TANZANIA:

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

(Leipzig 1996)

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Dar-es-Salaam, December 1995

Note by FAO

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CHAPTER 1
Introduction to Tanzania and its Agricultural Sector

1.1 LOCATION

Tanzania is found on the East African Coast approximately between latitudes 1°S to 12°S and longitudes 29° to 40'E (Map 1). Tanzania has borders with Kenya and Uganda to the north; Rwanda, Burundi and Zaire to the west; Zambia and Malawi to the south-west and Mozambique to the South; while to the east is the Indian ocean. Out of about 94.5 million hectares total area 88.5 mill. ha. are on actual land surface, the rest is under water. More than 40% of the country's total land area is covered by indigenous vegetation which is in turn represented as coastal forest, open woodlands, closed mountain forests, wet lands, scrub and bush lands.

Administratively, the country is a Union of Tanganyika (also refereed to as Tanzania mainland) and Zanzibar forming the United Republic of Tanzania. Zanzibar has an autonomous state government.

1.2 PHYSIOGRAPHY

The total area of Tanzania is 945,000 sq. km (of which 2,450 sq. km are in Zanzibar. Two thirds of this area is dominated by ancient plateaux. The Central Plateau comprises of gently undulating country over much of the western half at an elevation of 1200 m. Dissected highlands, up to 2,100 m, flank the deep trough of Lake Tanganyika to the west and extend, with isolated blocks of the Uluguru, Nguru, Usambara and Pare Mts. continuing a line to the northeast border. Plateau_w at a rather lower elevation and with more varied topography occur in the north-east and in the south-east behind the narrow Coastal Plain. Tectonic and volcanic activity have produced spectacular effects in the Eastern Rift Zone, the snow-capped dome of Kilimanjaro (5800 m asl), and Mt. Meru (4966). There are many mountain peaks to the west including the famous Ngorongoro Crater and the still active Ol Donyo Lengai.

Lakes Natron, Eyasi and Manyara lie in the rift valley floor. In the south, the Poroto and Rungwe mountains are built up from a smaller area of volcanic activity.

The plateau soils on the crests are deep, slightly acidic infertile sandy-loams, changing to dark clay soils in the shallow valleys and extensive interior basins. In the north-east part of the country, the predominating soils are slightly alkaline red-earths, sandy loams and clays. These change to a mosaic of sands, clays and coral along the Coastal Plain and on the off-shore islands.

1.3 CLIMATE

The mean annual rainfall varies widely from about 320-2,400 mm a year, with actual early records ranging from 110 mm in 15 days (at Mkomazi) to 3,250 mm in 153 days (at Tukuyu). Although comparatively well watered as a whole, there are considerable annual variations and most of the country has a long dry season with rain practically restricted to November - May period. A bimodal distribution is characteristic of the north-east and in the vicinity of Lake Victoria. About half of the country receives less than 750 mm a year, which is generally regarded in East Africa as necessary for any intensive form of agriculture. The predominant vegetation aspect is, therefore, of a dry type with local often abrupt changes to moist regimes in the highlands, parts of the coastal belt, near Lake Victoria and also wherever ground-water is available.

Being close to the equator, variations in mean monthly temperatures are slight. Mean annual maximum and minimum temperatures are very closely correlated with altitude.

1.4 VEGETATION

Tanzania is a tropical country and contains representatives of all the plant formations found in Africa's main ecological zones. It has about 10,000 species of higher plants (Polhill, 1968) compared to the estimated 30,000 species for the whole of tropical Africa (Brenan, 1978). The main vegetation types, are shown on Map 2 while the dominant species and locations where they are found are shown in appendix 1.

1.5 POPULATION

Based on the 1988 census, Tanzania's population in 1995 is 27.3 million with a growth rate of 2.8% per year. The population density is about 29 persons per square kilometre. The highest densities are found in Lake Victoria basin, North-Eastern Highlands, Southern Highlands and Dar es Salaam. Nearly 90% of the population lives in about 8,000 rural villages with an average of approximately 300 farm families per village. Rural migration to urban centres is increasing as a result of poor economic opportunities in the rural areas.

1.6 THE MAIN FARMING SYSTEMS

Subsistence type of farming for food crop production is practised over a large area of Tanzania. It is fairly common to find cereal crops grown in association with legumes although monocropping of rice, maize and wheat is not uncommon.

Most of the cash crops are grown by small scale farmers. Plantation crops such as sisal and sugarcane are grown in large farms.

1.7 THE AGRICULTURAL SECTOR

The economy of Tanzania hinges on the agricultural sector. The sector employs about 80% of the employed population; contributes about 60% of both GDP (at current prices) and merchandised exports. Food crops production dominates the sector, totalling 55% of agricultural GDP with livestock accounting for 30%. The sector is dominated by small holders organized in some 8,000 villages with an average holding of less than 2 ha per family. To-date it is also contended that the sector is virtually the backbone of the growing local manufacturing industry specializing in the processing of agricultural products. Traditional cash crops include coffee, sisal, tobacco, tea, cashewnuts and pyrethrum. Food crops include maize, paddy, wheat, sorghum, millet, cassava, beans, sweet potatoes and bananas. Except for years of uncertain rainfall, Tanzania is largely self-sufficient in food production. There is a cattle herd of more than 13 million head, 8 million goats and 5 million

sheep which play an important economic and social role in the economy. An estimated 90% of households keep livestock of some kind mainly for subsistence, but also for sale and social purposes. Cattle are particularly important for providing food, draft power, manure and cash income.

1.8 SEED SUPPLY SYSTEM

The National Programmes are engaged in a wide range of varietal development for both food and cash crops. These programmes account for major releases of new varieties which are mostly open and self pollinating with an exception of a few maize hybrid varieties. A seed multiplication system exists but does not cater for low volume, low value crops. Cash crops seed delivery system was through crop Marketing Boards for various individual crop types such as cotton, coffee, tobacco, pyrethrum, tea, etc. Recently, agricultural marketing has been liberalized, allowing the private sector to assume an important role in seed and inputs distribution. The private sector is, so far, only involved in testing new varieties developed outside the country but adapted to similar ecological conditions. A large proportion of seed grown in the country is from home-saved seed.

1.9 TRENDS IN PLANT PRODUCTION

Production of major food and cash crops during the years 1991/92 to 1994/95 is shown in Table 1 and 2 respectively. Accurate figures for food production are difficult to get due to prevalence of multicropping and informal marketing. On the overall food production normally meets national food needs. However, the prevalence of bad weather causes intermittent food deficits in various areas of the country. As it can be clearly seen from Table 1, production of food crops has fluctuated unevenly for different crops. Whereas the production of maize and paddy has been fairly unstable and in some instances falling, that of sorghum and millet has increased steadily.

Cash crops on the other hand have registered a more convincing performance, when compared to food crops. Production levels for most crops as indicated in Table 2 have been rising steadily during this period.

Table 1 Production of major food crops during the period 1991/92 to 1994/95 ('000 tons)

Year/crop	1991/92	1992/93	1993/94	1994/95*
Maize	2,226	2,282	1,813	2,797
Paddy	392.2	641	634	486
Sorghum/ millets	850	929.4	882	1,039
Wheat	64	59.4	38	81
Beans	312	405.8	224	562
Cassava	1,777.6	1,708.2	1,693	1,744
Potatoes	257	260	257	234

*** Projected production**

Table 2 Production of major cash crops during the period 1991/92 to 1994/95 ('000 tons)

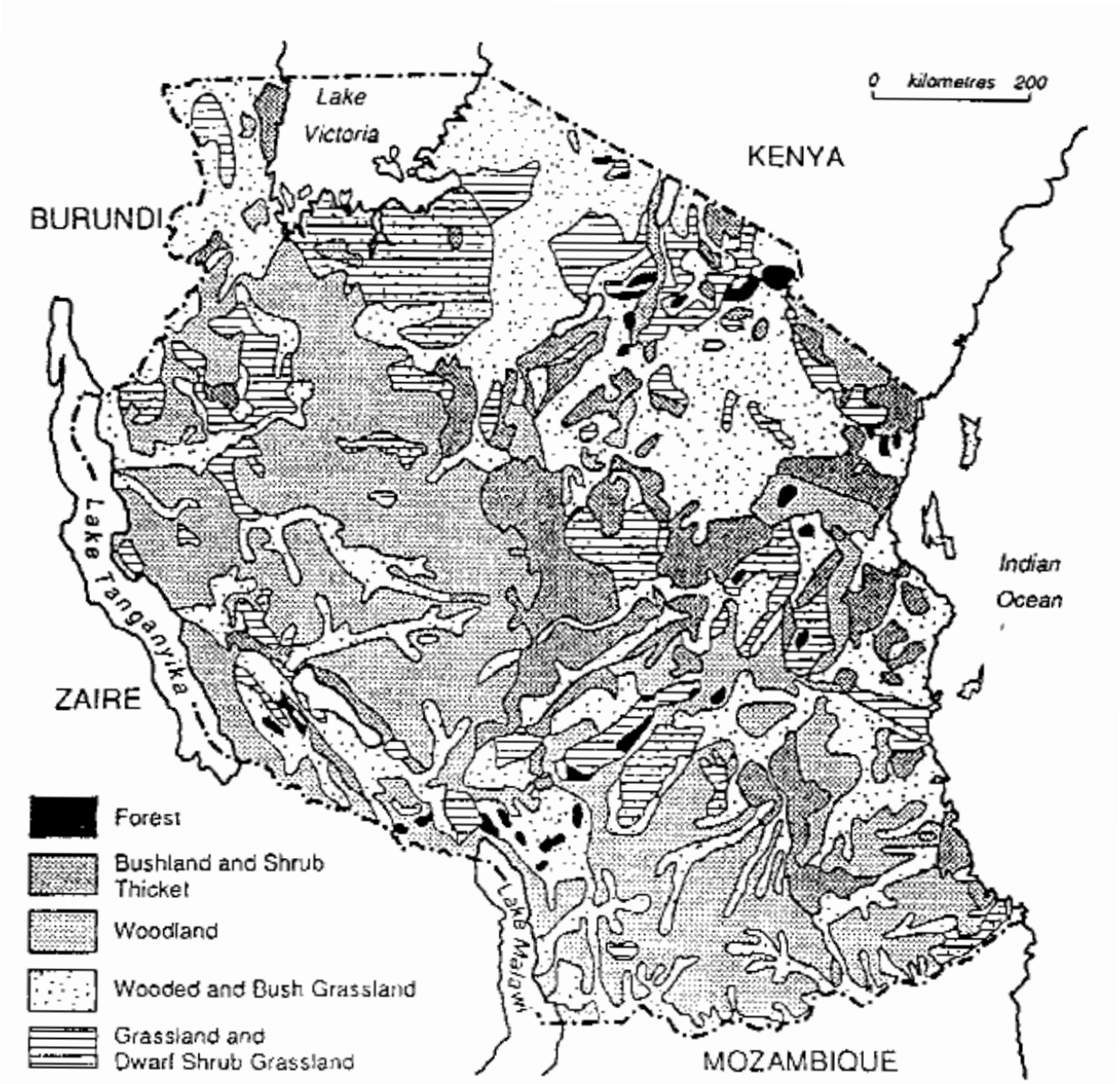
Crop/year	1991/92	1992/93	1993/94	1994/95`
Coffee	47,979	57,867	44,905	65,000
Cotton	267,000	305,862	264,792	420,000
Sisal	35,662	24,209	30,498	42,000
Tea	19,700	21,074	16,572	21,000
Cashewnut	42,425	33,000	46,598	64,000
Tobacco	16,240	18,752	17,500	24,000
Pyrethrum	2,468	2,700	1,819	2,500

*** Projected production**

Table 1 & 2: Source: Ministry of Agricultural 1994. Agriculture Sector Policy paper for the 2nd Rolling plan and forward budget 1994/95 - 1996/97. Sectoral Planning, Planning & Marketing Division, Dar es Salaam.

MAP 1 TANZANIA LOCATION. ADMINISTRATIVE REGIONS AND PRINCIPAL TOWNS

MAP 2 MAP OF MAJOR VEGETATION TYPES



Source: Adapted from Handbook of Natural Resources of East Africa, 1/4.0 million map of E. Africa, E. African Literature Bureau, Nairobi, 1976

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 INTRODUCTION

Tanzania has a vast potential of indigenous plants which could widen the food base and provide opportunities for other uses in agriculture, forestry, medicine, recreation, industry, etc. More than 50% (equivalent to 44.4 million ha) of the country's total land area is covered by indigenous vegetation.

2.2 FOREST GENETIC RESOURCES

The country has five major forest ecosystems with characteristic tree species occurring naturally in association. These ecosystems include Moist Lowland Forests (Lowland Rain Forests), Moist Montane Forests (Upland Rain Forests), Riverine Semi-swamp Forests, Dry Lowland Evergreen Forests and Dry Montane Evergreen Forests (Polhill, 1968).

2.2.1 Status of important forest species

About 77% of the indigenous vegetation is under some form of protection, however, deforestation rate is over 1% per annum. Among the indigenous tree species 22 are protected from uncontrolled harvesting such as:

Afzelia quanzensis
Allanbalankia stuhlmannii
Beilshmeidea kweo
Brachystagia hutchinsii
Cephalosphaera usambarensis
Dalbelgia melanoxylon
Juniperus procera
Khaya nyasica
Milicia excelsa

Ocotea usambarensis
Olea capensis
Ossyris spp
Oxystigmum msoo
Podocarpus usamberensis
Podocarpus latifolius
Pterocarpus angolensis

These species are massively cut for various uses such as sawn timber, construction timber and carvings. Thus these species are threatened and vulnerable for extinction because their regeneration potential is low.

Furthermore, the coastal area are rich in mangroves with at least ten known species (Appendix 11) which are important sources of fuel wood, structural timber, medicinal and die plants. The mangroves are also important breeding areas for fish. The survival of some the mangrove species is threatened by salt making industry along the coast.

2.2.2 Measures aimed at sustainable management

The overall national objective is to conserve natural ecosystems with their genetic resources so that the values and benefits of the forests are perpetuated. However, the draft forest policy of 1986 is fairly general and thus does not include specific policies to encourage sustainable utilization of the resources. The weakness was addressed in the Tanzania Forestry Action Plan (TFAP) 1991 - 2008. TFAP is very specific on such issues like increasing awareness on nature conservation, sustainable conservation by management of natural forest, research and training in conservation and creation of a network of nature reserves.

2.2.3 Important species threatened at species or provenance level

There is very little information on the species that are threatened. However, there is sufficient evidence to believe that there is potential danger of serious genetic erosion due to:

Overgrazing. Massive migration of livestock from Lake Victoria Basin through Miombo Woodlands of Western Tanzania to the Southern Highlands.

Shifting cultivation. Characterized by clearing and burning particularly for production of tobacco and finger millet.

Loss of habitats. Caused by construction of dams for hydropower production and resettlement of large populations in small areas. For example Mtera and Nyumba ya Mungu Dams had feasibility studies which did not consider effects on plant biodiversity. Similarly settlement of refugees in North-western and Southern Tanzania. caused serious losses of plant communities.

Destructive harvesting of herbs and roots. For various uses particularly for medicinal purposes.

Wingfield (1979) compiled a comprehensive list by based on Polhill's list of 1968 suggesting that over 700 species of vascular plants were seemingly rare or vulnerable (a partial list of these species shown in Appendix 2). However, the World Resources Institute recognizes 158 plant species that are threatened.

2.3 OTHER WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

The status of wild relatives of crops and rare species has not been addressed consistently. As a result one cannot be certain of the status of these species. There are, however, a number of major crops which have known wild relatives (Appendix 3a and 3b). There are also important pasture species (Appendix 4) in the major habitats which could be improved to derive cultivars for modern farming and ranching. There is also a great wealth of species that are exploited or have potential for ornamental use such as orchids and the world famous African violet (*Saintpaulia* spp) which has 20 endemic species.

Records show that numerous plant species are used for food and medicinal purposes in various parts of the country. For example, Msangi (1991) indicated that about 290 indigenous plant species in 77 families and more than 175 *genera* are used in Tanga and Kilimanjaro regions alone (see also other examples in Appendix 5 and 6).

2.4 LANDRACES AND OLD CULTIVARS

Landraces and old varieties are used extensively in Tanzania owing to the limited supply of commercial seed.

2.4.1 Information about traditional and improved varieties

A large proportion of Tanzania farmers do farming at subsistence level. Such farmers generally value and take pride for using crop varieties originating from their own societies. Tanzania has a wide range of cultures associated with its over 120 tribes. Environmental conditions are also very diverse. The number of traditional varieties selected to suit the different cultural values and environmental conditions, is also very large. Many traditional varieties are often given names which emphasize the qualities of the varieties thus resulting in easy sharing of information and seed of such varieties.

Seed of traditional varieties is normally exchanged freely within ethnic groups. As a result of these factors, traditional varieties are easily accepted and spread with ethnic groups.

Information about the varieties is usually better known to the elderly than to the younger generations. Such information is passed on from generation to generation orally. It is, therefore, difficult to obtain sufficient authentic information about traditional varieties unless one understands the culture associated with it.

Very few of the traditional varieties are documented. Even where there is some recorded information, it is difficult to match information since there are usually many names for the same variety and sometimes the same name is given to totally different varieties.

Information about improved varieties is generally easier to obtain since most improved varieties were released only recently and were documented. However, some of the older varieties introduced from other countries were not well documented. This is particularly true with vegetable crops.

2.4.2 Displacement of traditional varieties by improved cultivars

The subsistence nature of farming tends to encourage use of traditional varieties for a long period. For most crops farmers still have very old varieties being grown concurrently with more recent varieties. In many cases farmers believe that their varieties are superior to the new varieties in the major traits of interest to them. It is also true the older varieties tend to be more stable in many characters. Furthermore, the seed supply system is neither efficient nor aggressive enough to motivate farmers to adopt new varieties wholesome.

There are however, situations where new varieties have displaced the old varieties within a very short time. This is particularly true with maize.

The government does not encourage use of old varieties where new ones are already available. This is so because new varieties are expected to have been carefully bred to exceed the varieties they are replacing. Farmers also believe that improved varieties require inputs like fertilizers and pesticides which are costly and difficult to get in time.

Assessment of the significance of traditional crops and varieties has not been done comprehensively, however, various Farming Systems Research studies and reports from collection missions suggest that traditional crops and varieties contribute significantly to stability of food supply in the country. These traditional crops and varieties are genetically diverse, therefore, more adaptable to biotic and abiotic stresses.

2.4.3 Policies affecting protection of traditional varieties and wild resources

In general the government puts a lot of emphasis on food and cash crop production by increasing area under production and yield per unit area. Any attempts to increase area under production will either necessitate expansion to new areas or marginalization of minor crops.

In both cases traditional varieties and wild plant genetic resources may be negatively affected. As noted earlier Tanzania has vast areas of land that are under natural vegetation (where unique genetic resources can be expected to be found). Therefore attempts to expand land under agricultural production will lead to encroachment of these areas. At present there is no land tenure policy per se. There are sectoral policies for agriculture, forestry, land, minerals etc. that affect land tenure. These sectoral policies have many limitations which make it difficult to achieve sustainable utilization of resources. Some of the limitations are:

- tenure insecurity,
- ambiguity with respect to village boundaries,
- omission of grazing and access to water rights of nomadic groups in the semi-arid and arid areas,
- existence of communal grazing land.

CHAPTER 3
Conservation Activities

3.1 INTRODUCTION

In recent years the intensified exploitation of tropical and subtropical countries necessitated by the population explosion has led to wholesale destruction of nature over vast areas-to the extent that several natural ecosystems are on the verge of extinction. Today it is being realized by an increasing number of people and national institutions, as well as by international bodies that urgent measures are required if we want to save representative samples of most tropical ecosystems before it is too late. In Tanzania the need to actively conserve materials that will perpetuate plant diversity is even more necessary because of experience outlined in the previous chapter. It should be noted that efforts to conserve plant genetic resources have until recently been the responsibility of several institutions without much co-ordination. As a result of the formation of the National Plant Genetic Resources Committee in 1987 and the recommendations of the Biodiversity Convention, there is a new outlook in conservation and utilization of plant genetic resources in the country.

3.2 *IN SITU* CONSERVATION ACTIVITIES

By protecting and maintaining most wild species in their natural habitats, the process of evolution will continue with minimum interruption by artificial selective forces. Large areas of land (>25% of the country) are protected by various laws in National Parks, Game Reserves and Forest Reserves (Appendix 12). The NPGRC is required to collaborate with the various organs maintaining the protected areas to ensure that the form of protection in force is appropriate. Impact of the factors threatening wild genetic resources are difficult to detect. Therefore valuable gene pools of widespread species may disappear undetected, either because not enough is known about the distribution of genetic variation within the species or because the very abundance of the species masks the disappearance of its constituent gene pools. Polhill (1989) observed that floristic inventory has not reached a stage to begin

to monitor rates of extinction. Therefore, it is necessary to observe and analyse the status of certain species from time to time and take action before major losses occur. In some cases special protection in nature reserves may be the best solution. The University of Dar es Salaam has done considerable initial floristic surveys (Ruffo and Maliondo, 1991), while the Tanzania Forest Research Institute is already considering giving extra protection to some indigenous timber species, particularly those in the Eastern arc ecosystem which are being over-exploited (Madoffe, 1991). A similar approach is needed for medicinal and aromatic plants (Mahunnah, 1991) and for small indigenous forests which also stand the risk of over-exploitation.

3.3 *EX SITU* COLLECTIONS

Most of the *ex situ* collections in agriculture are maintained as breeders' working collections as seed or in field gene banks (Appendices 7-10). In forestry *ex situ* collections are mainly maintained in arboreta as shown in Table 3.

3.3.1 Balance between local and exotic germplasm

Both local and exotic germplasm are included in collections. The balance between local and exotic germplasm depends on the crop and resources available. In general the composition of national collections is mostly exotic. Being working collection there is preferential treatment of the materials in research stations with a bias towards exotic germplasm since they are usually in more advanced stage of development.

Table 3 Size and location of forestry arboreta

Location	Year Established	Number of Species	Area (ha)
Arusha region			
Usa	1961	10	0.1
Coast			
Kongowe	1974		
Tanga region			
Lushoto	1952	181	12.5
Mombo	1960	44	3
Longuza	1959	68	3.7
Amani		460	300
Lindi region			
Rondo	1959	6	2.5
Mwanza region			
Malya		33	3.1
Ukerewe	1958		
Iringa region			
Kigogo		55	?
Kihanga	1961	74	5.3
Kagera region			
Rubare		?	2.6
Mbeya region			
Kawetere	1961		
Kiwira	1965		

3.3.2 Germplasm exchange

Exchange of agricultural germplasm is generally in favour of introduction for most crops due to extensive collaboration between local plant breeders with International Agricultural Research Centres. However, since most previous collection missions initiated from outside, there have been substantial amounts of materials deposited in gene banks outside the country annually.

3.3.3 Size and nature of collections

The national collections held with the NPGRC are neither representative nor exhaustive of the existing diversity in the field. The collections are grossly inadequate for our purposes. The NPGRC is still in its early stages of establishment, therefore, most of the facilities needed for proper maintenance are yet to be acquired. The materials being maintained are still very few and manageable.

3.3.4 Collecting policy

So far collecting activities conducted in the country have been based on specific needs of institutions locally and externally. Therefore collections activities have been to a large extent donor driven and not necessarily planned to represent a local need. Where collection was planned and conducted by local personnel there has been a tendency to concentrate on breeding programme objectives.

3.4 STORAGE FACILITIES

The NPGRC was initiated as a result of a proposal to establish a Regional Plant Genetic Resources Centre for the SADC member states at Lusaka in Zambia. Each member state agreed to establish its National Plant Genetic Resources Centre to link up with the regional Centre. The SADC Plant Genetic Resources Centre (SPGRC) maintains base collections for member states, while the national centre maintain active collections. Therefore, duplicate samples for long term storage are sent to SPGRC. There are no formal arrangements as yet concerning safety samples, but this will be an issue to consider internally when the legal status of the NPGRC is finalized.

3.4.1 Storage conditions

The NPGRC maintains its accessions in cabinet freezers at temperature of -18oC and moisture content below 7%. Seeds are packed and sealed in aluminium foil packets.

So far we have attempted to follow internationally preferred standards. However, it has been very difficult to achieve them due to inadequacy of facilities. Equipment for seed technology are not yet available and any work done so far has been possible through borrowing of equipment from laboratories. In general the NPGRC is grossly under-equipped. There is need for building its capacity to handle plant genetic resources efficiently. To this end a project proposal is under preparation to solicit support from local and external sources for equipment, training and technical co-operation in specified areas.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

4.1 INTRODUCTION

In Tanzania agricultural research and development is organized on commodity basis. Use of germplasm largely depends on the objectives of the individual commodity programme. Each programme has its own working collections which are maintained at various research institutes under different storage conditions.

Forestry research and development is done under TAFORI which has a Silviculture Research Centre at Lushoto in Tanga region. The NPGRC is not yet availed with sufficient information to be able to monitor the use of Plant Genetic Resources in the country.

4.2 USE OF PLANT GENETIC RESOURCES COLLECTIONS

The NPGRC is still in the process of developing capacities and capabilities for promoting co-ordinate utilization of Plant Genetic Resources. In the meantime strong national commodity programmes are increasingly involved in the use of germplasm. These programmes are listed Table 4. Most of the commercial varieties of food crops are locally bred. There are only a few crops which attract commercial use of improved varieties; such as maize beans, sunflower, wheat, barley, and sugarcane.

4.3 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

A greater portion of Tanzania's agricultural production is at a subsistence level. Crop improvement programmes are mostly targeted to these resource poor farmers. Hence emphasis is given to development of varieties with environmental stability which are also suitable for Integrated Pest Management.

4.3.1 Objectives of plant breeding programmes

The national plant breeding programmes aim at developing new varieties with high yields and improved resistance to pests and diseases. All programmes have tended to use exotic germplasm to introduce specific genes, particularly those which improve quality and tolerance to abiotic stresses.

For food crops traits considered are those which will allow production to be done by small scale farmers, while for crops like coffee, cashew, barley and sugarcane there is more emphasis on quality and suitability for commercial production.

4.3.2 Output from plant breeding programmes

For those crops listed under specific commodity research programmes, there has been concerted efforts to encourage high quality scientific work in the last few years. However, there are still a number of constraints particularly a poorly developed seed industry and the presence of many low volume low value crops which are not attractive for commercial seed production. These constraints are now being addressed by reorganizing the seed industry through liberalization. The National Seed Industry Programme of 1989 clearly spells out the roles of public and private sectors in industry. It is expected that the introduction of private seed companies will hasten the use of improved varieties and expand breeding activities for market oriented farming.

As for the low volume, low value crops, the strategy is to continue using public funds to ensure that varieties of these crops are available to farmers until such time the private sector finds them attractive enough for serious investment.

4.3.3 Availability of seeds and recommendations to farmers

Most plant breeding activities are supported by the government but with the liberalization of the seed industry, it is expected that private companies will invest more in plant breeding and seed trade. The availability of in-country crop improvements to farmers is channelled through the National Seed Industry particularly for food, oil seeds, vegetable, pulses, potatoes & other tubers. Cash crops seed delivery system is through crop Marketing Boards for various individual crop types such as cotton, coffee, tobacco, pyrethrum, tea, etc. However, the National Seed Programme under the Ministry is responsible for co-ordination, monitoring seed production and utilization systems of all in-country products. Local farmers for quite a long time have been involved in assisting plant breeding activities of the Government by offering land, labour and other resources for on farm trials for evaluation of potential cultivars. The varieties therefore developed are for use by all classes of farmers. However, small scale farmers compose the bulk of intended beneficiaries.

Most of the commercial varieties of food crops are locally bred. There are only a few crops which attract commercial use of improved varieties; such as maize beans, sunflower, wheat, barley, and sugarcane.

4.4 USE OF FOREST PLANT RESOURCES

The forest germplasm is usually collected, preserved and distributed by TAFORI as research samples or for various afforestation programmes in Tanzania and elsewhere. Due to limitations in the storage of tree seeds at the Silviculture Research Centre Lushoto, a National Tree Seed Project was developed to meet the country's own seed requirement and for export. The project started in July 1989 under The Forest and Beekeeping Division which was later on changed into a National Tree Seed Programme (NTSP) with the same main objectives. The programme's national head office is located at Morogoro and operates with three zonal tree seed centres at Iringa (Southern Tanzania), Lushoto (N.E. Tanzania) and Morogoro. The zonal centre at Morogoro is built in combination with the national centre. This facility can be used very effectively to enhance collaboration between various institutions so as to maximize utilization of forest resources.

The national centre carries out the following activities and services:

- Documentation of the seed requirements from various customers.
- Identification, selection, registration and management of seed sources.
- Distribution of lists of seed and seed sources available.
- Contact and cooperation with other seed organisations.
- Applied research into phyto-sanitary problems, storage conditions, and pre-germination treatments.
- Advice and technical assistance to afforestation projects.

4.5 BENEFITS DERIVED FROM THE USE OF PLANT GENETIC RESOURCES

Up to the time the NTSP was established, there were no clear mandates given to any institution in the country in connection with deriving benefits from use or exchange of plant genetic resources. After the formation of NTSP it has become clear that a price tag can be put on most seed stock collected from within Tanzania. However, it is too early to assess the real benefits derived from use of plant genetic resources directly or indirectly.

4.6 IMPROVING PLANT GENETIC RESOURCES

Activities in plant genetic resources have been fairly successful in areas where people are likely to derive immediate benefits such as in traditional medicine and in afforestation projects. The Institute of Traditional Medicine of the University College of Health Sciences, Muhimbili, has sensitized a large number of traditional healers on the value of local plants and the need to collect as much information as possible.

In general activities related to plant genetic resources in forestry are unsatisfactory considering the large number of species known to exist in Tanzania. So far programmes related to plant genetic resources are still very general in order to accommodate as many ecosystems and species as possible. This situation is unsatisfactory because it does not offer opportunities for detailed studies in any of the seemingly very important species or ecosystems.

The main drawback in the conservation and utilization of forest genetic resources in Tanzania is the absence or inadequacy of information concerning them. Studies on plant genetic resources in the wild require heavy investment in resources and finance for a long period of time.

These constraints could be removed by sensitizing the government to pay more attention to research and development in forestry.

The available plant genetic resources are likely to be more useful in the future than they are now particularly in the light of rapid development in biotechnology.

In the short term it would be highly desirable to obtain as much information as possible about the resources to enhance future studies and utilization. To this end, detailed ecogeographic surveys are urgently needed. Such surveys, however, will be of little use if collection of representative samples of these materials is not done within a short period after the surveys. Therefore building the capacity of our local institutions to achieve reasonable standards of conservation would be highly desirable.

Considering the high cost of research and maintenance of germplasm assistance to develop the required capacity to handle sufficient volume of an information and materials is needed. Both financial and technical support are needed from local and external resources. Such support could come from local institutions who benefit from use of plant genetic resources and from external donors who have interest is the conservation and utilization of plant genetic resources.

Table 4 Commodity research programmes under the NARS

Programme	Crops		Plant Breeders & related
Maize	Maize	*Zea mays*	5
Rice	Rice	*Oryza sativa*	6
Sorghum and millets	Sorghum	*Sorghum bicolor*	1
	Pearl millet	*Pennisetum americana*	1
	Finger millet	*Eleusine coracana*	1
Wheat and Barley	Wheat	*Triticum aestivum*	1
	Barley	*Hordeum vulgare*	2
Grain Legumes	Cowpea Cowpea	*Vigna unguiculata*	1
	Green gram	*Vigna mungo*	
	Pigeon peas	*Cajanus cajan*	1
	Soy beans	*Glycine max*	
Common Bean	Common bean	*Phaseolus vulgaris*	5
Oil seeds	Sim sim	*Sesamum indicum*	1
Sunflower	Sunflower	*Helianthus annus*	2
Roots and tuber	Cassava	*Manihot esculenta*	1
	Sweet potatoes	*Ipomea batatas*	1
	Round potatoes	*Solanum tuberosum*	2
Coffee	Coffee	*Coffea arabica*	2
		Coffea robusta	1
Cotton	Cotton	*Gossypium hirsutum*	3
Tea	Tea	*Thea sinensis*	2
Sisal	Sisal	*Agave sisalana*	1
Coconut	Coconut	*Cocos nucifera*	3
Cashew	Cashew	*Anacardium occidentale*	2
Sugarcane	Sugarcane	*Saccharum officinale*	5
Tobacco	Tobacco	*Nicotiana tabacum*	1
Horticultural Crops	Tomato	*Lycopersicum esculentum*	
	Onions	*Allium cepa*	
	Amaranths	*Amaranthus spp*	
	Oranges	*Citrus sinensis*	
	Avocado	*Persia americana*	3
Viticulture	Grapes	*Vitis sp.*	1
Bananas	Bananas	*Musa sp.*	3
Pyrethrum	Pyrethrum	*Chrysanthemum cinerariaefolium*	2

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 INTRODUCTION

There are several government ministries and other institutions which handle or whose activities affect plant genetic resources. The Ministry of Agriculture and the Ministry of Tourism, Natural Resources and Environment are, however, the key ministries with programmes and policies directly related to plant genetic resources.

The National Plant Genetic Resources Committee (NPGRCom) established in 1987 draws membership from a wide range of institutions in order to ensure good representation of the relevant bodies. The NPGRCom is an advisory body, under the Ministry of Agriculture, that deals with all matters related to plant genetic resources.

5.2 NATIONAL PROGRAMMES

The National Plant Genetic Resources Centre (NPGRC) was initiated in 1991 as a project under the Ministry of Agriculture at the Tropical Pesticides Research Institute (TPRI). The rationale to put the NPGRC at TPRI was to allow it to have basic institutional support while preparing for more elaborate centre, as well as bringing it close to the National Herbarium of Tanzania (NHT) and the National Plant Quarantine Station (NPQS) both of which were already established by Act of Parliament. The NPGRC is therefore a project of the Ministry of Agriculture and is semi-autonomous. Since the NPGRC is still in the process of establishment, there are still a number of collaborative projects and programmes that have not been integrated fully in the National Programme. These are funded in various ways, including government and private organisations.

The vision of the NPGRCom is to achieve co-ordination through the NPGRC which will have the mandate and powers to lead the following activities in plant genetic resources:

- *ex situ* and *in situ* conservation;
- documentation;
- characterization;
- multiplication of *ex situ* materials;
- distribution for scientific use;
- germplasm enhancement through conventional methods and biotechnology;
- training and public awareness.

At present there is no formal involvement of Non-Governmental organisations and private firms or individuals in the National Programmes. This is, however, a short coming which should be corrected soon. NGO's and commercial firms are so far operating independently.

5.2.1 Goals and objectives of the government

In the broad sense the overall goal of the government policy is to achieve sustainable development that maximizes the long-term welfare of both present and future generations of Tanzanians. The following objectives are aimed at achieving this goal:

- to ensure sustainable and equitable use of plant genetic resources without degrading them or the environment;
- to conserve, protect and enhance the nation's natural and man-made heritage in plant genetic resources in all ecosystems as a base for development;
- to enhance derivation of direct benefits from existing plant genetic resources including raw materials for industrial sector and eco-tourism;
- to raise public awareness and understanding of our heritage in plant genetic resources and promote individual and community participation in this cause;
- to promote international co-operation in matters related to plant genetic resources.

In response to the recommendations of the Conversion for Bio-diversity, the national Programme is committed to:

- explore ways of recognizing farmers contribution to conservation and improvement of plant genetic resources;
- develop a sui generis system for exchange of plant genetic resources.

5.2.2 Organization structure and funding

The National Plant Genetic Resources Programme1 falls under the Department of Research and Training (DRT) which is headed by a Commissioner. The DRT is divided into seven divisions as follows:

- Information and Documentation.
- Planning and Evaluation.
- Crop Research.
- Livestock Research.
- Farming Systems Research.
- Support Services.
- Training.

Crop Research is headed by an Assistant Commissioner (AC(CR)) who is directly responsible for the activities of the NPGRCom as the Chairman. The Head of the NPGRC (the curator) is therefore a high ranking scientific staff answerable to the Commissioner of Research and Training through the AC(CR) on all policy and technical matters.

Administratively the Curator of the NPGRC reports to the director of TPRI who in turn reports to the Principal Secretary. TPRI is a semi-autonomous body under the Ministry of Agriculture with a board of directors responsible for policy issues, planning, budgeting and staff development.

The position of the curator is a substantive scientific post. Abolition of the post is possible by advise of the NPGRCom. to the Principal Secretary, who is the overall head of the Ministry.

Budgets are approved by the Principal Secretary based upon advice from the Commissioner of Research and Training. Although the NPGRC has its own budget line the level of funding is very insecure because the final allocation greatly depends on other activities in the Ministry Agriculture. Shortfalls can

be expected from year to year and reallocation of budgeted funds cannot be prevented in times of crisis.

The overall expenditure on conservation and utilization of plant genetic resources is difficult to assess due to fragmented records and lack of detailed breakdowns of actual budgets. However, on the basis of activities done in the sectors of agriculture and natural resources, it has been estimated that about 6% of budgetary allocation to these sectors is used or affects conservation. Table 6 shows the budgetary allocation for 1994 - 95. About 62% of the budget for 1994 - 95 was development budget which depends almost entirely on foreign support. Therefore, it can be argued that only less than 3% of government recurrent expenditure on agriculture and natural resources is used on conservation and utilization of plant genetic resources. Since the total allocation for the sector is only 6.2% of gross government expenditure, it follows that the proportion of expenditure on conservation and utilization of plant genetic resources is very small.

5.2.3 Legislations affecting plant genetic resources

Materials maintained *ex situ* are not protected by law as yet; but materials available in reserves are protected by default by the parliamentary Acts which established the reserves and the institutions which manage them, such as Forest Reserves, Game Reserves, Ngorongoro Conservation Area and National Parks.

The legal status of the *ex situ* collections and the programmes is still uncertain. There is an urgent need to readdress the issue in order to enhance co-ordination of plant genetic resources activities and streamline powers to direct and execute relevant national policies.

5.3 TRAINING

The manpower requirement for the NPGRC is as shown in Table 5. It is clear that the NPGRC is understaffed and needs to recruit new staff in order to achieve the desired output.

The curator holds a Ph.D. in plant breeding, the Seed Technologist is currently training at M.Sc. level in plant genetic resources; while the Documentation officer is a fresh graduate in Crop Production.

Therefore staff development in terms of new recruitment and specialized training is highly needed. Training is needed in the following areas:

- management of plant genetic resources;
- documentation;
- seed technology;
- seed production;
- laboratory techniques;
- glasshouse techniques;
- micropropagation;
- applied genetics;
- cytogenetics;
- plant taxonomy / systematics;
- plant exploration;
- survey statistics / biostatistics.

Both long and short courses are needed. Furthermore provision should be made for technical assistance aimed at providing on the job training.

5.3.1 Resource base for training in plant genetic resources

There is no specially designed courses for plant genetic resources in the country. However, the two universities -(Sokoine University of Agriculture and the University of Dar es Salaam) can be used to assemble customer made courses, given financial support.

Tanzania is well endowed with plant ecosystems under some form of *in situ* conservation. These areas could provide excellent opportunities for field practical albeit with international assistance.

It should be observed that whereas courses made available from else where could fill the range of national needs, it would be more appropriate if they would have a strong component of field practical that covers the whole spectrum of ecosystems enjoyed in Tanzania.

5.3.2 Public awareness

The general public is not sufficiently informed about conservation plans which have often been made without the consideration of the demands of the surrounding communities, resulting in land and natural resource use conflicts. The government through campaigns on specific issues such as forest conservation, soil erosion control, prevention of bush fire, indirectly educates people about plant genetic resources.

The issue of staff turn-over has several implications. As shown in Table 5, the programme does not have sufficiently well trained staff to execute the various activities. Besides there does not exist an aggressive recruitment programme in the government, and as such staff acquisition has been slow. To those already employed, the absence of an enabling environment has lead to low morale and hence low output.

Given the scenario painted above it is clear that most of the problems are domestic and they do not need external help. However, the international community could assist very significantly by making available appropriate facilities and training opportunities which would attract more staff and improve retention.

5.4 NATIONAL LEGISLATION

Until 1977 Tanzania enjoyed plant quarantine services from the defunct East African Community which had a well established station in Kenya. After the collapse of the community a new look at quarantine services had to be done ad hoc leading to the establishment of a local station. The quarantine system is thus not well developed. The seed industry was informal until 1973 when the first seed company was established by Act of Parliament. This was also accompanied by an Act on seed certification.

5.4.1 Quarantine

Import and export of plant genetic resources is affected by quarantine procedures like other plant materials. Planting materials imported as *in vitro* cultures are allowed into the country subject to meeting the required conditions of being disease free.

Delays of planting materials during passage through quarantine occur frequently as a result of a system which is deficient of appropriate equipment and competent staff.

Materials imported through quarantine can be planted out in open quarantine. It is not certain however, if the follow-up will be possible for materials kept for a long period by the NPGRC.

5.4.2 Seed trade

Currently, the government does not provide any direct incentives to farmers for conservation of traditional varieties. However, the government is contemplating on establishing a Farmers Rights Fund, which is expected to be administered for the benefit of traditional farmers and preservation of traditional cultivars. This is in recognition of the important role that farmers throughout the country have played in the custodianship of traditional cultivars of plants.

Sale and distribution of seed was until recently a monopoly of Tanzania Seed Company (a government owned company established by act of Parliament in 1973). With trade liberalization other seed companies are now in the seed trade.

The fact that government machinery was overseeing the sale and distribution of seed, there were many limitations including limited number of varieties put on sale, delays in delivery and poor quality of seed lots.

Farmers varieties often find their way into the seed market as "common grade seed". This is a "stop gap" measure legally accepted during periods of seed shortage.

5.4.3 Intellectual Property Rights (IPR)

A legislation enacted by the parliament in 1987 on Intellectual Property Rights for patentable materials (which excludes plants and animals) came into operation only recently. In the meantime a legislative proposal to establish Plant Breeders Rights has been prepared and is being reviewed. Effects of IPR on our genetic resources programmes are not fully appreciated. New implications are still coming to light as a result of intention to institute Plant Breeders Rights. Assistance in legal matters would be beneficial if training is done to build in capacity of handling such issues within the system.

5.4.4 Exchange of plant genetic resources

The country does not have a well documented policy on exchange of plant genetic resources, but it is in a process of reviewing with intention to adopt the draft FAO International Code of Conduct for Collection of Plant Genetic Resources.

Clearance for exporting plant genetic resources is given by the Head of Plant Genetic Resources Programme. Factors that influence decisions on exchange of germplasm include:

- intended use of the material,
- existing cooperation between requesting institution and Tanzania,
- how Tanzania will benefit,
- historical background of individuals and institutions requesting the materials.

Conditions placed on foreign collection missions (subject to review) are as follows:

- that collection missions should include a member of the NPGRC or an appointee of the curator,
- that duplicate samples should be deposited either with the NPGRC (in case of planting material) or NHT in case of voucher specimen,
- that expenses of the whole mission including those of the accompanying local staff must be met by the foreign collector,
- that the collector reviews all available information about the species to be collected.

5.5 OTHER POLICIES

Through trade liberalization price of seed is dependent on market forces. Consequently current prices are attractive and promote production of improved seed.

Further more the National Seed Policy provides for 5% of earnings from Foundation Seed sale to be given to breeding programmes that developed the variety. This implies an increased output of breeders seed which is increased into foundation seed for production of certified seed.

The Ministry of Agriculture through the Department of Co-operative Development is establishing Farmer based Rural Credit Facility which will increase the purchasing power of agricultural inputs.

The NPGRC is still in the formative stages; therefore it has not been involved in planning major agricultural development projects.

5.6 TRADE, COMMERCIAL AND OTHER INTERNATIONAL AGREEMENTS

Major policies which have had an impact on plant genetic resources are;

- Nationalization of major means of production.
- TANU (ruling political party) guidelines.
- Villagization campaign.

These policies resulted in people losing a sense of ownership of land and other property. As such degradation of the environment ensued, affecting public and private lands, and hence natural resources.

Recently there have been several policy changes (in line with international monetary situations) such as:

- National Economic Survival Programme (NESP).
- Structural Adjustment Programme (SAP).
- Economic Recovery Programme (ERP).
- National Environmental Policy.
- Trade liberalization.

The policy changes through NESP, SAP and ERP and trade liberalization helped to reduce economic tensions which would have lead to further degradation of the environment. However, trade liberalization has also resulted in increased exports of non-traditional crops and forest products, which is likely to affect the status of some plant genetic resources.

Implementation of National Environmental Policy will ensure sustainable utilization of natural resources.

Tanzania is a member of GATT and a beneficiary of a number of trade agreements affecting cash crops. The effect of these agreements on plant genetic resources is not yet very clear.

Table 5 Manpower requirement for the National Plant Genetic Resources Centre

Post	Duties	Preferred Qualification	N°	Remarks
Curator	Head of Centre	Ph.D.	1	Filled
Collector	Exploration, collection and *in situ* conservation	M.Sc.	1	Vacant
Seed technologist	Conservation of *ex situ* orthodox seeds, characterisation	M.Sc.	1	Filled
Documentation officer	Management of records on accessions, generation of reports	B.Sc. (Computer Science) or M.Sc.	1	Filled
Agronomist	Management of field gene banks, multiplication, characterisation	M.Sc.	1	Vacant
in vitro culture officer	Propagation by tissue culture, maintenance *in vitro* cultures, virus indexing	M.Sc.	1	Vacant
Geneticits	Genetic studies and biotechnological manipulations	Ph.D.	2	Vacant
Field Officers	Assist one or more scientist in field activities	Diploma	3	1 Vacant
Lab. technicians	Assist scientists in the laboratory, supervise routine lab. work	FTC	2	Vacant
Supporting staff	Assist in various activities e.g. data entry, lab routines, secretarial services etc.	Form IV/VI plus skill	6	5 Vacant

Table 6 Allocation of Funds that Affect Plant Genetic Resources 1994 - 95. (Tsh. '000,000)

Sector	Allocation 1994 - 95	% Gross Government Expenditure	Estimated Expenditure for Conservation and Utilization	% of Sector Allocation 1994 - 95
Agriculture	17,608.4	4.2	100.3	0.57
Natural Resources	8,643.9	2.0	1,484.7	17.18
Total	**26,252.3**	**6.2**	**1,585**	**6.04**

Source: Extracted from: The Rolling Plan and Forward Budget for Tanzania. Vol. 1. A Joint pubblication of The President Office, Planning Commission and Ministry of Finance Dar es Salaam.

CHAPTER 6
International Collaboration

6.1 INTRODUCTION

In this chapter we have made reference to the different agricultural and forestry research programmes per se since much of the work done in the country in collaboration with international institutions has been directly through the individual programmes rather than the National Plant Genetic Resources Programme. Except for Tobacco, Coffee, Cotton, Tea, Cashew, Sisal and Sugarcane, all the other crops shown in Table 4 have benefited from some form of international collaboration.

6.1.1 United Nation initiatives

Tanzania was among the signatories of Agenda 21 and the Convention on Biodiversity in 1992. Since adopting Agenda 21, the country has been working on a National Environmental Action Plan (NEAP) as a first step of implementation. The NEAP emphasizes, among other things, rational development and use of forest resources; promotion of alternative sources of energy to reduce consumption of fire wood, and the development of a national biodiversity profile as a baseline assessment and as an ongoing monitoring process. Baseline studies have already begun. The NEAP has also indicated areas which require legislation in order to provide legal powers to designated institutions in matters relating to the environment as a whole.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

6.2.1 The CGIAR

For a along time Tanzania has been a beneficiary of the activities of the CGIAR Centres and its specialized bodies the International Plant Genetic Resources Institute (IPGRI) and the International Services for National Agricultural Research (ISNAR).

The centres which include CIMMYT, CIAT, ICRAF, CIFOR, CIP, ICRISAT, ILCA, IITA, IRRI have been actively involved in training and exchange of germplasm through international nurseries and regional networks.

Their participation in regional networks have greatly benefited research programmes in the country. New varieties have been released based on materials received from these centres particularly of maize, beans, sorghum, cowpeas, wheat and rice. Many other materials have been used in breeding programmes as sources of genes or as reference varieties.

Research in Multipurpose Trees (MPT's) for fodder, fuel wood and improvement of soil fertility has been possible through technical support of ICRAF and supply of additional materials from ILCA, CIFOR, and ICRISAT.

Most of the support received from these centres came from centre-based staff in the region (SADC and Eastern African region).

IPGRI has been instrumental to a number of activities in Tanzania, including expert advice during the formation of the NPGRC, training and search for training opportunities, direct involvement in inventory and documentation of plant genetic resources.

Similarly ISNAR has been actively participating in the re-organization of agricultural research activities in the country, by providing consultancy in organisation and management using resident staff.

Training provided by CGIAR centres has been both in formal courses and through in-service training at a specified centre.

The CGIAR centres have specific mandates which are mostly commodity based. Tanzania like many developing countries has numerous other crops which have not been developed to a level that will attract research support from commodity based international institutions. Therefore, it would be more

supportive if some of the less known crops are studied within the CGIAR system as alternative to the major crops in the same environments.

Perhaps the most important role of IPGRI in the next decade is to bring to the attention of the world the value of specific marginalised plant genetic resources and ensure their conservation through appropriate modern and traditional technologies. Furthermore, IPGRI should take the initiative of assisting countries to use biotechnology for conservation and safe movement of plant genetic resources.

6.2.2 Other International Research Centres

Tanzania also benefits from the services of non-CGIAR centres such as AVRDC and ICIPE in the same manor as the CGIAR centres.

6.3 REGIONAL INTER-GOVERNMENTAL INITIATIVES

Tanzania is a member of SADC which has a plant genetic resources programme under SACCAR. Under this programme the SPGRC was formed to run plant genetic activities for the member states. This direct collaborative programme has led to the establishment of NPGRC's in member states and has promoted exchange of information within the SADC region. Apart from exchange of information the SPGRC maintains base collections for the region leaving the individual countries to handle active and working collections. The programme also includes a training component which is critical for the establishment of NPGRC's. Thus the initiative to have a SADC Plant Genetic Resources Centre has been of great advantage to the region in terms of training, conservation and ability to solicit funds for a common problem.

The SPGRC could further be developed into a reference centre for member states on matters of plant genetic resources; particularly on documentation and ecogeographic surveys and provide on the job training for newly employed scientists.

FAO has been active in Tanzania in many areas of agriculture and has been instrumental to the initiation of many training programmes in research and in production sectors. The efforts of FAO have had direct effects on seed production of food crops including indigenous vegetables.

CHAPTER 7
National Needs and Opportunities

From the foregoing chapters its evident that Tanzania is a vast country with diverse environments, cultures, and plant genetic resources. Tanzania also has the advantage that over 25% of its land area is reserved and protected for various natural resources particularly plants and wildlife. In order to conserve and make sustainable use of plant genetic resources the following need to be accomplished:

- a comprehensive inventory of plant genetic resources;
- a developed infrastructure to support and enhance *in situ* conservation;
- increased capacity to handle *ex situ* plant genetic resources including forestry materials;
- develop a capacity to study and genetically manipulate specific germplasm to enhance their utilization;
- develop a policy to involve farmers in plant genetic resources conservation, and provide benefits for their effort in the process.
- Restructure and elevate the National Plant Genetic Resources Centre to avoid duo-answerability and to give power to actively co-ordinate and direct plant genetic resources activities by:
  - **a.** creating a new semi-autonomous institution to which all *ex situ* materials handled by various research programmes could be entrusted,
  - **b.** giving the NPGRCom and NPGRC legal powers to handle matters related to plant genetic resources at all levels including permits for collection and export, custody of materials of special interest, and farmers rights,
  - **c.** involving Zanzibar in plant genetic resources activities at both national and regional level.
- Training of personnel to achieve excellence in relevant areas of plant genetic resources;
- develop capacity for maintaining data bases and dissemination of information to the public and users of plant genetic resources;

- creation of nature reserves for scientific purposes;
- step-up collaboration with relevant local and international institutions;
- sensitize the public and relevant government machinery on the implications of an insecure land tenure system, and loss of habitats through natural and man-made disturbances;
- re-structure or introduce training courses that address issues of plant genetic resources more consistently than at present.

CHAPTER 8
Proposal for a Global Plan of Action

International effort should be directed to the following.

- direct support for management and protection of mega-habitats with important plant genetic materials;
- research on under-utilized species to provide alternative crops;
- support individual countries to prepare programmes that derive benefits from pant genetic resources in a sustainable manner;
- continue searching for better ways of protecting farmers' rights;
- re-visit methods of *ex situ* conservation in the light of biotechnology for species with recalcitrant seeds and vegetatively propagated species;
- resolve issues of Intellectual Property Rights with respect to plant genetic resources;
- support existing regional centres to facilitate documentation and eco-geographic studies in their areas of jurisdiction;
- intensify efforts on the preparation of safe movement protocols for different plant species;
- maintain efforts in the documentation and monitoring of plant genetic resources.

APPENDIX 1

Main Vegetation Types, Dominant Species and Location According to Polhill (1968)

Forest Type	Dominant Species (General)	Location
Forest and Forest Grassland mosaic 1. Lowland rain forest	*Cephalosphaera, Allanblackia Isoberlinia, Macaranga,Newtonia, Parinari* and *Chrysophyllum*	Usambara Mts. Nguru and Uluguru Mts.
2. Moist montane forest	*Aningeria, Parinari, Ocotea with Podocarpus, Chrysophyllum, Cassipourea, Polyscias, Tabernaemontana (Conophangia), Macaranga, Neoboutonia*	East Usambara, Nguru & Uluguru mountains Moshi and Bukoba
3. Dry low-land evergreen forest	*Brachylaena, Manilkara, Cynometra*	North end of the East Usambara Mts. S W. Tanga & W. Handeni.
	Milicia, Albizia, Pteleopsis with Sclerocarya and *Lannea stuhlmannii*	Coastal belt from Tanga, Pangani to Lindi
4. Dry montane forest	*Juniperus, Olea, Ilex, Agauria, Cassipourea, Nuxia* and *Ekebergia*	W. Usambara Mts.
5. Forest-Grass Grassland mosaic	*Hyparrhenia, Exotheca, Themeda, Eragrostis* and *Eleusine jaegeri*	Uluguru Mts.; Ufipa plateau
Woodland (Decidous woodlands)	*Brachystegia, Julbernardia, Millettia, Dalbergia, Lonchocarpus, Combretum, Terminalia,Pleurostylia, Tamarindus, Acacia*	North, Western and Southern Tanzania
Bushland and Thickets	*Dalbergia, Dombeya, Markhamia, Lannea with Strychnos, Teclea, Diospyros, Commiphora, Acacia, Adansonia, Delonix, Grewia*	Widely distributed mostly: Itigi thicket, Mpwapwa, Iringa Kilosa and Handeni
Wooded Grassland and Grassland 1. Altimontane formations	*Echinochloa, Hyperrhenia rufa, Hyphaene, Sporobolus* and *Borassus* *Erica arborea, Philippia* and *Blaeria, often associated with Agauria, Rapanea, Myrica* and *Myrsine, Senecio* and *Lobelia*	Masai and Wembere steppes, Usangu plans, Rukwa and Malagaras Kilimanjaro and other mountains
Freshwater swamp	*Papyrus or Phragmiotes*	Lakes: Victora, Tanganyika and also scattered in riverine localities.

APPENDIX 2

List of families and genera that seem to have rare or vulnerable species

Family	Genus	No.of species
Aizoaceae	*Delosperma*	1
Annonaceae	*Artabotrys*	1
	Asteranthe	1
	Enantia	1
	Greenwayodendron	1
	Isolona	1
	Monanthotaxis	4
	Ophrypetalum	1
	Polyceratocarpus	1
	Toussaintia	1
	Uvaria	2
	Uvariodendron	1
	Xylopia	2
Apocynaceae	*Stephanostema*	1
Aquifoliaceae	*Ilex*	1
Araliaceae	*Cussonia*	2
	Polyscias	1
	Schefflera	2
Asclepiadaceae	*Ceropegia*	8
Balsaminaceae	*Impatiens*	16
Cenellaceae	*Warburgia*	2
Capparaceae	*Boscia*	1
	Thylachium	2
Caryophyllaceae	*Arenaria*	1
Celastraceae	*Hippocratea*	1
	Maytenus	3
Combretaceae	*Combretum*	1
	Pteleopsis	1
Commelinaceae	*Palisota*	1
Connaraceae	*Cnestis*	1
Convolvulaceae	*Astripomea*	1
	Convovulus	1
	Ipomea	7
	Stictocardia	1

Family	Genus	No.of species
Cucurbitaceae	*Coccinia*	1
	Cucumella	1
	Cucumis	1
	Diplocyclos	1
	Gerrardanthus	1
	Momordica	3
	Peponium	1
Dichapetalaceae	*Dichapetalum*	1
Dilleniaceae	*Dillenia*	1
Ebenaceae	*Diospyros*	1
Ericaceae	*Phillipia*	1
Euphorbiaceae	*Sapium*	1
Flacourtiaceae	*Casearia*	1
	Homalium	1
	Xylotheca	1
Gentianaceae	*Foroa*	1
	Urogentias	1
Gesneriaceae	*Linnaeopsis*	3
	Saintpaulia	22
	Streptocarpus	15
Gramineae	*Alloeochaete*	1
	Chlorocalymma	1
	Digitaria	3
	Eragrostis	2
	Farrago	1
	Humbertochloa	1
	Maltebrunia	1
	Pennisetum	3
	Polyneura	1
	Pseudocoix	1
Guttiferae	*Garcinia*	3
	Mammea	1
	Vismia	1
Hammamelidaceae	*Trichocladus*	1
Leguminosae		
Caesalpinioideae	*Baikiaea*	1
	Cynometra	7
	Oxystigma	1
	Stuhlmannia	1
	Tessmania	3
	Zenkerella	4

Family	Genus	No.of species
Mimosoideae	*Acacia*	2
	Albizia	1
	Entada	1
Papilionoideae	*Adenodolichos*	2
	Aeschynomene	2
	Argyrolobium	2
	Baphia	2
	Bolusia	1
	Crotalaria	10
	Dolichos	4
	Eriosema	4
	Erythrina	1
	Glycine	1
	Gamwellia	1
	Indigofera	7
	Humularia	1
	Kotschya	1
	Lotus	1
	Millettia	7
	Rhynchosia	4
	Sesbania	1
	Tephrosia	1
	Trifolium	2
	Zornia	1
Liliaceae	*Aloe*	16
	Kniphofia	1
Linaceae	*Hugonia*	1
Loganiaceae	*Adenoplusia*	1
Malpighiaceae	*Acridocarpus*	3
	Triapsis	1
Melastomataceae	*Dionychastrum*	1
	Dissotis	10
	Gravesia	4
	Memecylon	12
	Pimularia	1
	Tristemma	1

Family	Genus	No.of species
Melianthaceae	*Bersama*	2
Menispermaceae	*Cissampelos*	2
	Epinetron	1
Olacaceae	*Octoknema*	1
	Olax	3
Olaceae	*Jasminum*	2
	Schrebera	1
Orchidaceae	*Bonatea*	3
	Brachycorythis	1
	Disa	3
	Cynorkis	1
	Disperis	6
	Habenaria	9
	Holothrix	2
	Pterygodium	1
	Satyrium	4
Oxalidaceae	*Biophytum*	1
	Oxalis	1
Palmae	*Chrysalidocarpus*	1
Pandanaceae	*Pandanus*	1
Pittosporaceae	*Pittosporum*	1
Polygonaceae	*Oxygonum*	5
Primulaceae	*Anagallis*	2
	Ardisiandra	1
Rhizophoraceae	*Anisophyllea*	1
Rosaceae	*Chrysobalanus*	1
	Parinari	1
	Rubus iringanus	3
Rubiaceae	*Chamaepentas*	1
	Craterispermum	1
	Dolichometra	1
	Galium	1
	Mussaenda	1
	Oldenlandia	5
	Otiophora	1
	Pavetta	7
	Pentas	2
	Psychotria	1
	Rhipidantha	1
	Spermacoce	3
	Tapiphyllum	3

Family	Genus	No.of species
Sapotaceae	*Chrysophyllum*	1
	Malacantha	1
	Mimusops	1
Sterculiaceae	*Dombeya*	2
Tecophilaeaceae	*Cynastrum*	1
Turneraceae	*Streptopetalum*	1
Velloziaceae	*Xerophyta*	2
Verbenaceae	*Clerodendron*	1
Vitaceae	*Cyphostemma*	3
Zingiberaceae	*Aframomum*	5

Source: Wingfield, R.C. 1979. Tanzania. In Inga Hedberg (e.d) Systematic Botany, Plant utilization and Biosphere conservation. Proc. of a symposium in commemoration of the 500th anniversary of the University Inst. of Systematic, Botany Uppsala, Sweden. P.95.

This list does not include some families dealt with by Polhill (1968) which includes over 200 species endemic to Usambaraand Uluguru mountains and the Lindi area.

APPENDIX 3A

Some wild relatives of crops known to exist in Tanzania

Some wild relatives of crops known to exist in Tanzania

Crop	Species	Notes
Rice	*Oryza longistaminata*	Coastal areas, the Island of Zanzibar and Pemba, around Lake Nyasa, Flood plains of Malagarasi, Ruaha and Kilombero. May be a serious weed due to its branched and spreading rhizomes. Perennial Diploid.
	O. barthii (A Chev) syn: O. breviligulata	Ruaha National Park sometimes in association with *O. punctata*. Annual Diploid found in rice fields and in shallow water.
	O. punctata (Kotschy)	Cost and Morogoro Regions mainly from Kimara to Ifakara. Perennial and annual forms. Diploid or tetraploid. Frequently found in rice fields and irrigation channels, and pond margins found in swampy soils.
	O. eichingeri (A Peter)	Dar es Salaam area in wet forests under shade.
	O. brachyantha (A. Chev.)	Laterite pools in some parts of Kigoma District.
Pearl millet	*Pennisetun purpureum*	Wide spread in high rainfall areas, riverine sites, valley bottoms and forest margins.
	P. mezianum Leeke	Found in dry grasslands particularly disturbed peaces.
	P. Polystachyon	Wide distribution in grasslands on light soils.
	P. trisetum (Syn.P. schliebenii Pilg.)	Found in glades and clarings in upland ever-green forests.
	P. trachyphyllum Pilg.	Found along paths and glades of dry evergreen and rain forest, particularly in moist shady places.
	P. massaicum Stapf.	Found in black clay grassland or open bush, rarely in miombo at low to medium altitude.
	P. ramosum (Hochst.)	Found in swamp and valley grassland usually on

Crop	Species	Notes
	P. pedicellatum	Coastal bushland in disturbed places.
	P. unisetum	Found in bushland and wooded grasslands in moist and shady places.
	P. exile Stapf & C E Hubbard	Found in grasslands or bush at high altitude.
	P. glabrum Steud.	Found in grassland often in swampy places at high altitude.
	P. macrourum Trin. (Syn.P. validum Mez.) P. hohenackeri (Syn.P. haareri Stapf & Hubbard.)	Found along streams at medium to high altitude.
	P. stolzii Mez.	Found in grasslands, often in water at high altitude.
	P. hohenackeri (Syn. P. catabasis Stapf & Hubbard)	Found in upland grassland and swampy grasslands at medium to high altitude.
	P. riparium A. Rich (syn. P. salifex Stapf & C.E. Hubbard)	Found in swamps and wet places in the shade of forest edges and in cultivation at medium to high altitude.
	P. dowsonii Stapf & Hubbard	Found in swamps and stream banks at high altitude.
	P. clandestinum Chiov.	Found in grasslands at medium to high altitude.
	P. setaceum (Forsk.)	Found in rocky slopes and dry bush at low to medium altitude.
	P. squamulatum Fresen.	Found on rocky hill sides at medium altitudes.
	P. sphacelatum (Nees) Th.Dur & schinz.	Found in upland grass and glades in upland evergreen forest.
Finger millet	*Eleusine indica (L.) Gaertn.*	A very widespread weed often found on roadsides. Two subspecies - *E. indica ssp. indica E. indica spp.africana* (Kennedy - OBryne) S.M.Philips.
	E. jaegeri Pilg.	Found in grasslands and open forests mostly at high altitudes.
	E. multiflora A.Rich.	Found in open woodland often as a weed.
Cowpeas		See appendix 3b.
Sugarcane	*Saccharum sponteneum L. (Syn. Saccharum biflorum Forsk)*	Found in alluvial sands on river banks and in river beds.

Crop	Species	Notes
Sorghum	*Sorghum . macrochaeta Snowden.*	Found in swampy grassland, frequently hybridises with cultivated species.
	S. arundinaceum (Desn) Stapf (Syn.S. verticilliflorum) (Stend) (Syn .S usambarense) Snowden.Stapf (Syn S. brevicarinatum) Snowden.	Found in moist alluvial soils, grassland and river banks often as a weed.
	S. versicolor Andress	Found in coastal bushland seasonally swampy grassland, mostly on clay soils.
	S. purpureo-sericeum	Found in riverine or lakeside, mostly on clay soils and in open spaces in thickets.
Coffee	*C. mongensis Bridson (Syn. zanguebariae)*	Monga Shume Forest, Udzungwa Mts. (Known only in Tanzania).
	C.sp.A	Kimboza forest (only known from one location in Tanzania).
	C. eugenoides	Minziro forest, Kungwe - Mahali Peninsula Musenabantu.
	L. salvatrix	Rungwe district.
	C. pseudozanguebariae	Bridson Lushoto, Pangani, Coast Region and Zanzibar.
	C. sessiliflora Bridson spp. mwasumbii	Pugu hills. Only known from this site.
	Coffea zanguebariae	Found in Riverine thickets in Morogoro region.
	C. mufindiensis	Found in Forests in Iringa and Morogoro regions and Mpwapwa district.
	C.sp. B. Bridson	East usambara only known from one specimen.
	C.sp. D. Bridson	Mufindi (only known from one specimen).
	C.sp. E. Bridson	Morogoro near Mikese.
	C.sp. F. Bridson	Rufiji (Mafia).
	C.sp. G. Bridson	Kilosa - Ukaguru Mts Mamiwa Forest.
	C.sp. H. Bridson	Ulanga Magombera Forest R.
	C.sp. I. Bridson	Kigoma.
	C.sp. J. Bridson	Kilwa Nungu thickets in Brachystegia microphylla thickets

Crop	Species	Notes
Cassava	*Manihot grahamii* *M.dichotoma* *M.glaziovii*	Native of S.America. Escapes from cultivation.
Sword Bean	*Canavalia virosa*	Widespread in grasslands and lake shores.
	C. cathartica	Found in coastal bushland and open beaches.
	C. rosea	
Lablab beans	*Lab lab purpureus ssp. uncinatus*	Lablab is a monospecific genus that is closely related to Dolichos which has about 20 species listed in the flora.
Soyabean	*Glycine wightii*	Several subspecies found in grasslands.
Vetch	*Lathyrus sphaericus*	High altitude in forest and forest edges.
	L. hygrophilus	
Broad bean	*Vicia paucifolia* *Ssp. paucifolia &* *Ssp. malosana*	Found in grassland, roadside usually in moist places.
	V. hirsuta	Found in grassland scrub, forest glades and lava plains.
Sesame	*Sesamum angolense Welw.*	Found abandoned cultivation, roadsides and along river valleys in grasslands.
	S. angutifolium (Olu). Engl.	Common in cultivated/disturbed areas near homesteads, rodsides and short grasslands.
	S.calycinum	Found in grassland and wasteland and also in disturbed areas.
Vanilla	*Vanilla roscheri*	Terrestrial, liane. Found in coastal bushland, coral rock, mongrove swamps and open evergreen scrub.
	V. ramosa	Epiphytic, leafy liane. Found in forest and dense scrub on coral and in plantations.
	V. imperialis	Epiphytic, leafy liane. Found in shade up tree trunks.
Soursop	*Annona senegalensis*	Found in graslands and open woodlands.
	A. stenophylla	Found in Accasia and Brachystagia woodland Two subspecies.
Bitter goard	*Momordica pterocarpa*	Clearings and margins of upland rain - and ground water forest, bamboo thicket and upland grassland.

Crop	Species	Notes
	M. fresiorum	Upland rainforest and evergreen bushland.
	M. anigosantha	Lowland rain and ground water forest.
	M. cissoides	Undergrowth in rain forests and riverine forests.
	M. pycnantha	Known only from one collection in Lindi.
	M. foetida	Widely distributed particularly in disturbed areas.
	M. leicocarpa	Lowland rain forest in open places. Known only in Tanzania and Kenya.
	M. charantia	Widely distributed in lowland areas. Sometimes cultivated.
	M. balsanina	Coastal bushland.
	M. boivinii	Woodland.
	M. cymbalaria	Grassland.
	M. kirkii	Woodland.
	M. peteri	Lowland rainforest. Known only in Tanzania and Kenya.
	M. trifoliata	Bushland and woodland.
	M. rostrata	Bushland and woodland.
	M. cardiospermoides	Bushland and woodland.
	M. calantha	Margins of rain and ground water forests and valley grasslands.
Gourds	*Lagenaria breviflora (Benth) G. Roberty*	Found in rain and ground water forests and swampy areas.
	L. abyssinica	(Hook.f.) C. Jeffrey. Found in riverine and ground water forests. Also in old mountains.
	L. siceraria	Cultivated. Also found wild in grassland.
Cucumber	*Cucumis sacleuzii Paill*	Rain and swamp forest.
	C. metuliferus Nand.	Woodland and grassland.
	C. figarei Nandi.	Woodland and grassland.
	C. facifolius A.Rich.	Upland grassland.
	C. aculeatus Cogn.	Woodland and grassland.
	C. prophetarum ssp. dissectus (Nand) C. Jeffrey	Woodland and grassland.
	C. anguria L.	Wodland and grassland.
	C. dipsaceus spach.	Woodland and weed of cultivation.
	C. globosus C. Jeffrey	Grass 2nd growth in dry places. Found in Mbeya. Not known elsewhere.
	C. melo L.	Cultivated. Wild forms found as weeds of cultivated land and waste places.

Crop	Species	Notes
	C. hirsutus Sond.	Woodland and grassland. Also as a weed on old cultivated land.
Amaranth	*Amaranthus hybridus* *A. spinosus* *A. dubius* *A. tricolor* *A. thubgergii* *A. graecizan* *(3 subspecies)* *A. spargariocephalus* *A. lividus* *A. viridis*	Widespread weeds, mostly in disturbed places.

Information on Malvceae, Solanaceae and Convovulaceae was not compiled during preparation of this report but the families also include many indigenous species which are closely related to cultivated crops.

Compiled mostly from Flora of Tropical East Africa .

APPENDIX 3B

Wild relatives of cowpeas found in Tanzania

Subgenus	Section	Species
Vigna	*Vigna*	*V. marina* *V. luteola* *V. oblongifolia* *V. heterophylla* *V. ambacensis* *V. multiflora* *V. racemosa* *V. desmodioides* *V. parkeri* *V. multinervis* *V. fischeri*
	Comosae	*V. comosae* *V. comosa* *V. haumaniana*
	Reticulatae	*V. reticulata* *V. wittei* *V. platyloba* *V. pygmaea* *V. phoenix*
	Macrodontae	*V. membranacea* *V. friesiorum*
	Liebrechtsia	*V. frutescens*
	Catjang	*V. unguiculata*
Haydonia	*Hydonia*	*V. monophylla* *V. juncea*
	Microspermae	*V. richardiea* *V. schimperi* *V. triphylla*
Plectotropis	*Plectotropis*	*V. vexillata* *V. kirkii*
	Preudoliebrechtsia	*V. nuda*
Ceratotropis		*V. radiata var.* *V. sublobata*
Leptospron		*V. adenatha*
Macrorhyncha		*V. macrorhyncha* *V. praecox*

APPENDIX 4

Some important pasture species found in major habitats in Tanzania

Habitat	Species
Miombo Woodland	*Bracharia brizantha* *B. humidicola* *B. dictomera* *Andropogon gayanus* *Digitaria spp.* *Panicum spp.*
Montane vegetation	*Trifolicum masaiense* *T. Semipilosum* *T. burchellianum spp. johnstonii* *Desmodium perandum* *Parachetus communis* *Melibotus suaveolens* *Teramnus repens* *Pennisetum Clandestinum*
Acacis-combretum Woodland and shrubland	*Andropogon spp* *Eragrostis spp.* *Brachiaria fulva* *Vigna spp.* *Neonotoria wightii* *Alysicarpus spp.*

APPENDIX 5

Examples of some medicinals plants from Dodoma and Singida regions in Tanzania

Botanical Name	Local Name	Medicinal uses	Distribution in Tanzania
Achyrathes aspera	Mnamata	Roots are used for toothache, malaria preventing abortion and as antidote for poison.	T 1-8
Artemisia affra	Sasuku (Fiome)	Leaves are used for malaria, coughs, colds and fever.	T 3,4,5,6,8
Croton dichogamus C.	Muhalanga (Nyaturu)	Roots for wounds and throat sores.	T 1,2,4,8
marcostachys	Muwulugu (Gogo)	Stem bark and roots for treating livestock.	T 2,3,5,6,7
Cussonia arborea	Itahu (Rangi)	Wood carbon with oil is medicine for skin diseases.	T 1-8
Delonix elata	Hampaloi (Rangi)	Roots boiled and drunk as antidote for poison.	T 1-5, 7
Entada abyssinica	Ijwejwe	Roots for rheumatic pains, bark for abdominal pains coughs and fever.	T 1,4,5,6,8
Euphorbia grantii	Mlwito (Gogo) Isusu	Roots chewed as antidote for snake bites; sap (3 drops in porridge for constipation.	T 1,2,4-8
Ficus stuhlmanii *Jatropha curcas*	Msabi (Gogo) Mnyemba-Nhwanji (Gogo)	Roots for diarrhoea. Leaves and sap for eye disease and wounds, roots for hernia: seeds for constipation and syphilis.	T 1,2,4-8 T 1-8
Lannea Schweinfurthii *ssp. stuhlmannii*	Mvumba (Gogo) Mtarina (Rangi)	Bark is a remedy for chest pains.	T 1-8
Maeru parviflora	Msingisa (Gogo)	Leaves for eye drops aznd roots for stomach ache.	T 4,5,7,8

Botanical Name	Local Name	Medicinal uses	Distribution in Tanzania
Myria salicifolia	Mdatsa (Gogo)	Bark for tooth-ache and livestock.	T 2,3,5,6,7
Osyris lanceolata	Mkobola (Gogo)	Leaves are used as poultice for wounds, bark and roots for anaemia.	T 1-8
Ozora reticulata	Dute(Gogo)	Bark for stomach ache,coughs and diarrhoes, roots for tuberculosis, diarrhoea, hydrocele, venereal diseases and backache.	T 5,6,8
Vernonia abconica	Ipuna (Rangi)	Leaves for venereal diseases.	T 1-8

APPENDIX 6

Examples of food plants from Tabora region, Tanzania

Family	Botanical Name	Local Name (Nyamwezi)	Part Eaten
Amaranthaceae	*Aerva leucara* *Amaranthus dubius* *A. spinosus*	Kilindila Ntungu Ntungu	Leaves Leaves Leveas
Anaranthaceae	*Lannea edulis* *L. fulva* *L. rivae* *L. schweinfurthii* *ssp. stuhlmannii* *Sclerocarpa birrrea*	Mtinje-mudo Mselya Mtinje Msayu Mungogo	Fruits Fruits Frutis Frutis Fruits
Annonaceae	*Anona senegalensis* *A. stenophylla* *Friesodielsis* *obovata* *Hexalobus* *monopetalus*	Mutopetope Mutopetope Musalasi Mukuwa	Fruits Fruts Frutis Fruits
Bombacaceae	*Adansonia digitata*	Mupela, Mwandu	Fruits
Burseraceae	*Commiphora african* *C. mossambicensis*	Muponda Modonho	Roots Roots
Capparidaceae	*Clome hirta* *Cynandropsis gynandra*	Kasilisiki Mugagani	Leaves Leaves
Cruciferae	*Brassica oleracear*	Papike	Leaves
Cucurbitaceae Dioscoreaceae	*Momordica rostrata* *Peponium vilgelii* *Dioscorea Cochleariapiculata*	Lyungu-Lyanzoka Itungu	Fruits Tubers

Examples of food plants from Tabora region, Tanzania

Family	Botanical Name	Local Name (Nyamwezi)	Part Eaten
Ebenaceae	*Acalyphakirkii*	Munumbulu	Fruits
	D. mespiliformis	Msinde	Fruits
Euphorbiaceae	*Acalypha ornata*	Mukima-dibya	Leaves
	Oldrields dactylophilla	Muliwamfwengi	Fruits
Flacourtiaceae	*Flcourtia Indica*	Musingila	Fruits
Gramineae	*Dactyloctenium aegyptium*	Nsapa	Seeds
	D. giganteum	Nsapa	Seeds
Caesalpiniaceae	*Piliostigma thonningii*	Mulindambogo	Pods
	Tamarindus indica	Musis	Pulp
Liliaceae	*Knifophia sp.*	Muntindi	Flowers
Loganiaceae	*Strychnos cocculoides*	Mutonga	Fruits
	S. innocua		Fruits
	S. spinosa		Fruits

APPENDIX 7

List of some of the promising pastures and forage plants under evaluation at LPRI, MPWAPWA, Tanzania

Legumes

Aeschynomene americanum
A. falcata
Cassia rotundifolia
Centrosema pubescens
C. acutifolium
C. brazilianum
C. pascuorum
C. plumieri
C. pubescens
C. schotti
C. schotti
C. virginianum
Alysicarpus glumaceus
A. longifolius
A. monilifer
A. ovalifolius
A. rugosus
A. guaartinianus
A. vaginalis
Desmodium intrortum
D. canum
D. uncinatum
D. prostrata
Macroptilium atropurpueum
M. longipendunculatum
M. martii
Macrotyloma africanum
M. daltonii
M. axillare cv. Archer
Stylosanthes hamata
S. scabra c.v. Seca.

Grasses

Brachiaria brizantha
Bothriochloa insculpta
Cenchrus ciliaris
C. setigeru
Chloris gayana
Digitaria pentzii
Eragrostic curvula
E. Superba
Panicumatidotale
P. Coloratum
P. maximum
Pennisetum clandestinum
Setaria aceps
S. incrossata
Brachiaria humidicola
B. decumbens
B. miliformis
B. ruziziensis
Paspalum commersonii
P. dilatatum
P. plicatulum
Andropogon gayanus

APPENDIX 8

List of Agave species available at ARI, Mlingano

1. *A. mulmanii*
2. *A. horrida*
3. *A. cantala*
4. *A. Exkulasi*
5. *A. lespinasei*
6. *A. angustifolia*
7. *A. spectabilis*
8. *A. verschafeltii*
9. *A. amaniensis*
10. *A. attenuata*
11. *A. franzosinii*
12. *A. wercklei*
13. *A. sartorii*
14. *A. cylonacantha*
15. *A. ghieshreghtii*
16. *A. hecterocantha*
17. *A. miradorensis*
18. *A. zapupe*
19. *A. fourcroydes*
20. *A. decipiens*
21. *A. marmorata*
22. *A. Furcraea gigantea*
23. *A. fortunae*
24. *A. amaricana (variegated)*
25. *A. lespinasei, EX Thika*
26. *A. americana, EX Nairobi*
27. *A. niliuana*
28. *A. sisalana*
29. *A. bergerii*
30. *A. Sanserieria renbergii*
31. *A. Sanserieria sincavis*
32. *A. Sansevieria Cylindria*
33. *A. angustifolia (Voneg. marginata)*
34. *A. amaniensis (variegated)*
35. *A. americana Marginata Aurea*
36. *Sisal collected by Grundy*
37. *Non-flowering sisal No.32, Ex Thika*
38. *Dwarf sisal Ex Moshi*
39. *Non floweing sisal 7 Balam*
40. *Bunchy top sisal Lambo*
41. *Nonflowering sisal Ex Nairobi*

APPENDIX 9

List of Available Coffee species in the Field Collection at ARI Lyamungu

C. arabica
C. canephora
C. excelsa
C. liberica
C. zanguebarieas
C. mufindieansis
C. congensis
C. dewvrei
C. eugenoides
C. kapakata
C. khasiana
C. lingustroides
C. mauritian
C. racemosa
C. salvatryx
C. stenophylla
C. travancorensis
C. wightiana
C. fragrans
C. bengalensis
C. swynnertonni

APPENDIX 10

Important mangrove species in Tanzania

Avicennia marina
Bruguiera gymnorrhiza
Ceriops tagal
Derris trifoliata
Heritiera Littiralis
Lumnitrzera racemosa
Rhizophora mucronata
Sonneratia alba
Sessuvium portulacastrum
Xylocarpus granatum

APPENDIX 11

Fruit tree collections in mainland Tanzania

FRUIT NAME	*NO. OF ACCESSIONS*
Oranges	34
Tangerines	14
Lemons	7
Limes	9
Grapefruits	17
Citrus rootstocks	24
Avocado	20
Mango	12
Guava	3
Papaya	5
Macadamia	10
Banana	30
Apple	15
Peach & Nectarine	14
Pear	7
Loquat	3
Annona spp.	3
Bilimbi	1
Jackfruit	1
Eugenia spp.	2
Canistel	1
Persimmon	2
Pecan nut	1
Surinam cherry	2
Tamarind	4
Lychee	4
Fing	3
Plum	4
Quince	2
Momey apple	2
Bulberry	2
Carambola	1
Mangosteen	1
Bread fruit	1
Passion fruit	3
Pineapple	1

APPENDIX 12
List of protected areas

a. Gazzettzd Principal Forest Reserved (F.R.) in Tanzania

Protected Area Name	Type	Area (ha)
Mkusu F.R.	Catchment forest	3,674
Ndelemai F.R.	"	1,422
Balangai F.R.	"	988
Shume -Magamba F.R.	"	12,276
Amani - Zigi F.R.	"	1,141
Kwamkoro F.R.	"	2,210
Lutindi F.R.	"	2,176
Baga F.R.	"	3,059
Mzinga F.R.	"	255
Rudewa F.R.	"	556
Mtumbi F.R.	"	304
Bumba-Mavumbi F.R.	"	1,056
Mahezangulu F.R.	"	326
Derema F.R.	"	3,926
Handeni Hill F.R.	"	544
Kilanga F.R.	"	431
Kilindi F.R.	"	5,128
Kisima -Gonja F.R.	"	1,440
Kwamsambia F.R.	"	1,416
Mafi Hill F.R.	"	4,475
Mnyisi Scarp F.R.	"	674
Mtai F.R.	"	6,071
Amani West F.R.	Catchment Forest	145
North Nguru F.R.	"	14,052
Nkombola F.R.	"	192
Shagayu F.R.	"	7,830
Vugiri F.R.	"	40 ha
Kilimanjaro F.R.	"	107,828
Kindoroko F.R.	"	884
Minja F.R.	"	520
Chome F.R.	"	14,282
Kahe 1 F.R.	Dry lowland open forest	884
Chambogo F.R.	Catchment forest	5,466
Chongweni F.R.	"	92 ha
Maganda F.R.	"	12
Mramba F.R.	"	3,354
Vumari F.R.	"	1,820
Kirangahengai F.R.	"	322

Protected Area Name	Type	Area (ha)
Rau F.R.	Lowland ground-water forest	620
Kiswani F.R.	Lowland semidecid forest	70
Kankoma F.R.	Catchment forest	75
Koho Hill F.R.	"	78
Gonja F.R.	Lowland ground-water forest	88
Lake Duluti F.R.	Catchment forest	34
Burka F.R.	"	839
Loliondo F.R.	"	7,409
Njogi F.R.	"	466
Northern Highlands F.R.	"	89,151
Bereko F.R.	"	1,215
Essimangor F.R.	"	6,119
Hassama Hill F.R.	"	4,860
Marang F.R.	"	23,328
Meru F.R.	"	26,433
Monduli F.R.	"	8,971
Nou F.R.	"	29,121
Ufiomi F.R.	"	5,564
Kitumbeine F.R.	"	12,990
Gelai F.R.	"	2,448
Longido F.R.	"	2,015
Hanang F.R.	"	5,702
Haraa F.R.	"	628
Disalasala F.R.	"	6
Dindili F.R.	"	1,005*
Mindu	"	2,205
Mkungwe	"	5,645*
Mvuha	"	569
Pangawe West	"	184
Pangawe East	"	769
Rugles Brise	"	20
Shikurufuni	"	219
Kihiriri	"	208
Mamboya	"	455*
Pala Mt.	"	10,619
Talagwe	"	1,005
Iyondo	"	25,385
Kwiro/Nawange	"	623*
Kalunga	"	761
Ligamba	"	16

Protected Area Name	Type	Area (ha)
Mahenge Scarp	"	500
Matundu	"	8,599*
Mahulu	"	610
Mselezi	"	361*
Mwanihama	"	8,502
Myee	"	93
Nyangaje	"	138,075*
Sali	"	1,890*
Ikwamba	"	889
Iwonde	"	4,388*
Kanga	"	6,664
Memboto	"	137
Milindo	"	4,545
Mkinda	"	5,244*
Mwanihana	"	18,130
North. Uluguru	"	18,356
South Uluguru	"	17,293
Uponera	"	360
Ukwiva	"	54,632
S. Nguru	"	18,792
N. Mawiwa - Kisara	"	6,266
S. Mawiwa - Kisara	"	6,300
Nambiga	"	1,390
Mosagati	"	6,475
Kimboza	"	405*
Ruvu	"	2,983
Kitungalo	"	2,637
Bunduki	"	101
Palaulanga	"	10,600
Memboto	"	180
Minziro	"	>265
Rubondo Island	"	<265
Mbizi	"	30
Mulele Hills	"	>265
Ugalla River	"	?

Protected Area Name	Type	Area (ha)
Rubeho mts	"	300
Pugu Hills (+Pande Hill)	"	30
Zaraninge Plateau	"	25
Kilombero Scarp/Uzungwa	"	?
Image	"	65
Ndumbi	"	25
Rungwe-Poroto Mts	"	>270
Livingstone Mts	"	?
Rundo Plateau	Lowland semidecidous forest	c.250
Jozani (in Zanzibar)	?	Limited
Ngezi	?	<26

*** Showing considerable size difference from different reports**

b. National Parks (under the jurisdiction of TANAPA)

Name of Park	Area (ha)	Year of Establishment
Arusha	13,200	1967
Gombe	5,200	1968
Katavi	225,300	1974
Kilimanjaro	75,575	1973
L. Manyara	32,500	1960
Mahale Mount	157,700	1985
Mikumi	323,000	1964
Ruaha	1,295,000	1964
Rubondo	45,700	1977
Serengeti	1,476,300	1951
Tarangire	260,000	1970
Udzungwa	190,000	1992

c. Game Reserves (under jurisdiction of the Game Department)

Name of Game Reserve	Area (ha)	Year of Establishment
Biharamulo	130,000	1959
Burigi	220,000	1980
Ibanda	20,000	1974
Kigosi	700,000	1983
Kilimanjaro	90,000	1974
Kizigo	400,000	1974
Maswa	220,000	1969
Mkomazi	100,000	1951
Mount Meru	30,000	1974
Moyowosi	600,000	1982
Rumanyika	80,000	?
Rungwa	900,000	1951
Saadani	30,000	1968
Selous	5,000,000	1922
Ugalla River	500,000	1964
Umba	150,000	1974
Uwanda	500,000	1971
Usangu	?	?
Grumeti	?	?
Ikorongo	?	?

Source: Various. Compiled by Dr. WR Mziray

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References

Antony, F; J. Berthand, J.L. Guillaiment and **M. Lokird, 1987** FAO/BPGR Plant Gen.Res. Newsletter 69:23-29.

Appa Rao, S.; G.M. Mitawa; J. Felix and **M.H. Mangesha (1989).** Collection Pearl Millet Germplasm in Tanzania. FAO/IBPGR Plant Genetic Resources Newsletter 75/76:40-44.

Brenan, J.P.M. (1978). Some aspects of the phytogeography of Tropical Africa. Ann. Missouri Bot Gard. 665:437-470.

Madoffe, S. S. 1991. Genetic Resources of economically and ecologically important forest plants and their conservation status in Tanzania. In: Shao, F.M. et al. (eds) 1991. Plant Genetic Resources and Bitechnology. proc. of First National Workshop on Plant Genetic Resources and Biotechnology, Arusha, Tanzania, Benedictine Publications, Peramiho, Tanzania. p.239-250.

Mahunnah, R.L.A. 1991. Utilization and conservation status of medicinal plants in Tanzania. In:Shao,F.M. et al.(eds) 1991. Plant Genetic Resources and Biotechnology. Proc.of First National Workshop on Plant Genetic Resources and Biotechnology, Arusha, Tanzania. Benedicine Publications, Peramiho, Tanzania.p.280-290.

Padulosi S. and **N.Q. Ng 1990.** Collecting wild Vigna and Oryza in Tanzania FAO/IBPGR Plant Genetic Resources Newsletter 78/79:39-40

Polhill, R.M. (1968). Tanzania vegetation. In Inga and Olov Herdberg (eds.). Conservation of vegetation in Africa South of Sahara. Almqvist & Wiksells Boktykeri AB, Uppsala, Sweden pp. 1666-70.

Polhill, R.M. 1989. East Africa: In: Campbell, D.G. and Hammond H.O. (ed) 1989. Floristic Inventory of Tropical Countries. New York Botanical Garden. p. 225-232.

Ruffo, C. K. and **Maliondo, S. M. 1991.** Forest Plants Genetic Resources in Tanzania. In: Shao, F.M. et al.,(eds.) 1991. Plant Genetic Resources and Bitechnology. Proc. of First National Workshop on Plant Genetic Resources and Biotechnology, Arusha, Tanzania. Benedictine Publications, Peramiho, Tanzania. p. 224-238.

Wingfield, R.C. 1979. Tanzania. In Inga Hedberge (e.d) systematic Botany, Plant utilization and Biosphere conservation. Proc. of a symposium in commemoration of the 500th anniversary of the University Inst. of Systematic, Botany Uppsala, Sweden. P.95.

A Regional Plant Genetic Resources Centre SADCC. Plan of operation 1989-92. Prepared by SADCC Member states and Nordic Countries. SIDA, 1989.

Convention on Biological Diversity. United Nations Conference on the Environment and Development. June 5th 1992, Rio de Janeiro, Brazil.

Tanzania: Agricultural Sector Memorandum main report.Report No 12292TA World Bank.

National Agricultural and Livestock Research Masterplan. Ministry of Agriculture, Livestock Development and Cooperatives, Tanzania. Prepared by DRT and ISNAR 1991.

Proceedings of the National Workshop on National Agricultural and Livestockk Research in Tanzania; Arusha, April 25-30, 1988. Edited by F.M. Shao, A.N. Minjas, J.M. Haki, M.A. Kaale and Tollervey. Sponsored by URT/ SPAAR/ FRG and UK.

Tanzania Profile of Agricultural Potential. ODA Land Resources Development Centre, England, 1987.

Nikundiwe, A.M. 1994. Proceedings of the Second Annual Scientific Seminar held at COSTECH Building, Dar es Salaam, Tanzania, 28-30 June 1992 Volume 1. pg.172.

Flora of Tropical East Africa. (various parts)