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

TANZANIA

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EXECUTIVE SUMMARY

Tanzania lies between latitudes 1° – 12° south of the equator and between longitudes 30° – 40° east. It is mainly an agrarian society with agriculture, the mainstay of its economy, employing more than 80 percent of the total rural population and accounting for 26.5 percent of the total Gross Domestic Product (GDP), with over 21% contributed by the crop's sector. In recent years, Tanzania has attained self sufficiency in food production with annual surpluses, probably a reflection of enhanced capacity for the sustainable use of plant genetic resources for food and agriculture (PGRFA) situated in the context of a series of functioning farming systems. The sustainable use of PGRFA in Tanzania is also characterized by a viable seeds system that is underpinned by the supply of seeds produced by public research organizations and marketed by both private and public sector seed agencies. Of import is the in-built checks and balances in the seed system; the government's Agricultural Seed Agency (ASA) is responsible for the production and marketing of basic and certified seeds of public varieties while the private sector is responsible for, production and marketing of certified seeds of introduced and locally bred varieties. Tanzania Official Seed Certification Institute (TOSCI) is responsible for all seeds--related quality control interventions. It must be noted that while above structured seeds delivery framework provides the framework for ultimately entrenching a formal seed sector in the country, a significant majority of seeds – over 90% - used by famers are sourced through the informal seed sector. This underscores therefore the vital implemental roles of farmers in any envisaged evolution of the seeds system in particular and the entire PGRFA environments in the country and provides the impetus for the strengthening of the currently weak links between the informal and formal PGRFA sectors in Tanzania.

Tanzania is a country with considerable diversity in plant genetic resources including forest species found in over 40% of the country's total land area. The management of plant germplasm in Tanzania falls under the purview of the National Plant Genetic Resources Centre (NPGRC) which is responsible for surveys and inventorying of the resources. Government efforts to conserve forest plant genetic resources, including the National Forest Policy, have resulted in the over 37% of forests being designated as forest reserves and an additional 6% being situated in national parks. Threats to plant genetic diversity in Tanzania have included social factors such as over-exploitation by refugees and institutional weaknesses such as the absence of adequate documentation. Diversity within important staple crops is reportedly threatened and a number plant species are under threat of extinction with some of these having important uses e.g. being of medicinal values. The NPGRC, other government agencies, the civil society and both regional and international institutes work together to reverse this trend through efforts including surveys and inventories aimed at fostering *in situ* conservation of plant genetic resources. The National Land Policy is an important government intervention in this regard as it contains provisions for the protection of locations critical to the conservation of plant germplasm. Of vital importance in *in situ* conservation is the facilitation of the conservation of wild relatives of crop plants – a repository of genetic variation deployed in crop improvement. Activities, through funded projects, relating to on-farm management and improvement of plant genetic resources, involving famers in local farming communities, have been key to the conservation of these vital resources, however an overall stronger integration of the *in situ* and *ex situ* conservation efforts need to be pursued. Currently, there is no government policy that addresses this directly, a sub-optimal situation that should be reversed.

Germplasm accessions, mainly landraces or traditional cultivars, conserved in Tanzania number over 5 000. Most of these are exotic germplasm sourced through collaborative research and development activities. The seed propagated accessions are held as seeds in cold storage by the NPGRC, as well as in the relevant crops research institutes. Vegetatively propagated collections are mostly conserved in the field. As security, a part of the germplasm accessions held by the NPGRC are also duplicated in the SADC regional genebank based in Zambia some are held in international genebanks including those of eight CGIAR centres. There have been deliberate efforts to promote the development and commercial production of several under-utilized crop species in the country. Also, the government and the private sector partner in catalyzing the marketing of end-products of crops. *Ex situ* conservation of plant genetic resources in Tanzania will be well served by the injection of trained personnel, improved funding profiles, improvements in infrastructure and enhanced participation in relevant regional and international collaborations.

There exist very strong needs for the use of PGRFA in Tanzania principally within the country's national agricultural research institutes (ARIs) which are organised on the basis of commodity crops. Private seed companies also make extensive use of the conserved crop germplasm. In order to more efficiently maintain the conserved materials, germplasm characterization has been a major part of the activities of the NPGRC. The capacity for this will be greatly improved through the acquisition of molecular biology facilities and expertise in the country. While training in relevant fields has improved in recent years, the situation could be greatly improved through paying attention to the skill gaps articulated in this report. Pre-breeding activities in Tanzania are taking hold while crop improvement in general has resulted in the release of improved varieties of crops by the ARIs and by private local and foreign seed companies.

Three government entities, the Ministries of Agriculture, Food Security and Cooperatives and that of Tourism and Natural Resources along with the Vice-President's Office – Environment share the responsibilities for coordinating programmes, legislations and policies regarding PGR. The NPGRC and other relevant state agencies are resourced through their respective ministries. A National Information Sharing Mechanism on PGRFA is in place in the country. Though there are currently no specific legislations targeting genetic resources maintained *ex situ*, a number of legislations and policies have implications for the protection of, and access to, PGRFA.

Tanzania has a fairly reliable enabling environment for the sustainable use of PGRFA. The country has signed and acceded to the International Treaty on PGRFA and is a signatory to the Convention on Biodiversity. It has also implemented the National Environmental Action Plan – which seeks to minimize non-sustainable use of genetic resources -; has enacted an Environment Management Act – to regulate matters related to the environment - and established the National Environment Management Commission. Tanzania is also a member of the FAO Commission on Genetic Resources for Food and Agriculture and contributed to the development and adoption of the Global Plan of Action for the conservation and sustainable use of PGRFA. ARIs in Tanzania also work very closely with at least 10 centres of the CGIAR in crop germplasm maintenance and improvement and plays very active roles in the plant genetic resources programmes of the regional body, SADC. The finalization and passage of a proposed bill on PGRFA in Tanzania was identified as a priority. Also important for sustaining the national impetus for the sustainable use of PGRFA is the imperative of a better integration of its relevant policies with those of agriculture, science and technology. Information dissemination and the creation of awareness, especially at the grassroots level, were also identified as key to the sustainable use of PGRFA in Tanzania.

ABBREVIATIONS

AGROBASE	Agronomic Software
ARI	Agricultural Research Institute
ASA	Agricultural Seed Agency
ASPS	Agricultural Sector Program Support
AVRDC	World Vegetable Centre
CAS – IP	Central Advisory Service on Intellectual Property
CBD	Convention on Biological Diversity
CGIAR	Consultative Group of International Agricultural Research Centres
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
CIMMYT	International Maize and Wheat Improvement Centre
CIP	Centro Internacional de la Papa
CMVD	Cassava Mosaic Virus Disease
CORDEMA	Client Oriented Research Development and Extension Management Approach
CORE	Client Oriented Research
CWR	Crop wild relative
DANIDA	Danish International Development Agency
DIVA GIS	Geographic Information System
EARRNET	Eastern Africa Root Crops Research Network
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HORTI-Tengeru	Horticultural Research Institute Tengeru
HORTI-Tengeru	Horticultural Training Institute
ICIPE	International Centre of Insect Physiology and Ecology
ICRAF	International Centre for Research in Agro forestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
ISNAR	International Services for National Agricultural Research
ITK	Indigenous technical knowledge
IT-PGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MAFC	Ministry of Agriculture Food Security and Cooperatives
MPT	Research in Multi-Purpose Trees
NARS	National Agriculture Research Services
NCSS	Number Cruncher Statistical Systems – statistical software
NEAP	National Environmental Action Plan
NEMC	National Environment Management Council
NHT	National Herbarium of Tanzania
NLP	National Land Policy
NPGRC	National Plant Genetic Resources center

NPGRCom	The National Plant Genetic Resources Committee
NPQS	National Plant Quarantine Station
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
QDS	Quality Declared Seed
SADC	Southern African Development Community
SDIS	SADC Documentation and Information System
SINGER	System-wide Information Network for Genetic Resources
SPGRC	SADC Plant Genetic Resources center
SRI	Sugarcane Research Institute
SUA	Sokoine University of Agriculture
TaCRI	Tanzania Coffee Research Institute
TAFORI	Tanzania Forestry Research Institute
TARP II	Tanzania Agricultural Research Program Phase II
TBL	Tanzania Breweries Ltd
TFAP	Tanzania Forestry Action Plan
TOSCI	Tanzania Official Seed Certification Institute
TPRI	Tropical Pesticides Research Institute
TRIT	Tea Research Institute of Tanzania
TTSA	Tanzania Tree Seed Agency
UCA	Ukiriguru Composite A
VBSS	Vegetable Breeding and Seed Systems
WFP	Wild food plants

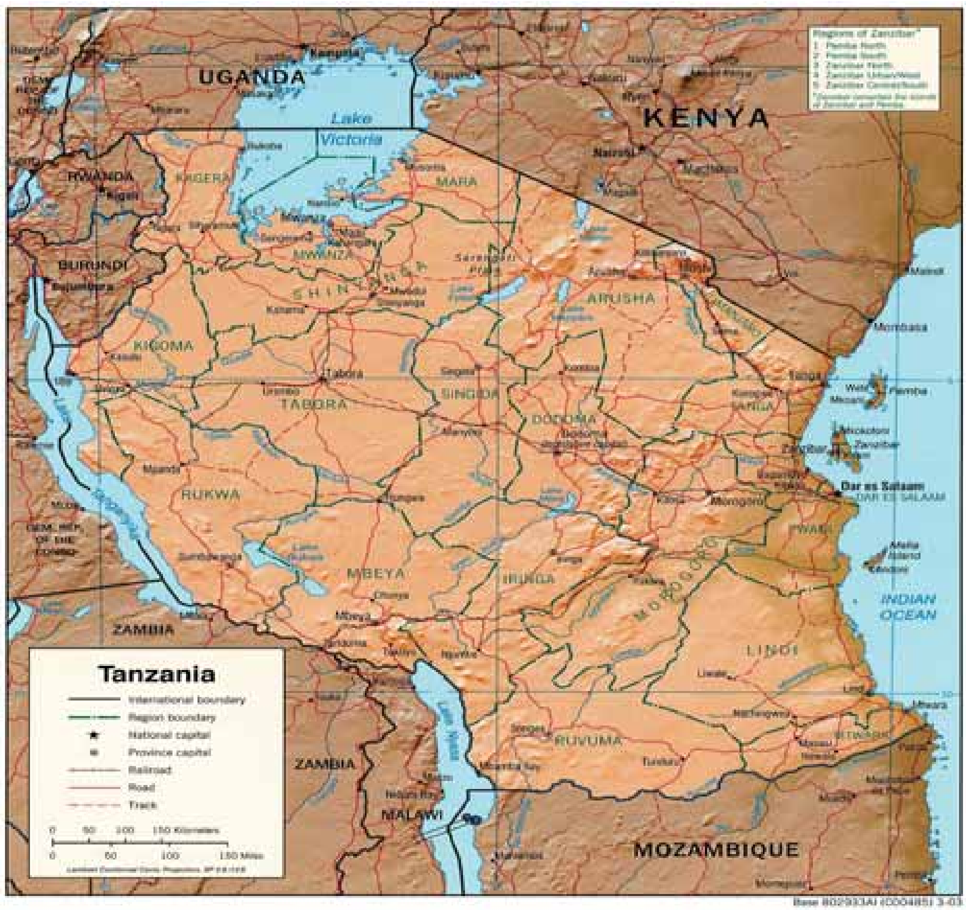
CONTENTS

INTRODUCTION

1. Size and location

The United Republic of Tanzania which comprises of the Mainland Tanzania and Zanzibar islands is located South of the Equator in East Africa between latitudes 1° – 12° South and longitude 30° – 40° east. It is bounded to the North by Uganda and Kenya, on the East by the Indian Ocean, to the South by Mozambique and Malawi, to the South West by Zambia, and to the West by the Democratic Republic of Congo, Burundi, and Rwanda[1].

FIGURE 1
Map of Tanzania



2. Physical Features

Tanzania is a country of highly varied physical features with a total area of 945 087 sq km (364 900 sq mi), including 59 050 sq km (22 799 sq mi) of inland water. The country is dissected by the two arms of Africa's Great Rift Valley which cut through the central plateau of Tanzania.

In the northeast, near the Kenya border, is a volcanic region with the snow-capped Mount Kilimanjaro, an inactive volcano that rises to 5 895 meters above sea level.

Africa's three great lakes Victoria, Tanganyika, and Nyasa are partly in Tanzania. Except for Lake Victoria, the most of the lakes lie in the Great Rift Valley. Lakes Tanganyika and Nyasa, in the west, are large, deep bodies of freshwater; those in the eastern rift, such as Lakes Natron and Eyasi, are small and saline and have no outward drainage.

Tanzania has nine major drainage basins[1] that, according to the recipient water body, can be categorized as follows:

Basin Draining to the Mediterranean Sea:

- The Lake Victoria basin, which is part of the Nile River basin.

Basins Draining to the Indian Ocean:

- The Pangani River basin;
- The Ruvu/Wami River basin;
- The Rufiji River basin;
- The Ruvuma River and Southern Coast basin;
- The Lake Nyasa (Lake Malawi) basin, which is part of the Zambezi River basin;

Basin Draining to the Atlantic Ocean:

- The Lake Tanganyika basin, which is part of the Congo River basin.

Basins Rift Valley (endorheic) basins, of which amongst others:

- The Lake Eyasi and Bubu depression; Lake Manyara;
- The Lake Rukwa basin.

River regimes follow the general rainfall pattern. River discharge and lake levels start rising in November-December and generally reach their maximum in March-April with a recession period from May to October/November. Many of the larger rivers have flood plains, which extend far inland with grassy marshes, flooded forests, and ox-bow lakes.

3. Climate

Tanzania has two distinct rainy seasons (long and short rains) in the north, from November to December and from March through May respectively. The short rains are low and erratic and poorly distributed along the coast, north-eastern and north-western parts of the country including the regions of Arusha, Manyara, Kilimanjaro, Tanga, Coast, Mara, Mwanza and Kagera. In the south there is one rainy season, from November to March.

The climate on the islands namely, Unguja and Pemba is tropical with heat tempered by sea breezes and is constant throughout the year, except during the rainy seasons. The island has two rainy seasons, the heavy rains fall in April and May, and the lesser in November and December.

4. Forest and vegetation

A total of 38.8 million hectares (43.9 percent of Tanzania's land area), is classified as forest. Forests grow mainly in the highlands and along the coast. Elsewhere there are steppe and savannah grasslands and some areas are semi-arid. There are about 13 million hectares of permanent forest reserves. The eastern border of Tanzania mainland with 800-km coastline is covered by mangroves, coral reefs and other marine life.

5. The agro-ecological zones

The country is divided into seven Agro-ecological zones which include the eastern, southern, southern highlands, western, northern highlands, central, and lake zones. The zones are defined by the changes in climate, socioeconomic status; land use, production practices, soil and land form (Appendix 1).

[1] http://www.eoearth.org/article/Water_profile_of_Tanzania

6. Population

Based on 2006 census estimates, Tanzania's population is about 39 million with a growth rate of 2.072% per year. Nearly 77% of the population lives in the rural areas and only 23% of the population live in urban areas[2].

7. Agricultural Sector

The agricultural sector which includes the crops, livestock and forestry sub sectors dominates the economy of the United Republic of Tanzania. It contributes to 26.5 percent of the total gross domestic product (GDP)[3] and 30 percent of the country export earnings. The sector is characterized by small-holders practicing subsistence farming with an average 0.2 to 2 ha per family farm household. The crop sub-sector contributes on average, 21.2 percent of the total agricultural GDP.

The traditional cash crops include coffee, sisal, tobacco, tea, cashew nuts, sugar and *pyrethrum* (Appendix 5). Food crops include maize, paddy, wheat, sorghum, pulses, millet, cassava, beans, sweet potatoes, round potatoes, pigeon peas, sesames, groundnuts, sunflower, bananas, vegetables and fruits. In recent years Tanzania has met its food requirements hence becoming self-sufficient in food demand. As shown in Appendix 4, Tanzania produces food of all major crops and in some cases exceeding its annual requirements. The national food status reports indicated that in 2007/2008 the country produced 10.03 million MT of major food crops which was 106 % of the total food requirement[4].

8. Farming systems in Tanzania

The country has various farming systems (Appendix 2), which are classified depending on climate, altitude, landscape, farm size, tenure and organization, soil types, cropping patterns, main crops, labour use, income levels, the ecological conditions and available natural resource base.

9. Seed system

Tanzania has well established public research institutions dealing with development of varieties and production of breeder's seed. These institutes and other local or foreign private seed companies have released a number of improved cultivars (Table 1 & Appendix 14) mostly open and self-pollinating composites, hybrids and clones.

The governmental Agricultural Seed Agency (ASA) is responsible for multiplication, distribution and marketing of basic and certified seeds of the varieties bred by public research institutions. The Agency produces certified seeds through its own seed farms, as well as contract growers located in various parts of the country. Seed quality control is carried out by the Tanzania Seed Certification Institute (TOSCI) which was re-established under the new Seed Act of 2003.

Private companies are also involved in the production, importation and distribution of improved seed of food crops (Appendix 3). Public research institutes are responsible for production of basic planting materials of cash crops, whereas bulk multiplication is done by respective crop boards. Production of basic and bulk planting materials for majority of cash crops is handled by semi-autonomous research institutions.

TABLE 1

Number of plant varieties of selected crops officially released for commercialization between 1995-2008

Crop species	Number of varieties
Maize	55
Rice	5
Wheat	5
Barley	5
Sorghum	4

[2] UN Report, 2007

[3] PRS/MDG PROGRAMMING Gleneagles Scenario Report URT, 2008

[4] Annual Budget Speech, 2008/2009. Ministry of Agriculture Food Security and Cooperatives

Crop species	Number of varieties
Beans	13
Cowpeas	1
Pigeon pea	3
Groundnuts	2
Sesame	1
Soybean	1
Sweet potatoes	6
Cassava	5
Sunflower	3
Tomato	3
Coffee	9
Tobacco	4
Cashew	16
Grapes	2
Total	142

Source: Ministry of Agriculture Food Security and Cooperatives

The informal seed sub-sector continues to be the major source of seed supply for the majority of farmers in Tanzania. More than 90% of the seeds sown by farmers are seeds saved on their own farms. Farmers in different parts of the country have continued to maintain their traditional seed supply system because the informal seed supply has failed due a number of reasons which include inefficient extension services and lack of credit facilities for farmers. Lack of sufficiently suitable varieties that are acceptable to small scale farmers and inaccessibility may have also contributed to this trend.

CHAPTER 1

STATE OF DIVERSITY

1.1 Landraces and Traditional Cultivars of Main Crops

Tanzania has a vast diversity of germplasm of great importance for food and income generation for farmers and the country in general. Landraces and traditional cultivars of all main crops hold a rich genetic diversity which harbours an important gene pool for crop improvement. These materials are the result of selection processes carried out by farmers over a long period of time in the different agro-ecological conditions that occur in the country. They are maintained by farmers and endowed with remarkable genetic variability, adaptability, unmatched qualitative traits and in some cases medicinal properties. This locally adapted germplasm can also play a very important role as a source of resistance to pests and fungal diseases in crop varietal improvement programmes. However at present this wealthy variability of complex quantitative and qualitative traits has been only marginally exploited, leaving a great deal of opportunities for the future development of improved cultivars by national breeding programmes.

Landraces and traditional cultivars are used extensively in Tanzania due to the limited acceptance and supply of commercial seed of improved cultivars. Some of the old cultivars still used in production include maize cultivars Katumani and UCA which were released in the late 1950s and 1966, respectively. It is estimated that currently only 10% of the total cultivated land is planted with certified seeds of improved cultivars; the rest of the area is planted with farm saved seeds of improved cultivars, traditional cultivars and landraces. The Ministry of Agriculture Food Security and Cooperatives is planning to undertake a study to detect the actual level of farm saved seeds as well as actual absorption rate of improved cultivars by farmers.

Local plant genetic resource management systems are responsible for providing seeds for the vast majority of food crops in Tanzania. The sustained cultivation of food crops has primarily been based on the use of indigenous landraces or traditional cultivars acquired through exchange among farmers. There is a great representation of diversity in terms of cultivars from different crops which are well adapted to local production conditions and household requirements, and widely cultivated around the country.

The links and interactions between local plant genetic resource management systems and formal plant genetic resource institutions are limited and weak. Commodity plant breeding programs have primarily been based on on-station trials and have taken little notice of the results from the farming systems research. Seed regulations have been based on international standards, which are not always compatible with farmers' management practices.

Efforts have been made to strengthen farmers' participation in the agricultural research process through innovative approaches such as Client Oriented Research (CORE) which was later changed to Client Oriented Research Development and Extension Management Approach (CORDEMA). Experiences gained from these approaches have shown that farmers can be useful partners in research, development and management of plant genetic resources.

A large proportion of Tanzania farmers are still subsistence producers who value and take pride for using crop cultivars originating from their own societies or farming environment which are also very diverse. The number of traditional cultivars selected to suit the different cultural values and environmental conditions, is also very large. Many traditional cultivars are often given names which emphasize the qualities of the cultivars thus resulting in easy sharing of information and seed of such cultivars. As a result, traditional cultivars are easily accepted and spread within ethnic grounds.

1.2 Reduction of the Agro-Biodiversity and Erosion of Plant Genetic Resources for Food and Agriculture

During the past 30 years worldwide concerns have been raised about the reduction of the agro-biodiversity and the erosion of plant genetic resources and these issues have become an important part of international treaties and national policies. In response to these concerns, over the last decade surveying and inventorying of plant genetic resources have been conducted in the country. These have helped to identify and establish crop collections of useful genotypes, to make them more readily available and to add value to the genetic diversity available for crop improvement programmes. At the same time *in situ* and *ex situ* conservation efforts have been set up to preserve threatened crop genetic resources.

As part of the National Biodiversity Action Plan, the National Plant Genetic Resources Centre conducted surveys and inventory on endangered species between 2002 and 2004. During the survey and inventory activities, indigenous technical knowledge of farmers was used in the process of identifying and assessing threatened and endangered species among the total genetic diversity of plants available. Both formal and informal surveying methods were used for the activities, including reconnaissance surveys, random sampling, transect walk, home and back yard survey, focus group discussion and semi-structured questionnaire and interviews. The coverage was at the regional, district, division, wards, and village levels.

Priority areas for further surveying and action to preserve a wide range of species of indigenous vegetables and fruits were identified. Most of these species are low yielding, pest and disease tolerant, early maturing and have poor culinary qualities. Studies conducted on wild and under-utilized vegetables and fruits indicate that these species are rich in both macro and micronutrients. Among the surveyed areas, Ruvuma region was found to have many wild and under-utilized food plants of high nutritional value which have not been documented.

Survey results have shown that plant genetic resources' erosion occurs in the country both at intra-specific level of main cultivated crops, as a loss of landraces or traditional cultivars, and at the species level, affecting wild crop relatives and wild or semi-wild food species. Its causes are several. Land degradation is strongly linked to biodiversity loss as in degraded lands farmers tend to concentrate on production of stress adapted species eg. cassava, sorghum and millets. Urbanization has resulted in changing lifestyles, the outcome being different preferences in consumption habits and consequently market demand and crop utilization. Furthermore, changes in agricultural practices and the use of genetically uniform modern cultivars contribute to replacing and marginalizing the highly diverse local cultivars and landraces in traditional agro-ecosystems.

In areas where there has been an influx of refugees there has been severe genetic erosion due to over exploitation of the traditional germplasm. The replacement of traditional cultivars with improved ones and the occurrence of environmental changes have also resulted in the emergence of new diseases.

In many cases no proper documentation is available neither on the extent of agro-biodiversity reduction and genetic erosion nor to what degree this has been caused by human or natural disasters. Overall the decline of crop diversity is largely a result of the replacement of traditional cultivars with high yielding modern cultivars. The decline is also brought about as a result of change in natural habitats caused by changes that have been occurring in the environment which are likely to speed up the loss of crop diversity even further. Other threats include over-exploitation of land and other natural resources, land use changes, fewer farmers cultivating the threatened crops, pests and diseases, drought, floods, lack of markets, deforestation, low priority of research and production of indigenous vegetables, poor seed distribution and availability, and lack of awareness on indigenous vegetables.

A number of threatened species and/or landraces within species were identified, including landraces of staple crops such as maize, finger and pearl millets and yams, and local vegetable species (see Appendices 6 and 7). Indigenous crop species such as *Cordyla africana, C. densiflora, Strychnos cocculoides, S. spinosa, Ximenia americana,* members of the family *Orchidaceae,* arrow root (*Tacca pinnatifida*) are in threat of extinction.

Species under threat unclude also those used for medicinal purposes, timber and fuel wood, a number of which are close to extinction due to over harvesting, deforestation or climate change.

1.3 Forest Genetic Resources

Tanzania has about 33.5 million hectares of forests and woodlands representing about 40 percent of the total land area. The forest ecosystems are categorized as pure forest reserves comprise of 3.4 percent, mangroves 0.3 percent and woodlands 96.3 percent of the total area. About 37.3 percent of the forest has been gazetted as forest reserves, 5.96 percent are forests and woodlands in national parks and 56.74 percent being non reserved forest land.

A modest area of 80 000 hectares of the gazetted area owned by the government is under plantation forestry and about 1.6 million hectares are under water catchments management. About 77% of the indigenous vegetation is under some form of protection and deforestation rate is over 1% per annum.

A number of indigenous tree species including agro forestry species have been massively cut for various uses such as sawn timber, construction and carvings. As a result, these species are threatened with extinction because of their low regeneration rate and are therefore protected from uncontrolled harvesting. Such species include:

- *Afzelia quanzensis*
- *Allanbalankia stuhlmannii*
- *Beilshmeidea kweo*
- *Brachystagia butchinsii*
- *Cephalosphaera usambarensis*
- *Dalbelgia melanoxylon*
- *Juniperus procera*
- *Khaya nyasica*
- *Milicia excelsa*
- *Ocotea usambarensis*
- *Olea capensis*
- *Ossyris* spp
- *Podocarpus usamberensis*
- *Podocarpus latifolius*
- *Pterocarpus angolensis*

Moreover, the coastal area are rich in mangroves with at least ten known species 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 and anthropogenic effects.

There are sectoral policies in agriculture, forestry, land, and minerals 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; and
- Existence of communal grazing lands.

The overall goals of the National Forest Policy of 1986 is to enhance the contribution of the forestry sector to sustainable development of Tanzania and the conservation and management of the natural resources for the benefit of present and future generations.

The objectives of the forestry sector based on the overall goal are defined as follows:

1. Ensure sustainable supply of forest products and services by maintaining sufficient forest area under effective management.
2. Increase employment and foreign exchange earnings, through sustainable forest based industrial development and trade.
3. Ensure ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility,
4. Enhance national capacity to manage and development the forest sector in collaboration with other stakeholders.

In spite of the conducive policies there are several problems facing forest conservation in Tanzania as a result of:

- Anthropogenic effects such as deforestation and destruction of the forest by fire;
- Outbreaks of insect pests, particularly in plantation forests; and
- Massive overgrazing due to migration of livestock.

CHAPTER 2

THE STATE OF *IN SITU* MANAGEMENT

2.1 Introduction

The genetic diversity present in thousands of plant species constitutes an intergeneration resource of vast social, economic and environmental importance. In recent years, the intensified exploitation of plant genetic resources due to increasing population pressure has put these essential resources under a serious threat. Several natural ecosystems in Tanzania may face extinction in the coming years, as a result of the extensive destruction of unprotected areas. Efforts to conserve plant genetic resources have been coordinated by NPGRC since its establishment in 1991, and have seen the involvement of several governmental organizations, among others TAFORI, ARIs, SUA and TTSA, as well as NGOs, regional and international institutions.

An increasing number of people, national institutions, as well as international bodies have realized that urgent measures are required to save representative samples of biodiversity components from most tropical ecosystems. The aim of genetic resource *in situ* conservation is to maintain conditions in which the genetic makeup of a species can continue to evolve in response to changes in its environment, at the same time reducing the rate of genetic erosion.

2.2 *In situ* Conservation Policies

In 1995 the government formulated the National Land Policy (NLP) and its guidelines, which has a direct effect on the protection of traditional cultivars and resources. The national land policy has categorized land use into:

- General lands - lands removed from the domain of deemed rights of occupancy, also known as granted rights of occupancy;
- Reserved lands - lands reserved principally for various conservation purposes; and Village lands - the rest of rural lands.

Furthermore, the NLP protects highly sensitive areas such as water catchments, forest areas of biodiversity, national parks and wetlands. Also it reserves village lands and some communal areas for conservation purposes.

2.3 Inventories and surveys

As discussed in the previous chapter a number of surveying and inventorying activities have taken place in the country during the past decade. Overall the major constraints that affect the adequate inventory of existing plant genetic resources in the country are the lack of sufficient financial and human resources that limit both the frequency and the scope of surveying and inventorying activities. Nonetheless, there are several opportunities such as enabling policy environment, accessible indigenous knowledge and existing collaboration between high learning institutions and NPGRC which should be used to strengthen these activities. While in the future, priority will continue to be given to surveying indigenous crops and their wild relatives, other complementary efforts should also be prioritized, including:

- Strengthening agricultural curriculum in agricultural colleges and universities by including indigenous vegetables;
- Improving documentation of indigenous vegetables and availability of data to stakeholders;
- Improving marketing of indigenous vegetables;
- Increasing collaboration between national and international research centres; and
- Strengthening national breeding programmes for under-utilized crops.

2.4 *In situ* Conservation of Wild Species and Relatives of Crop Plants

Overall crop wild relatives and wild species hasve not received adequate attention both in term of conservation and use, even though a number of them occur in the country. This is partly due to the fact that there are no comprehensive plans nor a national policy that formally supports their conservation and management.

Records show that numerous plant species are used for food and medicinal purposes in various parts of the country. Msangi (1991) indicated that about 290 indigenous plant species from more than 175 genera belonging to 77 taxonomic families are used in Tanga and Kilimanjaro regions alone.

Wingfield (1979) compiled a comprehensive list suggesting that over 700 species of vascular plants were seemingly rare or vulnerable. However, the World Resources Institute recognizes 158 plant species that are threatened.

Nonetheless some important activities on *in situ* conservation of wild relatives and wild plants for food in agriculture have been reported. These include *inter alia*:

- Domestication and commercialization of indigenous fruit trees of Miombo woodland in Mbeya (*Uyole*), Tabora (*Tumbi*), Iringa (*Ruaha)*, Shinyanga (*Rubaga*) Morogoro (TTSA) whose main areas of work was the restoration in site of species from the following taxon: *Uapaca kirkiana; Strychnos cocculoides; Vitex Mombasae; Flacourtia indica; Vitex Doniana; Sclerocarya birrea*.
- Promotion of conservation and sustainable utilization of Uapaca kirkiana in Southern Tanzania protected area.
- Conservation of edible orchids at Kitulo protected area and Development of conservation strategies for the wild edible orchids,
- Studies on the indigenous knowledge and plant bioversity in Kasulu District, Kigoma Region, Tanzania;
- Baseline survey of neglected and underutilized crops; and
- A survey of wild and underutilized edible plants in Ruvuma Region.

Many of these activities, which have been carried out or are still in progress, also aimed to raise awareness of the value of crop wild relatives and wild food plants for food security, plant breeding and commercial exploitation. Important pasture species occurring in the major habitats could be improved to produce cultivars for modern farming and ranching. There is also a great wealth of species, such as orchids and the world famous African violet (*Saintpaulia* spp.) and its 20 endemic species, whose commercial exploitation for ornamental use could produce increased valuable revenues.

TABLE 2.1

Activities contributing to *in situ* conservation of crop wild relatives and wild plants for food production

Name of programme/project/activity	Name of conservation area	Type of area	Name of taxon
Domestication and Commercialization of Indigenous Fruit Trees of Miombo Woodland	Mbeya (uyole), Iringa (Ruaha), Shinyanga (Rubaga) Morogoro (TTSA)	Restoration	*Uapaca kirkiana*; *Strychnos cocculoides*; *Vitex mombasae*; *Flacourtia indica*; *Vitex Doniana*; *Sclerocarya birrea*
Promotion of conservation and sustainable utilization of *Uapaca kirkiana* in Southern Tanzania	Southern zone of Tanzania	Protected	*Uapaca kirkiana*
Conservation of Edible Orchids in the Southern Highlands - Makete/Kitulo	Kitulo	Protected	*Orchids* spp.
Studies on the Indigenous Knowledge and Plant Bioversity in Kasulu District, Kigoma Region, Tanzania	Kasulu, Kigoma Region Tanzania		

The current status of the conservation of crop wild relatives and wild plants relevant to food production is still in progress with some work been undertaken. There are no existing plans nor a national policy that directly address and support the conservation of crop wild relatives. There has been quite an effort in the identification of endangered, nutritious richness, underutilized, multipurpose uses of wild food plants. Some work has been done on the implementation of management practices to maintain high level of crop wild relatives (CWR)/wild food plants (WFP) genetic diversity with the involvement of local communities. Other activities undertaken include encouraging public participation, arrangements for *ex situ* conservation of threatened and endangered CWR/WFP.

There has been great focus on the establishment and strengthening of zonal and regional botanical gardens in the country with the involvement of stakeholders. Exploratory missions have been taken towards the promotion of *in situ* conservation of wild crop relatives and wild plants for food production.

There is a need to raise farmers as well as policy makers' awareness of the value of crop wild relatives and wild food plants in order to protect them adequately and promote their domestication as it is the case for indigenous vegetables. The domestication of these food plants needs to be technically and financially supported by regional and international organizations.

There have been threats to the integrity of plant genetic resources from several causes such as:

- Deforestation,
- Changes in land use,
- Inappropriate forest use and management practices,
- Pollution and climate change, and
- Uncontrolled movement of germplasm.

Therefore, valuable gene pools of prevalent species may disappear undetected, because not enough is known about the distribution of genetic variation. By protecting and maintaining most wild species in their natural habitats, the process of evolution will continue with minimum interruption by anthropogenic forces. Large areas of land (≥25% of the country) are protected by various laws and established as National Parks, Game Reserves and Forest Reserves in which the NPGRC are in collaboration in the maintenance of these plant species.

2.5 Measures aimed at sustainable forest 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 Plant (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.

Thus, NPGRC has embarked on routine collection, conservation and management processes taking into account different levels of threats, patterns of land use, forest management practices and future selection and breeding programmes. At present data are being collated to determine the levels of threat, and to conserve threatened materials through complementary *in situ* and *ex situ* management approaches.

2.6 On-Farm Management and Improvement of Plant Genetic Resources

On-farm activities have been addressing management and improvement of PGRFA in local farming communities with the involvement of farmers as outlined in Table 2.2**.** Some of the activities include:

- Assessment of farmers' knowledge;
- Characterization and evaluation of local varieties;
- Studies on local varieties, population structure and dynamics;
- Seed multiplication and distribution of improved varieties;
- Assessment of improved varieties utilization and management;
- Socio-economic assessment of PGRFA;
- Pilot sites establishment in areas of high diversity;
- Establishment of stockists, collection centres and warehouse receipt system;
- Training of extension officers;
- Collection of indigenous vegetables;
- Community based research; and
- Participatory plant breeding.

Despite the aforementioned activities, there is a need of promoting on-farm management and improvement of PGRFA through:

- Formulation of networks at National, Regional and International levels that shall actively involve farmers and others stakeholders;
- Development and dissemination of information to farmers and other stakeholders;
- Incorporation of Indigenous /Traditional Knowledge to scientific systems;
- Strengthening monitoring and evaluation systems;
- Establishment of an early warning system for plant genetic erosion;
- Strong awareness creation by national, regional and international institute on PGRFA;
- Increased collaboration between NARS and farmers;
- Capacity building of farmers involved in conservation of horticultural crops (indigenous vegetables, spices and herbs, indigenous fruits and banana) as well as establishment of demo sites for the same;
- Training of field inspectors and seed producers;
- Agricultural policy should influence improvement of on-farm management of PGRFA;
- Initiate focused Zonal Seed Banks with support of regional and international PGR Networks.

At present there is no mechanism in place which facilitates rapid acquisition, multiplication, distribution and cultivation of reintroduced germplasm in areas that have been affected by natural disasters. However, the reintroduction of locally adapted germplasm and assistance to farmers in the restoration of agricultural systems following disaster has occurred with assistance from regional collaborators/countries by taking advantage of food crop parental stocks preserved at national and international agricultural research centres. In the 1980's the citrus greening disease *Candidatus Liberibacter* affected trees in Mpiji (Coast Region) and Ssonga (Tanga Region) causing serious loss of oranges. Efforts to revive the crop were made by reintroducing planting materials from Sokoine University of Agriculture (SUA), Zanzibar, HORTI-Tengeru, Songea, Bagamoyo and Tanga. In 2005 the Lake Zone was hit by the Cassava Mosaic Virus Disease (CMVD) causing serious loss of cassava crop. Action was taken by reintroducing different cassava cultivars from IITA, Uganda and EARRNET.

Efforts have been made to promote on-farm management of PGRFA though these have been limited by several constraints, among these, inadequate incentives provided to farmers, and insufficient seed or planting materials. Lack of well trained staff and insufficient funding to carry out these activities on an adequate scale also reduced the scope and impact of these efforts.

Considering the fact that on-farm management and improvement of PGRFA are not a national priority, there is a need to promote PGRFA through establishment of coordinated networks at national, regional and international levels by involving farmers and others stakeholders. During the period under review a number of individual farmers and farmers groups participated in projects addressing on-farm management and improvement of plant genetic resources for food and agriculture (Appendix 8).

TABLE 2.2
PGRFA on-farm management projects

Name of on-farm conservation programme/project	Local farmer community involved	Number of farmers involved
Improving Food Security in Sub - Saharan Africa through increased Utilization of Indigenous Vegetables; Studies on Seed Production and Agronomy of Major African vegetables		100
Cassava collection and characterization		
Agricultural Sector Program Support (ASPS) Phase I & II (Seed Production Component)	Individual farmers and farmers groups	>12 000
Babati Farmers Participatory Research Project	Farmers Research Groups	900
Agricultural Marketing Project	Farmers Research Groups	900
Survey on the status of *in situ* and on-farm conservation of Plant genetic resources in the country	Small- scale farmers in various districts	
Sorghum variety trials		
Grape varieties evaluation		

Name of on-farm conservation programme/project	Local farmer community involved	Number of farmers involved
Participatory Irrigation Development Program		20
TARP II-SUA Project		15
Community based seed multiplication for sesame, groundnuts, sorghum, cowpeas, pigeon peas, maize, green gram, rice and cassava		30 000

2.7 Assessment of major needs for *in situ* management

Farmers and other stakeholders are not sufficiently aware of the value of crop wild relatives and wild food plants because there is lack of initiative to use them in breeding programmes and to domesticate them. There is a need to assess farmer's knowledge on *in situ* management and characterize local varieties for utilization. The domestication of wild food plants needs to be technically and financially supported by regional and international organizations as national resources are limited and therefore focussed on major staple crops.

CHAPTER 3

THE STATE OF *EX SITU* CONSERVATION

3.1 Introduction

Ex situ collections in the country stand as a source of diversity and useful traits for crop genetic improvement, as well as a buffer for any emerging calamity/disaster. To fully take advantage of their value, which in many cases goes beyond the national boundaries, national, regional and international organizations should support an integrated and well coordinated strategy for *in situ*, on-farm and *ex situ* conservation that avoids duplication of efforts and promotes utilization of the conserved materials. *Ex situ* collections play an essential role for agricultural development by conserving and facilitating access to materials and their related information to be used by crop improvement and seed multiplication programmes. Adequate capacity, facilities, and financial provisions for collecting, conserving, documenting and regenerating materials must therefore be ensured.

TABLE 3.1

Germplasm holdings conserved at NPGRC

Crop Group	Genus	Number of Accessions	Crop Group	Genus	Number of Accessions
Cereals	*Amaranthus*	63	**Vegetables**	*Luffa*	8
	Eleusine	360		*Lycopersicon*	16
	Oryza	258		*Solanum*	16
	Pennisetum	56		*Typha*	1
	Sorghum	813	**Forages**	*Aeschynomene*	1
	Triticum	5		*Alysicarpus*	1
	X Triticosecale	8		*Canavalia*	3
	Zea	370		*Clitoria*	3
Legumes	*Arachis*	149		*Desmodium*	1
	Cajanus	47		*Eragrostis*	1
	Cicer	97		*Faidherbia*	1
	Glycine	11		*Leucaena*	1
	Lablab	17		*Macroptilium*	1
	Macrotyloma	7		*Mucuna*	13
	Phaseolus	430		*Neonotonia*	1
	Pisum	20		*Sesbania*	6
	Vigna	522		*Stylosanthes*	3

Crop Group	Genus	Number of Accessions	Crop Group	Genus	Number of Accessions
Vegetables	*Abelmoschus*	12	**Oil**	*Elaeis*	7
	Brassica	10		*Helianthus*	12
	Capsicum	14		*Ricinus*	6
	Citrullus	58		*Sesamum*	59
	Cleome	6	**Others**	*Abrus*	1
	Corchorus	9		*Albizia*	1
	Crotalaria	61		*Annona*	1
	Cucumis	109		*Atropa*	1
	Cucurbita	304		*Gossypium*	79
	Cyphomandra	1		*Hibiscus*	9
	Ipomoea	2		*Neorautanenia*	2
	Lagenaria	191		*Nicotiana*	2

Source: SIDS 2009

Most of the plant genetic resources *ex situ* collections for food and agriculture are maintained as breeders' working collections or as active collections from which breeders can periodically retrieve materials to enrich or rebuild their own working collections. Materials are stored either in refrigerated seed banks, in the case of orthodox seeded species, or in field banks, when vegetatively propagated plants and recalcitrant seeded plants are conserved. Forestry *ex situ* collections are mainly maintained in arboreta. The National Plant Genetic Resources Centre (NPGRC) holds the largest number of *ex situ* active collections conserved in the country. Germplasm holdings conserved at NPGRC are summarized per crop groups and genera in Table 3.1. More than 95% of the accessions conserved at NPGRC are landraces or traditional cultivars, while about 3% are materials collected from the wild.

3.2 Collecting Local and Exotic Germplasm

Ex situ collections made by NPGRC includes both local and exotic germplasm. The balance between the number of local and exotic germplasm collected largely depend on the crop and resources available (Table 3.2). Presently, most of the national working collections include mainly exotic germplasm. This bias towards using exotic materials in research stations is due to the fact that they are easily available through collaborative research programmes and are usually in more advanced stage of development.

TABLE 3.2
Types of local and exotic *ex situ* germplasm collected in the country

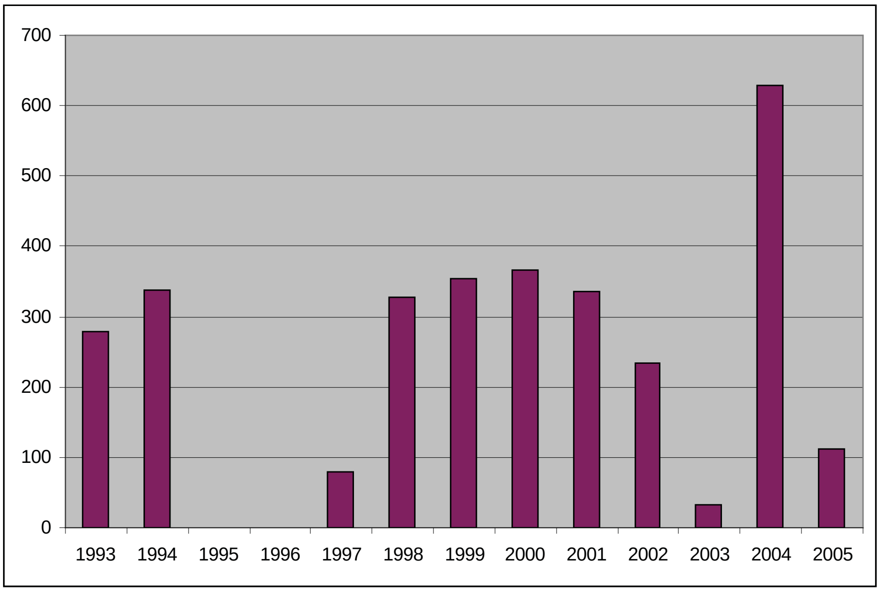
Name of *ex situ* collection	Name of taxon	Name of crop
Rangewide collection	*Uapaca kirkiana, Sclerocarya birrea*	
Maize landraces collection	*Zea mays*	Maize
Rice germplasm	*Oryza sativa*	Rice
Spices germplasm		Ginger, Cinnamon, Vanilla, Cloves, Black pepper, Tumeric, Paprika
Cotton germplasm	*Gossypium* sp.	Cotton
Cassava germplasm	*Manihot esculenta*	Cassava
Sweet potato germplasm	*Ipomoea batatas*	Sweet potato
Sorghum germplasm	*Sorghum bicolor*	Sorghum
Naliendele collections	*Sesamum indicum*	Sesame
Naliendele collections	*Arachis hypogaea*	Groundnuts
Naliendele collections	*Manihot esculenta*	Cassava
Naliendele collections	*Anacardium occidentale*	Cashewnut

As indicated in Appendix 9 other institutions including the national research programmes have been performing activities related to sustaining conservation of *ex situ* collections.

The NPGRC has been collaborating with the Millennium Seed Bank Project establishing short term collections of indigenous plant species. For medium term conservation activities, research is being conducted to determine the percent germination of *ex situ* materials, as well as studies on conservation and nutritional quality of endangered indigenous forest foods, fruit plant species and establishment of arboretum in selected Miombo and mountainous areas. There has been a concerted effort to develop conservation strategies of wild edible orchids in Tanzania. There is also work on exploration and collection of crop germplasm from various regions of Tanzania.

Furthermore, several collecting missions in various parts of the country (>665 sites from 117 districts) have been carried out as part of long term conservation strategies. Collecting addressed mainly vegetables, pigeon peas, maize, sorghum, millets and chick peas (Tables 3.1 and 3.3). Materials collected by NPGRC include cultivars, landraces and wild species.

FIGURE 3.1
Number of accessions collected in Tanzania during 1993-2005 and stored at NPGRC



Source: SDIS 2009

TABLE 3.3
Selected collecting missions for long-term conservation

Crop/Crop Group	Collection area	Collection taxon and crop	Number of accessions collected and conserved under long-term conditions
Indigenous Vegetable	Dodoma rural, Iramba Singida, Missugwi and Magu Mwanza	*Cleome gynandra* Amaranth, Jews mallow, Spider plant	2
Pigeon pea	Coast, Dar Es Salaam, Morogoro, Tanga, Arusha, Mtwara, Lindi and Manyara regions	*Cajanus cajan* Pigeon pea	123
Maize landraces	Iringa, Mbeya and Arusha regions	*Zea mays* Maize	81
Chick pea landrace	Mwanza, Shinyanga, Mara,Singida,Tabora and Arusha	*Cicer arietinum* Chickpea	89

3.3 Storage Facilities

As stated earlier most of plant genetic resources *ex situ* collections are maintained as breeder's working collections or as actve collections. These are stored either in refrigerated seed banks for orthodox seeded species or in field gene banks for vegetatively propagated plants and recalcitrant seeded plants.

At the ARIs, where plant breeders maintain their working collections materials are regenerated or multiplied every year to ensure availability of sufficient quantities of viable germplasm. This is due to lack of reliable storage facilities at their disposal. At NPGRC, where large number of collections of crop land races are conserved the materials are stored in vertical/upright freezers at the temperature of -20°C. Currently the 30 freezers avaible are fully used. Ten additional units are in the process of being purchased through the financial support from SPGRC.

3.4 Managing the Collections

NPGRC is also involved with the development of indigenous vegetables, germplasm collecting, characterization, multiplication and conservation of crop and wild species. In addition, samples of existing *ex situ* seed collections are periodically monitored as per germinability and viability, and, when needed, rejuvenated to maintain their genetic integrity.

3.5 Security of Stored Materials

A total number of 1 729 crop germplasm accessions conserved at NPGRC is also duplicated in the SADC genebank at SPGRC in Zambia, as base and active collection for long term conservation, and distributed to interested parties (Table 3.4).

Likewise conservation of accessions has been carried out in collaboration with other international centres for a total of 4 430 accessions collected in the country. Table 3.5 summarizes the number of accessions secured in long term conservation facilities at the CGIAR and AVRDC Centres.

TABLE 3.4

Materials collected in Tanzania and conserved in the base collection at SPGRC

Species	Number of Accessions
Abrus precatorius	1
Amaranthus sp.	1
Arachis hypogaea	43
Cajanus cajan	4
Cicer arietinum	89
Citrullus sp.	5
Cleome gynandra	2
Corchorus sp.	2
Crotalaris sp.	19
Cucumis sp.	5
Cucurbita sp.	13
Dolichos biflorus	1
Eleusine coracana	226
Hibiscus sabdarifa	1
Lablab purpureum	1
Lagenaria sp.	7
Lycopersicon esculentum	2
Mucuna sp.	1
Oryza sativa	90
Pennisetum glaucum	20
Phaseolus vulgaris	244
Pisum sativum	2
Ricinus communis	2
Sesamum indicum	10
Sorghum bicolor	730

Species	Number of Accessions
Vigna subterranea	65
Zea mays	143
Total	**1 729**

Source: SDIS 2009

TABLE 3.5
Materials collected in Tanzania and conserved in international genebanks' collections

Centre	Collection	Number of Accessions
AVRDC	*Allium* Collection	2
	Brassica Collection	23
	Capsicum Collection	21
	Glycine Collection	2
	Lycopersicon Collection	1
	Other Collections	20
	Solanum Collection	22
	Vigna Collection	14
BIOVERSITY	*Musa* genetic resources Collection	19
CIAT	Bean Collection	140
	Tropical forages Collection	392
CIP	Potato Collection	1
ICARDA	*Durum* wheat Collection	3
ICRISAT	Chickpea Collection	97
	Finger millet Collection	42
	Groundnut Collection	432
	Pearl Millet Collection	504
	Pigeonpea Collection	234
	Sorghum Collection	718
IITA	Bambara Groundnut Collection	26
	Cowpea Collection	434
	Soybean Collection	6
	Wild *Vigna* Collection	72
	Yam Collection	1
ILRI	Forage genetic resources Collection	855
	Oryza glaberrima Collection	3
	Oryza sativa Collection	125
	Wild rice Collection	44
WARDA	*Oryza glaberrima* Collection	3
	Oryza punctata Collection	5
	Oryza sativa Collection	157
	Wild rice Collection	12

Source: SINGER 2009

3.6 Documentation of *Ex situ* Collections

NPGRC uses the SADC Documentation and Information System (SDIS) to store, manage, and analyze data on *ex situ* collections. The system is currently holding information on more than 4 300 accessions. Data on tree seed collected for different uses is stored using Microsoft Excel.

3.7 Constraints and Needs

Several factors constraint the implementation of *ex situ* conservation activities in the country including inadequate human and financial resources, prevalence of pests and diseases and power outrage, as well as inadequate capacity for regeneration of germplasm. Gaps were detected in the existing collections in terms of incomplete geographical coverage of targeted taxa especially for the rice germplasm.

In order to address these challenges there is a need to strengthen collaborations with regional and international organizations and information exchange networks, training on conservation, and use of tools for mapping and soliciting funds from local and international bodies for sustaining *ex situ* conservation efforts. In future priority should be given to the regeneration of *ex situ* germplasm particularly rice (*Oryza sativa)* and spices (ginger, cardamom, vanilla) and the identification of genotypes with different levels of adaptations to prevalent crop biotic and abiotic stresses.

CHAPTER 4

STATE OF USE

4.1 Importance of Utilization of Plant Genetic Resources' Collections

In situ and *ex situ* conservation activities *per se* can ensure the preservation of the country diversity. However, in order to foster agricultural production and improve food security in the country, plant genetic resources as well as their associated information and knowledge must be made available and used by improvement and multiplication programmes, then distributed to farmers for cultivation and finally marketed and consumed.

Differenty crops often require specialized developmental programmes. Agricultural research and development in Tanzania, is organised on commodity basis involving both private and public institutions. Use of germplasm largely depends on the objective of the individual commodity programme. Each programme has its own working collections, maintained at various research institutes under different storage conditions.

Research and development for food crops are dealt with by the different national Agricultural Research Institutes and by private seed companies. Cash crops such as coffee and tea are under the responsibility of the Tanzania Coffee Research Institute (TaCRI) and the Tea Research Institute of Tanzania (TRIT) respectively which operate as semi-autonomous institutions. Forestry research and development is done under the Tanzania Forestry Research Institute (TAFORI), which has a Silviculture Research Centre at Lushoto in Tanga region. The National Plant Genetic Resources Centre (NPGRC) has responsibility of monitoring the use of all plant genetic resources in the country, although currently lack sufficient capacity to undertake this task.

Druing the past years, NPGRC has continued to improve its capacity to collect and characterize landraces of cereals, vegetables, oilseed crops, spices and others and to make them available for use to various crop breeders in the country (Appendix 11). NPGRC and research institutions characterize the genetic resources mainly as far as morpho-agronomic and biochemical traits are concerned. Recently efforts are underway to apply molecular markers techniques for characterization.

Research institutions often receive exotic germplasm from international research centres to increase diversity within the current collections. At present most of the crop varieties that are locally bred use introduced materials as parentals. Conversely, in the case of vegetables and forest germplasm improvement local landraces are generally used.

Breeding capacity differs from one crop to another. In the case of cereals, roots and tubers national capacity is increasing, while for fruits it is decreasing (Appendix 11). The low priority given to fruit crops and the lack of human and financial resources are the main causes for this decline.

A number of activities are ongoing including germplasm documentation, crop improvement, post harvesting processing, marketing, and multiplication of seed/planting material. In order to promote the use of materials stored in national *ex situ* collection several publications have been produced (Appendix 10).

4.2 Characterization and Evaluation

Characterization and evaluation of *ex situ* collections and accessibility of this information are an essential requirement for fostering the use of conserved germplasm either directly or thorugh improvement programmes. The level of characterization and evaluation of *ex situ* collections is overall acceptable as far as morphological and agronomic traits are concerned. Evaluations of biochemical traits as well as to biotic and abiotic stresses have been carried out for part of the common bean landrace collection, the finger millet and the *Cucurbita* collections at NPGRC. No substantial characterization activities based on molecular markers have been reported (Appendix 12). The SADC documentation and information system (SDIS) is used to store, manage and analyze data on germplasm characterization and evaluation at NPGRC. Characterization and evaluation data for about 2 000 accessions have been so far recorded in SDIS. AGROBASE and NCSS software are used at the Ministry of Agricukture and Food Security for storing and analysing crop related information. Overall the use of generic spreadsheet software appears still common among National Research Institutions.

For more effective characterization, evaluation and development of core collection to facilitate the use of germplasm, priorities should be given to acquisition of expertise and procurement of laboratory facilities to carry out molecular characterizations and evaluation of accessions. Partnerships between the National Research Institutions and NPGRC in carrying out these activities should be strengthened. Similarly, the adoption by all research institutions of a single standard system for managing accession-level PGRFA information that can take advantage of Internet technologies would facilitate information exchange as well as utilization and exchange of germplasm with the National Programmes.

As some of the materials needed in plant breeding are drawn from germplasm received from international research centres, these materials are evaluated and assessed as pre-breeding materials under local conditions by various research institutions for their adaptability and resistance or tolerance to abiotic and biotic stresses. This was the case of maize germplasm received from CIMMYT which has been used in developing maize cultivars resistant to drought and others with low nitrogen requirements.

4.3 Pre-Breeding and Genetic Enhancement

National Research Institutes have been involved in the assessment and improvement of a number of crops such as maize, finger millet, pigeon pea, pumpkins, rice and spices to mention a few with the participation of farmers. Areas of assessment and improvement included increasing intra-specific diversity in crops, monitoring intra-specific diversity in crops, increasing diversity in agricultural systems and application of participatory diversity methods. Other areas of assessment included improved quality protein maize, high yielding sorghum varieties, improvement of agronomic characteristics, qualities, tolerance to striga and resistance to pests and diseases.

Most of the research institutes in the country have been involved in genetic enhancement activities including introgression of specific traits. The purpose of genetic enhancement has been to introduce specific traits not available in the current breeding materials due to narrow genetic base of existing improved crop varieties. In addition, phenotypic screening and assessment has been done. Assessment of genetic diversity was made through pedigree studies and farmers were involved in setting priorities and implementation of various crop improvement programmes including maize and sorghum improvement programmes.

4.4 Plant Breeding

Plant breeding activities are conducted in Tanzania by public research institutions in collaboration with international research centres. They address several important crops including maize (ARI, Ilonga), rice (Sokoine University of Agriculture), beans (ARI Selian, Uyole, Lyamungu; Sokoine University of Agriculture), wheat (ARI Selian, Uyole), sorghum (ARI, Ilonga), cassava (ARI Kibaha), sweet potato (ARI Ukiriguru), groundnut (ARI Naliendele), sesame (ARI Naliendele), coffee (TaCRI) and cashew (ARI Naliendele). In a number of cases farmers have participated in the varietal selection process and/or in setting breeding priorities. Parental materials were reportedly sourced mainly from regional/ international networks (30% of the reported cases), the national genebank (24%), public organizations from developed countries (24%), local genebanks (12%) and international genebanks (12%).[5] During the past 20 years, these public research institutions and other local or foreign private seed companies have released a number of improved cultivars mostly open and self-pollinating composites, hybrids and clones (Appendix 14).

4.5 Promoting Development and Commercialization of Underutilized Crops Species

Many activities have been undertaken to promote and develop underutilized crops species of both agricultural and horticultural crops and traditional cash crops. To ensure the sustainability of such activities, three subject matter specialists from each district have been trained and two of them are responsible for supervision of seed production and one for seed quality. In addition, the government has formed the Agricultural Seed Agency (ASA) with the objective of producing, processing and marketing public bred varieties.

[5] National Information Sharing Mechanism on PGRFA (www.pgrfa.org/gpa/tza).

The Ministry of Agriculture Food Security and Cooperatives, through its Crop Promotion Unit has carried out activities to promote commercialization of underutilized field and horticultural crop species in many parts of the country and in some cases this work has been done in collaboration with institutions such as the Prisons and the National Service.

Factors which limit the development and commercialization of underutilized crop and species include funding to achieve effective research, awareness creation and promotion, lack of reliable information and limited staff specialized on such underutilized crops like yams, groundnuts, bambara groundnuts, pumpkins and spices.

4.6 Seed Production and Distribution

Formal and informal seed systems contribute to the production and distribution of improved seed in the country. The informal seed production and supply system provides for about 90 percent of cultivated seed. Formal seed supply system includes public and private sectors.

Tanzania Official Seed Certification Institute (TOSCI) is responsible for seed quality control in the country. Crop Development Department in the Ministry of Agriculture Food Security and Cooperatives is responsible for co-ordination and monitoring seed availability and distribution in the country.

Seed delivery system for traditional cash crops is through crop marketing boards for various individual crop types such as cotton, coffee, tobacco, pyrethrum, tea, cashew nut and private research institutes in coffee and tea.

Following the establishment of ASA in 2006, in order to improve the supply of quality seed for publicly bred varieties the Government initiated intensive seed production programmes that apply the FAO Quality Declared Seed (QDS) scheme with small scale farmers. These programmes have been useful to improve farmers' accessibility to quality seed. Supporting activities for the establishment and expansion of local seed grower's associations have been also reported by public and private institutions such as Horti-Tengeru, FARM Africa and NPGRC.

In spite of the Government's efforts to improve seed sector development, several constraints still need to be overcome including the insufficient availability of foundation seed, improper distribution channels, poor storage facilities which affect the over time seed germinability, high cost of seed and illegal seed traders. Private seed companies are biased to crops that are more profitable.

4.7 Market Situation of Plant Varieties and Value-Addition

The market and distribution of plant varieties varies between crops (Appendix 13). For example maize, sorghum and rice are major food crops in the country and therefore easily marketed. The Government in collaboration with the private sector is putting efforts to develop markets and increase consumption of plant varieties through processing of protein rich amaranths into flour and oil, processing of cassava and finger millet into flour and establishment of small scale industries for extraction of sunflower oil.

The Government has also facilitated creation of awareness among public and private stakeholders on diversity rich crops at national and district levels through promotional campaigns during annual agricultural shows, seed fairs, trade exhibitions and farmers field-days. Up-scaling of on-farm seed production is another initiative aimed at promoting such crop varieties.

Despite these efforts, without adequate improvement programmes that enhance the productivity of traditional varieties while retaining their adaptability to local conditions and their distinctive traits, scale commercial production of such varieties is not likely to occur.

4.8 Use of Forest Plant Resources

Forest germplasm is usually collected, preserved and distributed by TAFORI as research samples for various afforestation programmes in Tanzania and elsewhere. Due to limitations in the storage of tree seeds at the Silviculture Research Centre in Lushoto, a National Tree Seed Project was developed to meet the country's own requirement for forestry seed. The project started in July 1989 under the Forest and Beekeeping Division, which was later changed to a National Tree Seed Programme (NTSP) with the same main objectives. Activities of the programme are now under the coordination of the Tanzania Tree Seed Agency (TTSA) headquartered in Morogoro which operates with three zonal tree seed centres: at Iringa (Southern Tanzania), Lushoto (N.E. Tanzania) and Morogoro.

Forestry activities have improved in areas where people are likely to derive immediate benefit such as in traditional medicine and in aforestation projects. For example the Institute of Traditional Medicine of the University College of Health Science, 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 addition, there have been a lot of campaigns and tree planting in the country in order to conserve the environment.

There are several factors affecting activities related to forestry plant genetic resources, which include lack of proper infrastructure, financial, and human resources considering the large number of species known to exist in Tanzania. Studies on plant genetic resources in the wild require heavy investment in resources and finance for a long period.

The immediate need required to improve the development of forestry plant genetic resources activities include detailed eco-geographic surveys, capacity building to local institutions to achieve reasonable standard of conservation and skill improvement to handle sufficient volume of information and materials.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING NEEDS AND LEGISLATION

5.1 Introduction

The key ministries which manage and coordinate programmes, legislations and polices directly related to plant genetic resources include: The Ministry of Agriculture Food Security and Cooperatives (MAFC), Ministry of Tourism and Natural Resources and Vice President's Office –Environment.

The National Plant Genetic Resources Committee (NPGRCom) was established in 1987 and 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 Food Security and Cooperatives that deals with all matters related to plant genetic resources. NPGRC is responsible in day to day management of activities related to plant genetic resources and is closely supervised by the NPGRCom.

5.2 National Programmes for Plant Genetic Resources

5.2.1 Goals and Objectives

The overall goal of the governmental policy is to achieve a 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-tourisms;
- To raise public awareness and understand 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.

The Government of Tanzania has established various programmes and institutions and has taken initiatives to strengthen them in order to meet the above objectives.

The National Plant Genetic Resources Centre (NPGRC) was established in 1991 as a project under the Ministry of Agriculture Food Security and Cooperatives. It operates as a semi-autonomous institution based at the Tropical Pesticides Research Institute (TPRI) in Arusha. The rationale to put the NPGRC at TPRI was to allow it to have basic institutional support while preparing for a more elaborated 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 an Act of Parliament. In the past three years the government has initiated internal procedures aimed at putting in place a legal framework that will legalise and empower the NPGRC in its role to coordinate access and sustainable utilization of plant genetic resources.

The NPGRC has a mandate on the following activities related to the management of plant genetic resources:

- *Ex situ* and *in situ* conservation
- Documentation

- Collection and characterization
- Multiplication of *ex situ* materials
- Sustainable utilization of Plant Genetic Resources
- Distribution for scientific use
- Germplasm enhancement through conventional methods and biotechnology
- Training and public awareness.

MAFC through the Directorate of Research and Development is responsible for carrying out research on agricultural crops, production of breeder's seed, technology dissemination, and training of stakeholders. Such activities are performed by eight Agricultural Research Institutes (ARI's) which are supervised by seven zonal research institute found in different agro-ecological zones in the country. Higher learning institutions such as Sokoine University of Agriculture (SUA) also conduct agricultural research on plant genetic resources. In addition private seed companies utilize the introduced plant genetic materials in developing new varieties.

The Tanzania Forestry Research Institute (TAFORI) which was established in 1980 is responsible for research and development of forestry genetic resources, while Tanzania Tree Seed Agency, under the Ministry of Tourism and Natural Resources, enhances the supply of forest products and environmental conservation by producing and marketing high quality tree seed and other propagating materials.

Vice President's Office – Environment coordinates legal and institutional matters related to sustainable management of the environment, quality standards, public participation, environmental compliance and enforcement.

The Tanzania Official Seed Certification Institute controls production and marketing of quality seed in the country, including breeder's seed.

In addition to the above mentioned institutions a number of collaborative projects and programmes are developed and run by non-governmental and private organisations such as Farm Africa.

5.2.2 Funding of the National Programmes

NPGRC and other institutions receive funds through their respective ministries for implementation of national programmes on plant genetic resources. During the last five years the funding for NPGRC programme has improved through government and DANIDA supported programme on seed production (Table 5.2.1).

TABLE 5.2.1

Funds Received by NPGRC from Various Sources from 2003 to 2008 (Millions TShs.)

Source of funds	Financial years				
	2003/04	2004/05	2005/06	2006/07	2007/08
Direct Government funding	16.9	25.3	17.5	31.3	20.7
Through Regional Network (SPGRC)	NA	NA	7.7	10.8	18,0
Funded Projects	30.0	23.8	154.2	80.3	95,8
Total	**46.9**	**49.1**	**179.4**	**122.4**	**141.7**

5.3 National Networks for Plant Genetic Resources

With few exceptions, in the last decade there has been very little support for national networks specifically designed for plant genetic resources for food and agriculture. Babati farmers' agricultural research project under Farm Africa Programme was one of a few opportunities for farmers to network on plant genetic resources.

In 2006 an information network of key national stakeholders involved in PGRFA conservation and use has been established with support from FAO through the National Information Sharing Mechanism on PGRFA.[6] Under the coordination of the officially appointed National Focal Point for the implementation of the Global Plan of Action,[7] an internationally agreed framework for plant genetic resources conservation and use, key national stakeholders, including research centres, have joined efforts to periodically document the status of PGRFA in the country and to share and publish relevant information though the web portal of the Mechanism and its database which is accessible via an on-

[6] National Inforamtion Sharing Mechanism on PGRFA http://www.pgrfa.org/gpa/tza/tzawelcome.html
[7] http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPS/GpaEN/gpatoc.htm

line search engine. Data from the Mechanism have largely contributed to the preparation of this report. The Tanzanian Mechanism is part of an international information network of more than 64 countries world-wide[8] under the guidance of the FAO Commission on Genetic Resources for Food and Agriculture.[9]

5.4 Education and Training

5.4.1 Current Status and New Initiatives

In the last decade there has been tremendous improvement in training of technical staff at the NPGRC especially in the area of Plant Genetic Resources Management. The training ranged from short courses to PhD and MSc levels which were all done at Swedish and Danish universities. The staff received in-service training in a number of areas related to the management of PGRFA as shown on Table 5.4.1.

Although improvement in training of the existing staff is expected to improve the performance of NPGRC, staff development in terms of new recruitment and specialized training for NPGRC is still needed in terms of short and long courses in the following areas:

- Management of plant genetic resources;
- Documentation and data management;
- Laboratory techniques;
- Glasshouse techniques;
- Micro propagation;
- Applied genetics;
- Cytogeneticis;
- Plant taxonomy/systematic;
- Plant exploration;
- Survey statistic/biostatistics;
- Plant breeding;
- Seed technology;
- Plant biotechnology; and
- Geographical information system /DIVA GIS.

TABLE 5.4.1

Number of staff from NPGRC and related institutions trained on specific areas of PGRFA between 2000 and 2007

Name of training course	Number of staff
M.Sc. in Plant Genetic Resources Management	3
Plant Genetic Resources Management	14
Management of forage seeds	1
Information system course	3
Exploration of Plant Genetic Resources	2
Ph.D. in Plant Genetic Resources Management	1
M.Sc. in Ecology	1
Ph.D. in Bio-policy	1
Documentation and Information certificate	2
Seed production and marketing	10
Participatory planning, monitoring and evaluation of development projects	10
Project management for senior managers	10
Seed Quality control	20

[8] WISH-GPA http://www.pgrfa.org
[9] http://www.fao.org/nr/cgrfa/en/

In order to carry out its activities efficiently, NPGRC which is understaffed need to recruit new staff as indicated on Table 5.4.2.

TABLE 5.4.2.
Present Desired Manpower Requirement for the NPGRC

Post	Duties	Preferred Qualification	No	Remarks
Curator	Head of Centre	Ph.D/M.Sc	1	Filled
Collector	Exploration, collection and *in situ* conservation	M.Sc.	2	One vacant
Seed Technologist	Conservation of *ex situ* orthodox seeds, character station	B.Sc. (computer Science) or M.Sc.	2	One vacant
Documentation officer	Management of accessions records, database querying and quality control, generation of reports	M.Sc.	2	One vacant
Agronomist	Management of field gene banks, multiplication, character station	M.Sc.	1	Vacant
In vitro culture officer	Propagation by tissue culture, maintenance *in vitro* culture, virus indexing	M.Sc	1	Vacant
Geneticist	Genetic studies and biotechnological manipulations	Ph.D.	1	Vacant
Field Officers	Assist one or more scientist in field activities	Diploma	1	Vacant
Lab. Technicians	Assist scientists in the laboratory, supervise routine lab. Work	FTC	1	Vacant
Supporting staff	Assist in various activities e.g data entry, lab routines, secretarial service etc	Form IV/VI plus skill	1	Vacant

Source: NPGRC Reports, 2008

In addition to training and recruitment initiatives, NPGRC need technical assistance from bilateral and international development partners in order to continue carrying out on-the-job training.

As far as training opportunities related to PGRFA which are available within the country, the Sokoine University of Agriculture has continued to offer general and specific agricultural training courses on these areas. International technical and financial assistance may play a useful role in assisting the University to establish short and long courses on plant genetic resources for food and agriculture. In addition inclusion of PGRFA curriculum at all levels of higher learning training has been recommended by many stakeholders and is being considered by the training institutions.

The main challenges that limit success in providing education and training to staff working with PGRFA programmes include:

- Low priority accorded to PGRFA;
- Lack of financial resources for training on PGRFA; and
- Scarcity of trainers of trainees.

5.5 National Legislations affecting Plant Genetic Resources

Currently there is no specific legislation for management of materials maintained *ex situ* but a bill to provide for conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use for sustainable agriculture and food security and other related matters is in final stage of enactment. The proposed legislation is also expected to establish a legal status of the NPGRC and is expected to be operational soon.

A number of legislations and policies affect protection of or access to plant genetic resources even though they were designed to serve other broader purposes. These pieces of legislations include:

- Constitution of the United Republic of Tanzania of 1977
- National Environmental Management Act of 2004
- Plant Protection Act of 1997 (under review)
- Seed Act of 2003
- Plant Breeders' Rights Act of 2002
- Various Acts of Parliament which established the animal and plant reserves and the institutions managing the reserves such as Forest Reserves, Game Reserves, Ngorongoro Conservation Area and National Parks.
- Agriculture Policy of 1997 (under review)
- National Environment Management Policy
- Bio-safety Guidelines of 2007

5.6 Information Systems

The national information management and exchange system on plant genetic resources is still very weak and as a result of this, access to information for food and agriculture in the country is rather limited. Currently, there are very few activities which are focussed on development of data and information management systems for PGRFA such as Documentation of Data and Information on Plant Genetic Resources, Rice germplasm activity and Spices germplasm activity.

The establishment of the National Information Sharing Mechanism on PGRFA in 2006 has provided an opportunity for major stakeholders to share information in an organized manner (see also para. 5.3). At present the database of the Mechanism, which is accessible from the Mechanism internet portal (http://www.pgrfa.org/gpa/tza), includes *inter alia* detailed information on public and private institutions, experts, publications, projects, and cultivars.

As far as systems for managing information of *ex situ* collections are concerned, the SADC Documentation and Information System (SDIS) is being used at the NPGRC. Overall very sporadic use of international PGR information systems such as SINGER is reportedly made.

Despite the opportunities available for developing a comprehensive information system for an efficient management of plant genetic resources, there are challenges and constraints including financial and technical support which presently severely limit the capacity to meet existing needs.

The following are priority areas that need support:

- Institutionalize and strengthen with the involvement of a larger number of stakeholders the National Information Sharing Mechanism on PGRFA which has been effectively used to collect information for preparation of this report;
- Strengthening of ministerial data base system and link to the national data base;
- Improvement of internet connectivity within national research centres for better access to information on PGRFA from national and international PGR Centres;
- Publication and dissemination of findings on PGRFA among stakeholders; and
- Development, maintenance and dissemination of a catalogue of gene bank germplasm.

5.7 Public Awareness

Overall, the general public is not sufficiently informed about conservation plans which have often been made without adequately considering the needs of the involved communities, resulting in land and natural resources use conflicts. The government through campaigns on specific issues such as forest conservation, soil erosion control, prevention of bush fire, only indirectly contributes to raising public awareness about plant genetic resources' value and importance.

Overall the national programme does not have sufficient and well trained staff to properly implement the various activities including awareness creation.

5.8 Challenges

Main challenges, needs and priories for maintaining and strengthening the national programme on plant genetic resources over the next ten years include:

- Need to increase budget allocations to the national programme on plant genetic resources and related programmes;
- Need to establish a fully fledged unit for coordination of various programmes related to plant genetic resources that will promote networking at national level; and
- Need to speed up the process of putting in place a legal framework on plant genetic resources.

CHAPTER 6

THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 United Nations Initiatives

Tanzania is among the signatories of the Convention on Biodiversity in 1992. Since adopting Agenda 21, the country has initiated and implemented a National Environmental Action Plan (NEAP). The NEAP emphasizes, among other things, rational development and use of forest resources through the 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. The government has also enacted an Environmental Management Act to regulate matters related to the protection of the environment and to establish the National Environment Management Council (NEMC).

The country is also an active member of the FAO Commission on Genetic Resources for Food and Agriculture and during the past 12 years has benefited from technical and financial assistance from FAO on aspects related to PGRFA, in particular on information management and on seed quality control certification scheme. 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 quality seed production of some important crops including indigenous vegetables.

Together with 150 countries Tanzania has contributed to the development and adoption of the Global Plan of Action for the conservation and sustainable use of PGRFA, an FAO led initiative. Through this Report the country is contributing to the preparation of the second global assessment on the state of PGRFA, which will lead to the update of the Global Plan of Action in 2011. Tanzania has also participated in the negotiations of the FAO International Treaty on PGRFA, and has become member of the Treaty in 2004 (see also para. 7.2).

6.2 International Agricultural Research Centres

6.2.1 CGIAR

Tanzania has continued to benefit from the activities of the CGIAR Centres and its specialized bodies such as Bioversity International (formerly known as IPGRI), the defunct International Services for National Agricultural Research (ISNAR) and Central Advisory Service on Intellectual Property (CAS – IP).

CGIAR centres, which include CIMMYT, CIAT, ICRAF, CIFOR, CIP, ICRISAT, ILRI, IITA, and IRRI, have been actively involved in training and in the exchange of germplasm of their respective mandate crop through international nurseries and regional networks.

Participation of these institutions in regional networks has greatly benefited research programmes in the country. A number of improved varieties of maize, beans, sorghum, cowpeas, wheat, rice and vegetables have been released based on materials received from the centres and work done in collaboration with them.

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

Bioversity International has been instrumental to a number of activities in Tanzania, including training and search for training opportunities, direct involvement in inventory and documentation of plant genetic resources.

Tanzania like many developing countries has numerous other crops which have not been adequately 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. Surveying and carrying out inventory the lesser known edible wild fruits are among the he activities that need such support. Other areas which need collaborative action include:

- Enhancing curriculum development on indigenous vegetables and other food crops in high learning institutions
- Strengthening research on underutilized crops
- Increasing funding and resources for *in situ* and *ex situ* collection in the country
- Increasing manpower skills through training, exchange visits and networking
- Improving working facilities and infrastructure
- Strengthening germplasm exchange with international centres and other collaborative centres

6.2.2 Other International Research Centres

Tanzania also benefited from the services of non-CGIAR centres such as AVRDC-World Vegetable Centre, which is an observer member to the CGIAR. AVRDC has its regional centre for Africa in Arusha, Tanzania. It has done a great deal of developing new varieties of exotic and indigenous vegetables in collaboration with national research institute. A good example of such collaboration is development and release of two tomato varieties, Tanya and Tengeru 97 by the national Horticultural Research Institute (HORTI-Tengeru) where AVRDC provided germplasm and additional resources including necessary expertise. The two varieties are now the most popular varieties in Tanzania as well as in the neighbouring counties. In 2007 AVRDC initiated a new programme aimed at promoting vegetable breeding and development of sustainable seed systems in Africa. The ten year programme is known as Vegetable Breeding and Seed Systems (vBSS). The country also benefited from ICIPE in the same manner as it benefited from other 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 collaborative programme has led to establishment of NPGRC's in member states and has promoted PGRFA conservation and information exchange within the SADC region. SPGRC maintains base collections for the region leaving the individual countries to handle active and working collection. The programme also includes a training component, which is critical for the establishment and strengthening 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 common problems.

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

Networks for maintaining *ex situ* collections

Most of survey and inventory work on PGRFA has been done in collaboration with the centres of the Consultative Group of International Agricultural Research (CGIAR), including Bioversity International, and non CGIAR centres such as AVRDC and ICIPE. In terms of information on *ex situ* collections, Tanzania has benefited from SPGRC's support. Since 2000, NPGRC has conducted several *in situ* and on-farm inventories of germplasm collection.

The underlying priorities, needs, constraints and opportunities for further action at the national, regional and international levels include:

- Enhancing curriculum development on indigenous vegetables and other food crops in high learning institutions
- Strengthening research on indigenous vegetables and other crops
- Increasing funding and resources for *in situ* and *ex situ* collection in the country
- Surveying and inventorizing the lesser known edible wild fruits
- Increasing manpower skills through training, exchange visits and networking
- Improving working facilities and infrastructure
- Strengthening germplasm exchange with international centres and other collaborative centres

6.4 Challenges and Priority Needs

A number of challenges that are facing the country need to be addressed in collaboration with the international community. These challenges range from insufficient funds to protect and maintain threatened genetic materials. In addition there are too many accessions in the gene bank that need regeneration, and need to train more staff to manage such accessions.

Improved collaboration and support from the international organizations and programmes will play a big role in finding solutions for the above challenges. Such collaboration and assistance should focus on the following areas:

- Preparation of a complete map, using satellite technology together with a GIS to determine the distribution of the diversity of various crop landraces;
- Monitoring and evaluation of threats;
- Training on the use of new equipments and tools and conservation techniques;
- Strengthening communication skills among scientists working in the area of PGRFA management;
- Increase financial to facilitate strengthening of refrigeration system and equipment; and
- Research on agronomy and domestication of neglected and unadvertised plant species including indigenous vegetables.

CHAPTER 7

ACCESS TO PLANT GENETIC RESOURCES AND SHARING OF BENEFITS DERIVED FROM THEIR USE, AND FARMERS' RIGHTS

7.1 Introduction

Tanzania is among the few countries in the world which are endowed with the rich diversity of various plant species. In order for the country to benefit from these resources concerted efforts need to be done in conserving and creating a conducive environment for accessing the resources. Currently, only a fraction of existing national plant genetic resources are conserved *ex situ* by NPGRC and a legal framework to guide the access and use of plant genetic resources is in its final stages of development.

Tanzania has benefited from international agricultural research centres' *ex situ* storage facilities outside Tanzania for conserving some plant genetic resources, as in the case of sorghum (ICRISAT), maize (CIMMYT) and rice (IRRI).

At regional level, Tanzania collaborates with SADC Plant Genetic Resources Centre (SPGRC) based in Lusaka, Zambia in conserving crop accessions. The SPGRC apart from carrying out long term conservation of germplasm from all member states also provides technical support to various national plant genetic resources centres. Bioversity International also provides this type of support.

SPGRC, established in 1989 has since been keeping duplicate materials sent to them from sources including CGIAR centre. The number of accessions received from Tanzania by the year 2007 amounted to 5 percent of the total accessions from the SADC region[10]. The materials are conserved at the regional facilities with conditions and terms as provided unjder the Standard Material Transfer Agreement of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA).

7.2 Relevant International Conventions or Agreements signed or ratified by Tanzania

Tanzania has acceded and ratified a number of international treaties and agreements providing guidance on access to plant genetic resources and sharing benefits derived from their use.

Convention on Biological Diversity (CBD)

Tanzania became a member of the CBD on 8th March 1996. The Office of the Vice President- Environment is the National Focal Point for the implementation of the convention. In order to domesticate the convention the country has put in place a legal framework to regulate access and utilization of genetic resources. National Environmental Management Act was enacted in 2004 among other thing to domesticate the Convention.

International Treaty on Plant Genetic Resources for Food and Agriculture (IT- PGRFA)

Following the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture by the FAO Conference (through Resolution 3/2001) in November 2001, each country which is party to the treaty was required to put in place a legal framework to implement the Treaty. The treaty is in harmony with the Convention on Biological Diversity and aims at the conservation and sustainable use of plant genetic resources, and the fair and equitable sharing of benefits derived from their use.

[10] SADC Plant Genetic Resources Centre 18th Annual Report, 2007-2008

Tanzania signed and acceded to the Treaty in 2004. The national focal point responsible for the Treaty's implementation is in the Ministry of Agriculture Food Security and Cooperatives. A Draft Bill that will implement the Treaty and provide for the conservation and sustainable use of plant genetic resources for food and agriculture, and the fair and equitable sharing of the benefits derived from their use, will soon be sent to the Parliament. The proposed Act, among other things, addresses issues such as scope and coverage, sovereign rights over PGR, establishment of the National Plant Genetic Resources Institute, functions and powers of the Institute, conditions of Access to PGR, benefit sharing, farmers and local communities' rights, and establishment of a PGR Conservation Fund.

7.3 Benefits gained by Tanzania through PGRFA Networks

Tanzania is a member of SADC-PGR Network and has benefited on the transfer of technology among member countries, exchange of germplasm, exchange of information, training for National Programme Scientists, and joint germplasm characterization and evaluation activities.

Despite its limited capacity, NPGRC has managed to collect and store a total of 5 008 crop landraces to date. Currently there is an urgent need to carry out targeted collection of PGRFA that are endangered, endemic and of economic importance.

In 2006, the NPGRC, National Herbarium of Tanzania (NHT), Tanzania Tree Seed Agency (TTSA), the Botany department of the University of Dar es Salaam and the Royal Botanic Gardens Kew of UK launched the Millennium Seed Bank Project (MSBP) which aimed at collecting and conserving indigenous tree seeds of Tanzania.

7.4 Farmer's rights

Farmers through a continuous process have selected cultivars for crop production since the agriculture has taken place in the country. Throughout the years they have been the guardians and promoters of plant genetic diversity and its associated knowledge. Several initiatives have been undertaken to promote the use of this knowledge in the identification of valuable traits and plant genetic materials that breeders could use in improvement programmes. Farmers' access to improved cultivars occurs through formal or informal seed systems. In many cases they save seed from the harvest to be used in the next cropping season. For open pollinated varieties it is normally recommended to do so for not more than three generations. In case of protected varieties, the Plant Breeder's Rights Act of 2002 privileges farmers to save seeds of such varieties on their own farms but does not allow farmers to sell farm saved seed of such varieties. The proposed Bill on PGRFA is expected to further provide for the procedures for conservation and sustainable use of plant genetic resources for food and agriculture, and fair and equitable sharing of the benefits.

7.5 Future Needs

Finalization of the proposed Bill on plant genetic resources for food and agriculture and its operationalization will be the top priority need for Tanzania in the next few years.

CHAPTER 8

CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

Plant genetic resources are the basis of food security and sustainable agricultural development as they comprise the diversity of genetic material contained in traditional and improved cultivars as well as in crop wild relatives. This diversity provides for options to improve agricultural production and to find viable solutions to the occurrence of crop pests and diseases and to climate changes. Plant genetic resources are therefore a fundamental input for agricultural production, which in the country contributes to more than 26% of the total gross domestic product.

Due to environmental and demographic pressures, both traditional cultivars and wild relatives of crop varieties are continously being displaced by new improved materials and in many cases lost.Their loss implies the erosion of traits of tolerance, resistance and/or adaptability to specific factors from the genetic base upon which new cultivars will be developed. It therefore wickens the capacity of future improvement programmes to respond to environmental and market changes (e.g. new diseases, higher salinity in irrigation water, different consumer preferences, etc.) In order to ensure the preservation for future use of these threatened resources several collection missions have been undertaken in the country and a national genebank established. Breeders in Tanzania have gradually been using genes from the plant genetic resources for cultivar development, aiming to increase crops' tolerance and resistance to diseases, pests and improve other agronomic attributes.

Indigenous crops such as sorghum, millets and vegetables play an important role in food security and also improve the nutritional value of food. Production and marketing of small grains, legumes and indigenous vegetables such as nightshade, amaranths, have been at an increase. The Government with external donor assistance has been involved in a number of farmer support programmes, aiming at diversifying and increasing food security.

Herbal products for medicinal and nutrition purposes are of no exception to the danger of genetic erosion because of the unsustainable use of these products. Products derived from herbs/shrubs/trees are now gradually being commercialized e.g sandal wood and, aloe vera plant. Since these trees/herbs are found in the wild, there is a danger of unsustainable harvesting that may lead to depletion of the germplasm.

Rural based people have benefited from sales of herbal products such that markets and services for such products are growing generating an alternative source of income.

Future needs, constraints and priorities

At national level PGRFA policies are not adequately integrated into agricultural, science and technology policies. At the community level lack of appreciation of the diversity of genetic resources leads to its erosion through the displacement of landraces by improved varieties, loss of forest resources and anthropogenic activities.

REFERENCES

Hawtin G. 2004. The Global Crop Diversity Trust: A Foundation for Food Security. Plant Genetic Resources Newsletter, 2004, No. 139:7-10

J. Esquinas-Alcazar, 2004. International Treaty on Plant Genetic Resources for Food and Agriculture. Plant Genetic Resources Newsletter, 2004, No. 139:1-6

Kapange B. 2008. Germplasm Contribution to Food Security . SADC Plant Genetic Resources Centre (SPGRC) Network News, (January-June, 2008), pp. 2-3 & 8

E. Mutegi, Herman Akonaay and Patrick Ngwediagi, 2006. Report on the Second National Stakeholders Workshop on Establishing the National Information Sharing Mechanism on Implementation of the Global Plan of Action for PGRFA in Tanzania.

H. B. Akonaay, C. S. Mushi, W. H. Ntundu, W.C. Hamisy, L.P. Millinga and L. R. Nyange, 2004. Baseline survey of Neglected and Underutilized crops species (NUCS) in Tanzania. Final Technical Report submitted to the International Plant Genetic Resources Institute (IPGRI). pp. 1-45

Ministry of Agriculture Food Security and Cooperatives, 2000. Agricultural Extension reform in Tanzania. A vision and strategy outline to year 2010

Agricultural Sector Development programme framework and process document, final draft March, 2003

United Republic of Tanzania 2000. Tanzania agriculture; performance and strategies for sustainable growth

UN report of 2001

APPENDIX 1

MAIN FEATURES OF AGRO- ECOLOGICAL ZONES IN TANZANIA

Zones	Sub zones and areas covered	Main Problem	Soil and topography	Altitude (m)	Rainfall (mm/yr)	Area millions of hectares
Coast	North: Tanga (except Lushoto), coast, Dar es Salaam, South: Eastern Lindi and Mtwara (except Makonde escarpment)	-Infertile soils -Shifting cultivation -Bushfires -Deforestation -Water shortages -Soil erosion	-Infertile sands on gently rolling uplands. -Alluvial soils in Rufiji sand and infertile soils. -Fertile soils ion uplands and river flood plains	Under 300	North: Bimodal 750-1200 South: Unimodal 800-1200	6
Arid lands	Serengeti, Ngorongoro, Mkomazi, Pangani in Same , Eastern Dodoma	-Bush fires -Shifting cultivation -Deforestation -Water Shortage	North: Volcanic ash and sediments. Soils variable in texture and very susceptible to water erosion. South: Rolling plains of reddish sandy	North: 1300-1800 South: 500-1500	North: Unimodal, unreliable: 500-600 South: Unimodal and unreliable 400-600	
Semi-arid lands	Central Dodoma, Singida, North Iringa, some parts of Arusha, Shinyanga, Mwanza, Southern: Morogoro (except Kilombero, Wami basin, Uluguru Mts), Lindi and South West Mtwara	-Soil erosion -Poor farming practices -Shifting cultivation -Bushfires	Central: Undulating plains, with rocky hills and low scarps. Well-drained soils with low fertility. Alluvial hardpan and saline soils in eastern rift valley and lake Eyasi black cracking soils in Shinyanga. South-eastern: Flat or undulating plains with rocky hills. Moderately fertile loam and clay in south (Morogoro) infertile sands in center.	Central: 1000-1500 South-eastern: 200-600	Central: Unimodal and unreliable 500-800. Southern: Unimodal: 600-800	21.1
Plateau	Western Tabora, Rukwa (North and Centre) Mbeya (North), Kigoma and Parts of Mara Southern: Ruvuma and southern Morogoro	-Deforestation -Bushfires -Uncontrolled grazing -Shifting cultivation -Soil erosion	Western wide sandy plains and rift valleys scarps. Flooded swamps of Malagasi and Ugalla rivers have clay soils with high fertility sands in north.	800-1500	Western: Unimodal, 800-1000 Southern: Unimodal, very reliable, 900-1300	32.7
Southern and western highlands	Southern: A broad ridge from Morogoro, North of Lake Nyasa covering parts of Morogoro, Iringa and Mbeya Ufipa pleateaux in Sumbawanga Western: Along the shores of Lake Tanganyika in Kigoma and Kagera	-Bushfires -Soil erosion -Uncontrolled grazing -Poor farming practices -Shifting cultivation -Deforestation -Poor mining practices	Southern: Undulating plains dissected hills and mountains. Moderately fertile clay soils, with volcanic soils in Mbeya, South western: Undulating pleateaux above rift valleys. Sandy soils of low fertility. Western: North-south ridges separated by swampy valleys. Loam and clay soils of low fertility in hills with alluvium and clays in valley ponds.	Southern: 1200-1500 South western: 1400-2300 Western: 100-1800	Southern: Unimodal, reliable, local rain shadows, 800-1400 South-western: Unimodal, reliable800-1000 Western: Bimodal 1000-2000	12.8
Northern highlands	Northern: Foot of Mt. Kilimanjaro and Mt. Meru, Eastern rift to Lake Eyasi, Granitic Mts: Uluguru Mts in Morogoro, Pare Mts. In Kilimanjaro and Usambara Mts, in Tanga and Tarime Highlands in Mara.	-Poor farming -Bushfires -Shift cultivation practices -Deforestation -Soils in dry areas are prone to water erosion	Northern: Volcanic uplands, volcanic soils from lava and ash. Deep fertile loam and clays. Soils in dry areas prone to water erosion. Granitic mts steep mts sides to highland pleateaux. Soils are deep friable and moderately fertile on upper slopes, shallow and stony on steep slopes.	North: 100-2500 Granitic mts: 1000-2000	Northern: Bimodal, varies widely: 1000-2000	5.8
Alluvial plains	K-Kilombero (Morogoro) and W-Wami in Morogoro, U-Usangu in Mbeya, R-Rufiji in the coast	Overgrazing in the Usangu plains Poor farming systems Bush fires Deforestation	K-Central clay plain with alluvial fans East and West R-wide mangrove swamps delta. Alluvial soils sandy upstream, loamy downstream in floodplains. U-Seasonal alluvial fans with well drained black loam in West.		K-Unimodal, very reliable 900-1300. R-Unimodal often inadequate 800-1200. U-Unimodal 500-800 W- Unimodal 600-1800	10.2

APPENDIX 2

THE MAIN FARMING SYSTEMS AND THEIR PHYSICAL FEATURES IN TANZANIA

Farming System	Regions the System Found In	Crops grown	Distinctive features
Banana/coffee/ horticultural/tea and dairy farming	Kagera, Kilimanjaro, Arusha, Kigoma, Tanga, Ruvuma, Mbeya	Tree crops, coffee, tea, bananas, cereals, pulses, maize, pasture, horticultural crops (high value vegetables grown),	High intensive land use, volcanic soils with high fertility, land scarcity, high rainfall
Maize/legumes	Shinyanga, Rukwa, Morogoro, Arusha, Kigoma, Kagera, Iringa, Mbeya	Maize, legume, rice, cotton, coffee, palm oil, potatoes. There has been an increase in vegetables particularly tomatoes, onions and paprika in recent years.	Land not scarce, shifting and fallowing cultivation, practiced by a large number of small holder farmers and most of the marketed maize is produced from this system
Cassava, Coconut and Cashew nut system	Coastal Region, Eastern Lindi and Mtwara	Cassava, coconut and Cashewnut	The subsistence crop is cassava, while Cashewnut and coconut are the cash crops. Low rainfall, low soil fertility. Land not scarce, shifting cultivation practiced.
Wetland and irrigated Rice and sugarcane system	Alluvial valleys of the major river basins of Rufiji, Kilombero, Kyela, Lower Moshi, Ruvu and Usangu	Rice and sugar cane	Rice is the a staple for this farming system. Sugar cane cultivation is carried out on a large scale basis. Competition for water is not uncommon.
Sorghum/Bulrush millet/ livestock system (cotton and rice)	Sukumaland, Shinyanga, Rural Mwanza	Sorghum, Millet, Maize, Cotton, oilseeds and rice	Intense population pressure Declining soil fertility. Major activity is crop production, livestock play a major role in providing for meat, milk and draught power for cultivation and transportation
Tea/maize/pyrethrum system	Njombe and Mufindi in Iringa region	Tea, maize, irish potatoes, beans, wheat, pyrethrum, wattle trees, sunflower	Intense population pressure Declining soil fertility
Cotton/Maize system	Tabora, Kilimanjaro, Arusha, Mwanza, Shinyanga, Kagera, Morogoro, Mara, Coast, Mbeya, Singida	Cotton, sweet potatoes, maize sorghum groundnuts	Intensive cultivation livestock kept
Horticultural based system	Lushoto district , Tanga , Morogoro, Iringa, Arusha	Leafy vegetables, fruits, tomatoes, cabbages, sweet potatoes and pepper, indigenous vegetables passion fruits	
Pastoralists and agro pastoralists	Dodoma, Singida, part of Mara, Arusha, Chunya district Mbeya and Igunga district in Tabora	Sorghum, millet, maize groundnuts, tobacco and livestock	Deep attachment to livestock and simple cropping system, shifting cultivation. Moderate population density 30 per sq km. Limited resource base and poor and variable rainfall. However, crop production is by continuous migration in search for pastures
Plantations	Found along major railroads in the north and south of the country	Wheat, tea, sugarcane, sisal, coffee, tree production	Large state owned plantations as well as private owned land

APPENDIX 3

PRIVATE AND PUBLIC SECTOR CONTRIBUTION TO SEED DISTRIBUTION IN TANZANIA 2003/04-2007/08 IN METRIC TONNES

Year	Private (Tonnes)	Public (Tonnes)	Total (Tonnes)
2003/2004	4 280	357	4 638
2004/2005	8 698	1 436	10 134
2005/2006	8 748	1 728	10 477
2006/2007	14 869	1 656	16 525
2007/2008	16 174	217	16 391

APPENDIX 4

PRODUCTION OF MAJOR FOOD CROPS DURING THE PERIOD 2005/06 TO 2006/07

Crop	Year			
	2005/06		2006/07	
	Ha ('000')	Tonnes ('000')	Ha ('000')	Tonnes ('000')
Maize	2 570	3 373	3 168	5 446
Rice	664	783	764	1 624
Sorghum	716	700	1 236	1 383
Finger Millet	215	221	805	677
Wheat	53	110	58	89
Cassava	994	2 006	1 564	3 905
Bananas	500	1 140	167	1 392
Irish potatoes	-	-	92	590
Sweet potatoes	-	-	650	1 413
Beans	-	-	837	812
Cowpea	1 106	1 018	379	402
Sunflower	-	-	285	369
Soybean	-	-	2	2
Sesame	-	-	217	155
Total	**6 787**	**9 353**	**10 228**	**18 265**

APPENDIX 5

PRODUCTION OF MAJOR CASH CROPS DURING THE PERIOD 1999/00 TO 2004/05 ('000 TONS)

Crop	Year					
	1999/00	2000/01	2001/02	20002/03	2003/04	2004/05
Cashewnut	121.20	121.90	67.37	95.00	80.00	81.60
Coffee	47.80	50.00	36.18	52.44	32.00	54.00
Cotton	100.60	123.56	148.18	188.69	139.82	341.59
Pyrethrum	1.00	2.00	3.00	3.50	2.00	1.00
Tea	23.60	26.39	24.73	30.13	30.26	32.00
Tobacco	24.70	27.70	27.90	33.55	47.45	52.25
Sisal	20.60	20.50	23.54	23.64	23.86	26.76
Sugar	116.90	135.54	163.36	190.12	223.84	229.62

APPENDIX 6

PGRFA SURVEY AND INVENTORY COVERED AND PRIORITY AREA(S)

S/No	Title of survey/inventory	Area surveyed/inventoried	Area priority ranking for *in situ* conservation
1	Survey on the status of *in situ* and on-farm conservation of Plant genetic resources in the country	Dodoma, Lushoto, Manyara, Singida, Tabora, Mwanza, Iringa, Kisarawe, Muheza	High
2	A survey of wild and underutilized edible plants in Ruvuma Region	Lake Victoria catchments basin, Tanzania along the lake for Kagera, Mwanza and Mara Regions	High
3	Baseline survey of neglected and underutilized crops in Tanzania	Southern zone of Tanzania Mtwara and Lindi	High
4	Informal survey of farmers with local expertise on seeds and their knowledge	Mtwara and Lindi regons	Medium
5	Survey of rice genotype in rice growing areas of Tanzania		High
6	Survey/inventory for spices germplasm in Tanzania	Kasulu, Kibondo and Kigoma rural district	High
7	African eggplant collection, characterization and selection	Hedaru, Lushoto, Tengeru, Manyara, (Mbulu, Hanang, Kiteto, Babati), Arumeru, Arusha, Mwanga, Hai, Same	Medium-High
8	Indigenous vegetables germplasm collection characterization and enhancement	Dodoma and Mwanza	
9	Enhancing Production and Utilization of African Indigenous Vegetables through sustainable seed Production and Distribution for Better Health	Tanzania, Rwanda, Malawi and Uganda	
10	Documentation and Nutritional Quality Assessment of Selected Edible Wild Plants in Lake Victoria Catchments Basin, Tanzania	Kasulu, Kigoma rural, and Kibondo district	Medium
11	Sweet potato on-farm yield trial	Arusha	Medium-High
12	Sweet potato germplasm Conservation and enhancement	Tanzania	Medium
13	Promotion of Neglected Indigenous Leafy and Legume Vegetable Crops for nutritional Health in Eastern and Southern Africa (Phase 1)	Tanzania, Rwanda, Malawi, Uganda	High
14	Promotion of conservation and sustainable utilization of *Uapaca kirkiana* in Southern Tanzania	Ruvuma Region	High
15	Promotion of spices/herbs production for sustainable income generation and poverty alleviation in Northern Tanzania	Ausha Singida and Dodoma	High
16	Germplasm Management of Underutilized African Vegetables for Improving Agro-biodiversity, Food Security and Increasing Income of Rural and Urban Poor in Southern Africa	Arusha and Kilimanjaro	High
17	Identification and maintenance of seed sources for indigenous edible fruit trees	Mbeya and Makete	Medium-High
18	Introduction and evaluation of high value fruit materials	Iringa, Morogoro, Kilimanjaro, Lushoto, Dodoma	High
19	Personal scientific observations and farmer responses	Kasulu Kigoma rural and Kibondo District	High
20	Rural seed fairs	Mtwara and Lindi Region	Medium
21	Farmers indigenous knowledge on seeds, forest products and medicinal plants	Mtwara and Lindi region	Medium-high

APPENDIX 7

SURVEYING METHODS, THREATENED SPECIES, PROVEN CAUSES AND PRESUMED CAUSES OF THREAT ON PRGFA

Description of methods used	Major threatened species of PGRFA	Proven causes of threat	Presumed causes of threat
Reconnaissance survey, Random sampling,	*Cordyla africana, C. densiflora, Strychnos cocculoides, S. spinosa, Ximenia americana*	Overexploitation	Introduction of exotic vegetables, poor/low market, low priority on research and production of indigenous vegetables, poor seed distribution and availability
Transect, Home and back yard surveys	Members of the family *Orchidaceae*	Overexploitation for trade and land use changes	Wild fires during harvesting, poor access to markets, no research and development intervention
Focus groups and semi structured questionnaire	Arrow root (*Tacca pinnatifida*),Tomato tree (*Cemaphora betacea*), Local hitherto grown maize varieties	Few farmers cultivating the crop	Lack of research and promotional support to improve uses of these species, use of a narrow genetic base in crop improvement
	Local landraces and old varieties of finger millet, pearl millet, fiwi and yams.	Pests and diseases, drought, floods, lack of markets, introduction of new seeds	Ignorance, genetic erosion due to overexploitation refugees as a result of replacement by improved and exotic vegetables/emergence of new diseases/ environmental stresses and changes/
Survey was conducted in Ruvuma region. Visit coverage was Regional, District, Division, wards, and village	Mushroom spp., Medicinal plots	Deforestation	Lack of awareness on indigenous vegetables,

APPENDIX 8

ON-FARM MANAGEMENT AND IMPROVEMENT OF PGRFA WITH THE PARTICIPATION OF INDIVIDUAL FARMERS AND LOCAL FARMERS GROUPS

Name of on-farm conservation programme/project	Local farmer community groups involved	Number of individual farmers involved
Improving Food Security in Sub - Saharan Africa through increased	-	100
Utilization of Indigenous Vegetables	-	
Studies on Seed Production and Agronomy of Major African vegetables	-	
Cassava collection and characterization	-	
Quality control of on-farm seed production in selected regions of Tanzania	-	
Babati Farmers Participatory Research Project	Farmers Research Groups	900
Agricultural Marketing Project	Farmers Research Groups	900
Survey on the status of *in situ* and on-farm conservation of Plant genetic resources in the country	Peasant farmers from various districts	
Sorghum variety trials		
Grape varieties evaluation		50
Agricultural Sector Program Support (ASPS) Phase I (Seed Multiplication) Project		20
Agricultural Sector Program Support (ASPS) Phase II (Seed Multiplication) Project		20
Participatory Irrigation Development Program TARP II-SUA Project		15
Community based seed multiplication for sesame, groundnuts, sorghum, cowpeas, pigeon peas, maize, green gram, rice and cassava		30 000

APPENDIX 9

TTT ACTIVITIES RELATING TO SUSTAINING *EX SITU* COLLECTIONS, CONSERVATION METHOD(S) USED AND THE NUMBER OF PROFESSIONALS INVOLVED

***Ex situ* conservation programme/ project/activity**	**Participating Institution(s)**	**Type of activity**	**Other activities**	**Number of staff involved**
National Vegetable Seed Programme	HORTI TENGERU	Seed genebank (short term collections)	Production of seed foundation for breeding companies for commercial purposes	2
Storage of Reference Materials	TOSCI	Seed genebank (short term collections)	Training of Inspectors and Seed producers	6
Research on project survey on propagation, *ex situ* conservation and nutritional quality of endangered indigenous forest food and fruit plant species in selected Miombo and montane	TAFORI***	Seed genebank (short term collections); Arboretum		4
Exploration and Collection of crop germplasm from the Lake zone and the Southern zones of Tanzania	NPGRC	Seed genebank (medium term collections); Seed genebank (short term collections)		6
Development of Cryopreservation of coffee germplasm	NPGRC	*In vitro* conservation; Cryopreservation		4
Millennium Seed Bank Project	NPGRC, NHT, TTSA & BOTANY DEPART-UNIV OF DAR ES SALAAM	Seed genebank (short term collections)		6
Development of conservation strategies for the wild edible orchids in Tanzania	NPGRC	Seed genebank (medium term collections); Seed genebank (short term collections)		2
Indigenous vegetables Germplasm collection characterization and conservation	NPGRC	Seed genebank (medium term collections); Seed genebank (short term collections)		7
Multiplication and Characterization of crop germplasm accessions	NPGRC	Seed genebank (medium term collections); Seed genebank (short term collections)		7
Survey on the status of *in situ* and on-farm conservation of Plant genetic resources in the country	NPGRC	Seed genebank (medium term collections); Seed genebank (short term collections)	inventory survey of plant genetic resources in Tanzania	
Rice germplasm and conservation activity	NPGRC	Seed genebank (short term collections); Field genebank		4
Spices germplasm collection and conservation activity	MAFC	Seed genebank (short term collections)		3
Cotton	ARI UKIRIGURU & ARI ILONGA	Field genebank		3
Cassava, Sweet potato	ARI UKIRIGURU & ARI KIBAHA)	Field genebank		7
Sesame, Groundnut, Cassava and Cashewnut breeding	ARI NALIENDELE	Seed genebank (short term collections); Field genebank		3

APPENDIX 10

AVAILABLE PUBLICATIONS SHOWING TYPE OF INFORMATION COVERED ON *EX SITU* COLLECTIONS

Title of publication	Author(s)	Name of *ex situ* collection	Publication media	Publication coverage	Data type
Tanzania Variety Catalogue	TOSCI & Department of Crop Development of MAFC	Storage of Reference Materials	Hard-copy (printed/ facsimile)	Passport data;Evaluation/ characterization data	Analyzed data
Seed germination on indigenous trees in Tanzania. Including notes on seed processing, storage and plant uses	TTSA	Tree seed collection for different end use	Hard-copy (printed/ facsimile)	Evaluation/ characterization data	Analyzed data
A catalogue of plant genetic resources under *ex situ* conservation at the NPGRC, Arusha	NPGRC	Orthodox seeds	Hard-copy (printed/ facsimile)	Passport data;Evaluation/ characterization data	Raw data; Analyzed data
Characterization of Germplasm		Orthodox seeds	Hard-copy (printed/ facsimile)	Evaluation/ characterization data	Analyzed data
Evaluation of five accessions of *Cucurbita maxima* collected from different ecological zones in Tanzania	NPGRC	Evaluation of accessions belonging to the family *Cucurbitaceae*	Hard-copy (printed/ facsimile)	Passport data;Evaluation/ characterization data	Analyzed data
Rice germplasm collection and characterization in Tanzania	Unpublished, Developed by MAFC	Rice germplasm characterization	Hard-copy (printed/ facsimile)	Evaluation/ characterization data	Analyzed data

APPENDIX 11

STATUS OF BREEDING CAPABILITY AND UTILIZATION OF GENETIC RESOURCES AT THE NPGRC FOR THE PERIOD FROM 1996-2007

Programme	Crops		Status of Breeding Capability	
			No. of Plant Breeders & related scientists	Breeding Capability
Maize	Maize	*Zea mays*	5	Increased
Rice	Rice	*Oryza satira*	6	Increased
Sorghum and Millets	Sorghum Pearl millet Finger millet	*Sorghum biootor* *Pennisetum Americana* *Eleusine coracana*	1 1 1	Increased
Wheat and Barley	Wheat Barley	*Triticum aestirum* *Hordeum vulgare*	1 2	Increased
Grain Legumes	Cowpea Cowpea Creen gram Pigeon peas Soy beans	*Vigna auguiculata* *Vigna mungo* *Cajan oajan* *Glycine max*	1 1	Stable
Common Bean	Common bean	*Phaseolus vulgaris*	5	Increased
Oil seeds	Sim sim	*Sesamum indium*	1	Increased
Sunflower	Sunflower	*Helianthus annun*	2	Decrease
Roots and tuber	Cassava Sweet potatoes Rounds potatoes	*Manihot esculenta* *Ipomea botatas* *Solanum tuberosum*	1 1 2	Increased
Coffee	Coffee	*Coffee Arabica* *Coffee robusta*	2 1	Increased
Cotton	Cotton	*Gossypium hirsutum*	3	Stable
Tea	Tea	*Thea sinensis*	2	Increased
Sisal	Sisal	*Agrave sisalana*	1	Stable
Coconut	Coconut	*Cocoa nucifera*	3	Stable
Cashew	Cashew	*Anacadium accidentale*	2	Increased
Sugarcane	Sugarcane	*Saccharum afficinale*	5	Increased
Tobacco	Tobacco	*Nicotiana tabacum*	1	Stable
Vegetable Crops	Tomato Onions Amaranths	*Lycopersicum esculentum* *Allium cepa* *Amaranthus* spp	1 3	Increased
Fruits crops	Oranges Avocado	*Citrus sinensis* *Persia amaricana*		Decreased
Viticulture	Grapes	*Vitis* sp.	1	Stable
Bananas	Bananas	*Musa* sp.	3	Increased
Pyrethrum	pyrethrum	*Chrysenthemum anerairice blum*	2	Decreased

APPENDIX 12

EVALUATION AND CHARACTERIZATION OF EX SITU COLLECTIONS

Ex situ collection	% accessions characterized or evaluated as per					
	Morphological traits	Molecular markers traits	Agronomic traits	Biochemical traits	Abiotic stress	Biotic Stress
Coconut	85	50	54	66	87	87
Maize landraces collection (*Zea*)	60	0	60	0	0	0
Common bean land race collection (*Phaseolus vulgaris*)	70	0	30	30	10	10
Sorghum landrace collection (*Sorghum bicolor*)	30	0	10	10	10	5
Finger millet landrace collection (*Eleusine coracana*)	80	0	40	30	20	10
Pumpkin landrace collection (*Cucurbita maxima)*	40	0	20	20	10	10
Characteristics of East African Highland Bananas of Tanzania (*Musa* sp.)	100					
Rice germplasm (*Oryza sativa*)	86	0	86	2	86	0
Spices (Ginger, Cinnamon, Cardamon, Cloves, Black pepper, Vanilla, Tumeric, Paprika)	0	0	0	0	0	0
Oil palm	50	0	0	0	0	0
Cotton (*Gossypium* sp.)	53	46	53	46		
Sesamum indicum	60	0	40	0	5	0
Groundnuts (*Arachis hypogaea*)	90	0	60	0	20	0
Cassava (*Manihot esculenta*)	60	0	30	0	20	0
Cashewnut (*Anacardium occidentale*)	90	30	0	30	0	0

APPENDIX 13

MARKET SITUATION OF PLANT VARIETIES AS DEVELOPED BY PUBLIC AND PRIVATE INSTITUTIONS IN TANZANIA

Name of crop / taxon	Current market situation	Number of local varieties in the market	Number of local varieties with economic potential for new markets development
Sorghum *Sorghum bicolor*	Attempts are underway to develop new markets	10	2
Maize *Zea mays*	Attempts are underway to develop new markets	26	
Rice *Oryza sativa*	Existing markets have been expanded and some new markets developed	15	6
Bambara *Vigna subterranea*	No attempts are presently being made to develop new markets	3	1
Soybean *Glycine max*	No attempts are presently being made to develop new markets	0	0
Yams *Dioscorea bulbifera*	No attempts are presently being made to develop new markets	7	1
Sesame *Sesamum indicum*	Markets are well established and expanded;Attempts are underway to develop new markets	0	0
Groundnut *Arachis hypogaea*	Markets are well established and expanded;Attempts are underway to develop new markets	0	0
Cashewnut *Anacardium occidentale*	Markets are well established and expanded;Attempts are underway to develop new markets	0	0

APPENDIX 14

NATIONAL VARIETY LIST SINCE 1950s AS UPDATED IN 2008

- **Species: Maize (*Zea mays* L.)**

Variety	Year of release	Owner(s)/Maintainer	Optimal production altitude range (masl)	Grain yield (t/Ha)	Special attributes/Disease reaction
Katumani	late 50's	KARI - Katumani	<1500	3.0 – 3.5	Suitable in areas with short rainfall
H 622	1968	EAC/KARI/Kenya Seed Co.	1200 – 1650	6.0-7.0	Fairly tolerant to leaf blight and leaf rust but susceptible to grey leafspot.
H 511	1968	EAC/KARI/	1300 – 1700	4.0 -5.0	Earlier in maturity
H 632	1968	Kenya Seed Co.	1200-1650	6.0-7.0	Fairly tolerant to leaf blight and leaf rust but susceptible to grey leaf spot
H 6302	1976	EAC	>1500	8.0 – 8.5	Highly tolerant to northern leaf blight and rust
UCA	1976	ARI-Ukiriguru	900-1500	4.0 – 6.0	Suitable in drier areas
Tuxpeno	1976	ARI - Ilonga	0 -900	3.0 -4.0	Suitable in coastal and lowland areas
H 614	1977	EAC	>1500	7.0	Very susceptible to maize streak virus.
ICW	1977	ARI - Ilonga	0-900	4.0 -6.0	Suitable in lowland areas
Kilima St	1983	ARI - Ilonga	900 -f1500	5.0 – 6.0	Streak tolerant
Staha	1983	ARI - Ilonga	0 -900	4.0 5.0	Streak tolerant
Kito	1983	ARI - Ilonga	0 -1300	2.0 – 3.0	Suitable in drier areas
TMV 1	1987	ARI - Ilonga	<1500	4.0 – 4.0	Streak and rust resistant
TMV 2	1987	ARI - Uyole	>1500	7.5 – 8.0	Resistant to *Turcicum* leaf blight
Cholima 1	1992	Dakawa	0 -900	6.5	Tolerant to maize streak virus, leaf blight and leaf rust
Cholima 3	1992	Dakawa	0 -900	6.5	Tolerant to maize streak virus, leaf blight and leaf rust
CG 4142	1993	Cargill Zimbabwe (PTY) Ltd	900- 1500	4.8	Ear rot, leaf blight and leaf rust resistant
C 6222	1994	Cargill Zimbabwe (PTY) Ltd	900 – 1500	10.0 – 15.0	Tolerant to ear rot, leaf blight (*Helminthosporium turcicum* Pass) and leaf rust (*Pucinia sorghi*)
PAN 6195	1995	Pannar Seeds Co.Ltd	1000 – 1500	6.0	Tolerant to maize streak, intermediate resistant to ear rot and leaf blight
PAN 6549	1995	Pannar Seeds Co. Ltd	500 – 1500	6.0	Tolerant to rust, maize streak, ear rot and leaf blight.
PAN 6481	1995	Pannar Seeds Co. Ltd	1000- 1500	6.0	Moderately tolerant to maize streak and leaf blight Tolerant to ear rot and rust
PAN 695	1995	Pannar Seeds Co.Ltd	1000 – 1500	6.0	Tolerant to ear rot, leaf blight and rust
C 5121	1997	Cargill - Zimbabwe	1000 – 1600	10.0 – 15.0	Resistant to blight (*Helminthosporium turcicum* Pass), leaf rust (*Pucinia sorghi*), ear rot
C 5051	1999	Cargill - Zimbabwe	1000 – 1600	10.0 – 15.0	Resistant to blight leaf (*Helminthosporium turcicum* Pass), leaf rust (*Pucinia sorghi*), ear rot
PAN 6243	1999	Pannar Seed Co. Ltd	1000 – 1500	8.0	Tolerant to grey leaf spot,Northern Leaf Bright (NLB), rust and ear rot
CRN3631	1999	Monsanto Hybrid Seeds Co.	900 – 1500	8.1	Resistant to ear rot. Moderately tolerant to maize streak virus and grey leaf spot
PHB 30A15	1999	Pioneer Seed Co. Ltd	1000 – 1500	5.0 – 10.0	Partial resistance to maize streak virus. Tolerant to grey leaf spot. Very resistant to leaf blight and ear rot
H 625	2000	Kenya Seed Co. Ltd	1500 – 2400	9.0 – 10.0	Resistant to lodging, leaf rust, leaf blight, drought and grey leaf spot Prolific Good husk cover
H 513	2001	Kenya Seed Co. Ltd	900 – 1500	7.0 – 8.5	It is fairly resistant to moisture stress

Variety	Year of release	Owner(s)/Maintainer	Optimal production altitude range (masl)	Grain yield (t/Ha)	Special attributes/Disease reaction
UH 615	2001	ARI - Uyole	1200 – 1800	6.0 – 8.0	Tolerant to grey leaf spot (GLS) and leaf blight
Lishe H1	2001	ARI - Selian	1000 - 1500	4.0 – 7.0	Quality protein maize [Has 10 % protein like other maize varieties but its protein has twice level of essential amino acids (Lysine and tryptophane)] Tolerant to GLS and *E.turcicum* leaf blight, susceptible to MSV, good resistant to *Diplodia*, Fusarium cob rots and *Puccinia sorghi* rust
Lishe H2	2001	ARI -Selian	500-1600	4.0 -7.0	Quality protein maize [Has 10 % protein like other maize varieties but its protein has twice level of essential amino acids (Lysine and tryptophane)] Very good resistant to Maize streak virus (MSV), good resistant to Grey leaf spot (GLS), Diplodia, Fusarium cob rots, E.turcicum leaf blight and *Puccinia sorghi* rust
Lishe K1	2001	ARI-Selian	500-1600	4.0-6.0	Quality protein maize [Has 10% protein like other maize varieties but its protein has twice level of essential amino acids (lysine and tryptophane)] Susceptile and moderate resistant to Maize Streak and Gley Leaf Spot respectively, good resistant to *Diplodia*, *Fusarium* cob rots, *E.turcicum* leaf blight and *Puccinia sorghi* rust
Situka M1	2001	AR-Selian	1000-1500	3.0-5.0	Tolerant to maize streak and Grey leaf spot. Resistant to *Diplodia*, *Fusarium* leaf bright and *Puccinia sorghi*
Situka 2	2001	AR-Selian	500-1600	4.0-6.0	Tolerant to maize streak and grey leaf spot Resistant to *Diplodia*, *Fusarium*, leaf bright and *Puccinia sorghi*
PAN 15	2001	Pannar Seeds Co. Ltd	500-1500	7.0	Tolerant to maize streak virus, grey leaf spot , northern leaf blight, Rust, ear rot
PAN 77	2001	Pannar Seeds Co. Ltd	>1500	7.0	Tolerant to maize streak virus , grey leaf spot, northern leaf blight, rust, ear rot
PAN 691	2001	Pannar Seeds Co. Ltd	>1500	7.0	Tolerant to maize streak virus, grey leaf spot, northern leaf blight, rust, ear rot
Pwani H04	2001	Kenya Seed Co	0-800	7.0	Well adapted to hot, humid low lands, Partially resistant to maize streak virus
CRN 3891	2001	Monsanto Hybrid Seeds Co.	900-1500	8.0-9.0	Moderately tolerant to maize streak virus
DK 8071	2001	Monsanto Hybrid Seeds Co.	1000-1600	8.0-9.0	Tolerant to grey leaf spot and rust
PHB 30H83	2001	Pioneer Seed Co.	800-1800	7.0-10.0	Medium resistant to leaf blight and rust, ear rot and grey leaf spot resistant
SC 627	2001	Seed Co. Ltd	500-1400	5.0-10.0	Excellent resistance to grey leaf spot. Moderately resistant to rust and resistant to leaf blight. Good stress tolerance, lodging resistance and prolificacy. Has very good adaptability. Rust resistance: average
PHB 30G97	2001	Pioneer Seed Co.	800-1500	7.0-10.0	Tolerant to grey leaf spot and ear rot.
DH 01	2002	Kenya Seed Co.	90-120	2.0-5.0	Drought resistant and good husk cover
H 628	2002	Kenya Seed Co.	150-180	9.0-12.0	Lodging resistant
DK 8051	2002	Monsanto Hybrid Seeds Co.	120-140	6.0-9.0	Excellent tolerance to grey leaf spot
DK 8031	2002	Monsanto Hybrid Seeds Co.	100-110	5.0-8.0	Good tolerance to grey leaf spot.
Longe 4	2003	FICA SEED Ltd	900 -1500	6.38	Have acceptable levels of resistance to foliar diseases. Drought tolerant and Maize Streak resistant
Longe 2H	2003	FICA SEED Ltd	900 – 1500		
DH 04	2003	Kenya Seed Co. Ltd	500-1200	8.0	Very good resistant to Leaf blight and Leaf Rust
DH 03	2003	Kenya Seed Co. Ltd	200-1000	Above 6.0	Resistant to Cob rots
KS H519	2003	Kenya Seed Co. Ltd	1400-1700	Above 8	Good resistant to Leaf blight and Leaf Rust
SC 407	2003	SEED CO. Ltd	500-1400	1-8	Good stress tolerance and fairly good tolerance to Grey leaf Spot (GLS). Has good tolerance to Maize Streak Virus (MSV)
SC 403	2003	SEED CO. Ltd	500-1400	1-6	Very good adaptability and stress tolerance, good lodging resistant Very good resistant to MSV, good resistant to cob rots and leaf blight, and moderate rust rust resistance

Variety	Year of release	Owner(s)/Maintainer	Optimal production altitude range (masl)	Grain yield (t/Ha)	Special attributes/Disease reaction
SC 513	2003	SEED CO. Ltd	500-1400	4-9	Moderate resistant to Cob rots and good resistant to Leaf blight (*Helminthrosporium turcicum*) and Rust resistance Excellent tolerant to grey leaf spot Prone to Phaeosphaeria leaf spot Good adaptability and stress tolerance
H 515	2003	Kenya Seed Co. Ltd	1200-1600	4-5	
SC 713	2003	SEED CO. Ltd		6-13	It has excellent tolerance to Maize Streak Virus (MSV) and good tolerance to Gley Leaf Spot (GLS)
PAN 23	2003	Pannar (Pty) Ltd	850-1500	4-7	Good resistant to Cob rots, Leaf blight (*Helminthrosporium turcicum*) and Leaf Rust
PAN 33	2003	Pannar (Pty) Ltd	850 – 1500	4-7	Good resistant to Maize Streak Virus, Cob rots, Leaf blight (*Helminthrosporium turcicum*) and Leaf rust
PAN 63	2003	Pannar (Pty) Ltd	850 – 1500	5-8	Good resistant to Maize Streak Virus, Cob rots, Leaf blight (*Helminthrosporium turcicum*) and Leaf rust
UH 615	2003	ARI Uyole	1200 – 1800	8-9	Good level of tolerance to Grey Leaf Spot Lodging resistance
PAN 4M-17	2004	Pannar (Pty) Ltd	0- 1500	4-6	Good resistant to Cob rots, Leaf blight (*Helminthrosporium turcicum*), and Leaf Rust Good adaptability, stress tolerance, lodging resistance, and prolificacy
PAN 4M-19	2004	Pannar (Pty) Ltd	0-1500	4-7	Good resistant to Cob rots, Leaf blight (*Helminthrosporium turcicum*), and Leaf Rust
UH 6303	2004	ARI-Uyole	1200-1800	9-10	Good resistant to Leaf blight (*Helminthrosporium turcicum*), and Grey Leaf Spot
Longe 6H	2004	Finca Seed Ltd	900 – 1500	8 -9	Drought tolerant. Good poundability. Early maturity
TAN H611	2006	Tanseed International Ltd	Low to medium	4-7	Good resistance to Maize streak virus, *Turcicum* leaf blight, Cob rots, Grey leaf spot and Common rust Has twice level of essential amino acids: Lysine and Tryptophane than normal maize
TAN 250	2006	Tanseed International Ltd	Low to medium	3-5	Excellent resistance to Maize streak virus and Grey leaf spot, good resistance to *Turcium* leaf blight, Cob rot and Common rust
TAN 254	2006	Tanseed International Ltd	Low to medium	4-6	Good resistance to Maize streak virus, *Turcicum* leaf blight, Cob rots, Grey leaf spot and Common rust
VUMILIA K1	2007	ARI Selian	Medium	Late	Very good resistant to Maize Sreak Virus
VUMILIA H1	2007	ARI Selian	Medium	Late	Good resistant to Maize Sreak Virus, cob rots, leaf blight and rust
WH 505	2007	Western Seed Co. Ltd	1000-1800	135-150	Tolerant to Maize Streak Virus, Leaf blight, and rust
WH 502	2007	Western Seed Co. Ltd	1000-1800	135-165	Tolerant to Maize Streak Virus, Leaf blight, and rust
WH 403	2007	Western Seed Co. Ltd	1000-1800	135-165	Tolerant to Maize Streak Virus, Leaf blight, and rust

- **Species: Paddy (*Oryza sativa*)**

Variety	Year of release	Owners/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes
Supa	Before 1950's	ARI Katrin	0-400	1.5-3.5	-Leaf blade pubescence: pubescent -Leaf angle: erect -Auricle colur: pale green -Days to heading: 93-100 -Culm angle:erect -Flage leaf angle:erect -Panicle type:intermediate -Second branching: light -Awn presence:absent -Grain shape:slender -Seed coat colour: white	Moderately resistant to rice yellow mottle virus and shealth rot

Variety	Year of release	Owners/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes
IR 54	1980's	ARI Katrin	400-600	4.0-7.0	-Leaf blade pubescence:intermediate -Leaf angle:erect -Auricle colur:pale green -Days to heading:93-100 -Culm angle:intermediate -Flage leaf angle:erect -Panicle type: intermediate -Second branching:heavy -Awn presence:long and partly awned -Awn colur:gold -Grain shape: some white belly -Seed coat colour:white -Scent (aroma):aromatic	Moderately resistant to blight and sheath rot
IR 22	1983	ARI Katrin	400-1000	6.6-8.0	Days to maturity: 120-134	Resistant to bacterial blight
KATRIN	1983	ARI Katrin	400-1000	6.6-8.0	-Leaf blade pubescence: intermediate -Culm angle:erect -Flage leaf angle:erect -Panicle type: compact -Second branching -Awn presence:absent -Scent (aroma):not scented Plant height: medium statured	Very low panicle shattering
Dakawa	1990	Dakawa	400-1000	3.5-5.2	-Leaf blade pubescence: pubescent -Leaf angle:horizontal -Days to heading: 75-85 days -Culm angle:intermediate -Flage leaf angle:horizontal -Panicle type: compact -Awn presence:absent -Awn colur:absent -Grain shape:medium slender grains -Seed coat colour: straw -Scent (aroma): scented -Plant height: 108 cm (semi-tall)	None-photoperiod sensitive. Resistant to lodging except under very high N levels. Easy to thresh
TXD 85	2001	Dakawa	0-400	4.8-7.0	-Leaf blade pubescence: glabrous -Leaf angle:erect -Days to heading:98-98 days -Flage leaf angle:erect -Panicle type: intermediate -Awn presence:short and partly awned -Awn colur: gold -Grain shape:slender -Scent (aroma): lightly scented -Plant height: semi-dwarf 103.5 cm	Moderately resistant to sheath rot, rice blast and Rice Yellow Mottle Virus
TXD 88	2001	Dakawa	0-400	2.8-6.5	-Leaf blade pubescence:glabrous -Leaf angle:erect -Days to heading:86-95 days -Flage leaf angle:erect -Panicle type: intermediate -Plant height: semi-dwarf -Awn presence: absent -Grain shape:slender -Scent (aroma):lightly scented	Moderately resistant to shealth rot, rice blast and Rice Yellow Mottle Virus
TXD 306 (Saro 5)	2002	Dakawa	0-600	4.0-6.5	-Leaf blade pubescence:pubescent -Leaf angle:mixture of different types -Days to heading: 100-102 -Flage leaf angle: mixture of different types -Panicle type: intermediate Awn presence:absent Seed coat colour: light brown Scent (aroma): semi-aromatic	Moderated susceptible to Rice Yellow Mottle Virus and sheath rot. Adapted to rain-fed lowlands and irrigated ecosystems.

Variety	Year of release	Owners/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes
Kalalu	2006	SUA		2-3	-Leaf blade pubescence: glabrous -Leaf angle: horizontal -Flage leaf angle: horizontal -Panicle type:intermediate -Awn presence: shortly and partly awned -Scent (aroma): -Plant height: 118 cm	Resistant to Rice Yellow Mottle Virus and Rice blast
Mwangaza	2006	SUA		2-3	-Leaf blade pubescence: glabrous -Leaf angle:horizontal -Flage leaf angle: horizontal -Panicle type: heavy -Awn presence:shortly and fully awned -Plant height: 118 cm	Resistant to Rice Yellow Mottle Virus and Rice blast

- **Species: Wheat (*Triticum aestivum*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Mamba	1973	ARI Selian	1283-2400	2.0-3.0		Resistant to stripe rust
Nyati	1973	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: strong -Flag leaf altitude: drooping -Culm glaucosity: strong -Sheath glaucosity: strong -Spike density:moderate dense -Spike glaucosity: weak -Awns: very long -Plant height: 87 cm -Awn colour: -white -Colour:medium red Shape: elliptical and shrivelled	Moderately resistant to yellow, leaf and stem rusts.
Mbuni	1975	ARI Selian	1200-2400	1.5-4.1	-Leaf glaucosity: weak -Growth habit: upright -Culm glaucosity: semi-prostate -Auricle pubescence: strong -Sheath glaucosity: strong -Spike shape: fusion -Spike density: lax -Spike glaucosity: weak -Awns: awned -Glume pubescence:absent -Glume colour:light green -Plant height: 80 cm -Awn colour: white -Spike attitude: inclined - Kernel colour:white - Kernel shape: ovate	Susceptible to leaf, stem and yellow rust.
Kweche	1975	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: weak -Growth habit:upright -Culm glaucosity: mod+pubscence -Stem node pubescence: absent -Auricle pubescence: weak -Sheath glaucosity: strong -Spike shape: fusform -Spike density: mid-dense -Spike glaucosity: strong -Awns: awned -Glume pubescence:absent -Glume colour:bluish green -Plant height : 104 cm -Spike attitude: nodding -Kernel colour:medium red -Kernel shape: elliptical and shrivelled	Medium susceptible to yellow rust

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Trophy	1975	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: weak -Growth habit:upright -Flag leaf altitude: erect -Culm glaucosity: strong -Auricle pubescence: weak -Sheath glaucosity: strong -Spike shape: oblong -Spike density: lax -Spike glaucosity: medium -Awns: spical awnletted -Glume pubescence:absent -Plant height: 113 cm -Spike attitude: erect -Kernel colour:medium red -Kernel shape: ovate	Medium red seed colour. Susceptible to yellow rust
Tai	1977	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: weak -Growth habit: upright -Culm glaucosity: medium -Auricle pubescence: weak -Sheath glaucosity: oblong -Spike shape: mid-dense -Spike density: weak -Spike glaucosity: weak -Awns: awned -Glume pubescence:absent -Glume colour:light green -Plant height: 109 cm -Awn colour: brown -Spike attitude: inclined Kernal colour:dark red Kernal shape: ovate	Has dark red kernel colour Moderately susceptible to yellow and stem rust.
Kozi	1977	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: weak -Growth habit: upright -Culm glaucosity: strong -Steam node pubescence: medium -Auricle pubescence: absent -Sheath glaucosity: strong -Spike shape: oblong -Spike density: mid-lax -Spike glaucosity: weak -Awns: awned -Glume pubescence:absent -Glume colour:light green -Plant height : 80 cm -Awn colour: white -Spike attitude: inclined -Kernel colour:white -Kernel shape: ovate	Has dark red kernel colour Moderately susceptible to yellow rust
Joli	1977	ARI Selian	1283-2400	2.0-3.0	-Leaf glaucosity: weak -Growth habit: upright -Culm glaucosity: medium -Steam node pubescence: absent -Auricle pubescence: weak -Sheath glaucosity: strong -Spike shape: fusion -Spike density: lax -Spike glaucosity: weak -Awns: awned -Glume pubescence:absent -Glume colour:grass green -Plant height:85 cm -Awn colour: white -Spike attitude: nodding -Kernel colour:white - Kernel shape: ovate	Moderately resistant to yellow rust.

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Viri	1983	ARI Selian	1283-2400	1.5-4.7	-Leaf glaucosity: medium -Groth habit: upright -Culm glaucosity: strong -Auricle pubescence: medium -Sheath glaucosity: strong -Spike shape: oblong -Spike density: mid dense -Spike glaucosity: medium -Awns: awned -Glume pubescence:absent -Glume colour:bluish green -Plant height:89 cm -Awn colour: white -Spike attitude: inclined - Kernel colour:white -Kernel shape: ovate	Resistant to yellow and leaf rust. Moderately susceptible to stem rust.
Mbayuwayu	1987	ARI Selian	1200-2400	1.4-2.8	-Leaf glaucosity: strong -Growth habit: erect -Flag leaf altitude: erect -Culm glaucosity: strong -Spike density: medium -Awns: medium -Plant height: 92 cm -Awn colour: white -Spike attitude: inclined -Kernel colour:pale red -Kernel shape: ovoid	Moderately resistant to yellow, stem and leaf rusts. Has brown seed colour.
Azimio 87	1987	ARI Selian	1200-1800	1.8-3.0	-Growth habit: erect -Flag leaf altitude: erect -Culm glaucosity: strong -Spike density: strong -Awns: strong -Glume pubescence: -Plant height: 80 cm -Awn colour: white -Spike attitude: inclined -Kernel colour:white -Kernel shape: semi-elongated	Resistant to stem, leaf and yellow rusts.
Tausi	1987	ARI Selian	1283-2400	2.0-4.0	-Leaf glaucosity: strong -Growth habit: erect -Flag leaf altitude: erect -Culm glaucosity: strong -Spike density: strong -Plant height:70 cm -Awn colour: white -Spike attitude: inclined -Kernel colour:white	Susceptible to leaf, stem and yellow rusts.
Tembo					-Leaf glaucosity: weak -Growth habit:upright -Flag leaf altitude: -Culm glaucosity: mod+pubscence -Steam node pubescence: absent -Auricle pubescence: weak -Sheath glaucosity: strong -Spike shape: fusform -Spike density: mid-dense -Spike glaucosity: strong -Awns: awned -Glume pubescence:absent -Glume colour:bluish green -Plant height: 104 cm -Spike attitude: nodding -Kernel colour:medium red	
Selian 87	1987	ARI Selian	1200-1800	1.8-3.0	-Leaf glaucosity: strong -Growth habit: erect -Flag leaf altitude: erect -Culm glaucosity: strong -Spike density: medium -Awns: medium -Plant height: 92 cm -Awn colour: white -Spike attitude: inclined -Kernel colour:pale red -Kernel shape: ovoid	Highly resistant to stem, leaf and yellow rusts
Juhudi No. 1	1987	TANWAT	1700-2200	3.0-4.0	-Days to maturity: 90-110	Resistant to all yellow, stem and leaf rusts. Resistant to *Septoria*

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Njombe 6	1987	TANWAT	1500-2400	2.1-4.1	- Days to maturity:110-120	Highly resistant to leaf, stem and yellow rusts
Njombe 7	1987	TANWAT	1500-2400	3.0-4.2	- Days to maturity: 110-120	Highly resistant to all rusts *Fusarium* spp and root fungi. Resistant to *Septoria* spp.
Kware	1989	ARI Selian	1300-1400	2.0-3.0	-Growth habit:erect -Flag leaf altitude: straight -Culm glaucosity: strong -Auricle pubescence: absent -Spike shape: straight inclined -Spike density: mid-dense -Awns: present -Glume colour:white at maturity -Awn colour: -blue green before, maturity white maturity Spike attitude: nodding -Kernel colour:white -Kernel shape: ovate	Moderately resistant to yellow, leaf and stem rusts. Moderately resistant to *Septoria*, leaf and spot blotch
Chiriku	2002	ARI Selian	1300-2400	2.2		Slow rusting
Sifa	2004	ARI Uyole	1700-2300	4.5 – 5.0	-Growth habit:erect -Culm glaucosity:present-whitish -Auricle pubescence: hairs present -Spike density: dense -Awns: awned -Glume pubescence: very weak or absent -Glume colour:whitish green -Kernelcolour:yellow -Kernel shape: ovate -Plant height: 83 cm	Moderate resistant to Septorial leaf blotch and Stripe rust
Riziki C_2	2006	ARI Selian	1000 - 1500	2.7	-Leaf glaucosity: present (medium) -Growth habit:erect -Culm glaucosity:weak -Auricle pubescence: medium -Sheath glaucosity: medium -Spike shape: parallel -Spike density: medium -Spike glaucosity: medium -Awns: awned -Glume pubescence: absent -Glume colour:straw white -Plant height:86 cm -Awn colour: -white -Spike attitude: straight -Kernel colour:brown -Kernel shape: semi elongated	Moderate resistant to Stripe rust, Stem and Leaf rust
Riziki C_1	2006	ARI Selian	1000-2000	3.5	-Leaf glaucosity: absent -Growth habit: erect -Culm glaucosity: absent -Auricle pubescence: weak -Sheath glaucosity: absent -Spike shape: parallel -Spike density: medium -Spike glaucosity: absent -Awns: awned -Glume colour:white -Plant height: 99 cm -Awn colour: white -Spike attitude: straight -Kernel colour:brown -Kernel shape: semi elongated	Moderate resistant to Stripe rust, Stem and Leaf rust

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Lumbesa	2006	ARI Selian	1000-2000	3.5	-Leaf glaucosity: absent/ weak -Growth habit: erect -Culm glaucosity: absent -Auricle pubescence: weak -Sheath glaucosity: absent/ weak -Spike shape: parallel -Spike density: medium -Spike glaucosity: absent/ weak -Awns: awned -Glume pubescence:medium -Glume colour:straw white -Plant height: 80 cm -Awn colour: white -Spike attitude: straight -Kernel colour:brown -Kernel shape: semi elongated	Moderate resistant to Stripe rust, Stem and Leaf rust

- **Species: Wheat (*Triticum durum*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Duma	1983	ARI Selian	1283-2400	1.1-4.5	-Leaf glaucosity: weak -Growth habit:upright -Culm glaucosity: strong -Auricle pubescence: absent -Sheath glaucosity: strong -Spike shape: oblong -Spike density: mid-dense -Spike glaucosity: strong -Awns: awned -Plant height: 79 cm -Awn colour: -brown -Spike attitude: inclined -Kernel colour:amber -Kernal shape: ovate	Resistant to stem rust

- **Species: Barley (*Hordeum vulgare* L.)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (Tons/Ha)	Distinctive Characters	Special attributes/Disease reaction
Makete 1 (naked barley)	1987	ARI Uyole	1850-2500	2.0-3.5	-Ear glaucosity: weak -Flag leaf altitude: drooping -Culm glaucosity: strong -Plant height : 80 cm	Resistant to leaf rust and tan spot
Kibo	1991	ARI Serian	1300-1900	3.5-4.0	Growth type: erect -Colour of leaves : green -Tillering capacity: moderate -Spike: spikelets have long awns -Colour of spike at grain filling: light green -Awns colour: light green -Hairiness of awns: rough	Moderate malting quality. Resistant to powdery mildew, loose and covered smut. Resistant to leaf and stem rusts.

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (Tons/Ha)	Distinctive Characters	Special attributes/Disease reaction
Subira	1995	TBL	1300-200	2.6	-Growth type: erect -Spike density: long very lax -Colour of spike at grain filling: pinkish -Leaf colour: green -Length and shape of basal rachis internode: short, curved -Degree of awning: moderate -Plant height: 60 cm -Awns colour: pinkish -Hairiness of awns: rough	Moderate malting quality. Resistant to powdery mildew, loose and covered smut Resistant to leaf and stem rusts. Tolerant to net and spot blotches.
8519	1996	TBL	1000-1200	2.0-3.5	-Growth type: erect -Colour of leaves : pale green -Size of leaves: large -Tillering: fair -Spike density: long very lax -Colour of spike at grain filling: green -Colour of spike at grain filling: pinkish -Awns colour: pinkish -Hairiness of awns:	Moderate malting quality. Tends to have high N content. Resistant to powdery mildew, loose and covered smut. Resistant to leaf and stem rusts. Tolerant to net and spot blotches
Bima	1998	TBL	1500-2200	1.0-2.1	-Growth type: semi-erect -Colour of leaves: pale green -Size of leaves: small -Tillering: heavy -Spike density: medium lax -Colour of spike at grain filling: pinkish -Plant height: medium -Awns colour: pinkish	Very good malting quality. Resistant to powdery mildew, loose and covered smut. Resistant to leaf and stem rusts. Susceptible to net and spot blotches.
Kusini	2001	TBL	1000-1200	2.0-3.0	-Growth type: erect -Colour of leaves: pale green -Size of leaves: small -Tillering: medium -Spike density: medium lax -Number of fertile rows in spike: 2 -Colour of spike at grain filling: pinkish -Plant height: medium -Awns colour: green	Good malting quality. Resistant to powdery mildew, loose and covered smut. Resistant to leaf and stem rusts. Tolerant to net and spot blotches. Susceptible to lodging in more fertile and humid environment.
9831	2004	TBL	1000-1200	80 - 90	-Growth type: erect -Colour of leaves: pale green -Spike density: medium lax -Colour of spike at grain filling: strongly pink -Plant height: medium -Awns colour: strongly pink -Grain length: medium long -Days to 50 % ear emergency: early, about 50 DAP	Disease Reaction: Moderate

- **Species: Oats (*Avena sativa*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive Characters	Special attributes/Disease reaction
Kudu	1987	ARI Uyole	1770-2350	7.0	-Standability at late tillering:erect -Plant height: 121 (cm) -Culmglaucosity:medium -Flag leaf attitude at booting:droopping -Flag leaf sheath glaucosity:strong -Flag leaf hairiness:weak -Leaf blade glaucosity:weak -Mature ear colour:white -Ear glaucosity:very weak -Ear density:loose -Degree of awning:slight -Grain brush hairs:heavy -Days to spike emergence:65-70	Forage crop. Resistant to *Septoria*, crown rust and tan spot

- **Species: Triticale (*x Triticosecale*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive Characters	Special attributes/ Disease reaction
T. Tembo	1982/3	ARI Uyole	1000-2400	3.4	-Leaf glaucosity: weak -Growth habit: upright -Culm glaucosity: medium -Sheath glaucosity: strong -Spike density: mid dense -Spike glaucosity: strong -Awns: awned -Plant height: 104 cm -Awn colour: white -Kernel colour:medium red -Kernel shape:elliptical and shrived	Resistant to all rusts, tolerant to tan spots, spot blotch and *Septoria*
Uyole Sangara	1986/7	ARI Uyole	1500-2400	>4.0	-Leaf glaucosity: weak Growth habit: erect -Days to 50 % flowering: 68-76 days -Culm glaucosity: medium -Sheath glaucosity: strong -Spike density: weak -Spike glaucosity: weak -Awns: awned medium -Plant height: 107 cm -Awn colour: white -Kernel colour:white -Kernel shape:elliptical	Resistant to all rusts and *Septoria*
TANWAT T.87	1987	TANWAT	1500-2400	4.0	-Leaf glaucosity: weak -Growth habit: semi prostate -Culm glaucosity: medium -Sheath glaucosity: medium -Spike glaucosity: medium -Awns: awned -Plant height: 127 cm -Awn colour: brown -Kernel colour: ambercolour -Kernel shape:elliptical	Resistant to *Septoria, Helminthosporium* and *Fusarium* spp

- **Species: Sorghum (*Sorghum bicolor*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive Characters	Special attributes/Disease reaction
Serena	1960	EAC	600-1500	3.0-3.5	Grain colour: red	Tolerant to *Striga hermonthica* and *S. asiatica* and S. *Forbesii*.
Tegemeo	1978	ARI Ilonga	600-1500	2.5-3.0	-Hairiness: absent -Plant colour: tan -Leaf colour: light green, some plants have puplish pigments on lower leaves -Plant height: 1.5-1.8 m -Days to 50 % flowering: 70-72 -Awn at maturity: absent -Head shape: bell -Grain colour: white (pearl), -Glume colour: straw,	Susceptible to *Striga* hermonthica and S. *asiatica* and S. *Forbesisi*.
Pato	1997	ARI Ilonga	600-1500	1.6-3.3	-Leaf colour:green medium leafy, drooping -Plant height: 190 -240 cm -Days to 50 % flowering: 67-72 days, -Head shape: medium sized semi open, short bulky heads -Grain colour: creamy white with purple specks -Glume colour: black, very conspicuous -Grain form: elliptic	Susceptible to *Striga hermonthica* and S. *asiatica* and *S. Forbesisi*
Macia	1998	ARI Ilonga	600-1500	2.5-3.0	-Plant colour: tan -Plant height: 120-150 cm (semi-dwarf) -Days to 50 % flowering: 60-65 -Awn at maturity: absent -Head shape: symmetric, semi-compact, large and bulbous with good exertion (10-15 cm) -Grain colour: creamy white -Grain form: elliptic	Moderately resistant to *Striga hermonthica* and *S. asiatica* and S. *Forbesii*
Wahi	2002	ARI Ilonga	600-1500	3.5	-Stem diameter of lower third (at maturity): large -Glume colour at maturity: reddish brown -Glume length at maturity: short -Cariopsis colour after threshing: straw yellow -Grain shape in dorsal view: circular -Grain shape in profile view: circular - Leaf width: broad	Highly tolerant to *Striga hermonthica,* S. *asiatica* and *S. Forbesii.* Resistant to leaf blight and sooty stripe. Susceptible to long smut.
Hakika	2002	ARI Ilonga	600-1500	3.5	Stem diameter of lower third (at maturity): small -Glume colour at maturity: reddish brown -Short -Glume length at maturity: short -Cariopsis colour after threshing:orange -Grain shape in dorsal view: elliptic -Grain shape in profile view: elliptic - Leaf width: narrow -Rooting ability : has high power of rooting	Resistant to *Striga hermonthica* and *S. asiatica* and S. *forbesii.* Resistant to leaf blight.

- **Species: Pearl Millet (*Pennisetum glaucum*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Shibe	1994	ARI Ilonga	0-1200	1.8-2.0	-Tillering attitude at head emergency: erect -Spike shape:cylindrical -Bristle length :absent -Days to flowering: 90-95 -Spike shape:cylindrical -Seed colour:grey -Seed shape:obovate -Plant height (m):1.5-2.5	Resistant to *Striga hermonthica* and *S. asiatica* and *S. Forbesii*
Okoa	1994	ARI Ilonga	0-1300	2.0-2.5	-Tillering attitude at head emergency: erect -Spike shape:cylindrical -Bristle length :absent -Days to flowering: 87-92 -Spike shape:cylindrical -Spike density at maturity: compact -Seed colour:grey -Seed shape:obovate -Plant height (m):1.8-2.8	Resistant to *Striga hermonthica* and *S. asiatica* and S. *Forbesii* Moderately tolerant to ergot disease (Sugary disease)

- **Species: Bean (*Phaseolus vulgaris*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Canadian wonder	1977	ARI Selian	1000-1800	1.1-2.4	-Anthocyanin colouration:present - Leaf colour:green -Growth habbit:upright erect -Twining tendency: absent -Plant height (cm):46 -Days to flowering:33 -Flower colour:purple -Pod colour at maturity:yellow -Seed shape:kidney -Testa texture:smooth -Testa colour:dark red -Seed size:large	Moderately resistant to halo blight and bean common mosaic virus
Kabanima	1980	ARI Uyole	1200-1800	1.5-1.8	-Anthocyanin colouration:present -Leaf colour:green -Growth habbit:upright erect -Twining tendency: absent -Plant height (cm):40 -Days to flowering:39 -Flower colour:white -Pod colour at maturity:cream -Seed shape:kidney -Testa texture:smooth -Testa colour:mottled red -Seed size:large	Resistant to anthracnose and rust
Uyole 84	1984	ARI Uyole	900-2000	1.5-2.0 (non staked) 2.5-4.0 (staked)	-Anthocyanin colouration:absent -Leaf colour:light green -Growth habbit:climber (aggressive) -Twining tendency: present -Plant height (cm): up to 200 -Days to flowering:42-46 days -Flower colour:white -Pod colour at maturity:cream yellow -Seed shape:round and semi -Testa texture:smooth -Seed size:medium	Resistant to anthracnose and halo blight
Uyole 90	1990	ARI Uyole	1500-2000	1.5-2.0	-Days to maturity: 60-62 -Days to 50 % flowering: 30-32	It is tolerant to halo blight and angular leaf spot

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Uyole 94	1994	ARI Uyole	1000-1800	1.0-1.8	Days to maturity: 90-92 -Days to 50 % flowering: 40	Resistant to *ascochyta* and rust, tolerant to Bean Common Mosaic Virus and Angular Leaf Spot
Uyole 96	1996	ARI Uyole	1000-1800	1.0-1.8	Days to maturity: 85 -Days to 50 % flowering: 38	Tolerant to rust, ascochyta and Bean Common Mosaic Virus
Uyole 98	1998	ARI Uyole	1000-2000	1.2-2.0	-Days to maturity: 85 -Days to 50 % flowering: 38	Resistant to anthracnose, angular leaf spot and rust. Tolerant to halo blight and *ascochyta*
Ilomba	1990	ARI Uyole	1200-2000	1.5-2.5	-Days to maturity: 88 -Days to 50 % flowering: 40	Resistant to anthracnose, halo blight and rust, Tolerant to *ascochyta*
Lyamungu 85	1985	ARI Lyamungu	900-1800	1.2-1.5	-Anthocyanin colouration:present - Leaf colour:green -Growth habbit:upright erect -Twining tendency: absent -Plant height (cm):46 -Days to flowering:33 -Flower colour:purple -Pod colour at maturity:yellow -Seed shape:kidney -Testa texture:smooth -Seed size:large	Resistant to anthracnose, angular leaf spot, Bean Common Mosaic Virus and intermediate to common bacteria blight.
Lyamungu 90	1990	ARI Lyamungu	900-1800	1.2-1.6	-Days to maturity: 80-85	Has low tannin content Resistant to leaf rust and anthracnose
Selian 94	1994	ARI Selian	900-1500	2.5-3.5	-Anthocyanin colouration:weak -Leaf colour:dark green -Growth habbit: erect -Twining tendency: present -Plant height (cm):50-60 -Days to flowering:42 -Flower colour:pink -Pod colour at maturity:light yellow -Seed shape:oval -Testa texture:smooth -Testa colour:light pink with red speckles -Seed size:medium	Moderately susceptible to anthracnose and angular leaf spot
Jesica	1997	ARI Selian	1000-1500	2.0-3.4	-Days to maturity: 80-85 -Days to 50 % flowering: 35	Resistant to anthracnose, Bean Common Mosaic Virus and halo blight, moderately resistant to bean rust, angular leaf spot, common bacterial blight
Selian 97	1997	ARI Selian	1000-1500	2.0-2.8	-Leaf colour:dark green -Growth habbit:strong erect stem with braches -Twining tendency: absent -Plant height (cm):40 -Days to flowering:40 -Flower colour:pink -Pod colour at maturity:light yellow -Seed shape:kidney -Testa texture:smooth Testa colour: red (but lighter than Canadian wonder) -Seed size:large	Resistant to anthracnose, Bean Common Mosaic Virus and halo blight, moderately resistant to bean rust, angular leaf spot, common bacterial blight
Rojo	1997	SUA	<1000	2.2	-Days to maturity: 67-74 -Days to 50 % flowering: 32-37	Resistant to Bean Common Mosaic Virus, moderately resistant to common bacterial blight and nematodes. Grains are fast cooking

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Wanja	2002	ARI Uyole	800-1800	1.5	-Anthocyanin colouration:green -Leaf colour:green -Growth habbit:upright -Twining tendency: absent -Plant height (cm):35-45 Days to flowering:38-38 -Flower colour:pink -Pod colour at maturity:cream -Seed shape:larege kidney -Testa texture:smooth -Testa colour: greenish Khaki -Seed size:large	Early maturity and drought tolerant. Large khaki seeds with black halo around the hilum
BILFA 16	2004	ARI Uyole	1000-1900	1.5-2.5	-Anthocyanin colouration:green -Leaf colour:green -Growth habbit:bushy with many branches -Twining tendency: absent -Plant height (cm):40-44 -Days to flowering:30-38 -Flower colour:pink -Pod colour at maturity:yellow -Seed shape:plumb -Testa texture:smooth -Testa colour: broken white stripes on dark red background -Seed size:medium	Tolerant to Halo blight, Drought resistant Resistant to Anthracnose and bean rust
Uyole 04	2004	ARI Uyole	1200-2000	2.0 – 2.5	-Leaf colour:green -Growth habbit: many branches and tendency to tail -Twining tendency: semi climber -Plant height (cm):45-60 -Days to flowering:30-38 -Flower colour:pink -Pod colour at maturity:pale cream/whitish -Seed shape:kidney -Testa texture:smooth -Seed size:large	Resistant to Bean rust, Anthracnose and Tolerant to Halo blight and drought
Pesa	2006	SUA	Low to medium	0.9-1.5	-Growth habbit:bush -Twining tendency: none -Plant height (cm):44 -Days to flowering:28-32 -Flower colour:pink - Pod colour at maturity:light brown -Seed shape:kidney -Testa texture:smooth -Testa colour: dark red	Moderate resistant and Angular Leaf Spot. Resistant to Bean Common Mosaic Virus and short to modern cooking time
Mshindi	2006	SUA	Low to medium	0.9-1.5	-Anthocyanincolouration :present -Leaf colour:green -Growth habbit:bush -Twining tendency: none -Plant height (cm):48 -Days to flowering:28-32 -Flower colour:pink -Pod colour at maturity:light brown -Seed shape:roundish -Testa colour:grey mottled -Seed size:medium	Moderate resistant to Angular Leaf Spot and Resistant to Bean Common Mosaic Virus Has short to modern cooking time
Selian 05	2005	ARI Selian	1000-1500	1.0-1.6	-Days to flowering:43 -Flower colour:white -Pod colour at maturity:yellow -Seed shape:oval -Testa colour: khaki -Seed size:large	Resistant to Bean rust, Anthracnose, Mosaic Virus, and Halo blight
SELIAN 06	2007	ARI Selian	>1500	2.5-3.0	-Days to flowering:40 -Flower colour:white -Pod colour at maturity: light brown -Seed shape:oval -Testa colour: white -Seed size:medium	Resistant to Bean rust, Anthracnose, Mosaic Virus, and Halo blight

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/ Disease reaction
Cheupe	2007	ARI Selian	>1500	2.5-3.0	-Days to flowering:42 -Flower colour:white -Pod colour at maturity: light brown -Seed shape:oval -Testa colour: white -Seed size:medium	Resistant to Bean rust, Anthracnose, Mosaic Virus, and Halo blight

- **Species: Cow pea (*Vigna unguiculata*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Tumaini	1978	ARI Ilonga	0-1500	2.4	-Leaf colour:darkness Leaf texture: smooth -Growth habbit:indeterminate -Twining tendency: slight -Days to flowering:48 -Flower colour:purple -Seed colour: tan -Seed shape:kidney -Seed size:medium	Resistant to mosaic virus and intermediately resistant to bacterial blight
Fahari	1978	ARI Ilonga	0-1500	2.4	-Growth habbit:indeterminate -Twining tendency: semi-erect -Days to flowering:50 -Flower colour:purple -Seed colour: cream -Seed shape:kidney	Resistant to mosaic Virus
Vuli 1	1984	ARI Ilonga	0-1500	1.8-2.0	-Leaf texture: smooth -Growth habbit:determinate -Twining tendency: erect -Flower colour:purple -Seed colour: red -Seed shape:kidney	Resistant to mosaic virus and intermediately resistant to bacterial blight
Vuli 2	2003	ARI Ilonga	Below 1500	2.0-2.5	-Growth habbit:determinate -Twining tendency: semi-trailing -Flower colour:purple -Seed colour: white/cream -Seed shape:kidney	Moderately susceptible to pests Resistant to, Bacterial blight, Cowpea Mosaic Virus

- **Species: Green gram (*Phaseolus aureus* syn. *Vigna radiata* var. *radiata*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Nuru	1978	ARI Ilonga	0-1350	1.5	-Growth habbit: determinate -Plant height (cm): 14-66 -Days to flowering:50 -Flower colour:purple -Pod colour at maturity: black -Seed shape:rhomboid -Testa texture:smooth	Resistant to mosaic virus and intermediately resistant to bacterial blight
Imara	1982	ARI Ilonga	0-1350	1.5	-Growth habbit: semi-prostate -Plant height (cm): 42 -Flower colour:purple -Pod colour at maturity: brown -Seed shape:rhomboid -Testa texture:smooth -Seed size: Large than Nuru	Resistant to mosaic virus and moderately resistant to bacterial blight. Wide adaptability

- **Species: Pigeon pea (*Cajanus cajan*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (Tons/Ha)	Distinctive characters	Special attributes/Disease reaction
Komboa	1999	ARI Ilonga	<1500	4.0 (grain) and 10.0 (green pods)	-Growth habbit:compact -Plant height (cm): 100 -Days to flowering:65 (under optimum temp. 20-24^{0}C) -Base flower colour: red (exterior) -Second flower colour:orange (interior) -Duration of flowering: sychronous -Pod colour: green with slight striples -Seed colour pattern: mottled -Seed eye colour:brown -Base seed colour: white (cream) -Seed second colour: brown	Early maturing variety
Mali	2002	ARI Ilonga	500-1500	1.0 – 3.0	-Growth habbit:compact to semi-erect -Growth habbit:compact -Leaf: large and green -Plant height (cm): 100 -Days to flowering:113-130 -Flower: ivory-coloured and do not open fully -Pods: green with purple streaks and are borne in clusters at the branch terminals	Resistant to fusarium wilt. Has desirable seed and consumer acceptability. Tolerant to insect pest and drought.
Tumia	2003	ARI Ilonga	Below 1500		-Growth habbit:compact and semi erect - Leaf colour large green leaf - Flower colour: ivory coloured. - Pod colour:the pods are green and very broad, and are borne in clusters at the branch terminals	It is susceptible to Fusarium wilt

- **Species: Ground nut (*Arachis hypogaea*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Red Mwitunde	1976	ARI Naliendele	< 1500	0.1-1.7	-Days to maturity: 120	May suffer from sprouting if late rained during harvest or if lifting is delayed.
Nyota (Span cross)	1983	ARI Naliendele	< 1500	1.2	-Stem branching:sequential -Stem hairiness:scarce -Laateral branches habbit:non distichous -Leaf colour:light green -Leaflet shape:cunoate -Leaflet hairiness:sparce and short -Length of reproductive branch:short -Flower colour: yellow -Days to 50 % flowering:38 -Pod break:slight -Pod constriction:slight -Seed colour:small -Growth habbit: small seeds light	Tolerant to *Cercospora* leaf spots
Johari	1985	ARI Naliendele	< 1500	1.3	-Leaf colour:dark green -Leaflet shape:cunoate -Flower colour: yellow -Days to 50 % flowering:45 -Pod break:deep -Pod constriction: moderate -Seed colour: tan -Growth habbit:decumbent -Plant colour:darkgreen	Resistant to *Cercospora* leaf spot. Has seed dormancy.
Pendo 98 (Spanish)	1998	ARI Naliendele	< 1500	1.5	-Lateral branches habbit: erect -Leaf colour: light green -Days to 50 % flowering: 27-30 -Pod break: incnspicuous -Pod constriction:not marked -Seed colour: tan (monochrome) -Growth habbit: erect	The seed exhibits no seed dormancy. Has better shelling % and 100 seed weight than Sawia (Virginia)
Sawia 98 (Virginia)	1998	ARI Naliendele	< 1500	1.5	-Lateral branches habbit: erect -Leaf colour: dark green -Length of reproductive branch:- -Flower colour: -Days to 50 % flowering: 30-32 -Pod break: absent or very incnspicuous -Pod constriction:absent or very shallow -Seed colour: tan (monochrome) -Growth habbit: semi-erect	The seed exhibits seed dormancy. Has less shelling % and 100 seed weight compared to Pendo 98

- **Species: Sesame (*Sesamum indicum*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (Tons/Ha)	Distinctive characters	Special attributes/Disease rection
Naliendele 92	1992	ARI Naliendele	< 1500	1.2	-Has basal, compact branching -Heavy leaf shedding at maturity	Susceptible to bacterial blight
Zawadi 94	1994	ARI Naliendele	Up to 1500	1.0	-Has basal, profuse branching -Capsules turn from green to purple at maturity -Dull white seed, however if harvested during prolonged rains the colour changes to brown	Tolerant to leaf spots *Cercoseptoria* sesame, stem rot and *Fusarium* spp
Ziada 94	1994	ARI Naliendele	Up 1500	1.0	-Late maturing plant (120-130 days) - Plant colour:light green -Branching: has profuse branching -Seed colur:white-brown bold seeds but change to cream white if harvested in prolonged rains	Tolerant to leaf spots *Cercoseptoria sesami* Good oil content: 56.87 %
Lindi 02	2006	ARI Naliendele	Up to 1500	1.2	- Branching:has basal, compact branching -Capsules size: long capsules, 2-3 carpels within the same plant - Seed colour:very white seeds	Tolerant to leaf spots, *Cercoseptoria* sesame, stem rot, and *Fusarium* spp. Susceptible to Flea beetles, (*Alocyphe bimaculate*) Good oil content: 55.61 %

- **Species: Soya Bean (*Glycine max*)**

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Grain yield (Tons/Ha)	Distinctive characters	Special attributes/Disease reaction
Soya Uyole 1	2002	ARI Uyole	1000-1800	1.5-3.0	- Growth habit:plant has up-right growth habit - Leaf colour: has green leaf colour with hairy texture - Pod colour:pod has cream/brownish colour at maturity - Seed shape:seed has short plump shape, - Testa colour: cream - Helium colour: brown	Does not lodge and shatter

- **Species: Sweet potatoes (*Ipomoea batatas*)**

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Simama	2000	ARI Ukiriguru	0-2000	10.0-20.0	-Plant type: Semi-compact -Vine predominant mature colour: Green -Vine tip pubescence: None -Mature leaf shape: Lobed -Leaf shape of mature lobe: Elliptic -Storage root shape: Elliptic -Storage root skin colour (predominant): cream Storage root flesh colour (predominant): cream -Storage root arrangements: closed cluster	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus and sweet potato mild mottle virus. Moderately resistant to weevils.
Vumilia	2000	ARI Ukiriguru	800-2000	10.0-20.0	-Plant type: Spreading -Vine predominant mature colour: Green -Vine tip pubescence: Sparsed -Mature leaf shape: Lobed - Leaf shape of mature lobe: Elliptic -Storage root shape: Oblong -Storage root skin colour (predominant): Cream -Storage root flesh colour (predominant): Cream -Storage root arrangements: Closed cluster	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus and sweet potato mild mottle virus. Moderately resistant to weevils.
Sinia	2000	ARI Ukiriguru	800-2000	10.0-20.0	-Plant type: Spreading -Vine predominant mature colour: Mostly purple -Vine tip pubescence: Sparse -Mature leaf shape: Lobed -Mature leaf shape of mature lobe: Semi-elliptic -Storage root shape: Long elliptic -Storage root skin colour (predominant): Purple -Storage root flesh colour (predominant): Orange -Storage root arrangements: Open cluster	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus and sweet potato mild mottle virus. Moderately resistant to weevils.
Mavuno	2000	ARI Ukiriguru	800-2000	10.0-25.0	-Plant type: Spreading Vine predominant mature colour: Green -Vine tip pubescence: None -Mature leaf shape: Cordate -Leaf shape of mature lobe: Teeth -Storage root shape: Elliptic -Storage root skin colour (predominant): Cream - -Storage root flesh colour (predominant): Cream -Storage root arrangements: Closed cluster	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus and sweet potato mild mottle virus. Moderately resistant to weevils.

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Jitihada	2000	ARI Ukiriguru	0-2000		-Plant type: Semi-compact -Vine predominant mature colour: Green -Vine tip pubescence: Moderate -Mature leaf shape: Lobed - Leaf shape of mature lobe: Linear (narrow) -Storage root shape: Oblong -Storage root skin colour (predominant): White -Storage root flesh colour (predominant): white -Storage root arrangements: open cluster	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus, and sweet potato mild mottle virus. Moderately resistant to weevils.
Ukerewe	2002	ARI Kibaha	< 1000	9.0	-Plant type: Spreading -Vine predominant mature colour: Green -Vine tip pubescence: None -Mature leaf shape: Lobed -Mature leaf shape of mature lobe:Semi- elliptic -Storage root shape: Long elliptic -Storage root skin colour (predominant): Purple -Storage root flesh colour (predominant): Cream -Storage root arrangements: very dispersed	Moderately resistant to sweet potato feathery mottle virus, sweet potato sunken vein virus and sweet potato mild mottle virus. Moderately resistant to weevils.

- **Species: Cassava (*Manihot* spp.)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Kibaha	2003	SRI Kibaha		30.0	- Outer skin root colour: dark brown -Inner skin root colour: cream - Ground storability: 12-15 months -Time of root biodegradation: starts after 6 day from harvesting	Resistant to drought, moderate resistant to Cassava Mottle Virus and Cassava Brown spot diseases Resistant to Cassava Green Mottle pest Ecological adaptability: Humid sub-humid (coastal areas) tested for more than 15 years
Naliendele	2003	SRI Kibaha		12.0	-Outer skin root colour: Brown -Inner skin root colour: purple -Ground storability: 12-15 months -Time to root biodegradation: starts after 3 day from harvesting	Ecological adaptability: Humid sub-humid (coastal areas) tested for more than 5 years
Mumba	2003	SRI Kibaha		29.0	-Outer skin root colour: brown -Inner skin root colour: cream -Ground storability: 12-15 months -Time to root biodegradation: starts after 4 day from harvesting	Moderate resistant to drought, Cassava mottle Disease and Cassava Brown spot disease, Resistant to Cassava Green Mite pest Ecological adaptability: Semi-arid (Hombolo) tested for 6 years

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Kiroba	2004	SRI Kibaha		26.0	-Outer skin root colour: dark brown -Inner skin root colour: purple -Ground storability: 10-12 months -Time to root biodegradation: starts after 4 day from harvesting	Ecological adaptability: Humid sub-humid (coastal areas)
Hombolo 95	2004	SRI Kibaha		39.0	-Outer skin root colour: brown -Inner skin root colour:cream -Ground storability:12-15 months -Time to root biodegradation: starts after 6 days from harvesting	Resistant to CMD, CBSD, CGM and drought Ecological adaptability: Semi-arid (Hombolo) tested for 5 years

- **Species: Sunflower (*Helianthus annus*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Record	Before 1950's	ARI Ilonga	0-2000	1.0-2.0	-Days to maturity: 110-130 -Days to 50 % flowering: 35-45	Susceptible to sunflower rugose mosaic virus and sunflower yellow ringspot Oil content: 50%
CRN 1435	1999	Monsanto South Africa	900-1500	2.0-2.5	-Leaf shape: Cordate -Depth of margin indentations: Intermediate -Blade altitude: Descending -Corolla colour: Yellow -Anther colour: Brown -Pericarp main colour: Black -Stripe colour: Gray -Has wide adaptation, good lodging resistance and stress tolerance	Resistant to *Septoria*, *Alternaria* spp, sunflower rugose mosaic virus and sunflower yellow ringspot
PAN 7352	2002	Pannar Seed Co.	500-1500	1.5-2.5	-Leaf shape: Cordate -Depth of margin indentations: Medium -Blade altitude: Flat -Corolla colour: Yellow -Anther colour: Black -Pericarp main colour: Black -Stripe colour: White	Moderately resistant to *Septoria, Alternaria* spp, sunflower rugose mosaic virus and sunflower yellow ringspot Has excellent adaptation and stress tolerance, good lodging resistance
K. Fedha	2006	Kenya Seed Co.Ltd	1500 - 2250	3.0 – 3.5	-Leaf shape: Flat -Depth of margin indentations: ---Deep to medium -Blade altitude: Scabrous -Corolla colour: Yellowish -Anther colour: Yellow -Pericarp main colour: Black -Stripe colour: Gray	Moderately resistant to *Septoria helianth, Altenaria* spp and Sunflower Viral Diseases -Has wide adaptation (from coastal to highlands), good lodging resistance and stress tolerance

- **Species: Tomato (*Lycopersicon lycopersicum*)**

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
Tengeru 97	1997	HORTI-Tengeru	400-1500	60-80	-Growth habit: indeterminate -Day to 50 % flowering: 31 days from transplating -Days to 50 % fruiting: 47 days from transplating -Leaf shape: ovate to lanceolate in outline interrupted-pinnate to twice pinnate -Fruit colour:red -Firmness:very firm -Plant height: 95-100	Resistant to root-knot nematodes, tomato mosaic virus (ToMV) and *Fusarium* wilt. Tolerant to Tomato Yellow Leaf Curl Virus (TYLCV)
Tanya	1997	HORTI-Tengeru	400-1500	40-60	-Growth habit: Determinate -Day to 50 % flowering: 30 days from transplating -Days to 50 % fruiting: 45 days from transplating -Leaf shape: ovate to lanceolate in outline interrupted-pinnate -Fruit colour:red -Firmness:very firm -Plant height: 45-50	Susceptible to most common diseases of tomatoes
MERU	2007	HORTI-Tengeru	500-1500	60-100	-Growth habit: Indeterminate -Day to 50 % flowering: 24-27 days from transplating -Days to 50 % fruiting: -Leaf shape: -Fruit colour:red -Firmness:firm -Plant height: 45-50	Resistant to *M.incognita, M.javanica, M.hapla, Powdery mildew* and late blight

- **Species: Coffee (*Coffea arabica*)**

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Dry bean yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
N 39-1	2005	TaCRI	900-1800	2.5-3.0	-Plant habit: shrub -Plant height: tall >170 cm -Overall appearance: pyramidal -Vegetative development: sympodial -Branching habit (primary): many with many secondary and tertiary -Angle of insertion of primary branches: semi-erect -Young leaf colour: bronze -Inflorescence position: axillary -Number of flowers per axil: 17 -Fruit colour: red -Fruit shape: oblong -Seed colour: cream -Seed shape: elliptic	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Dry bean yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
N 39-2	2005	TaCRI	900-1800	2.5-3.0	-Plant habit: shrub -Plant height: tall >165 cm -Overall appearance: pyramidal -Vegetative development: sympodial -Branching habit (primary): many with many secondary and tertiary -Angle of insertion of primary branches: semi-erect -Young leaf colour: bronze -Inflorescence position: axillary -Number of flowers per axil: 16 -Fruit colour: red -Fruit shape: roundish -Seed colour: cream -Seed shape: elliptic	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size
N 39-3	2005	TaCRI	900-1800	2.5-3.0	-Plant habit: shrub (distinct trunk) -Plant height: tall >170 cm -Overall appearance: pyramidal -Vegetative development: sympodial -Branching habit (primary): many with many secondary and tertiary -Angle of insertion of primary branches: semi-erect -Young leaf colour: bronze -Inflorescence position: axillary -Number of flowers per axil: absent -Fruit colour: red -Fruit shape: oblong -Seed colour: cream -Seed shape: elliptic	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size
N 39-4	2005	TaCRI	900-1800	2.5-3.0	-Plant habit: shrub -Plant height: tall >170 cm -Overall appearance: bushy -Vegetative development: sympodial -Branching habit (primary): many with many secondary and tertiary -Angle of insertion of primary branches: semi-erect -Young leaf colour: bronze -Inflorescence position: axillary -Number of flowers per axil: absent -Fruit colour: red -Fruit shape: roundish -Seed colour: cream -Seed shape: elliptic	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Dry bean yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
N 39-5	2005	TaCRI	900-1800	2.5-3.0	Vegetative development: sympodial -Branching habit (primary): MMS &T -Angle of insertion of primary branches: semi-erect -Young leaf colour: greenish -Inflorescence position: axillary -Number of flowers per axil: 15 -Fruit colour: red -Fruit shape: obovate -Seed colour: cream -Seed shape: oblong	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size
N 39-6	2005	TaCRI	900-1800	2.5-3.0	Vegetative development: sympodial -Branching habit (primary): MMS &T -Angle of insertion of primary branches: horizontal -Young leaf colour: brownish -Inflorescence position: axillary -Number of flowers per axil: 19 -Fruit colour: red -Fruit shape: oblong -Seed colour: cream -Seed shape: oblong	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size
N 39-7	2005	TaCRI	900-1800	2.5-3.0	Vegetative development: sympodial -Branching habit (primary): MMS &T -Angle of insertion of primary branches: semi-erect -Young leaf colour: bronze -Inflorescence position: axillary -Number of flowers per axil: 9 -Fruit colour: red purple -Fruit shape: roundish -Seed colour: cream -Seed shape: oblong	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size
KP 423-1	2005	TaCRI	900-1800	2.5-3.0	Vegetative development: sympodial -Branching habit (primary): MMS &T -Angle of insertion of primary branches: horizontal -Young leaf colour: brownish -Inflorescence position: axillary -Number of flowers per axil: 14 -Fruit colour: red -Fruit shape: roundish -Seed colour: cream -Seed shape: oblong	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size

Variety	Year of release	Owner(s)/ Maintainer seed source	Optimal production altitude range (masl)	Dry bean yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
KP 423-3	2005	TaCRI	900-1800	2.5-3.0	Vegetative development: sympodial -Branching habit (primary): MMS &T -Angle of insertion of primary branches: horizontal -Young leaf colour: greenish -Inflorescence position: axillary -Number of flowers per axil: 9 -Fruit colour: red -Fruit shape: oblong -Seed colour: cream -Seed shape: elliptic	Resistant to Coffe Berry Diseases (*Colletotrichum kahawae)*, Leaf rust (*Hemileia vastatrix*), Added advantage in bean size

- **Species: Tobacco (*Nicotiana tabacum*)**

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
PD 4	1992	ARI Tumbi	1050-1500	2.5	-Coleoptile hairiness: present -Leaf colour at maturity: dark green -Leaf colour at curing: greenish yellow -Leaf hairiness: present -Stem colour: dark green -Stem strength: strong -Plant hairiness: present -Plant height: 90-130 cm -Days to flowering: 59-69 -Flower colour: pink -Capsule colour at maturity: light brow -Seed colour: light brown	Moderately susceptible to root knot nematodes. Slightly susceptible to tobacco mosaic virus (TMV), frog –eye and *Alternaria*
RG 17	2006	Tanzania Leaf Tobacco Company	900-1500	0.112	-Coleoptile hairiness: present -Leaf colour at maturity: green -Leaf colour at curing: deep lemon -Leaf hairiness: 50 % -Stem colour: pale green -Stem strength: not very strong -Plant hairiness: 50 % -Plant height: 60 cm -Days to flowering: 70 days -Flower colour: white-pink or pinkish -Capsule colour at maturity: dark brown -Seed colour: dark brown	Moderately susceptible to root knot nematodes. Slightly susceptible to tobacco mosaic virus (TMV), frog –eye and *Alternaria*
ULT F10	2006	Tanzania Leaf Tobacco Company	900-1500	0.154	-Coleoptile hairiness: present -Leaf colour at maturity: green -Leaf colour at curing: deep orange -Leaf hairiness: 80 % -Stem colour: pale green -Stem strength: not very strong -Plant hairiness: 80 % -Plant height: 70 cm -Days to flowering: 70 % -Flower colour: white-pink or pink -Capsule colour at maturity: dark brown -Seed colour: dark brown	Moderately susceptible to root knot nematodes. Slightly susceptible to tobacco mosaic virus (TMV), frog –eye and *Alternaria*

Variety	Year of release	Owner(s)/ Maintainer and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special attributes/Disease reaction
K 326	2006	Tanzania Leaf Tobacco Company	900-1500	0.125	-Coleoptile hairiness: present -Leaf colour at maturity: green -Leaf colour at curing: deep orange -Leaf hairiness: 80 % -Stem colour: pale green -Stem strength: not very strong -Plant hairiness: 80 % -Plant height: 70 cm -Days to flowering: 70 % -Flower colour: white-pink or pink -Capsule colour at maturity: dark brown -Seed colour: dark brown	Moderately susceptible to root knot nematodes. Slightly susceptible to tobacco mosaic virus (TMV), frog –eye and *Alternaria*

- **Species: Cashew (*Anacardium occidentale*)**

Variety	Year of release	Ownner/ Maintainance and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special alttributes/ Disease reaction
AC 1	2006	ARI Naliendele	0-800	36	-Brown flush -Apple shape: cylindrical -Apple coulur: orange -Nut shape: kidney -Flower colour: pink	Resistant to Powdery mildew, Anthracnose, and Die back
AC 4	2006	ARI Naliendele	0-800	59	-Red flush -Apple shape: cylindrical -Apple coulur: orange -Nut size: Large -Nut apex orientation: slightly tend to bend (on either the left or right side) away from direction of suture	Resistant to Powdery mildew, Anthracnose, and Die back
AC 4/17	2006	ARI Naliendele	0-800	16	-Nut apex: thin and relatively small-flattened -Dominantly thick bulging flanks starting from just near the lower end of the stylar scar and extend up to the upper shoulders, behind their side of suture -One side of the flank protrudes more than other side	Resistant to Powdery mildew, Anthracnose, and Die back
A C 10	2006	ARI Naliendele	0-800	39	-Aged leaves turn reddish, the aged leaves colour resembles mature apple colour -Very loose nut attachment to cashew apples, some nuts detach when or before falling on ground	Resistant to Powdery mildew, Anthracnose, and Die back
AC 10/129	2006	ARI Naliendele	0-800	67	-Brown flushes -Apple shape: cylindrical -Apple colour: yellow	Resistant to Powdery mildew, Anthracnose, and Die back
AC 10/220	2006	ARI Naliendele	0-800	53	-Green flushes relatively broad and large -Apple colour:yellow -Apple shape: conical	Resistant to Powdery mildew, Anthracnose, and Die back

Variety	Year of release	Ownner/ Maintainance and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special alttributes/ Disease reaction
AC 14	2006	ARI Naliendele	0-800	41	-Apple shape: long conical -Apple colour: orange -Pink/purple colouration that remain on nuts up to maturity	Resistant to Powdery mildew, Anthracnose, and Die back
AC 22	2006	ARI Naliendele	0-800	36	-Growth habit:natural tendency of the stem to grow relatively upright, even in the case of grafted plant	Resistant to Powdery mildew, Anthracnose, and Die back
AC 34	2006	ARI Naliendele	0-800	47	-Green flushes, which are relatiuvely narrow -Apple colour: yellow -Apple shape: round	Resistant to Powdery mildew, Anthracnose, and Die back
AC 43	2006	ARI Naliendele	0-800	55	-Apple shape: cylindrical -Apple colour: red with entire dark red strips at harvesting maturity	Resistant to Powdery mildew, Anthracnose, and Die back
AZA 2	2006	ARI Naliendele	0-800	49	-Growth habit: semi dwarf tree -Apple shape:conical -Apple colour: greenish yellow at harvesting maturity	Resistant to Powdery mildew, Anthracnose, and Die back
AZA 17	2006	ARI Naliendele	0-800	47	-Apple shape: conical -Apple colour: yellow -Nut shape: elongated	Resistant to Powdery mildew, Anthracnose, and Die back
AZA 17/79	2006	ARI Naliendele	0-800	14	-Apple colour:yellow -Apples shape: conical -Nut shape: flattened -Nut apex shape: round	
AZA 17/156	2006	ARI Naliendele	0-800	62	-Apple colour:orange -Apple shape: round	Resistant to Powdery mildew, Anthracnose, and Die back
AZA 17/158	2006	ARI Naliendele	0-800	14	-Dark brown flushes -Apples shape: Conical -Apple colour: yellow	Resistant to Powdery mildew, Anthracnose, and Die back
AC 4/285	2006	ARI Naliendele	0-800	29	-Red (bright red) flushes, -Leaf shape: Obovate leaves -Apple colour: orange apples -Apple shape: Cylindrical	Resistant to Powdery mildew, Anthracnose, and Die back

- **Species: Grape vine (*Vitis vinifera* L.)**

Variety	Year of release	Ownner/ Main-tainance and seed source	Optimal production altitude range (masl)	Grain yield (t/Ha)	Distinctive characters	Special alttributes/Disease reaction
Makutupora Red	2007	Viticulture Research and Training Centre Makutupora	1050	10-15	Red colour when ripped	Adaptability to drought: highly adapted Transportability: good Uses: Red wine
Chenin Nyeupe	2007	Viticulture Research and Training Centre Makutupora	1050	10-30	Produce green grapes when ripped	Fairly drought resistant Uses: White wine making

Source: Ministry of Agriculture Food Security and Cooperatives