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

ZAMBIA

ZAMBIA: SECOND REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

FINAL REPORT

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PREFACE

The second country report on the state of national plant genetic resources for food and agriculture is a product arising from national stakeholder consultation, participation and information sharing. The process started in May 2007 when Zambia Agriculture Research Institute (ZARI) undertook to spearhead the establishment of the National Information Sharing Mechanism (NISM) on the implementation of the Global Plan of Action (GPA) on plant genetic resources for food and agriculture (PGRFA) and preparation of a country Report on the state of PGRFA with funding from the Government of Canada and technical backstopping from Bioversity International. This process endeavoured participation of key stakeholders in providing and exchanging country-level PGRFA conservation and use information.

Zambia Agriculture Research Institute (ZARI) was the coordinating institution for the process and by delegation, the National Plant Genetic Resources Centre was designated National Focal Point (NFP) for implementation and monitoring of the process. A total of twenty institutions were consulted out of which nine key stakeholder institutions were involved in information gathering and sharing.

The process of producing this report was the undertaking of the National Focal Point with input from key stakeholders arising from the second technical workshop and other sources. The FAO guidelines and format were used for the compilation of this report.

The report is, therefore, a strategic analysis on the state of plant genetic resources for food and agriculture, capacity for its conservation and management and use over a period of ten years in Zambia. It has been submitted to the FAO Commission on Plant Genetic Resources for Food and Agriculture as an official document of the Zambian government.

Dr. W. Mwale
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EXECUTIVE SUMMARY

Zambia lies in the south-central Africa covering an area 752 629 km^2, lying on a plateau between altitudes 900 to 1 500 metres above sea level. Rainfall is the dominating factor influencing climate pattern in the country and it is, therefore, the major factor in distinguishing the three agro-ecological regions of the country. In general terms, the northern part of the country receives more annual rainfall than the south. Economically, the mining, tourism and agricultural sectors make significant contributions to the economy.

The contribution of the agricultural sector to the national economy has been variable over the past decade and currently it is estimated to contribute 22% to the GDP. Food crop production is mainly in the hands of small-scale farmers who constitute more than 60% of the farming community and still largely based on traditional practices. These farmers mainly cultivate and use their own crop varieties that have been locally developed over cycles of selection, thereby contributing to the development and maintenance of a rich crop genetic diversity. They have mainly relied on their traditional crop varieties for decades for their livelihood and food security despite, in most cases, them yielding comparatively lower than improved varieties. In general, there is a favorable environment for achieving substantial progress in the agricultural sector in Zambia. The problem of HIV/AIDS is, however, impacting negatively on economic development in general and the agricultural sector in particular. Growth in the agricultural sector, for instance, declined to 2.8 percent in 2007 from 3.9 percent in 2006, attributed mainly to the reduced production of major food crops, such as maize, sorghum, millet, groundnuts and sunflower. Crop production declined as a result of the floods that were experienced in the major agriculture producing provinces.

There are approximately 100 plant species that are cultivated in Zambia. Of these, about 15% are indigenous crop species including sorghum, millets, cowpea, bambara groundnuts, sesame and traditional vegetable species. About 75% are exotic species, 7% of which were introduced and have been naturalized to the local condition. These crops include maize, beans, groundnuts, cassava, sweet potato, mango and avocado pear. Traditional crops namely sorghum, finger millet, pearl millet and cowpea as well as the locally developed varieties of maize, beans, cassava, sweet potato, groundnuts and pumpkins could be singled out as important cultivated crop species grown for food in Zambia. Other locally available useful plant species in Zambia are wild relatives of rice, cowpea, sorghum, cucurbits, kenaf and sesame. However, the extent to which these resources have been used locally in crop improvement programmes is limited. There is also a wide range of indigenous vegetable species such as amaranths, *Bidens pilosa* (Black jack), *Cucumis* spp. *Cleome gynandra* (Cat's whiskers) and *Corchorus* spp. (Jute) and fruit trees that are either under semi-cultivation or could be gathered from the wild by users. These species are exploited for leafy vegetables and fruits.

Although maize is the principal staple food crop traditionally grown almost throughout the country, other major food crops grown in some parts of the country include sorghum, finger millet, rice, beans, cassava, groundnuts, and sweet potato. Important fruit tree crops are citrus, mango, banana, papaya and avocado. The country's important cash crops include coffee, tobacco, cane sugar and cotton. A number of factors contribute to genetic erosion for most of the crops. Replacement of traditional varieties by improved ones for major crops such as maize, sorghum and groundnuts can be singled out as one of the major factors. Cassava and sweet potato have also gotten more affected by this factor over the past ten years than before as a result of the increased effort in variety development and the promotion as part of crop diversification strategy to enhance food security. Other crops such as finger millet, pearl millet and beans have also been affected though to a lesser degree. The continued shift in the choice of crops grown by small scale farmers, with more and more land being taken up by mainly cash crops like cotton, tobacco, sugarcane and hybrid maize, continued to pose a major threat to the genetic diversity on-farm of the traditional cereals, grain legumes and root and tubers crops.

The institutions responsible for conducting inventories and surveys of plant genetic resources in general include National Plant Genetic Resources Centre, Department of Biological Resources of the University of Zambia, Zambia Forestry Division and Zambia Wildlife Authority. Nonetheless there has been no systematic and coordinated inventories and survey especially that each institute works within its mandates, needs and priorities. Future focus for inventories and surveys need to be directed at capacity building in most institutions, revision of relevant policies and legal instruments and provision of adequate support.

In Situ conservation of wild plant genetic resources for food and agriculture has mainly been undertaken in the national parks under the Zambia Wildlife Authority and national forest reserves under the management of the Forest Research Division. Zambia formulated the National Biodiversity Strategy and Action Plan (NBSAP) a national strategy for

implementing the convention on Biological Diversity. The NBSAP, which was adopted in 1999, was formulated to ensure that biodiversity activities meet national interests as well as priorities actions required for achieving the objectives of the conservation in the years to come. The creation of forest reserves has been the main strategy of conserving forest genetic resources. Conservation of forest genetic resources in Zambia is being spearheaded through the Zambia Forest Action Plan Program (ZFAP) and the Provincial Forest Action Plan (PFAP).

On-farm conservation activities in Zambia were initiated in 1998 by the National Plant Genetic Resources centre as part of the regional initiative involving Malawi, Zambia and Zimbabwe. The initial activities which were undertaken in collaboration with SADC Plant Genetic Resources Centre (SPGRC), Biodiversity Community Network (BCN) and Department of Agriculture, focusing on community-based on-farm conservation aimed at gathering data and information that would assist to develop methodologies for on-farm conservation. The focus changed towards the promotion of the multiplication and restoration of farmers' varieties (landraces) have been undertaken on a pilot scale involving selected communities of Rufunsa in Lusaka province and Chikankata in Southern province. Future focus should include development of appropriate policy and legislation supporting on-farm PGR conservation, capacity building and co-ordination of on-farm PGR conservation and strengthening local seed systems.

The National Plant Genetic Resources Centre is responsible for most *ex situ* conservation activities. Currently it is holding 5 996 accessions of different crop species in form of seed samples in sealed aluminium foil bags, maintained as an active collection under long term freezer storage conditions of -20°C temperature. The *ex situ* collection at the NPGRC also includes 207 germplasm material of cassava (152) and sweet potato (55) maintained as living plants in a field genebank. These collections of cassava and sweet potato represent an estimated 50% of total diversity available in the country, with the rest available *in situ* conditions, in farmers' fields. During the period under review, the NPGRC has distributed 782 accessions of different crop species to research and learning institutions, NGOS and farmers. Major constraints affecting the *ex situ* management of the PGRFA collections in the country include limited capacity of the seed dryer, lack of appropriate equipment such as germinator and other laboratory facilities and inadequate technical staff.

Zambia Agriculture Research Institute (ZARI) is the largest public research institution conducting crop research, focusing on variety development and improvement. Other research institutions involved in variety development are the Cotton Development Trust and Crop Science Department of the School of Agricultural sciences at the University of Zambia. Variety development takes place in the following crops: maize, sorghum, finger millet, pearl millet, wheat, sunflower, cassava, sweet potato, ground nuts, common beans and soyabeans. Limited efforts ending at variety selection takes place in crops such as vegetables, rice, cowpea, bambara ground nuts, pigeon pea, kenaf and tree & plantation crops. Much of the germplasm used in these crop development and improvement programmes is introduced especially for the major food and cash crops such as maize, sorghum, groundnuts, wheat, cotton, sunflower and beans. Local germplasm collected from within the country has also been incorporated in the breeding programmes for some of these crops. Minor crops such as finger millet, pearl millet, bambara groundnut and sweet potato have utilised more of local germplasm than introduced crops.

The National Plant Genetic Resource Centre shoulders the responsibility of conserving locally available plant genetic resources in the country. The NPGRC falls under the Zambia Agriculture Research Institute (ZARI) which is one of the departments under the Ministry of Agriculture and Co-operatives. The activities of the national programme include field collections, characterization and evaluation, seed regeneration, multiplication and documentation of collected and stored germplasm. The NPGRC carries out these activities in close collaboration with the SADC Plant Genetic Resources Centre (SPGRC) and crop working groups within ZARI. The multisectoral National Plant Genetic Resources Committee (NPGRCom) provides policy guidance to the national PGR programme. Membership of the NPGRCom is drawn from stakeholder institutions such that include the Natural Resources and Forestry Departments of the Ministry of Tourism, Environment and Natural Resources (MTENR), Crop Science Department of the School of Agricultural Sciences at the University of Zambia, National Institute of Scientific and Industrial Research, Mundawanga Botanic Gardens, Zambia wildlife Conservation Authority and local and international NGOs and farmer organizations. One of the major challenges to the contribution of PGRFA is the inadequate appreciation, at all levels, of its value and becomes a major factor in the erosion of the diversity of local PGRFA. At policy levels this lack of appreciation means PGRFA considerations are not adequately integrated into various sectoral policies and legal instruments.

Zambia participates in a number of PGRFA and crop networks that exist at sub regional and regional levels. At the highest level collaboration on PGR related issues within the Africa region has been realized through the intergovernmental fora such as the African Ministerial Conference on Environment (AMCEN) and the relevant scientific committees of the African Union (AU) and the New Partnership for Africa's Development (NEPAD). It continues to participate in the regional PGR network under aegis of the SADC Plant Genetic Resources Centre.

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I am indebted to the Director ZARI for his invaluable moral, logistical and material support to the whole process. The Directors of all the participating institutions deserve appreciation for their cooperation in the entire process. The various contact persons in each of the participating institutions who spared their valuable time contributing to the strengthening of the NISM are fully appreciated.

Mr. Dickson Ng'uni
National Focal Point

ABBREVIATIONS AND ACRONYMS

AIDs	Acquired Immunodeficiency Syndrome
AMCEN	African Ministerial Conference on Environment
AVRDC-ARP	Asian Vegetable Research and Development Centre-African Research Programme
AU	African Union
BCN	Biodiversity Community Network
CBD	Convention on Biological Diversity
CIMMYT	International Maize and Wheat Improvement Research Centre
CITES	Convention on International Trade in Endangered Species
CoP	Conference of Parties
CSO	Central Statistic Office
CPI	Consumer Price Index
CDP	Cooperative Development Programme
CDT	Cotton Development Trust
FAO	Food and Agricultural Organization of the United Nation
FEWS	Famine Early Warning System
FNDP	Fifth National Development Plan
FRA	Food Reserve Agency
FSP	Fertilizer Support Programme
GART	Golden Valley Agricultural Research Trust
GB	Governing Board
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GPA	Global Plan of Action
GRPI	Genetic Resources Policy Initiative
GRZ	Government of the Republic of Zambia
GTZ	German Technical Aid to Zambia
HIV	Human Immunodeficiency Virus
IBPGR	International Board on Plant Genetic Resources
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDF	Irrigation Development Fund
IDRC	International Development Research Centre
IRRI	International Rice Research Institute
ITCZ	Inter-tropical Convergence Zone
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MACO	Ministry of Agriculture and Co-operatives
MTENR	Ministry of Tourism Environment and Natural Resources
MLS	Multilateral System
NBSAP	National Biodiversity Strategy and Action Plan
NEPAD	New Partnership for Africa's Development
NISM	National Information Sharing Mechanism
NFP	National Focal Point
NGOs	Non Governmental Organisations
NPGRC	National Plant Genetic Resources Centre
ODI	Overseas Development Institute
PGRFA	Plant Genetic Resources for Food and Agriculture
PFAP	Provincial Forest Action Plan
SADC	Southern Africa Development Community
SDIS	SADC Documentation and Information System

SMTA	Standard Material Transfer Agreement
SPGRC	SADC Plant Genetic Resources Centre
TRIPs	Trade-Related Intellectual Property Rights
WTO	Zambia Forest Action Plan
ZARI	Zambia Agriculture Research Institute

GENERAL INTRODUCTION TO THE COUNTRY

1. Physiogeography

Zambia is a land locked country in south-central Africa covering an area 752 629 km^2, lying on a plateau between altitudes 900 to 1 500 m above sea level. The highest parts of the plateau are in the North East, with the plateau slopping gradually to the South West. The country lies between latitude 8° and 18° S and longitudes 22° to 35° E respectively. Zambia has a long land border on the west with Angola but is divided from its neighbours to the south by the Zambezi River. To the southwest is the thin projection of Namibian territory known as the Caprivi Strip, at the eastern end of which four countries (Zambia, Namibia, Botswana, and Zimbabwe) appear to meet at a point—a "quadripoint"—although the precise nature of the meeting is contested. Man-made Lake Kariba forms part of the river border with Zimbabwe. Mozambique is Zambia's neighbour to the southeast, Malawi to the east, and Tanzania to the northeast. The long border with the Democratic Republic of Congo starts at Lake Tanganyika, crosses to Lake Mweru, and follows the Luapula River to the Pedicle, a wedge of Congolese territory that cuts deep into Zambia to give the country its distinctive butterfly shape. Westward from the Pedicle the frontier follows the Zambezi-Congo watershed to the Angolan border.

2. Relief and drainage

The general slope of the plateau on which the country sits is toward the southwest, although the drainage of the Zambezi turns eastward to the Indian Ocean. Over most of the country, ancient crystalline rocks are exposed, the product of prolonged erosion processes. Most areas of the western part of Zambia are overlain by younger sandy deposits, relict of a once more extensive Kalahari Desert. In central and eastern parts of the country, down warping of the plateau surface forms swamp- or lake-filled depressions such as Lake Bangweulu and the Lukanga Swamp; in more elevated regions, ridges and isolated hills made up of more resistant rocks punctuate otherwise smooth skylines.

The continental divide—between the Congo River drainage, which flows to the Atlantic, and that of the Zambezi, which drains into the Indian Ocean—runs along the Zambia-Democratic Republic of Congo border west of the Pedicle and then northeastward to the border with Tanzania. Both the Luapula (which drains the Bangweulu basin into Lake Mweru) and Lake Tanganyika are tributary to the Congo. The rest of the country lies within the Zambezi basin, the river itself rising in northwestern Zambia and circling through Angola before traversing the sandy plains of western Zambia. At the Victoria Falls it drops 300 feet into a mile wide chasm at the head of the gorge leading down to Lake Kariba and the trough-like middle part of its valley. It has two main tributaries in Zambia. Rising on the Copperbelt, the Kafue River drains the Lukanga Swamp and Kafue Flats before an abrupt descent to the Zambezi. The Luangwa River, mostly confined within its rift trough, is quite different. The Bangweulu Swamps and the Kafue Flats are wetlands of international importance.

3. Geology and soils

The oldest rocks of the country are volcanics and granites of the Bangweulu block in the northeast. This old structure is partly covered by ancient sedimentary rocks, and together they constitute the basement complex. Sedimentaries of the Katanga System (550 to 620 million years old) are extensive in the central areas, and mineralisation of these rocks is the basis of Zambia's mining industry. Later sedimentary rocks of the Karoo (Karroo) System filled rifted troughs in the plateau surface, some of which, as in the Luangwa and middle Zambezi valleys, have been partially re-excavated. Coal seams occur in Karoo rocks to the north of Lake Kariba. These structural troughs are ancient features. Younger rifts in the

north, part of the East African Rift System, are occupied by Lakes Mweru and Tanganyika. Karoo and older sedimentaries are also found in the west, buried under the predominantly sandy deposits of the Kalahari System.

The soils of the plateau are generally of poor quality, long-continued weathering and erosion having leached many of their nutrients. Much of the plateau is covered by the so-called Sandveld soils, which have sandy surface layer overlying clayey subsoil, often with laterite (an iron-rich horizon). Shifting cultivation is widespread, and for more permanent cultivation soils need to be carefully managed. More fertile red clay soils occur over limestone and basic rocks and have attracted commercial farming. Soils of the Kalahari Sands have little agricultural potential and are mainly under woodland. The black clay soils of some floodplains and swamp areas are highly fertile but difficult to cultivate, being waterlogged in the rainy season and rock-hard when dry.

4. Climate

The country's climate is moderated by altitude and latitude. The marked seasonal pattern of rainfall is caused by the north and south movement of the intertropical convergence zone (ITCZ), following the apparent movement of the sun. In January the ITCZ is in its southernmost position, and the rainy season is at its peak; by June it has moved north, and the weather is dry. Summer rains reduce the high temperatures that might be expected at this time.

Rainfall (concentrated in just five months) is highest over the Bangweulu basin and along the Congo-Zambezi watershed, averaging about 1 500 millimetres per annum, declining southward to the middle Zambezi valley, which averages less than 700 millimetres per annum. The Luangwa valley is also drier than the surrounding plateau. Rainfall is less reliable in the drier regions, and failure of the rains in the south and southwest periodically brings serious reduction in crop harvest and, hence, famine to these areas.

Temperature is moderated by altitude, mean daily maximum temperatures higher than 100° F (38° C) occurring only in the Luangwa valley and the southwest. The coolest area is the high Nyika plateau on the border with Malawi. During the cold months (June and July), the area west of the Line of Rail is coolest, with mean minimum temperatures mostly under 45° F (7° C). Sesheke, in the southwest, has frost on an average of 10 days per year.

The average annual hours of sunshine range from more than 3 000 in the southwest to less than 2 600 on the eastern border. Winds are predominantly easterly-southeasterly, although in the rainy season winds blow from the northwest and north. Wind speeds are rarely strong enough to cause damage.

Although the major contrast is between the rainy and the dry periods, Zambia has three distinct seasons; a cool and dry season, a hot and dry season and a hot and wet season. The temperatures range from 10°C to 27°C in the cool and dry season and 27°C to 38°C in the hot and wet season.

The warm wet season lasts from November until April. The movement into Zambia of the moist Congo air mass from the northwest heralds the start of the rains, usually in early November in the north of the country and toward the end of the November in the south. The change from dry to wet conditions is transitional rather than abrupt. December and January are the wettest months. Cloud cover lowers maximum temperatures but also limits radiative heat loss at night, so that minimum temperatures are kept relatively high. Relative humidity values are high, typically 95 percent in early morning but declining to 60–70 percent by mid afternoon. Sunshine is surprisingly frequent, even during the rainy season, averaging six hours of sunshine per day in January, in Lusaka for instance. Rainfall declines rapidly in April with the northward movement of the ITCZ.

The cool dry season lasts from April until August. The sun is overhead in the Northern Hemisphere, so temperatures are low; July is usually the coldest month. Clear skies allow maximum radiation and result in especially low temperatures on calm nights, with occasional ground frost occurring in sheltered valleys.

The hot dry season lasts from August until November. This is a period of rapidly rising temperatures; just two months separate July, the coldest month, and October, usually the hottest (although if the rains are delayed November can be hotter). Usually by mid-October cooler oceanic air moves in, leading to increasing humidity and cloud formation. High temperatures and increasing humidity make this one of the least comfortable times of the year, although the first rains wash away dry-season dust.

The country has experienced some significant change in the weather pattern particularly in terms of rainfall during the past ten years. More droughts and floods were experienced, which impacted significantly on crop production and crop diversity in particular. Both droughts and floods are thought to have led to some loss of crop diversity on-farm. The droughts occurred during the 2001/02, 2003/04 seasons while there were floods during the 2005/06 and 2007/08 seasons in most parts of the country.

Rainfall is the dominant factor influencing climate pattern in the country. It is, therefore, the major factor in distinguishing the agro-ecological regions of the country (Regions I, II and III). The ecological regions and their farming systems are briefly described below:

Agro-Ecological Region I lies between altitudes 300-900 m above sea level and receives an annual rainfall of between 600 and 800 mm. The three major farming systems of the region are:

- The sorghum/ millet based hand hoe and cattle farming system;
- The Pearl millet, sorghum, cassava, oxen based Farming systems, and
- The sorghum/ maize and cattle based farming system.

Agro –Ecological Region II – lies between altitude 900 – 1 100 m above sea level and receives between 800 and 1 000 mm of rain annually. This region has four farming systems:

- The maize based hand hoe system;
- The maize/ cattle mixed system;
- The cassava based hand hoe system
- The central Zambezi flood plain farming system (ox-based sorghum, maize, pearl millet and cassava)

Agro-Ecological Region III – lies between 1 100-1 700 m above sea level and receives over 1 000 mm of rainfall annually. There are four main farming systems in this region:

- Cassava based hand hoe farming system;
- The sorghum based hoe farming system;
- The mound (Fundikila) Farming system;
- The Finger millet based on slash and burn (Chitemene) Farming system.

5. Vegetation type

The country's vegetation, estimated to comprise 5 000-6 000 plant species, is classified into three major categories namely the forests, woodlands, termitaria and grasslands. The vegetation greatly varies from evergreen forests to semi-desert types, due to influence of landscape, soils and drainage, topography and weather patterns in their sub ecosystems. The closed forests comprise *cryptosepalum* evergreen, the decidous *Baikiaea* forests and to a limited extent the *Parinari, Marquesia* motane, *riparian* swamp and *itigi*. The savannah woodlands are the open forests and account for 71% of the total forest area in Zambia. On the plateau, the Savannah woodlands are dominated by the Miombo woodlands, mainly a semi continuous cover dominated by small leguminous trees of the *Brachystegia* and *Julbernardia* genera but with a significant grassy undergrowth covering 47% of the country's forests. This is followed by the Kalahari woodland, Mopane and Munga woodland. Mopane woodland, in which *Colophospermum mopane* dominates but in which the baobab is distinctive, occurs in the drier and hotter valleys of the Zambezi in the south and in the Luangwa valley. Zambezi teak (*Baikiea plurijuga*) occurs in the southern fringe of the area covered by the Kalahari Sands. Mukwa (*Pterocarpus angolensis*) is found in the Lake Bangweulu area. The open grasslands occur in areas where there is seasonal flooding including the wetlands and dambos notably in the Bangweulu and Lukanga regions, in the upper Zambezi and the Kafue flats.

Pressure on forest resources has resulted in deforestation and subsequently loss of genetic resources and land degradation. The forest cover has been affected by a number of factors; those arising from human activities such as clearing for agriculture and mining activities and demand for timber and fuel wood, including charcoal production. The total woodland area deforested by charcoal and agriculture in central Zambia alone is, presently, estimated at 2.5 and 19.3 percent respectively.

The most critical situation is near big towns and along the line of rail and main roads, where demand for wood fuel and timber is high. Localised increased population affects forests, as more land is demanded for agriculture and settlement. Deforestation rate in Zambia is estimated at 800 000 ha per year. Measures to control deforestation have been constrained by inadequate resources, weak institutional capacity and lack of community participation.

6. Population

Rapid increases in the population combined with over-exploitation of resources threaten the resources base and in turn the lives of the people. With declining social-economic conditions in Zambia, the increase in population, estimated at 10.3 million people (year 2000), growing at 3.1% per annum and expected to double in 23 years implies that the number of people who exploit natural resources as a means of sustaining themselves would increase as the population grows. In addition, the population density in some localities is extremely high, largely as a result of urbanisation and immigration. All these factors (immigration, urbanisation and density) combined exert pressure not only on social and economic services, but also on land. These problems are evident in Southern, Central and Eastern provinces, resulting in outward migration of the rural populations from these areas to other provinces that are less densely populated, in particular Northern and North Western provinces.

7. General performance of the economy

Overall the economy of Zambia has been improving over the last 10 years, but more so from 2003 to date following the revamping of copper mining spurred by high prices of the metal on the international market. The economy has continued to register positive growth going by the real gross domestic product which increased from 5.8% in 2006 to 6.2% in 2007 though remained below the 7% target for the year 2007. Apart from the mining sector and copper production in particular other sectors that have had significant contributions to the economy are the agricultural and tourism sectors.

The average Gross Domestic Product over the last 10 years has been $15.93 billion (2007) while the GDP per capita has been US$1 400 (2007). There has also been a general decline in the inflation rate, which from 2007 came to single digit level. During 2007 the annual inflation (CPI) averaged 8%. The commercial bank interest rates have generally been high over the last 10 year period, although there has been slight movement downwards in the last two years.

Despite improvements in the economy and the creation of new employment opportunities levels of unemployment are still relatively high. The inflow of foreign investment has increased over the 5 years mainly directed to the mining sector mainly on the Copperbelt, Northwestern and Southern provinces of the country.

8. General performance of agricultural sector

The agriculture sector grew to 3% in 2006, slowing down to 2.8 percent in 2007. The reduction was mainly attributed to the poor prices offered for cotton and tobacco which resulted in drastic drop in production in the two crops. Farming in Zambia, especially that concerned with food production is mainly in the hands of small-scale farmers and still largely based on traditional practices. These farmers and the local communities in which they live have contributed to the development and maintenance of a rich crop genetic diversity on which they have depended for their livelihood in general and food security in particular. Small-scale and resource poor farmers constitute more than 60% of the farming community in Zambia. These farmers mainly cultivate and use their own crop varieties that have been locally developed over cycles of selection. The rural small-scale farmers have mainly relied on their traditional crop varieties for decades even if most of them yield lower than improved varieties. Traditional farmers value indigenous plant genetic diversity because of certain desired traits inherent in them such as ease of processing, good storability and taste.

Comparatively the agricultural sector employs the highest labour force at about 85% in 2007 and remains the main source of income and employment for most of the people especially in rural areas. The industry and services sectors employ 6% and 9% of the labour force, respectively.

Historically farming for crop production in Zambia has been biased towards maize production. This emphasis led to the neglect of other traditional crops important for food security in terms of technologies, financing and marketing.

In this scenario the failure in maize production inevitably led to deterioration of the food security situation both at household and national levels. The promotion of maize production was characterised by subsidies on inputs such as fertilisers and seed. Recent strategies towards increasing and sustaining agricultural production include the need to diversify into other crops other than maize.

In general, there is a favorable environment for achieving substantial progress in the agricultural sector in Zambia. The problem of HIV/AIDS is, however, impacting negatively on economic development in general and the agricultural sector in particular.

Although agricultural production has been increasing over the past 10 years, decline in production has been recorded during some seasons due a number of reasons, including climatic factors. Growth in the agricultural sector declined to 2.8 percent in 2007 from 3.9 percent in 2006. This was mainly attributable to reduced production of major food crops, such as maize, sorghum, millet, groundnuts and sunflower Table 1). Crop production declined mainly as a result of the floods that were experienced in the major agriculture producing provinces. However, the forestry and fishing sub-sectors registered positive growth of 5.2 percent and 1.8 percent, respectively.

TABLE 1
Area Planted, Yields and Crop Production, 2005-2007

Crop	Area Planted			Yield (Mt/ha)			Crop Production in Mt		
	2005/06	2006/07	Percent Change	2005/06	2006/07	Percent Change	2005/06	2006/07	Percent Change
Maize	784 524	872 812	11.25	1.82	1.57	(13.79)	1 424 439	1 366 158	(4.09)
Sorghum	43 627	31 596	(27.58)	0.48	0.40	(16.20)	21 047	12 773	(39.31)
Rice	14 358	20 067	39.76	0.97	0.91	(6.14)	13 964	18 317	31.18
Millet	69 529	56 817	(18.28)	0.69	0.38	(44.84)	48 159	21 707	(54.93)
Sunflower	39 416	28 829	(26.86)	0.38	0.31	(18.41)	15 003	8 953	(40.32)
Groundnuts	144 250	147 320	2.13	0.58	0.37	(35.65)	84 010	55 215	(34.28)
Soyabeans	44 034	38 947	(11.55)	1.31	1.42	7.93	57 815	55 194	(4.53)
Seed Cotton	152 262	89 312	(41.34)	0.78	0.61	(20.99)	118 426	54 886	(54)
Mixed Beans	54 532	55 532	2.07	0.51	0.43	(14.53)	27 697	24 164	(12.76)
Burley Tobacco	**14 306	*10 000	(30.10)	1.00	1.00	0.00	**14 306	10 000	(30.10)
Virginia Tobacco	**11 765	*8 265	(29.75)	1.70	1.88	10.76	14 685	15 562	6
Wheat	17 144	19 188	11.92	7.58	6.42	(15.30)	93 482	115 843	23.92
Cassava	362 355	391 844	8.14	2.92	2.92	0.00	1 059 887	1 185 599	11.86

Source: Ministry of Agriculture and Co-operatives Report

The area planted for a number of crops declined in the 2006/7 season when compared with 2005/6 season. Most notable were seed cotton (down by 41.3 per cent) and Burley and Virginia tobacco (down by 30.1 and 29.8 percent respectively). However, the area planted to Maize and Rice both increased (11.3 per cent and 39.8 per cent, respectively).

The yields per hectare for a number of crops also fell between 2005/6 and 2006/7, the largest declines were registered for Millet (44.8 per cent) and Groundnuts (35.7 per cent); however, increases were registered in Virginia Tobacco (10.8 per cent) and Soyabeans (7.9 per cent).

The changes in area planted and yield per hectare influenced the total crop production, with large proportional increases registered for rice (18 317 Mt up from 13 964), Wheat (115 843 Mt from 93 482) and Cassava (1 185 599 Mt up from 1 059 887). Total production of Maize fell to 1 366 158 Mt from 1 424 439 Mt, while the biggest proportional fall between the two years was in Millet (down by 54.9 per cent).

In addition to the floods, the decline in maize production was due to low fertiliser application by small scale farmers, use of recycled seed and poor crop husbandry practices. The low fertilizer application was attributed to the high cost of commercial fertiliser and the limited coverage of the Fertiliser Support Programme (FSP).

9. Crop production and food security situation

The nation has in the recent past experienced serious droughts, which have led to poor crop harvest, especially of maize in most parts of the country. In mitigating the impact of drought, a number of Non-Governmental Organisations (NGOs) have through government and external donor assistance been involved in a number of farmer support programmes

aimed at diversified and increased food production and improved household food security in case of small-scale farmers.

Generally, the country's resource endowment is ideal for production of a wide range of crops, livestock, and fish given the diversity of the country's agroecological zones.

The low agricultural productivity, which has led to food insecurity at both national and household levels, has been attributed to the following factors:

- Unfavourable weather conditions such as erratic rainfall, droughts, floods,
- Unreliable and poor service delivery particularly for small-scale farmers,
- Marketing constraints especially in outlying areas as a result of poor infrastructure notably feeder roads,
- Inadequate agricultural finance and credit,
- Poor accessibility, and administration of land as well as low utilisation
- Policy inconsistency especially with respect to commodity and fertiliser marketing

Given the vast resource endowment in terms of the main factors of agricultural production i.e. biological resources, land, labour and water, Zambia has very good potential to increase and expand agricultural production. This potential also lies in the efficient and increased utilisation of available natural resources. There are four main potential sources of agricultural growth visa-vis expansion of cultivated area; increasing in yield by efficient utilization of the locally available genetic potential to develop new or improve the existing crop varieties; crop diversification; and improvement in livestock productivity. It is estimated that only 14% of total agricultural land is currently being utilised for agricultural related activities.

10. Agricultural policy environment

Zambia's development goals recognise, among others, the need to reduce poverty and improve household and national food security and the important role of the agricultural sector in achieving this. A productive and sustainable agricultural sector is seen as being critical to achieving economic growth and poverty reduction. The role of improved technologies, including the potential role of modern biotechnologies, in improving and increasing agricultural production and, hence, food security has also been appreciated.

Zambia has, however, experienced limited success in overall economic development in general and agricultural development in particular. A number of policy changes, including those aimed at facilitating and supporting the development of a sustainable and competitive agricultural sector that ensures food security at household and national levels and to maximise the sector's contribution to Gross Domestic Product (GDP) have been instituted in recent times. Agriculture is expected to feature prominently in Zambia's economy and in particular, become an increasingly important source of foreign exchange and remove dependency on copper or mineral resources.

Efforts to liberalise the economy in general and the agricultural sector in particular that began in the early 90s led to policy changes that resulted in the liberalisation of agricultural marketing for all inputs and products including exports, removal of various subsidies, the privatisation of all agro parastatals and private sector participation in commodity marketing and input supply.

These policy changes have had some negative impact on the small scale farmers who are the main producers of food crops, contributing an estimated two thirds of the nation's staple food requirements. A liberal market economy entails that the private sector becomes the main player in the marketing of agricultural inputs and produce. It was also realised that there was inadequate infrastructure and private sector capacity to adequately support the agricultural sector, particularly the small scale farmers. Some of the negative impacts of these rapid policy measures include uncertainty in crop marketing i.e. no guaranteed market for farmers especially those in outlying areas, input and output price variability across seasons and regions, drastic reduction in fertiliser use, and fluctuations in the production of the main staple food crop maize over the years. On the other hand, production of other food crops such as cassava, sweet potatoes and mixed beans increased. This made Government to review some of the strategies to try and address some of these problems, such as the introduction of some form of fertiliser subsidies to the vulnerable but viable farmers and streamlining the role of the Food Reserve Agency (FRA) in crop marketing.

The government formulated a new agricultural policy (2004-2015) whose overall objective is to facilitate and support the development of a sustainable and competitive agricultural sector that assures food security at national and household levels and maximises the sector's contribution to the gross domestic product (GDP).

The following are the priority policy objectives:

- To ensure national and household food security through an all-year round production and post-harvest management of adequate supplies of basic food stuffs at competitive costs
- To contribute to sustainable industrial development by providing locally produced agro-based raw materials
- To increase agricultural exports thereby enhancing the sector's contribution to national balance of payments
- To generate income and employment through increased agriculture production and productivity
- To ensure that the existing agricultural base is maintained and improved upon

Under the food security objective maize, sorghum, millet, cassava, sweet potato, beans and groundnuts are some of the crops targeted. Apart from the focus on food production, policy emphasis is also on food processing, promoting utilisation, food crop storage and preservation, nutrition and food safety.

The agricultural policy also highlights the important role of the natural resource base, which include land, water and genetic resources to support sustainable agricultural development and the need to take measures to address them.

Under the current agricultural policy, government is emphasising the need for strong public/private sector partnerships in order to develop the agricultural sector and attain food security. On one hand the public sector is expected to focus on the provision of services and support to vulnerable but viable small-scale farmers particularly in the remote and disadvantaged areas. Emphasis is in such areas as capacity building of farmer organisations, service delivery such as extension, research and direct support in form of inputs/credits where necessary. On the other hand, the private sector is expected to increase direct investment in the sector, play the role of credit provision, marketing and input supply.

The agricultural policy also pays attention to large-scale agricultural development. Government recognises that expansion in commercial farming can attract additional investment in agro-processing, which can have positive direct and indirect benefits on the rural poor.

Maize being a stable food crop has continued to be an important crop. Production of other food crops such as sorghum, millets and cassava is being encouraged, particularly in areas not suitable for maize production, through a crop diversification programme. The sector has diversified into the production of cash export crops at intermediate or commercial farming scale such as tobacco, cotton, oil crops, flowers and other horticultural crops, especially vegetables and cut-flowers.

The government has in recent years embarked on the formulation of new policy measures, which include the draft Cooperative Development Policy (CDP) and also the revision of the legal framework governing the Cooperative Movement under the Cooperative Societies Act of 1998. Other policy issues included the enactment of the Plant Breeder's Rights Act of 2007; Cabinet's approval of the National Irrigation Policy and Plan (NIP); and the launch of the Irrigation Development Fund (IDF).

As part of the implementation of the Fifth National Development Plan (FNDP), Government approved the developed National Cross-Sectoral Strategic Framework and Monitoring Matrix for Food Security in Zambia; and officially launched the Food Security Task Force to spearhead the monitoring of food security strategies' implementation during period of the FNDP.

Other policy and legal changes include the enactment of the Biosafety Act, process for the development of the National Intellectual Property Policy and review of the Science and Technology Policy.

CHAPTER 1

THE STATE OF DIVERSITY

Zambia possesses a wide range of local genetic resources of cultivated plant species, their wild relatives and some useful wild plant species. There are approximately 100 plant species that are cultivated in Zambia. Of these, about 15% are indigenous crop species including sorghum, millets, cowpea, Bambara groundnuts, sesame and traditional vegetable species. About 75% are exotic species, 7% of which were introduced and are fully integrated into the local farming systems and adapted to the local conditions. These crops include maize, beans, groundnuts, cassava, sweet potato, mango and avocado pear. Traditional crops namely sorghum, finger millet, pearl millet and cowpea as well as the locally developed varieties of maize, beans, cassava, sweet potato, groundnuts and pumpkins could be singled out as important cultivated crop species grown for food in Zambia.

Other locally available useful plant species in Zambia are wild relatives of rice, cowpea, sorghum, cucurbits, kenaf and sesame. However, the extent to which these resources have been used locally in crop improvement programmes is limited. There is also a wide range of indigenous vegetable species that occur as wild, semi wide and as tolerated useful weeds include amaranths, *Bidens pilosa* (Black jack), *Cucumis* spp. *Cleome gynandra* (Cat's whiskers) and *Corchorus* spp. (Jute). Other leafy vegetable species that could be classified as tolerated weedy species are *Celosia trigyna, Ceratotheca sesmoides, Cissampelos mucronata, Cleome hirta, Cleome monophylla, Commelina africana, Gallinsoga parviflora* and *Portulaca oleracea.*

Ethnic and cultural diversity continue to play an important role in the development and perpetuation of certain crop species and particular varieties within species. Certain crop species and varieties are associated with particular group(s) of people because of one reason or the other. For example, the Tumbuka people of Lundazi district in Eastern Province have maintained a brown bean variety for generations. This particular bean variety is red to brown seeded and provides good flavour when cooked. Certain maize varieties namely *Gankata* & *Siluntuba* are associated mainly with the Tonga people of southern province. *Siluntuba* is characterized by large, white, dent and floury grains. However, unlike *Gankata, and Kampelya, which are the* other local maize varieties in Southern province, *Siluntuba* is prone to pest and disease attack in storage. Besides being resistant to storage pests such as weevils, *Gankata* grows and yields well in a wide range of soils. *Hapungani* and *Hickory king*, also maize varieties among the Tonga people like *Siluntuba* are characteristically large grain type. The Bemba and Senga people of Chinsali and Chama districts of Northern and Eastern provinces respectively have maintained one variety of finger millet known as *Ntanga* in Senga, because of its early maturing attributes and thus ability to provide food early in the year. The Lala people of Central province have maintained Livingstone potato for its food and economical value.

TABLE 2

Some of the cultivated plant species found in Zambia under three main categories

Category	Species	Remarks
1. Indigenous	Sorghum	Includes crops with wild relatives occurring in Zambia and those domesticated within Africa
	Fingermillet	
	Pearlmillet	
	Cowpea	
	Bambara groundnut	
	Sesame	
2. Locally naturalised exotic	Maize	Includes introduced exotic crops that have been under cultivation for long enough a period as to have evolved some useful adaptive variation and are integrated in the local farming system
	Beans	
	Groundnuts	
	Cassava	
	Sweet potato	
	Mango	
	Avocado	
3. Recently introduced exotic crops	Soyabean	These are considered to be of recent introduction and have not evolved much local adaptive variation and not integrated into the local traditional farming systems
	Wheat	
	Strawberry	
	Apple	

1.1 The state of diversity of major crops

Major crops found in Zambia are given in the Table 3. Although maize is the staple food traditionally grown almost throughout the country, other major food crops grown in some parts of the country include sorghum, finger millet, rice, beans, cassava, groundnuts, and sweet potato. The most important fruit tree crops are citrus, mango, banana, papaya and avocado. Coffee, tobacco and cotton are important cash and export crops.

TABLE 3
Major and Minor Crops Found in Zambia

Category	Crop Species	Remarks
Major crops	Maize	Diversity includes several local varieties and 134 improved varieties have been released since 1997.
	Sorghum	There are several traditional sorghum varieties. Through formal research 16 improved varieties have been released. There are some wild related species that are found in most parts where sorghum is cultivated.
	Cassava	Crop diversity including local crop varieties and improved cultivars. Formal breeding systems have developed seven (7) improved varieties
	Pearl millet	Farmers hold high diversity in the form of local varieties besides availability of 10 improved varieties
	Finger millet	Local farmers in higher rainfall areas especially in the northern Zambia maintain high diversity of the crop. Five (5) improved varieties have been developed under formal research.
	Beans	High diversity of both dwarf or bush type and climbing types of beans occur in Zambia. Seventeen (17) improved varieties have been released from the formal breeding.
	Groundnuts	The crop is grown under both the large and small scale levels. Ten (10) improved varieties have been released. A range of locally adapted varieties are found to occur throughout the country.
	Cowpea	Important crop in hotter and drier parts of Zambia, replacing beans as a food crop for grain and leaf in those areas. The formal research has released 6 improved varieties. There are also a number of wild related species known to occur in the country
	Sweet potato	The released eight (8) improved varieties have added to existing wide genetic variation represented by local varieties found through out the country on-farm.
	Rice	There are a few local varieties still grown by small scale farmers in certain parts of the country. There has been limited introduction of germplasm and development of improved varieties during the past ten years. A number of wild related species are still found in certain parts of the country.
	Sunflower	Varieties from early introductions may be found in some sunflower producing areas. Sunflower cultivation in Zambia is concentrated in Southern, Central and Eastern provinces. Most of the germplasm used in the breeding programme of sunflower should essentially be introductions.
Minor	Bambara groundnuts	Except for 2 improved varieties, the available local varieties account for most of the available genetic variation.
	Pumpkins	Local varieties constitute larger part of diversity.
	Pigeon pea	Wide variation occurs in characters such as height, morphology and photoperiodism.
	Water melon	A range of local varieties are to be found especially in drier and hotter parts of the country. A few improved and introduced varieties are cultivated.
	Sesame	Mainly local varieties

Maize remains an important staple food crop in Zambia, being grown almost throughout the country. Although the area planted to improved varieties is generally thought to have increased over the last ten years most landraces that were developed overtime are still cultivated by small scale farmers for their special characteristics such as storability and good taste. The traditional varieties are generally tall, late maturing and low grain yielders. However, in certain other cases dwarf and early maturing varieties of maize have also been maintained by local farmers. Most variation is in the size and shape of cob, row number and grain colour. Most of the diversity has been collected and conserved at the National Genebank and duplicated in the base collection at the SADC Plant Genetic Resources Centre.

Wheat is the perhaps the world's number one staple food crop. It is, however, still considered to be of recent introduction in Zambia. Most wheat in Zambia has been grown as an irrigated crop. Efforts to develop improved rainfed varieties and promote its production under rainfed conditions have not been successful. The prospects for the integration of wheat into the traditional farming system are, therefore, not good in the near future.

Sunflower has been grown as a commercial crop and as such has not been well integrated into the traditional farming system. Varieties from early introductions may be found in some sunflower producing areas. Sunflower cultivation in Zambia is concentrated in Southern, Central and Eastern provinces. Most of the germplasm used in the breeding programme of sunflower should essentially be introductions.

Sorghum cultivation seems to have been on the decline over the last ten years. This is mainly due to its replacement by maize. Its cultivation has, however, remained in the drier and hotter areas of southern province where the cultivation of maize is more problematic on account of low moisture and to a lesser extent in Western, Northwestern, Central and Copperbelt provinces. The cultivation of sorghum among small scale farmers is still largely based on local varieties, although there are a number of improved varieties available, whose cultivation is being adopted by some farmers. A wild form occurs in the sorghum growing areas, probably *Sorghum verticilliform.* A lot of interactions between the cultivated and wild forms are suspected to occur as the wild types frequently occur as weeds in the crops. *Sorghum. verticilliform* is said to cross freely with the cultivated species.

Much of pearl millet cultivation is done in Western and Southern provinces. The area planted to pearl millet, however, seems to have declined over the last ten years, mainly due to its being replaced by maize. Much of the current cultivation is based on local varieties despite the availability of a number of improved varieties.

Rice in Zambia is grown in the Zambezi floods plains of Western province, Chambeshi flats in the Northern province, the Luangwa flood plains in Eastern province, the lake basins of Mweru and Bangweulu in Luapula and sporadically on the Copperbelt in the dambo sites and along Kafue River and some seasonal streams. New germplasm introductions especially for upland rice have been made in recent years. Local varieties still used by small scale farmers in the rice producing areas are largely still based on the indica types thought to have initially come from neighboring countries particularly Angola and Tanzania. Rice is not considered a staple food crop for most people in Zambia and is mainly used as a supplementary food.

Soyabeans is considered a recent introduction in Zambia. A number of varieties have been developed mainly through selection from introduced germplasm. Its cultivation has been expanding among commercial farmers over the last ten years, but has not picked up among small scale farmers. It is mainly grown as a cash crop as it is still not considered as food among the local population.

Common beans is grown in almost every part of the country but is more extensively grown in Eastern and Northern provinces where wide variability is encountered. Its production has increased in Northwestern and Central provinces in the last ten years. A lot of variation is still to be found in seed colour, size and shape. Generally speaking, medium large seed size is preferred locally. New germplasm introductions have continued to be brought into the country adding to the existing diversity through the development and release of improved varieties. Much of the local diversity has been collected and conserved at the National and Regional genebanks.

Ground nuts are mostly grown in Eastern province where the most common varieties are *Chalimbana* which characteristically is of the spreading habit, *Makulu red* and *Natal common* and a few cultivars occur sporadically. Groundnut, however, is cultivated in all provinces of the country to varying degrees. The local types are generally small seeded having less incidence of pops. There is not much local variation in groundnuts compared to beans.

For minor crops, a wide array of indigenous vegetables species existing either as cultivated, semi- cultivated or weedy forms are utilised. For genetic resources of traditional vegetables, these have received comparatively low priority since the inception of Zambia's NPGRC in the early 1990s. Traditional Farming System has played an important role in preserving this genetic diversity. Most traditional cultivation practices include passive conservation of semi-cultivated or wild relish species.

Over the past few years the Ministry of agriculture through ZARI has undertaken exploratory research on a number of commonly used indigenous vegetables such as *Corchorus*, *Cleome, Amaranths*, Cucurbits and other crop species. Of these, the cucurbits, with several of the species being native to the region, are among the major vegetables species used by subsistence farmers in Zambia. Various cucumis species, exhibiting a lot of variation and occurring as cultivated, semi-cultivated, weedy and wild types occur throughout the country.

There has been renewed interest in recent years in the utilisation of local vegetable species as food, which has resulted in increased production and marketing.

1.2 Genetic erosion

The major factor contributing to genetic erosion for most of the crops discussed above continues to be replacement by improved varieties, especially for major crops such as maize, sorghum and groundnuts. Cassava and sweet potato have also gotten more affected by this factor over the past ten years than before as a result of the increased effort in variety development and the promotion as part of crop diversification strategy to enhance food security. Other crops such as finger millet, pearl millet and beans have also been affected though to a lesser degree. The continued shift in the choice of crops grown by small scale farmers, with more and more land being taken under mainly cash crops like

cotton, tobacco, sugarcane and hybrid maize, continued to pose a major threat to the genetic diversity *on-farm* of the traditional cereals, grain legumes and root and tubers crops.

Based on the number of released crop improved varieties, maize (*Zea mays* L) has the highest diversity of modern varieties, followed by wheat (*Triticum aestivum*)), sunflower (*Helianthus annuus*), soyabean (*Glycine max*), sorghum (*Sorghum bicolor* L.), bean (*Phaseolus vulgaris*), groundnut (*Arachis hypogea*), rice (*Oryza sativa*), cotton (*Gossypium hirsutum*), pearl millet (*Pennisetum glacum*), sweet potato (*Ipomoea batatas*) and cassava (*Manihot esculentum*). The number of improved varieties for most major crops has generally been increasing.

CHAPTER 2

THE STATE OF THE *IN SITU* MANAGEMENT

2.1 Inventories and surveying

The institutions responsible for conducting inventories and surveys of plant genetic resources in general include National Plant Genetic Resources Centre, Department of Biological Resources of the University of Zambia, Zambia Forestry Division and Zambia Wildlife Authority. Nonetheless there has been no systematic and coordinated inventories and survey especially that each institute works within its mandates, needs and priorities.

Focus for future inventories and surveys should be directed at:

- Capacity development in most institutions involved in inventories and survey, in particular, capacity for methods and technology applications to enable standardized inventories, human resource such as taxonomists, GIS specialisation.
- Relevant policies and legal instruments should be developed to guide
- Financial support is needed at national level to support programmes prioritising PGRFA and host habitats for conservation.
- Priority areas for genetic resource erosion should be quickly identified at the national level through a gap analysis evaluation i.e. protected versus unprotected areas.

2.2 *In situ* management

In situ conservation of wild plant genetic resources for food and agriculture has mainly been undertaken in the national parks under the Zambia Wildlife Authority and national forest reserves under the management of the Forest Research Division. Zambia formulated the National Biodiversity Strategy and Action Plan (NBSAP) a national strategy for implementing the Convention on Biological Diversity. The NBSAP, which was adopted in 1999, was formulated to ensure that biodiversity activities meet national interests as well as priorities actions required for achieving the objectives of the conservation in the years to come. Following formulation of NBSAP, an assessment of status of biodiversity was undertaken. The following threat factors to biodiversity were identified including: deforestation and habitat destruction, land use conflicts, climatic change, introduced species, pollution, lack of biodiversity knowledge and cultural and social values attached to biodiversity use. In addition the analysis established unmet needs for diversity in Zambia. The major problem areas identified included:

- The status of protected areas and their ecosystem not adequately known.
- Under representation of ecosystems in the protected areas system.
- Under protection of the protected areas.
- Unsustainable use of biodiversity.
- Weak community involvement in biodiversity management
- Stock of biological resources and their dynamics inadequately known.
- Inadequate provision and protection of community rights in the management of biological resources.
- Imbalance in access to and sharing of benefits from biological resources.
- Inadequate conservation of traditional crop varieties.
- Wild varieties of crops insufficiently surveyed and conserved.
- On-farm conservation of crops poorly understood and documented.
- Collection, exchange and transfer of crop genetic resources inadequately controlled.
- Lack of mechanism for addressing threats from genetically modified organisms.
- Insufficient knowledge base for biotechnology.
- Weak and uncoordinated effort between government agencies and local communities in biological resources management.

The creation of forest reserves has been the main strategy of conserving forest genetic resources. Conservation of forest genetic resources in Zambia is being spearheaded through the Zambia Forest Action Plan Programme (ZFAP) and the Provincial Forest Action Plan (PFAP), which prepared Forest Action Plans for four provinces namely, Central, Copperbelt, Luapula and Southern commenced in February 2000.

The other programme under Famine early warning Systems (FEWS) is Early Warning Systems Programme is being implemented by institutions responsible for early warning, vulnerability asses and disaster management such as Meteorological Department, Ministry of Agriculture and Co-operatives and Central Statistical Office (CSO).

2.3 On-farm conservation

The *in situ* method for the conservation of PGRFA such as useful wild plant species, wild related plant species and local crop varieties remains an important strategy. On-farm conservation activities in Zambia were initiated in 1998 by the National Plant Genetic Resources centre as part of the regional initiative involving Malawi, Zambia and Zimbabwe. The initial activities which were undertaken in collaboration with SADC Plant Genetic Resources Centre (SPGRC), Biodiversity Community Network (BCN) and Department of Agriculture, focusing on community-based on-farm conservation aimed at gathering data and information that would assist to develop methodologies for on-farm conservation.

The focus changed towards the promotion of the multiplication and restoration of farmers' varieties (landraces) have been undertaken on a pilot scale involving selected communities of Rufunsa in Lusaka province and Chikankata in Southern province. The initial on-farm conservation activities have generated a lot of interest among the local farming communities and policy makers, with calls to scale up the activities. These activities have involved seed multiplication of certain local varieties that are threatened with loss with the aim of restoring them in the respective communities and sharing of information about the local crop diversity through seed fairs. So far indicators are that farmers appreciate traditional varieties but genetic erosion has been taking place due to the introduction of new varieties and certain farmer practices. It has been found that food security is one of the major determinants of farmers' choice of variety.

Future focus should include:

- Appropriate policy and legislation supporting on-farm PGR conservation
- Capacity building and co-ordination of on-farm PGR conservation
- Community and farmers' rights
- Strengthening of community Seed security networks

CHAPTER 3

THE STATE OF *EX SITU* MANAGEMENT

3.1 State of collections

Currently, the National Plant Genetic Resources Centre (NPGRC) is holding 5 996 accessions of different crop species in form of seeds samples, maintained as an active collection under long term storage conditions. The *ex situ* collection at the NPGRC also includes 207 germplasm material of cassava (152) and sweet potato (55) maintained as living plants in a field genebank. Table 3 shows the number of major crops held by the gene bank as 31 December 2007.

TABLE 3
Number of Accessions for major crops held at the National genebank as at 31 December 2007

Crop Species	Number of Accessions
Sorghum	1 350
Groundnuts	561
Cowpeas	657
Finger millet	297
Pumpkin (Cucurbits)	641
Maize	685
Bambara ground nuts	163
Beans	309
Pearl millet	379
Rice	196
Pigeon pea	153
Okra	245
Water melon	75
Castor	45
Sunflower	42
Other crop species	194
Total	**5 996**

Seed samples that are hermetically sealed in aluminium foil bags are stored in deep freezers operating at temperatures between -18°C to -20°C. The required low seed moisture content of below 7% is achieved by drying seed samples using a dehumidifier drier.

Care is taken to ensure that the original seed samples stored in the genebank are of high quality in terms of viability. Testing for viability for stored seed samples is now being done at 10 year intervals from the initial 5 year interval. Regeneration undertake on seed samples found to have lower viability levels than the minimum recommended for storage, ensures that conserved seed samples remain of high quality and therefore do not lose their genetic integrity.

3.2 Collecting

The NPGRC has been carrying out germplasm collection missions most of which were of rescue and multicrop nature. Much of the collecting has been conducted on farmer fields targeting mainly traditional local varieties. Being multicrop the collecting missions covered all cultivated crop species, though there was some bias in targeting major food crops, which include maize, sorghum, finger millet, pearl millet, ground nuts, and beans. Minor crops collected include cowpeas, bambara groundnut, various cucurbit and local vegetable species Much of the collecting was done during the period 1997- 2004, resulting in largely the whole country being covered with a few gaps in terms of geographical and species coverage remaining. A few multicrop rescue collecting missions, necessitated by threats of drought and floods mainly in the southern and lower and drier parts of the country have been undertaken. There have been a few collections of wild crop relatives of rice, cowpea and sorghum collected in the country during the last 10 years. There has also been a shift to target the collection of vegetatively propagated crops, in particular, cassava and sweet potato. Although most collection missions were initiated by the NPGRC a few were initiated and undertaken by crop research programmes, as is the case with cassava and maize. It is estimated that about 50% of the total collections conserved at the national genebank have been collected in the last 10 years.

Priority for future collecting is on gap filling in terms of species and geographical coverage. This will mainly involve underutilised cultivated and wild plant species that are currently under-represented in the collection. Remote areas especially those that are prone to disasters such as floods and droughts will also be prioritised.

3.3 Storage facilities

The twenty-eighty (28) deep freezers currently available at the genebank provides adequate storage space for the available number of seed sample accessions. Seed samples are stored in the deep freezers at temperature between -18°C to -20°C. A dehumidifier drier is available at the National Genebank to dry seed samples to the required moisture content before storage.

3.4 Security of stored materials

The germplasm accessions stored in the national genebank is secure in the sense that these are duplicated in the base collection at the SADC Plant Genetic Resources Centre (SPGRC). The standby generator that was acquired and installed at the beginning of 2007 has enhanced the security of the seed samples conserved by facilitating continuous supply of electricity and hence, the functioning of the storage facilities. The acquisition and installation of the standby generator was timely as it coincided with the beginning of significant power shading from the main electricity grid, resulting in frequent and prolonged power cuts. It is further expected that SPGRC will deposit duplicates of the accessions maintained in the base collection at the Global Seed Vault in Slavbard, in Norway and further enhance the security of the collections.

It should, however, be noted that not all seed samples in the active collection at the national genebank are duplicated at SPGRC yet due to various problems, but mainly inadequate seed amount. Regeneration and multiplication of the seed samples accessions not yet duplicated is currently a priority activity for the national PGR programme.

3.5 Documentation and characterisation

The national genebank uses SADC Documentation and Information System (SDIS) to enter data from the field collections, i.e. passport data that accompanies seed samples when they arrive at the genebank. The other data and information documented are accession management data, which include germination, characterisation and moisture content data. All passport, characterization and regeneration data have been entered on SDIS. Active collection data pertaining to management information are updated on regular basis.

About 33% of the collections have been characterised using morphological and agronomic data generated from accessions grown in the field. A significant number of accessions have not been characterised as there was a scale down on this activity in order to focus effort on multiplication and regeneration activities. The crops that have been characterised include sorghum, finger millet, pearl millet, beans, Bambara groundnuts, cowpeas, ground nuts, and maize.

3.6 Seed multiplication and regeneration

Multiplication activity has been carried out for those accessions with inadequate seed amounts, mainly to facilitate duplication at SPGRC base collection and, when required, distribution to end users. Seed regeneration was also carried out for those accessions with low viability below 85%. All the seed multiplication and regeneration activities are carried out during the rainy season due to lack of irrigation facilities at the sites used for this purpose.

A major accession multiplication and regeneration exercise was embarked on during the 2007/2008 season, when 950 accessions of different crop species were planted out at different sites. The objective was to harvest enough seed for most of the accessions held at the NPGRC and have these deposited at the SPGRC base collection and thereby contribute to narrowing the gap between the number of accessions deposited at SPGRC and the total number of accessions available across all the NPGRCs within the network.

3.7 Germplasm movement

The germplasm accessions in the active collection are meant for distribution to end users such as breeders, scientists, and farmers. During the period under review, the NPGRC has been distributing germplasm accessions of different crop species to research and learning institutions, NGOS and farmers (Table 4). These institutions have requested germplasm for research; characterisation and seed multiplication. Crop species distributed since 1997 include maize, cowpea, sorghum, pearl millet, finger millet, beans, sweet potatoes, cassava, sesame and local leafy vegetables. Germplasm accessions have also been distributed to farmers and individuals on request.

TABLE 4
Summary Germplasm distribution to users for the period 1997-2008

Crop	Accessions	Requester	Year
Beans	50	Food Legume Improvement Team, Zambia	1997
Pumpkin	34	Vegetable Research Team, Zambia	2001
Maize	34	Seed Control and Certification Institute, Zambia	2001
Pearl millet	11	Sorghum and Millet Improvement Programme, Zambia	2001
Sorghum	20	Sorghum and Millet Improvement Programme, Zambia	2001
Bambara g/nuts	18	University of Swaziland	2002
Pumpkin	19	University of Swaziland	2002
Cleome	9	University of Swaziland	2002
Amaranths	5	University of Swaziland	2002
Okra	9	University of Swaziland	2002
Cowpea	100	Food Legume Diversification Project, Zambia	2002
ALVs	79	AVRDC-ARP, Arusha, Tanzania	2002
Maize	278	University of Zambia	2003
Amaranths	1	Natural Resources Development College, Zambia	2003
Beans	18	Food Legume Improvement Programme, Zambia	2004
Cucurbita sp	23	Golden Valley Agricultural Research Trust, Zambia	2005
Cowpea	7	Golden Valley Agricultural Research Trust, Zambia	2005
Amaranths	5	Golden Valley Agricultural Research Trust, Zambia	2005
Citrullus	1	Golden Valley Agricultural Research Trust, Zambia	2005
Hibiscus	2	Golden Valley Agricultural Research Trust, Zambia	2005
Okra	1	Golden Valley Agricultural Research Trust, Zambia	2005
Corchorus	1	Golden Valley Agricultural Research Trust, Zambia	2005
Cleome	1	Golden Valley Agricultural Research Trust, Zambia	2005
Maize	15	Imperial College of London, United Kingdom	2005
Sweet potato	6	Riverside Institute, Zambia	2007

Crop	Accessions	Requester	Year
Cassava	5	Riverside Institute, Zambia	2007
Sesame	4	University of Zambia	2008
Pumpkins	16	University of Zambia	2008
Total	**782**		

3.8 Assessment of major *ex situ* needs

The following actions will need to be undertaken to improve *ex situ* conservation of the national collections in Zambia:

- Capacity building of human resources in molecular techniques, and data base and information management.
- Filling gaps in collections
- Rationalising collections to avoid duplication.
- An equipped laboratory for molecular characterisation, *in vitro* and tissue culture laboratory.
- A reliable germinator to monitor viability of stored materials
- Develop irrigation infrastructure facilities and screen houses for multiplication and regeneration activities.

Major constraints affecting the ex situ management of the PGRFA collections in the country include the following:

- Lack of screen houses to facilitate regeneration and multiplication of some of the more difficult plant species.
- Lack of laboratory capacity to facilitate use of modern biotechnological methods for characterisation and evaluation.
- Inadequate qualified human resource

CHAPTER 4

THE STATE OF USE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

4.1 Characterisation and evaluation of genetic diversity

The Zambia Agriculture Research Institute (ZARI) is the largest public research institution conducting crop research, focusing on variety development. Other research institutions involved in variety development are the Cotton Development Trust (CDT) and The Department of Crop Sciences of the School of Agricultural Sciences at the University of Zambia.

The Crop Improvement and Agronomy Division under ZARI houses Crop Research Programmes that are responsible for variety development of important food and cash crops (Table 4). Variety development takes place in the following crops: maize, sorghum, finger millet, pearl millet, wheat, sunflower, cassava, sweet potato, ground nuts, beans and soyabeans. The varieties developed are evaluated through multilocation field trials across the agroecological regions such as GART for maize and sorghum trials (Figure 1). Limited efforts ending at variety selection takes place in crops such as vegetables, rice, cowpea, bambara ground nuts, pigeon pea, kenaf and tree & plantation crops.

Much of the germplasm used in these crop development and improvement programmes is introduced especially for the major food and cash crops such as maize, sorghum, groundnuts, wheat, cotton, sunflower and beans. Local germplasm collected from within the country has also been incorporated into the breeding programmes for some of these crops. Minor crops such as finger millet, pearl millet, bambara groundnut and sweet potato have utilised more of local germplasm than introduced crops.

There has been renewed interest in recent years on the need to screen and evaluate local germplasm for major crops such as maize, sorghum, cassava, beans and cowpeas, in particular focusing on the evaluation for stress tolerant traits such as drought and soil acidity.

FIGURE 1
ZARI Sorghum Varieties in Field Trials at GART

TABLE 4
Crop Research Programmes under ZARI

Programme	Crops
Cereals	Finger millet
	Pearl millet
	Maize
	Rice
	Sorghum
	Wheat
Food Legumes	Groundnut
	Bean
	Soybean
	Cowpea
	Pigeon pea
	Bambara groundnut
Oilseeds	Sunflower
	Minor oil crops
Fibre Crops	Kenaf
Vegetables	Exotic Vegetables
	Indigenous Vegetables
Tree & Plantation	Fruit and Nut
	Coffee
Root and Tubers	Cassava
	Sweet potato

4.2 The role of farmers

The farmers play a role in determining the type of varieties developed. Farmers value certain characteristics of varieties that breeders have to concentrate on. These are characteristics such as earliness, drought tolerance, low nitrogen tolerance, soil acidity tolerance, bird resistance, disease resistance, good storability, grain type, sweetness, bitterness, nutrient content, etc. The idea is to develop a number of varieties with different attributes for farmers to select from. Certain traits are or may be negatively correlated with yield e.g. earliness and disease resistance.

The appropriateness of developed and/or improved varieties as demanded by the farmers is important if utilization of local plant genetic resources for food and agriculture has to be a reality. The case in point is the maintenance of a local variety of groundnuts, Kadononga, by traditional farmers in Rufunsa in Chongwe district (Figure 2).

FIGURE 2
A local variety of Groundnuts, Kadononga, in a farmer's field in Rufunsa

4.3 Utilisation of conserved plant genetic resources and major constraints

High yielding varieties are sometimes found to have poor storage qualities (e.g. WP 13, a sorghum variety), susceptible to bird damage (some sorghum varieties), unacceptable colour (e.g. some beans varieties), poor taste, poor poundability (some dent maize varieties), small kernel size (e.g. MMV 400), high oil content (groundnut MGV 4). High oil content is not desirable for small-scale farmers who use groundnuts in vegetables. Sweet varieties of cassava may be prone to theft. The challenge is to address the issues while at the same time not sacrificing yield because ultimately increased productivity (yield per unit area) is important. It becomes necessary in certain cases to sensitise farmers on the importance of some traits. For example an early variety is recommended for short season areas while late varieties are recommended for long season areas.

The ZARI has released a number of improved varieties with attributes such as: high yield, stability, adaptation to target environments, tolerant to (biotic) and (abiotic) stresses and desirable plant, fruit and grain quality.

For the varieties developed and released in the last 10 years under crop research programmes under ZARI, as indicated in Table 5 below, there is a significant proportion of varieties derived from locally collected germplasm. The maize, sorghum, finger millet, pearl millet, bean, cowpea, cassava and sweet potato research programmes are known to have accessed germplasm from the National Genebank for screening and evaluation.

A number of varieties given in the Table above are direct selections from local germplasm. These include *WP 13* for sorghum, *Misacas 3* for castor, *Kabulangeti* for beans, *Katete* for cowpeas, *Kalungwishi* for sweet potato, *Kampolombo* for cassava, *Chibuli* for finger millet, *Sepo* for pearl millet and all the three bambara groundnut varieties.

Germplasm introductions from external sources outside the country continue to be a major feature of the crop development and improvement programmes for all crops except bambara groundnuts which has wholly depended on local germplasm. The major sources of introduced germplasm are the International Agriculture Research Centres, such as ICRISAT, CIMMYT, CIAT, CIP and IRRI.

Some of the major constraints to the utilisation of conserved plant genetic resources in Zambia are the lack of appreciation of the value of locally available plant genetic resources and the perceived advantages of introduced germplasm. These are compounded by marketing constraints and biases in the legal and policy framework that constrain the development of traditional varieties.

TABLE 5

ZARI Crop Varieties Released from 1997 to 2007

Crop	Variety	Year Of Release
Maize	GV 408, GV 470, GV 412, GV 512 GV 61, GV 67, GV 607, GV 702 GV 703, GV 704, GV 722 Pop 10, Pop 25 GV 640, GV659, ZM 421, ZM 521, ZM 621	1998 2002 2004
Sorghum	ZSV 15, MMSH 1257, MMSH 1324 MMSH 625, MMSH 1365, WP-13	1998 2005
Pearl millet	Sepo Tuso, Kuomboka Mulatiwa, Liseli Dola	1997 1998 2005 2007
Finger millet	Chibuli	2001
Bambara nut	Fubila, Malumbe	2000
Bean	Chambeshi Lyambai, Lukupa Kalungu Kabulangeti, Kapisha, Kabale	1998 1999 2004 2007
Pigeon pea	Luangwa	2001
Castor	Misacas 3	2000
Ground nut	Champion, Luena	1998
Cassava	Kampolombo, Chila, Tanganyika, Mweru	2001
Rape	Nanga	1997

Crop	Variety	Year Of Release
Cowpea	Katete	2004
Soyabean	Lukanga Mulungushi	2004 2005
Sweet potato	Kalungwishi, Lukusashi, Lukulu, Lunga	2003
Wheat	Mampolyo, Nseba	2006

Efforts made towards addressing some of the above concerns, have led to a number of initiatives directed at the promotion of the conservation, use and development of traditional varieties. These included the crop diversification strategies under MACO; community based seed multiplication programme and on-farm conservation programme of farmer varieties under the National Plant Genetic Resources Programme. These efforts have, however, not been accompanied by a comprehensive review of the legal and policy framework supporting or affecting them, a fact, which may have fundamental impact for their long-term sustainability.

4.4 Future priorities and needs

One of the future priorities and needs to improve the utilisation of conserved plant genetic resources in Zambia is the need to increase crop research covering the underutilised traditional food crops as well as some of the new crops with new commercial and industrial value. These would include food legumes such as common bean, cowpea and bambara groundnuts, sorghum and millets, cassava, sweet potato, fruit trees and oil crops such as Jatropha. There is increased demand for information for instance pertaining to the production characteristics of Jatropha following its use in the production of biofuel.

There is also need to develop the irrigation infrastructure to facilitate supplementary irrigation during drought periods and enable off season cropping to support in particular the production of foundation seed.

CHAPTER 5

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION

5.1 Introduction

The National Plant Genetic Resource Centre (NPGRC) shoulders the responsibility of conserving locally available plant genetic resources in the country. The NPGRC falls under the Zambia Agriculture Research Institute (ZARI), which is one of the departments under the Ministry of Agriculture and Co-operatives. The activities of national programme include field collections, characterisation and evaluation, seed regeneration, multiplication and documentation of collected and stored germplasm. The NPGRC carries out these activities in close collaboration with the SADC Plant Genetic Resources Centre (SPGRC) and crop working groups within ZARI. To strengthen the activities of the national programme, the NPGRC is also carrying out on- farm conservation of local crop varieties among affected farming communities in Rufunsa, Lukwipa in Chongwe district and Chikankanta in Mazabuka district, involving altogether 140 farmers. These activities are carried out in close collaboration with the Department of Agriculture and local NGOs, such as Biodiversity Community network (BCN). The NPGRC falls under the Crop Improvement and Agronomy Division within ZARI. The national programme has its budget line funded by Government and gets additional support from the Nordic donor countries through the SPGRC project. Over the past 10 years the SPGRC has helped to develop and strengthen the capacity of the NPGRC in terms of financial, technical and training support.

5.2 National programme

As part of national efforts towards the conservation of crop genetic diversity, the Zambian government in 1989 established the National Plant Genetic Resources Programme under the Ministry of Agriculture and Co-operatives, as a counterpart to the SADC Regional Plant Genetic Resources Programme, with the main objective of contributing to sustainable crop production by ensuring the availability of a broad genetic base and preserving the country's crop genetic heritage and the associated traditional practices and indigenous knowledge systems. These would be achieved through the following specific objectives:

- To explore and collect the locally available crop/plant genetic resources.
- To establish the Genebank facility for the *ex situ* conservation of crop genetic resources. The facility should include seed storage and maintenance of living plants or vegetative material.
- To develop strategies for on-farm conservation of crop/plant genetic resources.
- To characterise the crop/plant germplasm maintained at the genebank or found in the country.
- To document all information available on crop/plant genetic resources and make both information and germplasm available to breeders and other researchers.
- To contribute to international plant genetic resources conservation and utilisation through among other things facilitating exchange of crop/plant genetic resources with other genebanks.

Activities under the programme have included germplasm collection expeditions from farmers' fields throughout the country. The collected crop germplasm is being conserved at the National Genebank or National Plant Genetic Resources Centre (NPGRC) located at Mount Makulu Research Centre.

National stakeholders institutions involved in the implementation of the programme include the Natural Resources and Forestry Departments of the Ministry of Tourism, Environment and Natural Resources (MTENR), Crop Science Department of the School of Agricultural Sciences at the University of Zambia, National Institute for Scientific and Industrial Research, Mundawanga Botanic Gardens, Zambia Wildlife Conservation Authority and local and international NGOs and farmer

organisations. The level of commitment in terms of funding support to national programme activities has not changed much over the last ten years. Some of the challenges for next 10 years include the provision of secure funding support to the national programme. In order to sustain the national PGR programme over the next 10 years there is need for the government to increase its funding support, especially considering the fact that the SPGRC source may not be available after 2009 when the current Nordic donor support comes to an end.

Organisation of the national programme

Administratively, the National Plant Genetic Resources Centre is headed by the Curator /Team leader who reports to the Chief Agricultural Research Officer for Crop Improvement and Agronomy. The total number of staff for the NPGRC as provided by the approved Treasury Authority is six (6) professionals and eight (8) technical research assistants. Presently, there are six (6) members of staff, i.e. two (2) professional staff and two (2) technicians. One senior officer retired from the civil service and one senior officer is on study leave pursuing PhD studies. One technician is also on study leave pursuing BSc degree programme at one of the national universities.

5.3 Training

Training of staff has been ongoing throughout the last ten years. The major component of this has been the MSc programme obtained from the University of Birmingham through Nordic donor support under the SPGRC project. In this regard four NPGRC staff members have been trained over the past ten years. Zambia has also continued to participate in the annual short course in Genebank Management provided by the Nordic Genebank. Zambia has also benefited from a recently introduced PhD programme supported under the same Nordic funding, with one member of staff currently pursuing this programme in Sweden under a sandwich arrangement. Other members of staff have obtained BSc degree training from the local Universities. In addition, most members of staff have also benefited from short specialized courses organized by SPGRC within the SADC region.

Maintaining qualified staff still remains a problem due to unattractive and uncompetitive conditions of service. Over the years trained and experienced members of staff have left the National PGR programme for employment elsewhere both within and outside the country.

Future Needs and Priorities

- Strengthening training programmes for staff in PGR related areas.
- Availability of courses in PGR locally.
- Financial support for training in PGR, especially at MSc level.
- Training in biotechnology, biosafety and molecular techniques.

Constraints

- Financial support is limited.
- PGR related topics are not addressed in the curricular in higher institutions.

5.4 Policy and legislation

The national biodiversity strategy highlights *ex situ* conservation as a strategy for achieving the conservation of genetic diversity of Zambian crops. This was to be achieved through: the review and improvement of the system of seed samples maintained in the gene bank, the regeneration of seed samples maintained in the gene bank, establishment of field genebanks and *in vitro* facilities to conserve the genetic diversity of vegetatively propagated crops and establishing duplicate safety *ex situ* collection.

Two draft policies namely; National Agricultural and Co-operatives Policy (NAP) (2003 - 2015) (Final Draft, 2004) and National Policy on Indigenous Knowledge, Genetic Resources and Folklore (Final Draft, 2005) have incorporated promotion and conservation of traditional crop varieties and livestock breeds. The NAP claims to promote the conservation and utilisation of local crop varieties yet it is not explicit on the development of the informal seed sector, which is the driving force for the traditional crop varieties.

CHAPTER 6

REGIONAL AND INTERNATIONAL COLLABORATION

6.1 Regional and sub regional networks

Zambia participates in a number of PGRFA and crop networks that exist at sub regional and regional levels. At the highest level collaboration on PGR related issues within the Africa region has been realised through the intergovernmental fora such as the African Ministerial Conference on Environment (AMCEN) and the relevant scientific committees of the African Union (AU) and the New Partnership for Africa's Development (NEPAD).

Zambia has also collaborated at regional level through the involvement of local NGOs. This is through for instance the Community Biodiversity Development Conservation (CBDC) Programme, which is a global programme involving selected countries in Africa, Latin America and Asia, which brings government institutions and NGOs together at global, regional and national levels

SADC Plant Genetic Resources Network

Zambia participates in the SADC Plant Genetic Resources Network, which was established in 1989 as a 20-year project with the mandate to conserve the plant genetic resources of the sub region through a network of National Plant Genetic Resources Centres (NPGRCs) with the goal of contributing to the well being of people of the region. The network has grown in strength over the last 10 years in terms of number of countries involved and enhanced information sharing on technical issues pertaining to plant genetic resources management, facilitated through the annual review and planning meetings held for the network. This annual event brings national genebank managers or curators and other technical staff together to share successes and problems encountered in the management of PGRFA, in particular *ex situ* collections. These meetings have proved effective and useful in building capacities among national programmes thereby strengthening the sub-regional network. Zambia continues to host the SADC Plant Genetic Resources Centre (SPGRC), which coordinates the network. The SPGRC also holds duplicate safety collections from all participating NPGRCs in the network. To date SPGRC has over 12 000 accessions stored in the base collection from over 23 000 accessions in the active collections of NPGRCs.

The SADC Plant Genetic Resources network has expanded over the years since its establishment with 12 out of 14 SADC member countries having established National Plant Genetic Resources Centres (NPGRCs) to coordinate and implement the national PGR programmes. Congo Democratic Republic and Madagascar which joined the SADC more recently have not yet established NPGRCs. Efforts are, however, underway to assist these countries became active participants of the network by strengthening and establishing the national PGR programmes.

Zambia has continued to actively participate in the programmes and activities of the network both at policy and technical levels. At policy level the chairperson of the National Plant Genetic Resources Committee (NPGRcom) in Zambia sits on the Board of SPGRC, while individual experts participate in all the regional Crop Working Groups (RCWGs).

Other Zambian institutions involved in the activities of the network at the technical level include relevant government departments in the Ministry of Tourism, Environment and Natural Resources and Ministry of Agriculture and Co-operatives, private research institutions, relevant departments at the University of Zambia and local NGOs. These institutions have mainly been used to carry out certain technical activities either directly in collaboration with SPGRC or indirectly through the NPGRC. The Seed Control and Certification Institute, a seed regulatory agency under the Ministry of Agriculture and Co-operatives has provided specialised laboratory services in seed viability testing. The Crop Science Department, School of Agricultural Sciences at the University of Zambia has been involved in characterisation and evaluation activities while some local NGOs have been involved in on-farm conservation activities, advocacy and awareness creation programmes and activities. These programmes and activities have significantly contributed to raising levels of awareness in the country on the importance of plant genetic resources conservation and use.

Through its collaboration in the network Zambia has benefited greatly in terms of human resource development through long and short term training provided through donor support facilitated through the regional network programme. Four people have obtained MSc degree in Plant Genetic Resources Conservation and Utilisation from the University of Birmingham while more 10 have undergone short course training on Genebank Management at the Nordic Genebank. One person started a PhD programme in 2007. This human resource capacity development has enabled the country to effectively implement programmes and activities for PGRFA conservation and utilisation.

6.2 International programmes

Bioversity International

Zambia has maintained and continued collaboration with Biodiversity International, formally International Plant Genetic Resources Institute (IPGRI). Major and ongoing areas of collaboration with Bioversity International include training and information sharing. Through its many publications, Bioversity International has been a valuable partner in providing useful information on genetic resources conservation and use. This collaboration has in the last five years focused more on national policy development related to plant genetic resources for food and agriculture.

One such project in which Zambia has participated is the *Genetic Resources Policy Initiative* (GRPI), coordinated and implemented by *Bioversity International* that aims to strengthen the capacity of developing countries to design comprehensive policy frameworks for genetic resources. Five other countries; Uganda, Egypt, Ethiopia, Nepal, and Peru and two sub-regions (West and Central Africa and East Africa) are participating in this project. The main objective of the GRPI project in Zambia was to strengthen the influence and capacity of key stakeholders in the policy development process. During Phase 1, implemented between 2002 and 2003, the GRPI activities in Zambia focused on the collection, analysing and synthesising data and information on stakeholders' views regarding research and capacity building needs. This was done through a stakeholder appraisal exercise targeting relevant stakeholders at national level and those in selected rural communities. A number of policy related problems affecting the conservation, management and use of genetic resources were identified. These include inadequate appreciation of the value of genetic resources, limited knowledge on what genetic resources are available, their conservation and use and low level of awareness on issues related to ownership rights, access to genetic resources and benefit sharing at all levels.

In order to address the above-mentioned problems three main activity areas touching on policy research and advocacy were implemented during Phase 2 of GRPI in Zambia.

These are:

1. Awareness creation on the value of genetic resources and related knowledge, conducted through a range of activities focusing on increasing understanding and awareness regarding the role of genetic resources in Zambia;
2. Assessing conditions of ownership and access to local genetic resources, conducted through a range of activities aimed at the domestication of the ITPGRFA and associated policy development.
3. Promoting the incorporation of traditional crop varieties in local seed systems, conducted through a range of activities aimed at promoting the role and value of traditional varieties and breeds at local and national levels.

The final outputs from the GRPI project in Zambia are expected to include policy briefs relating to the above problems areas, with the aim of influencing policy development relevant in the implementation of PGRFA programmes and activities at the national level, including domestication of relevant international agreements to which Zambia is party, especially the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

It is expected that this forum will also contribute to raising awareness among participants on the important issues of access and benefit sharing related to genetic resources for food and agriculture within the Zambian context.

International Rice Research Institute (IRRI)

Zambia collaborates with the International Rice Research Institute (IRRI), both in terms of PGRFA conservation and utilisation programmes and activities. Zambia for instance participated in a wild rice collection project that involved a number of countries within the region between 1999 and 2002. This project was subcontracted to SPGRC, and involved planning of the collections and provision of training. The NPGRC conducted the collection, while IRRI provided the financial support and technical information. Sub samples of all the collected seed samples of wild rice were sent to IRRI as duplicate samples to be conserved, characterised and multiplied.

Overseas Development Institute (ODI)

Zambia participated in a workshop on incentive measures for on-farm conservation of agro-biodiversity in 2001, jointly organised by ODI and SPGRC. The organizing committee of this workshop also had representatives from GTZ of Germany and CTA of the Netherlands. The International Development Research Centre (IDRC) also contributed funds to the workshop. Participants in the workshop were drawn from across the Africa region. Further collaboration in terms of implementing some of the follow-up field studies was spearheaded by Biodiversity Community Network, a local NGO.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Zambia has continued to collaborate with ICRISAT, mainly in germplasm exchange involving its mandate crops such as sorghum, millets, groundnuts etc.

International Maize and Wheat Improvement Research Centre (CIMMYT)

Zambia has continued to collaborate with CIMMYT, mainly in germplasm exchange involving maize and wheat. Other collaborative activities include germplasm characterisation and evaluation. This collaboration has mainly been through the Maize Research Programme in Zambia. CIMMYT has also in recent years sponsored the collection of local maize germplasm and included these in evaluation programme mainly looking at traits related to drought tolerance.

6.3 International agreements

Zambia is party to a number of international agreements or conventions that promote sustainable management of biodiversity in general and plant genetic resources for food and agriculture in particular, and their sustainable use. These include the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species (CITES), and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), as well as the World Trade Organization (WTO), in particular the agreement on Trade Related Intellectual Property Right (TRIPs).

Zambia continues its active involvement in the development and strengthening of the global system of plant genetic resources, in particular through its participation in the two main international agreements relevant to plant genetic resources for food and agriculture. These are Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Other global fora in which Zambia participates is the FAO Commission on Genetic Resources.

Convention on biological diversity

Zambia has continued to be actively involved in the CBD process at the international level as a contracting party through participation in the COP meetings as well as the SABSTA meetings. At the national level Zambia initiated the implementation of CBD through the preparation and adoption of the National Biodiversity Strategy Action Plan (NBSAP) in 1999 and has since been able to secure funding support to implement some of the programmes and activities through the Global Environmental Facility (GEF). Zambia has also followed with interest, the developments regarding the Access and Benefit Sharing Regime at the regional and international levels.

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

Zambia participated in the negotiations leading to the development and adoption of the ITPGRFA, which came into force on 29th July 2004. Zambia, which signed the Treaty on 4 November 2002, negotiated as part of the Africa region and actively contributed to the formulation of the regional position on a number of contentious issues, including recognition of farmers' rights and fair and equitable benefit sharing arising from utilisation of PGRFA. Zambia also participated on the contact group that negotiated the Standard Material Transfer Agreement (SMTA), which is an important instrument for facilitating access and benefit sharing under the Multilateral System (MLS) of the Treaty.

Zambia ratified the International Treaty on Plant Genetic Resources for Food and Agriculture on 13th March 2006 in time to be a Contracting Party at the time of the first session of the Governing Body (GB) in June 2006, in Madrid, Spain. It represented the Africa region on the Bureau at this session and was elected Chair of the second session of the GB at the end of the first session. Zambia successfully chaired the second session of GB in Rome in 2007 and was subsequently re-elected chair for the third session of GB planned for the first quarter of 2009.

Zambia ratified the Treaty following its appreciation of the importance of such a global legally binding instrument in the regulation of PGRFA management and the benefits that may be obtained from being party to the treaty. Major benefits envisaged include facilitated access to PGRFA of crops designated under the MLS and benefit sharing through

capacity building, technology transfer and information sharing as well as funding for programmes and activities in PGRFA management at the national level.

During the year 2007, two ZARI senior members of staff were part of a four-man delegation that attended and participated at the Second Meeting of the Governing Body of the Treaty held during the period 28th October to 2nd November 2007 at FAO Headquarters in Rome, Italy.

6.4 Needs to improve international collaboration

Being party to the Treaty, Zambia is expected to take steps towards implementing the provisions of the Treaty. The Government, through the Ministry of Agriculture and Co-operatives, has taken steps in this direction by designating a National Focal Point (NFP) within ZARI. To advance the implementation process, the National Plant Genetic Resources Committee has recommended that ZARI be designated as the Authority for implementation of the Treaty. The timely implementation of the Treaty will enable Zambia realise a range of benefits that the Treaty may provide.

An informal international consultation on Farmers' Rights was held in Lusaka, Zambia, from 18th to 20th September 2007, jointly organised and co-hosted by the Ministry of Agriculture and Food and the Fridtjof Nansen Institute, both from Norway; and the Zambia Agriculture Research Institute. The main objective was to contribute towards preparing the agenda item on Farmers' Rights for the Second Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture, which was held during October/November 2007 in Rome, Italy.

As a first step towards initiating the national process to implement or domesticate the International Treaty, ZARI, through the NPGRC, organised and conducted an awareness creation seminar on the Treaty and its implementation challenges. The seminar came up with a number of recommendations on the actions required to implement the Treaty at the national level. These will form the basis upon which ZARI will further its interventions in the process of domesticating the Treaty.

CHAPTER 7

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

7.1 International policy and legal framework

Access to genetic resources and associated benefit sharing involves some of the most controversial questions in the implementation of the Convention on Biological Diversity to date. In addition, these same questions form the basis of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Zambia is aware of the existing policy and legal frameworks at the global level that have brought about change with regard to access and benefit sharing. A process aimed at development of a national Access and Benefit Sharing mechanism has been initiated through a working group coordinated by the Ministry of Tourism, Environment and Natural Resources. The National Biodiversity Strategy and Action Plan (NBSAP) developed and adopted in 1999, provides a policy framework for developing such a mechanism.

7.2 State of access to genetic resources

There is limited information available regarding the existing patterns of exchange and use. Other problems that relate to patterns of exchange and use are the ownership and control frameworks that underlie the patterns of exchange and use. The accurate identification of these frameworks is critical to the establishment of any equitable and effective access and benefit-sharing regime. The second problem area is the relationship between farmers and genebanks and breeding programmes. Genebanks and breeding programmes are only as effective as the degree to which farmers can access the improved materials they develop and maintain.

Practically, there is lack of an appropriate access and benefit sharing mechanism, particularly where these relate to local rural communities.

In order to formulate and effectively implement national access and benefit sharing legislation, Zambia requires capacities drawn from a wide range of disciplines. These include legal and policy aspects as well as scientific and technical issues, Intellectual Property Rights, and local communities' role and rights in the access regime. Like most countries in Africa Zambia, however, does not possess all this expertise. Without adequate capacity, there is a danger that laws will be established merely in writing, but will neither be enforced nor applied.

Another important component of the Treaty with significant relevance from the point of view of the Treaty implementation at the national level is the realisation of Farmers' Rights, considered critical to ensuring the conservation and sustainable use of plant genetic resources for food and agriculture. According to Article 9 of the Treaty, the implementation and realisation of Farmers' Rights rests with the national governments. Measures for the realisation of Farmers' Rights suggested under Article 9 include protection of traditional knowledge, equitable benefit-sharing, participation in decision-making, and the right to save, use, exchange and sell farm-saved seeds and propagating material. Not much has been done in Zambia to implement Farmers' Rights. The initial plans and thinking was that Farmers' Rights would be dealt together with Breeder's rights in a single piece of legislation. This was aborted when it was decided midway that these two be separated. This separation was to the detriment of Farmers' Rights as priority was given to developing legislation that catered for Breeder's Rights within Plant Variety Protection Act. The need to implement Farmers' Rights, however, remains under discussion through stakeholder sensitisation. Such sensitization was done during 2007 for technocrats and policy makers and specific recommendations on the way forward made.

CHAPTER 8

CONTRIBUTION OF PLANT GENETIC RESOURCES TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

The indigenous crops such as sorghum, finger millet, pearl millet and cowpea as well as the landraces of introduced but naturalised crops such as maize, beans, cassava, sweet potato, groundnuts and pumpkins are important cultivated species in Zambia. These resources play an important role in agricultural development, food security and the alleviation of poverty.

One of the key genetic resources policy issues with major implications at national level is the appreciation of the value of local genetic resources and how this links with developmental issues such as poverty alleviation, food security enhancement, good nutrition and health.

Genetic resources for food and agriculture play a critical role in Zambia's national economy and livelihoods of rural communities.

8.1 Crop production and food security situation

The nation has in the recent past experienced serious droughts, which have led to poor crop harvest, especially of maize in most parts of the country. In mitigating the impact of drought, a number of Non-Governmental Organisations (NGOs) have through government and external donor assistance been involved in a number of farmer support programmes aimed at diversified and increased food production for small-scale farmers for improved household food security. Various input distribution programmes have continued to have a positive impact on the provision of inputs to farmers in the past six agricultural seasons. Unfortunately, most farmers remain substantially dependent on inputs distributed by the Government and Non Governmental Organisations without graduating into self sustaining farmers. The major input programmes are GRZ Fertiliser Support Programme (FSP), PAM's Food Security Pack (FSP) and the FAO input programme. All these programmes were necessitated by the need to facilitate farmers' recovery from previous droughts.

Generally, the country's resource endowment is ideal for production of a wide range of crops, given the diversity of the country's agroecological zones.

The low crop productivity, which has sometimes led to food insecurity at both national and household levels, has been attributed to the following factors:

- Unfavourable weather conditions (erratic rainfall, droughts, floods)
- Unreliable and poor service delivery particularly for small-scale farmers,
- Marketing constraints especially in outlying areas as a result of poor infrastructure notably feeder roads,
- Inadequate agricultural finance and credit,
- Poor accessibility, and administration of land as well as low utilisation
- Policy inconsistency especially with respect to commodity and fertiliser marketing

8.2 Agricultural production potential

Given the vast resource endowment, Zambia has very good potential to increase and expand crop production. This potential also lies in the efficient and increased utilisation of available PGRFA. There are three main potential avenues through which crop production can be increased visa-vis expansion of cultivated area, increasing in yield by efficient utilisation of the locally available genetic potential to develop new or improve the existing crop varieties and crop diversification.

Most small-scale farmers in Zambia have not been able to reap the benefits of scientific plant breeding due to a number of reasons. One is the widespread poverty, which prevents them from applying the agronomic practices required to take full advantage of improved seed. Farmers have continuously used a diversity of crops and varieties to ensure food security and to optimise productivity usually under the serious resource –constrained environment.

Researchers within ZARI have demonstrated that the different types of crop varieties that have been developed have positively impacted on the lives of the farmers and the general public at large in the following ways:

1. Food security. Increase in yields of crops planted to improved varieties has ensured food security at household and national level. Farmers who use seed of improved varieties record an increase in food production.
2. Increased incomes from cash crops sold directly or indirectly e.g. through the sale of oil from sunflower have been realised. Cassava utilization, processing and marketing training has offered farmers business opportunities in the community by selling cassava snacks.
3. Varieties of sorghum and finger millet that are high yielding and ideal for brewing have benefited the industry. Increased productivity of these improved finger millet varieties has increased trade with the brewing industry in a neighbouring country. Sorghum has a superior grain for brewing because of its good malting capacity.
4. Fabricators have been motivated to fabricate more cassava processing equipment as quantities have increased from the use of improved varieties.
5. Animal feed companies have shown interest in the use of cassava in livestock feed. Increased demand as a result of this can only be met through the use of improved varieties that yield much better than local varieties.
6. Farmers have appreciated the advantages of improved varieties as production at the household level increased and the demand for seed increased too. Seed of some improved varieties are not readily available with seed companies citing low demand. This has led to the development of the informal seed sector involved in the seed multiplication of a number of these varieties through mainly on-farm seed programmes supported by government and NGOs. Seed of varieties of pearl millet, maize, finger millet, wheat, groundnut, bean, sorghum, soybean, sunflower, rice, cassava and sweet potato are multiplied on-farm in all provinces.
7. Varieties of vegetables and food legumes are contributing to the supply of nutritious food. These have become even more important for People living with HIV and AIDs. Varieties of maize rich in vitamin A and other micro elements are being developed.
8. Imports of seed of improved varieties are greatly reduced as a result of the contribution of varieties coming from ZARI resulting in savings in foreign exchange.
9. Crop diversification. A wide range of crop varieties are being developed: maize that is tolerant to low soil fertility and drought, varieties of drought tolerant crops such as sorghum and root & tuber crops (response to changes in the environment), sorghum varieties that are tolerant to bird damage, have few disease and insect pest problems and are nutritious for food and feed (forage sorghum).
10. Conservation of land. High yielding varieties result in high productivity and reduce the need to increase yield through increased cultivated area.
11. Market development. Small grains and legumes have been viewed as subsistence crops with very little scope for commercialisation. The inconsistent supply of quality grain is frequently cited as a major factor in deciding to use maize. A collaborative effort involving ZARI, Zambia Breweries, Golden Valley Agricultural Research Trust (GART), Care International and other stakeholders has embarked on a commercialization project in Kazungula District. A market survey was conducted in Kazungula district to evaluate the potential of a sorghum market. The objectives included the need to establish a market (local and export), identify & quantify demand, promote sorghum production & consumption, ensure food security, mitigate drought, increase income and profitability of farmers, create sustainable micro enterprises (value adding), develop scaled-up sorghum strategy and value chain management The research findings reported a market potential of 11 000 metric tons.

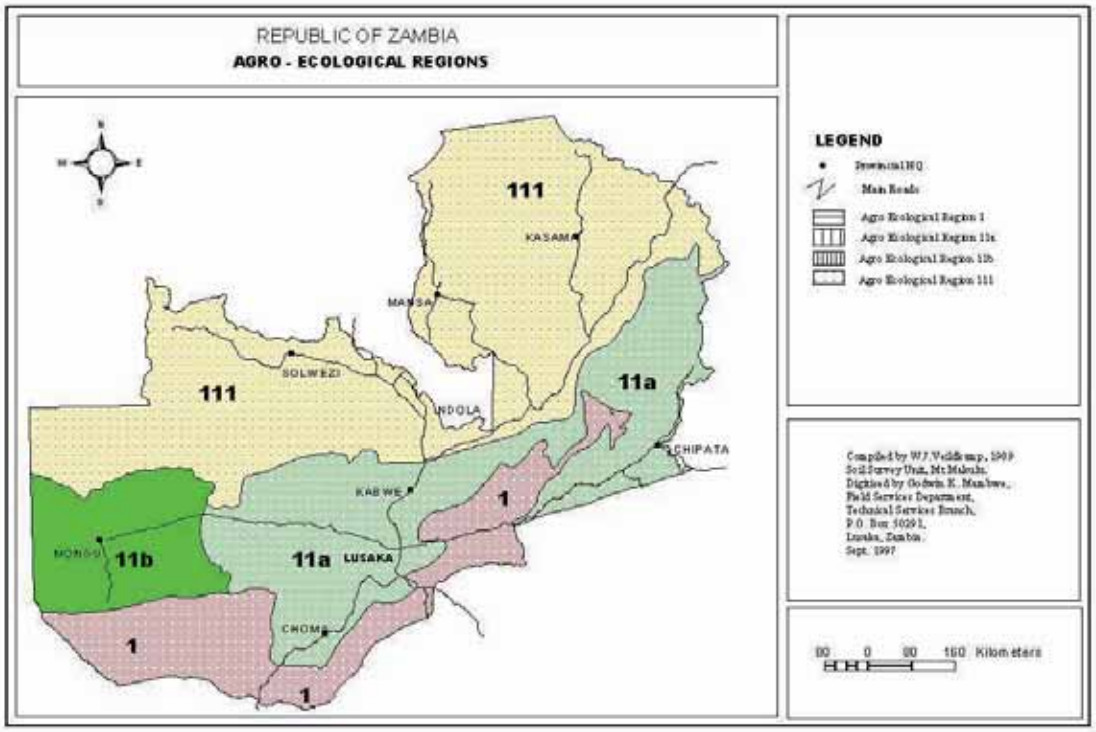
In the 2005/2006 season 633 farmers planted 300 hectares from three tons seed of improved varieties distributed by CARE under technical backstopping of ZARI. Zambia Breweries signed contracts with co-operatives, under the auspices of CLUSA, where farmers belonged. Thus small scale farmers had the opportunity to profitably produce sorghum for a specific end-use market where the end-user facilitated the grain production and post-harvest collection.

8.3 Future needs and priorities

One of the major challenges to the contribution of PGRFA is the inadequate appreciation, at all levels, of its value and becomes a major factor in the erosion of the diversity of local PGRFA. At policy levels this lack of appreciation means PGRFA considerations are not adequately integrated into various sectoral policies and instruments, such as agricultural and science and technology policies. At the community level a lack of appreciation of the diversity of genetic resources leads directly to erosion through phenomena such as the displacement of landraces by improved varieties or the loss of wild relatives or forest resources through land conversion and other activities. At the level of urban consumer traditional crop varieties are frequently viewed as somehow inferior to mainstream commercial commodities. This leads to low or no demand for local varieties thereby providing no incentive for farmers to produce local products.

ANNEX 1

AGROECOLOGICAL MAP OF ZAMBIA



ANNEX 2

HEADS OF KEY STAKEHOLDER INSTITUTIONS CONSULTED DURING THE PROCESS OF NISM

The second report on the state of national plant genetic resources for food and agriculture is a product of extensive stakeholder institution consultation. The stakeholder institutions were identified having explored their input into the GPA monitoring especially as it relates to the twenty priority activities of the Global Plan of Action. A total of nineteen (19) institutions were identified as potentially key to the implementation of the GPA monitoring in Zambia, which could be classified as three statutory bodies, two private entities, five NGOs, one Trust and eight government departments.

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