work.

The conservation programmes as planned by both the MPGRC and the Ministry of Research and Environmental Affairs are strongly geared towards implementation of the Convention on Biological Diversity, with a hope of full implementation of its provisions.

Since the establishment of the MPGRC the government has shown its commitment in providing finances for the operations and personnel. However, because of economic hardships, it has been apparent that it is necessary to have bilateral or multilateral funding in order to have the basic infrastructure required for conservation activities and these include provision of adequate space for seed processing, basic laboratory equipment and human resources development through relevant training.

As of now the use of plant genetic resource collections is regulated by the National Plant Genetic Resources and Biotechnology Committee of the Ministry of Research and Environmental Affairs which is responsible for protecting the national collections from unlawful expatriation. It might be necessary to consider formation of legislation that will provide legal protection and guidelines on the plant genetic resources. Malawi's plant genetic resources will be subject to the Convention on Biological Diversity provisions regarding use and access to them.

The ultimate goal of the plant genetic resource conservation activities is to ensure continued availability of plant genetic diversity which will help in future breeding work to produce new adaptable varieties. Food security can only be realised if there is enough diversity in terms of the number of different 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 TRAINING

To many countries including Malawi, plant genetic resource conservation is quite a new field such that coverage in school curricula is just something being given consideration in recent times. Most of the personnel at the Malawi Plant Genetic Resources Centre (MPGRC), specialised in fields other than Plant Genetic Resources Conservation.

This lack of specialised personnel is very true even at national level. However, a decisive start has been made in the conservation field by making use of personnel who were trained in agricultural sciences as some of the work done in the germplasm conservation work can be through application of the theories learned in those other specialised fields like seed technology. Another helpful approach has been training of the personnel in short courses in germplasm conservation.

Germplasm conservation is quite a specialised field demanding in-depth understanding if the personnel doing the work are to be able to plan useful conservation projects. Problems encountered in the conservation work demand carefully and scientifically planned investigative research projects in order to come up with real solutions. While literature may exist on some of the relevant issues in this field, other problem areas have very sketchy guide lines, some of which are too theoretical to be of any practical use in solving those problem. All this exerts demand on the germplasm conservation personnel to be adequately well versed in this field hence specialisation to higher academic qualifications is very much called for.

While considering training for the personnel at the plant genetic resource centre, it is almost as equally important to think of arousing enough awareness in the field of germplasm conservation amongst scientists working with plant materials as well as the farming community. This can be done through inclusion of those other scientists in the international or regional courses and workshops, holding of in-country workshops and comprehensive development of the school curriculum to include germplasm conservation.

In the national programme for germplasm conservation, skill in the fields of germplasm health, data management, taxonomy, social and anthropological techniques and plant breeding are solicited from specialists from other programmes or institutions. However, existence of the capabilities in the national conservation programme would be of much help.

For example, data management is one of the very important sections within the conservation activities without which no useful work will emanate from the programme. In order to make the material usable by breeders, meaningful agronomic evaluation and pre-breeding work needs to be done from which useful information can be made available which will attract end users of the germplasm under conservation.

With enough help from external sources in form of financial assistance and possibly short time personnel assistance, educational institutions like Bunda College of Agriculture which is a constituent College of the University of Malawi, the Natural Resources College and the Malawi College of Forestry can develop curricula which are strong in the field of conservation. These institutions together with personnel from other national institutions and from the region can also be instrumental in offering national and regional workshops and training courses in conservation which would afford participation of a large number of people as compared to those which need travelling to distant countries.

5.3 NATIONAL LEGISLATION

The importation and exportation of plant materials in Malawi is legislated by the quarantine regulations. Certain plant species can only be imported into the country in seed form or *in vitro* cultures.

However, illegal importation and exportation of wild plants is not adequately addressed by the quarantine regulations. The newly proposed Environmental Management Act if enacted will improve the conservation our wild plants.

With enough observance of the set regulations importation of plant material is done without unnecessary delays.

On the sale and distribution of seed there is a seed Act which regulates the trade. Due to inadequate funding and personnel, the regulations for the seed Act are not yet fully enforced. However, the seed sale is in such a way that some seed can only be sold as certified seed while other seed types can be sold even as uncertified. Seed for crops like tobacco and maize can only be sold through the official seed marketing channels if it is certified.

On the other hand farmers are free to trade and distribute seed through non-official marketing channels even though the seed is not certified. In such instances the seed is sold like any other commercial crop. In tobacco nevertheless, farmers are discouraged from trading in, and planting uncertified seed in order to prevent transmission of seedborne diseases like the bushy top (a viral disease) . Since the official seed marketing channels are only involved with certified seed, this means that most of the seed that can be procured by farmers through such channels are pure varieties not landraces.

For the seed certification scheme to register a crop for certified seed production it needs to be assured that the parent material is genetically uniform or stable which will produce seed that is true to the characters described by the breeder of that variety. This requirement limits very much the availability to farmers of seed material which has a broad genetic base like landraces (which are normally a mixture of genotypes) as usually grown by farmers.

Knowing that most of the varieties released by breeders are pure varieties (have a narrow genetic base) but yet in most cases yield higher than the unimproved landraces, it is quite difficult for policy makers to make a decision on whether to recommend production of the high yielding varieties with a narrows genetic base or to encourage production of landraces which quite often have higher yield stability.

As most countries are aiming at expanding productivity per unit area, it is very usual that production of the high yielding pure varieties is the one receiving more encouragement. It is necessary that it should be impressed upon the breeders that they should be considering inclusion of a wider genetic base in the high yielding varieties rather than leaving the issue to policy makers and the farmers.

Establishment of Intellectual Property Rights is being considered in Malawi as it will protect breeders, products from being abused by others without any benefits being shared with the breeder of the materials. It is felt that with the IPR enforced, breeders will be encouraged to do more work realising that they will be able to benefit or get recognition from the output. This is likely to increase use of the local plant genetic resources because for the breeders to come up with adapt-

able varieties they will need use of the local germplasm. This in turn will make people recognise the full value of the indigenous plant genetic resources hence appreciate the needs for their conservation.

Foreign scientists can use Malawi's plant genetic resources for any purpose as long as official channels are followed in obtaining the material. Currently there is a Plant Genetic Resources and Biotechnology Committee which is charged with responsibility to regulate the exportation of plant material from the country. Foreign missions are allowed to make germplasm collection and export part of their collections as long as duplicate samples are left within the country and if permission to make such a collection mission has been sought from the relevant authorities. However, this practice is being revised in light of the Convention on Biological Diversity (CBD). Even on collections prior to the CBD, Malawi suggests to the international community that accessions should also be addressed by this convention because the earlier plant genetic resource agreements were weaker than the CBD.

5.4 OTHER POLICIES

As reported above it is mainly the certified seed which is sold through the official seed marketing channels. Usually, seed is sold at a higher price than commercial grain. Therefore this makes production of seed of pure varieties which can sell as certified seed more advantageous than production of seed of landraces. Smallholder farmers' input loans in Malawi are provided in a package which includes seed of improved or pure varieties and such inputs usually have a certain amount of subsidy.

Therefore for a farmer to be eligible to getting a farming loan, he is supposed to use the inputs (fertilizers and chemicals) on a crop grown from "improved" varieties. The main reason for this, for instance in maize production, was that the improved varieties yield higher than the local or "unimproved" varieties. Therefore, in order for farmers to get a higher productivity per unit are of land, they ought to use the improved varieties. This is quite in line with the aim of getting food self-sufficiency.

Conversely, this thinking has worked counter to the encouragement of conservation of local germplasm. Farmers concentrate on production of varieties with a narrow genetic base as opposed to the local landraces of maize and other local crops like finger millet, pearl millet and groundbeans which are not eligible for provision of production loan let alone any form of subsidy. To some extent, farmers have shown resistance in totally abandoning production of the local landraces because of their perceived benefits. For example, most of the local maize

grown by farmers is liked because it is of flint and hard endosperm type making it more resistant to weevil damaged and does not crush easily when pounding to remove the bran (this is the common processing procedure).

Most of the earlier hybrid maize varieties did not have these qualities. Therefore, it was quite common that farmers would get the credit package to produce the hybrid maize just for sale while a portion of the field would be grown to local maize for household consumption.

Even though it can be argued that farmers are still able to grow the local landraces despite the active encouragement and promotion of the improved varieties, it should be realised that as more economic advantage keeps on working against these local landraces farmers' interest in the conservation of these materials will keep on declining. This has been evident on the fact that some of the local crops like groundbeans, pearl-millet, finger-millet and velvet beans are becoming less popular and hence less common.

While the economic benefits brought about by the improved pure varieties can not be denied, it is also just as important to realise the adaptability and the yield stability offered by the local landraces. Plant breeders need to consider production of improved varieties which have a wider genetic base which include the various genotypes which exist in the gene pool.

It is quite apparent that it is necessary to take a multidisciplinary approach in the planning of major agricultural development projects. Some people have a notion that conservation of the local germplasm can be done by farmers out of a habit or necessity even without an active input by the policy makers. From the recent trends on the status of plant genetic diversity, it is very evident that personnel from plant genetic resource programmes need inclusion in the planning of the major agricultural development projects. Such projects need to be appraised, monitored and evaluated for their impact on the conservation and utilisation of the plant genetic resources if continued survival of the available plant germplasm is to be ensured.

5.5 TRADE, COMMERCIAL AND OTHER INTERNATIONAL AGREEMENTS

To some extent, trade policies can have an impact on germplasm available in the country. For example, in Malawi trade liberalisation on groundnuts resulted in many traders coming in to buy and export the crop and this affected seed available for planting. The seed growers were not willing to sell their produce as "certified" seed because they could get higher prices by selling their produce just

as a commercial crop. This can eventually result in depletion of seed reserves together with the existing intra-species genetic diversity unless a matching price incentive to the seed producers is instituted.

CHAPTER 6
International Collaboration

6.1 UNITED NATIONS INITIATIVES

6.1.1 UNCED

Malawi adopted Agenda 21 at the UNCED-Earth summit in Rio de Janeiro in Brazil.

The country has continued to support conservation activities in the country through provision of personnel to work in plant genetic resource programmes. Limited financial support has been provided for conservation activities, training workshop for crop working group members and the gene bank personnel.

Meetings have also been held and committees were formed to spearhead the conservation of biological diversity which included fauna, flora and ecosystems.

Members of these committees were asked to make an outline of activities to be undertaken to collect baseline data for inventory compilation from which major conservation projects can be prepared for submission to donors for funding.

6.1.2 FAO GLOBAL SYSTEM

It would help countries if the Commission could assist in documenting all germplasm accessions which are in foreign institutions.

It should also facilitate repatriation of duplicate samples from foreign gene banks to countries of origin.

If an international fund for conservation was established Malawi would be a beneficiary.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

6.2.1 THE CGIAR

The consultative group on International Agricultural Research (CGIAR) has been supportive to the national plant genetic resource conservation programme and to other agriculture scientist in the country for a long time.

Several seed collection missions have been carried out in the 1970s and 1980s sponsored by various CGIAR centres.

Most of these collections are still being kept at those centres and arrangements are being made to repatriate duplicate samples to the national programme since most of the samples that were left in the country during the time of collection have been lost due to poor storage conditions as existed before the establishment of the MPGRC.

Training of national personnel in national plant genetic resource utilization and germplasm enhancement has been benefited from various CGIAR Organisation like CIMMYT, ICRISAT, IPGRI, IITA and many others. Such training has been through sponsorship to attend course organised by other institutions and in service training at CGIAR centres like ICRISAT, IITA and CIMMYT.

The newly established MPGRC has benefitted in the acquisition of reference materials from IPGRI, for instance, crop descriptor booklets, newsletters and other publications. These reference materials provide invaluable information which aids in most of the activities and decisions made on germplasm conservation projects.

To other agricultural programmes, CGIAR centres have been very supportive in the provision of enhanced materials like in maize and finished varieties for instance cassava, sorghum, groundnuts and pigeon peas.
Most of this support from CGIAR centres are from both centres within Malawi as well as regional and those away from the region.

As most of the CGIAR centres have well equipped gene banks, the material can continue being kept at those centres, only that duplicate samples need to be repatriated to countries of origin upon request. On the new initiatives which CGIAR centres can be requested to take, they should be ready to furnish national programmes with characterisation and evaluation information on materials originating from the country.

6.2.2 Regional Research Centres

Malawi does have a relationship with some of the regional research centre, for instance, the Asian Vegetable Research and Development Centre (ASVRDC). Some Malawians have benefited from the vegetable production training offered by the centre.

6.3 REGIONAL INTERGOVERNMENTAL INITIATIVES

Malawi is participating in a Southern African Development Community (SADC) regional project for plant genetic resource conservation. The project, implemented by the Southern African Centre for Cooperation and Agricultural Research (SACCAR), has its headquarters at the SADC Plant Genetic Resources Centre (SPGRC) in Lusaka, Zambia and its main aim is to help in manpower training, germplasm conservation and utilization and to provide a forum for exchange of knowledge in conservation activities.

The project provides a regional approach to problem solving thereby rendering a wholistic approach to solving conservation problems, instead of having each country working in isolation. Some of the conservation problems span across country boarders thereby needing collaborative approach. From the project, more support in the procurement of some laboratory equipment and finances for seed collection missions has been realised.

The project has a cost component in that member countries are expected to make a financial contribution for the operations of the project. Another cost factor on regional projects is that priorities for the region may not be true to country situations hence there is need to adopt the regional priorities in the way that will suit individual member country needs. Malawi is also participating in a SADC Tree Seed Centre project which has a main focus on forest seed collection and sales.

One of the ways regional projects can help national programme is on the pooling together of trained human resources. Some of the functions carried out by national programmes can be taken over by the regional project where necessary. For example, if a country is not able to carry out characterisation and evaluation work on its germplasm it should be possible to request the regional centre to do the work. This would help countries which do not have enough resources, especially trained manpower.

6.4 BILATERAL INTERGOVERNMENTAL INITIATIVES

Apart from participating in the SADC regional project for germplasm conservation, Malawi does not have any bilateral assistance on the plant genetic resource conservation activities. This has a negative effect on the full implementation of conservation activities as certain worthwhile conservation projects cannot be carried out because of resource constraints. It has been quite difficult to get adequate infrastructural development from the regional project alone as certain things which need rectification are not covered within the scope of the project.

CHAPTER 7
National Needs and Opportunities

From the international body there is need to aid the national initiatives in conservation activities in the following areas:

- Training of personnel in conservation and utilisation of plant genetic resources.
- Funding of plant genetic resource activities like inventorying, characterisation and evaluation, *in situ* and *ex situ* conservation.
- Infrastructure development for, example, office and laboratories, vehicles, equipment and establishment of a semi-autonomous germplasm conservation programme.

CHAPTER 8
Proposals For a Global Plan of Action

Certain problem areas demand consideration at a global level. These problem areas are as follows:

- Funding for conservation projects.
- Human resource development.
- Habitat conservation.
- Environmental education.
- Networking.
- Country studies (inventories).
- Working out regulations for Intellectual Property Rights, Farmers' Rights, patenting of plant genetic resources, right of access to plant genetic resources and sharing of information and other benefits resulting from plant genetic resources with the donor of the material.
- Work out the legal use and ownership of the material collected from different countries prior to the Convention on Biological Diversity.

Appendix I

Crops and the wild relatives present in Malawi

Crop Species	Wild Relatives
1 Cereals	
Eleusine corocana (Finger millet)	*E. indica sub sp. africana*
	E. indica sub sp. indica
Oryza sativa (rice)	*O.barthii*
Sorghum bicolor (sorghum)	*S. arundicum*
	S. rigidifolium
	S. versicolor
	S. verticilliflorum
2.Legumes	
Vigna unguiculata (Cowpea)	*V. fischeri*
	V. unguiculata sub. sp dekindtiana var. dekindtiana
	V. unguiculata sub sp. dekindtiana var. mensensis
	V. unguiculata sub.sp dekindtiana var. pubescens
3. Other crops	
Saccharum spp. (sugarcane)	*S. spontaneum*
Coffea sp. (coffee)	*C. ligustroides*
Amaranthus spp. (Amaranthus)	*Amaranthus spp.*
Cucumis spp	*Cucumis spp.*
Musa spp. (banana and Plantain)	*Ensete ventricosa*
Dioscorea spp.(yams, air/potato yams)	*Dioscorea spp.*
Gossypium spp (Cotton)	*Gossypium spp.*
Phoenix dactylifera (date palm)	*P. reclinata*
Elaeis guineensis	*E. guineensis*

Appendix II

A list of endangered (wild) species of Malawi

Adina microcephala	Mwenya
Afzelia quanzensis	Mkongomwa, msambamfumu
Borassus aethiopum	Palm, Mvumo
Brachystegia spp	Miombo
Bridelia micrantha	msopa, mpasa
Burkea africana	Mkalati
Burttdavya nyasica	
Chlorophora excelsa	Mvule
Colophospermum mapane	Tsanya
Combretum imberbe	Mnangali
Cordyla africana	Mtondo
Dalbergia melanoylon	Phingo
Diospyros mespiliformis	Msumwa
Entandrophragma caudatum	Napalali, Mziza
Entandrophragma excelsum	Muluru
Erythrophleum suaveolensis	Mwabvi
Hyphaene crinata	Mgwalangwa
Hyphaene ventricosa	palm
Jateorhiza bukobensis	
Khaya nyasca	Mbawa
Orchid species	
Pterocarpus angolensis	Mlombwa
Raphia farinifera	palm
Terminalia sericea	Naphini
Widdringtonia nodiflora (W. whytei)	Mulanje cedar
Aloe species	

Appendix III

Plant accessions held by the Malawi Gene Bank

Scientific Name	Common Name	Local Name	Total
Seed samples:			
Arachis hypogea	groundnuts	mtedza	24
Cajanus cajan	pigeon peas	nandolo	15
Cicer arientimum	chick pea	tchana	1
Cucumis anguria	small prickly cucumber	zikanyanga	2
Eleusine corocana	finger millet	mawere	66
Helianthus annus	sunflower	mpendadzuwa	125
		"khofi"	1
Lablab purpureus	Hyacinth beans	nkhungudzu	15
oryza sativa	rice	mpunga	14
Pennisetum glaucum	pearl millet	mchewere/natchatcha	43
Phaseolus lunatus	Lima beans	kabaifa/kapoji	13
Phaseolus vulgaris	beans	nyemba	32
Pisum sativa	garden peas	nsawawa	5
Ricinus communis	castor seed	nsatsi	2
sesamum indicum	sesame	Chitowe	6
Sesbania sesban	sesbania	jerejere	39
Sorghum bicolor	sorghum	mapira	380
Stizolobium atterimum	velvet beans	kalongonda/tangale	48
Vigna radiata	Green gram	mphoza	9
Vigna unguiculata	cow peas	khobwe and nseula	92
Vigna subterranea	Bambara nuts	nzama	43
Zea mays	maize	chimanga	128
Vegetative samples			
Acacia albida		nsangu	5
Annona senegalensis		mpoza	3
Azanza garkeana		matowo	2
Cinnamomum verum	cinnamon		1
Dioscorea spp.	yam	chilazi	1
Elletaria cordatum	cardamon		1
Flacourtia indica		nthudza	3
Hyphaene spp.	palm	mgwalangwa	1
Impomea batatas	sweet potato	mbatata	34
Manihot esculenta	cassava	chinangwa	50
	Pappadillars		2
Psidium guava	guavas	gwafa	3
Sacchurum officinarum	sugarcane	nzimbe	94
Syzgium cordatum		nyowe/chisu	2
Treculia africana		njaya	1
Uapaka kirkiana		masuku (achizungu)	4

Acknowledgment

This document was prepared through collaborative effort by

L. Nsapato
H. Mande
Malawi Plant Genetic Resources Centre

A. Chikuni
Magombo
National Herbarium and Botanic Gardens of Malawi

R. Bima
Parks and Wildlife

M. Mkandawire
J. Lowore
Forestry Research Institute of Malawi

Prof. J.H. Seyani
General Manager of the National Herbarium and Botanic Gardens of Malawi

References

ANONYMOUS. 1991: Pasture annual report. Chitedze Agricultural Research Station, Malawi.

CHAPMAN J.D. 1990: Mount Mulanje, Malawi: a plea for its future. Braeriach, Urlar Road, Aberfeldy, Perthshir, U.K.

Department of Research And Environmental Affairs 1994: National Environmental Action Plan, Volume 1.

MACKAY J.H.E. 1982: Register of Australian herbage plant cultivars: supplement to the 1972 edition. CSIRO. Division of Plant Industry. Melbourne. Australia.

MAGHEMBE J.A. and J.H. SEYANI 1991: Multipurpose trees used by smallholder farmers in Malawi: results of an ethnobotanical survey. AFRENA Report.

Malawi Population and Housing Cencus, 1987. Vol. 1.

MSISKA H.D. and G.Y. KANYAMA PHIRI 1992: Evaluation of potential forage genetic resources from Malawi: an overview. Paper presented at the Workshop for National Crop Working Groups and Gene Bank staff. 12th to 16th October, 1992. Bvumbwe Agricultural Research Stadon, Malawi.

SAKAI I. 1989: A report on the Mulanje cedar resources and the present crisis. Forestry Record No. 65, Malawi.

WILLIAMSON J. 1975: Useful plants of Malawi. Revised and Extended Edition. University of Malawi.