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Kenya National Strategy on Genetic Resources within the Context of Climate Change

2016 – 2020

The International Treaty
ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Kenya National Strategy on Genetic Resources Within the Context Of Climate Change

2016 – 2020

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Genetic Resources Research Institute (GeRRI) of the
Kenya Agricultural and Livestock Research Organization
P.O. Box 781 - 00902 Kikuyu, Kenya
Tel: 020 - 2025539
Email: director.grri@kalro.org
http://www.genetic.kalro.org

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Message from the Cabinet Secretary

Agriculture continues to be the backbone of Kenya's economy. It contributes about 26% of the Gross Domestic Product (GDP), 60% of export earnings and employs about 70 per cent of the population. Moreover, through links with manufacturing, distribution and service- related sectors; agriculture contributes a further 27% of the country's GDP. Apart from being the country's main source of food, it is a major foreign exchange earner. However, continued productivity of the agricultural sector faces many challenges, among them climate change and biodiversity decline that require urgent attention.

Loss of biodiversity due to human activities has been more rapid in the past 50 years than at any time in human history and is now exacerbated by climate change. Globally, since the 1900s, some 75 percent of landraces has been lost as farmers worldwide have left their multiple local varieties and landraces for narrow based and genetically uniform, high-yielding varieties. Considering the role of biodiversity in providing ecosystem services that are supportive of agricultural production systems, a threat to biodiversity is considered to be a threat to food and nutrition security.

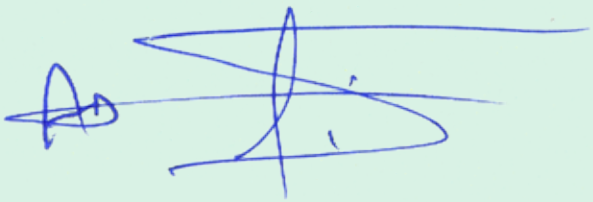
Genetic resources are a key component of biodiversity and benefits people through contribution to material welfare and livelihoods including agricultural resilience, social relations, health, ecosystem services, and freedom of choices and actions. The drivers of biodiversity loss and subsequent declining ecosystem services are projected to continue in an accelerated manner. The most important direct drivers of biodiversity loss and declining ecosystem service are habitat loss through land use changes, physical modification of rivers or water withdrawal from rivers, climate change, invasive alien species, overexploitation, and pollution. While many people have benefited from the conversion of natural ecosystems to human-dominated ecosystems and from the exploitation of biodiversity, these gains have been achieved at growing costs in the form of biodiversity loss, degradation of ecosystems, and the exacerbation of poverty for other groups of people.

In order to achieve greater progress toward climate change adaptation, it will be necessary to strengthen response options that are designed with the conservation and sustainable use of biodiversity and ecosystem services as the primary goal. These responses will improve human well-being and reduce poverty. They need to be designed in such a way that indirect and direct drivers of climate change and biodiversity loss are effectively addressed and programmes to tackle them effectively implemented.

Science can help ensure that decisions are made with the best available information. This strategy document is informed by findings of a study on the conservation status of plant genetic resources and their utilization, and how this relates to climate change adaptation strategies and programmes in Kenya. The study was undertaken in eleven counties from the arid and semi-arid areas of the country. The study also consultatively looked at the existing institutional, policy and legal frameworks in relation to genetic resources conservation, and their linkages with on-going climate change adaptation and mitigation initiatives. The purpose was to elucidate the impact of climate change on the continued survival of genetic resources and the role of their conservation and use, in climate change adaptation initiatives in Kenya. The study revealed that as currently structured, there was minimal appreciation of the role of biodiversity in climate change adaptation strategies planning and programmes.

It is on this basis that this strategy document strongly recommends integration of biodiversity issues to climate change adaptation planning and strategies. The document interrogates the drivers of climate change and biodiversity loss, and proposes coping strategies and options. Recognizing that the future of biodiversity will ultimately be determined by society, this document accordingly underscores involvement of farmers, extension workers and all stakeholders in the war against impacts of climate change and biodiversity loss. The document thus proposes strategies and actions necessary to assist mainstreaming biodiversity conservation into climate change adaptation strategies, programmes and projects in Kenya.

On behalf of the ministry and on my own behalf, I thank the secretariat of the Benefit sharing Fund (BSF) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the Food and Agricultural Organization (FAO) of the United Nations, for supporting the work that culminated in the development of this strategy document. I also appreciate the effort of the United Nations Development Programme (UNDP) in steering the implementation of the said project.



Mr. Adan Mohamed
Ag. Cabinet Secretary
Ministry of Agriculture, Livestock and Fisheries

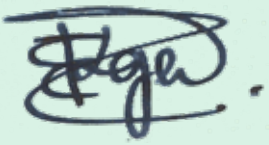
Foreword

This National strategy and action plan on mainstreaming conservation of genetic resources in climate change adaptation strategies, programmes and projects, is the first strategy document developed by the Genetic Resources Research Institute (GeRRI) of the Kenya Agricultural and Livestock Research Organization (KALRO). The document is meant to guide management of plant genetic resources for food and agriculture in a changing climate. The strategy responds to priority plans and actions identified and agreed on in the second Global Plan of Action (GPA) for plant genetic resources for food and agriculture, and correlates the same to those of the National Climate Change Action Plan (NCCAP). The Strategy provides a comprehensive framework for sustainable use, development and conservation of Plant Genetic Resources for Food and Agriculture as well as mainstreaming climate change impacts into the conservation agenda. Also, the document proposes systems for consensus building when engaging different stakeholders to develop mechanisms for equitable sharing of benefits accrued from utilization of plant Genetic Resources for Food and Agriculture.

The strategy was developed through a consultative process that involved extensive review of available documents, consultations with stakeholders and seeking inputs from various experts, thus living the spirit of consensus building. It shall remain to be a dynamic document which will be reviewed biannually so as to include emerging issues and incorporate alternative views from stakeholders while monitoring progress of implementation.

We are grateful to the lead consultant Dr. Dan Kiambi of the African Biodiversity Conservation and Innovation Centre, and the KALRO staff who worked with him, including, Elizabeth Okwuosa, Stephen Kimani, Grace Mbure, Geoffrey Ngae, and Ndung'u Kimani. We acknowledge Zipora Otieno of UNDP, and stakeholders from Ministry of Agriculture, Livestock and Fisheries, Ministry of Environment and Natural Resources, Department of Resource Survey and Remote Sensing, Kenya Forest Service, Kenya Industrial Property Institute, Kenya Wildlife Service, National Museums of Kenya for their contribution.

KALRO supports GeRRI in this endeavour and is committed to the implementation of the strategy. We call upon our partners and all stakeholders to support us in this noble task of conserving our national heritage.



Eliud K. Kireger (PhD)
Ag. Director General Kenya
Agricultural and Livestock
Research Organization

Desterio Ondieki Nyamongo (PhD)
Ag. Director Genetic Resources
Research Institute

Acronyms and Abbreviations

ABS	Access and Benefit Sharing
ASAL	Arid and Semi-arid Lands
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CBD	Convention on Biological Diversity
CBOs	Community Based Organizations
CCCUs	Climate Change Coordination Units
CDM	Clean Development Mechanism
CFU	Carbon Finance Unit
CIDA-Canada	Canadian International Development Agency
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EAPGREN	Eastern Africa Plant Genetic Resources Network
EMCA	Environment Management and Coordination Act
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GeRRI	Genetic Resources Research Institute
IGAD	Intergovernmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for Conservation of Nature
KAGRC	The Kenya Animal Genetic Resources Centre
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KENAFF	Kenya National Farmers' Federation
KFS	Kenya Forest Service
KMFRI	Kenya Marine and Fisheries Research Institute
KWS	Kenya Wildlife Service
MEMR	Ministry of Environment and Mineral Resources
MoALF	Ministry of Agriculture, Livestock and Fisheries

MTEF	Medium Term Expenditure Framework
MTP	Medium Term Planning
NACOSTI	National Commission on Science Technology and Innovation
NBSAP	National Biodiversity Strategy and Action Plan
NCCRS	National Climate Change Response Strategy
NEAP	National Environment Action Plan (2009)
NEPAD	New Platform for African Development
NGOs	Non-Governmental Organizations
NISM	National Information Sharing Mechanisms
NMK	National Museum of Kenya
PGR	Plant Genetic Resources
SIDA,	Swedish International Development Agency
UPOV	International Union for the Protection of New Varieties of Plants Convention
USAID	United States Agency for International Aid
WTO's-TRIPS	World Trade Organization's Trade Related Intellectual Property Rights

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1.0 Introduction

Agriculture is the mainstay of Kenya's economy directly contributing about 26% of Gross Domestic Product (GDP) and a further 27% through linkages with manufacturing, distribution and service related sectors. Sustained growth of the sector is crucial to the country's overall economic and social development. More than one-third of Kenya's agricultural produce is exported, and this accounts for 65% of Kenya's total exports. The agricultural sector accounts for 18% of total formal employment in the country. However, over the past decade, the performance of the sector has been far from satisfactory with the agricultural growth rate lagging behind the population growth rate. This trend has led to increased incidences of food insecurity, raised poverty levels, declining incomes, loss of employment and a shift from self-sufficiency to reliance on food importation and food aid. Kenya's average poverty level exceeds the 50% population mark. Causes of poverty and food insecurity in Kenya include low agricultural productivity, inadequate access to productive assets (land and capital), inadequate infrastructure, limited marketing opportunities, high population pressure on land, inadequate access to appropriate technologies by farmers, effects of global trade, and slow institutional and sectoral reform process. Moreover, climate change and variability threaten to worsen performance of this important economic sector, thereby further increasing food insecurity especially among the very poor.

Climate change results in increased variability and intensity of droughts and floods, more invasive species, and generally higher temperatures. In Kenya, data on temperature and rainfall from the Kenya Meteorological Department over the last fifty years, as well as annual State of the Environment Reports provide clear evidence of climate change. Rainfall patterns indicate increased irregularity and variability with neutral to slightly decreasing trends in annual rainfall over most areas in Kenya. However, a general increase in rainfall during September to February has also been observed, suggesting a tendency of the 'Short Rains' (October-December) to extend into the normally hot and dry January and February over most areas. Though not overly significant, lower rainfall levels have been observed in annual rainfall, in the 24-hour intensity as well as in relation to the 'Long Rains' which usually contribute a significant percentage of the annual rainfall. There has also been a notable trend of temperature increase over most of the country between 1960 and 2006. All these factors render rainfed domestic agriculture less effective in meeting nutrition and food security needs of the nation.

Kenya is a rich source of genetic diversity, the conservation and utilization of which could be used to contribute significantly to enhance economic growth. Plant genetic resources are the biological basis of the country's food security and directly or indirectly support the livelihoods of the Kenyan people. They consist of the diversity of genetic material contained in traditional varieties and modern cultivars grown by farmers as well as crop wild relatives and other wild plant species that can be used as food, medicine, essential oils, gums and resins, fodder and forages, fibre, shelter, timber and fuel wood, among others.

Kenyan people derive most of their food, medicinal and industrial products from both wild and domesticated components of plant genetic resources. The diversity could thus be leveraged as a potent adaptation strategy especially for small-scale farmers in the face of climate change. However, for this to be realized, genetic resources management must be fully integrated in research and development of the relevant economic sub-sectors. Furthermore, a pathway to full integration within the broad policy regime needs to be established. In addition, institutional frameworks for conservation and utilization of genetic resources as well as mainstreaming these resources in national strategies and action plans on climate change require to be developed.

The conservation and utilization of this vital component of biodiversity is imperative for sustainable livelihoods, agricultural productivity, climate change resilience and economic development. Maintaining a rich diversity of economically important species including indigenous food crops, along with wild crop relatives as well as indigenous animal breeds will be a critical component of climate change adaptation in the coming years. Yet, the diversity of plant and animal genetic resources is on the decline in Kenya. Traditional crop varieties continue to be increasingly replaced with elite cultivars and the genetic base of indigenous animal breeds being replaced or diluted by improved breeds. This trend has been accelerated by climate change, population pressure, changes in land-use, over-exploitation, and inappropriate agricultural development practices.

The diverse ecosystems in Kenya are a source of rich microbes and microbial genetic resources. Unfortunately, there is limited understanding of their diversity status and potential value since minimal inventory and valuation assessment has been conducted. While a concerted conservation effort of plant and animal genetic resources is underway in Kenya, it needs both strengthening and integration within the broader government and non-government cross-sector programmes.

Extensive crop breeding that relies on access to genetic resources will certainly be required for crop adaptation under conditions of climate change. Furthermore, substantial knowledge and insight is needed to gauge what types of diversity exist in ex situ gene banks, in situ in natural habitats and on-farm in agricultural landscapes that will be needed in future. Fundamental questions remain to be addressed. For example, how are regional patterns of climate expected to change in future, and how shall these changes affect agro-ecosystems in Kenya. There are also several strategic investment issues to consider including the traits, crops and regions that should be central to strategic decisions on ex situ and in situ conservation, and use of genetic resources. It is also imperative to consider actions that need to be taken to characterize and evaluate germplasm currently conserved at the Genetic Resources Research Institute (GeRRI). Establishing linkages with breeders to ensure that germplasm conserved is utilized in developing "climate-ready varieties" for deployment in diverse Kenyan agro-ecosystems is critical. Therefore, policies and legal frameworks are needed to ensure effective conservation and sustainable utilization of plant genetic resources, including their mainstreaming in climate change action plans and in agricultural research agenda.

With the growing impact of climate change, there will undoubtedly be an increase in demand for varieties that are adapted to new environmental conditions, including pest and disease spectra. Ability to access a wide range of genetic diversity is central to meeting this demand. Thus, the genetic diversity conserved in GeRRI gene banks shall become increasingly important in underpinning efforts of plant breeders as they develop varieties adapted to the new conditions.

Farmers are the primary conservators of diverse landraces and animal breeds. They are endowed with skills and knowledge needed to carry out a continual process of variety development and breed improvement with capacity to adapt to drought, high temperatures, and other variations, while maintaining or increasing productivity. Development of appropriate varieties and improved breeds is bound to become increasingly difficult as climate change and variability increase. To address this challenge, small-scale producers and farmer organizations need to actively participate in collaborative breeding efforts together with research and extension institutions. This requires building capacities to combine state-of-the-art plant and animal breeding methods with traditional practices. Additionally, sustainable agricultural practices that maximize productivity and agro-ecosystem resilience must be identified, strengthened and disseminated.

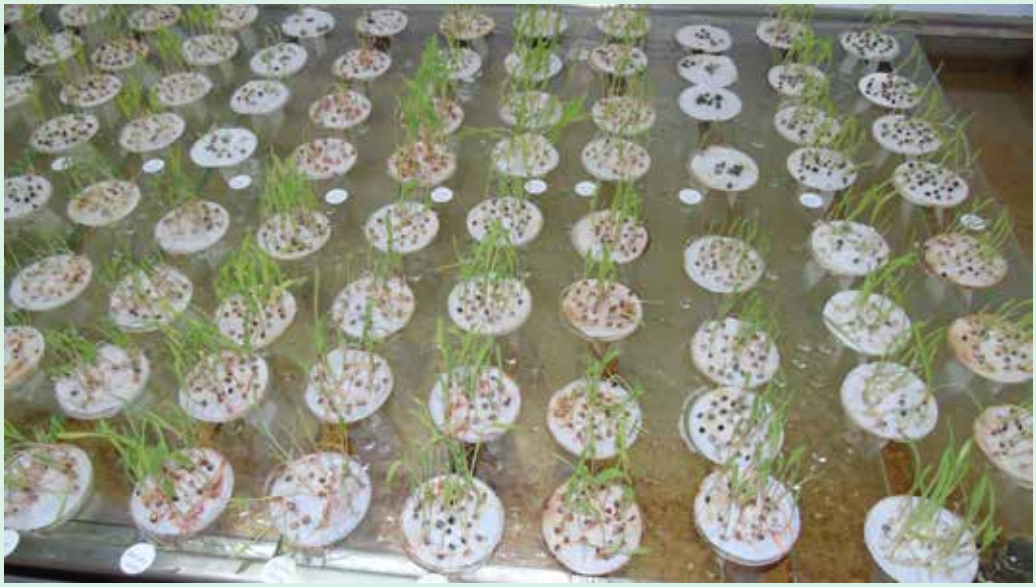
Supporting policies, incentives measures and market structures should work together to help motivate and reward farmers, while supportive institutions provide cost-effective and timely technical assistance, credit and other services.

Collaborative work to enhance and promote the sharing of indigenous knowledge on conservation and management of indigenous animal breeds, crop diversity and cultivation practices needs to be strengthened. Moreover, a legal and policy framework to guide the provision of incentives for conservation of plant and animal genetic resources and benefit sharing is needed in order to sustain conservation efforts in the long-term. The major information gaps on social dynamics of seed access and exchange, maintenance of indigenous animal breeds, community level conservation and grass-roots collaborative activities need to be addressed.

2.0 Vision

A vibrant and well-coordinated genetic resources conservation agenda, servicing food security, climate change resilience and economic prosperity initiatives.

PGR conservation in a tissue culture lab



Germplasm viability monitoring

3.0 Mission

Harness, conserve and promote greater and sustainable use of genetic resources for increased food security, resilience of agricultural production systems, improved health and socio-economic advancement within the context of climate change.

Germplasm collection and conservation to safeguard food security and improve the livehood of the Nation

4.0 Expected Outputs

1. Genetic resources conservation and climate change adaptation strategies mainstreamed in the national and county action plans to promote economic development.

2. Human, institutional and financial capacities for conservation and sustainable use of genetic resources enhanced.

3. Accessibility to and availability of genetic resources for use by communities, famers and researchers enhanced.

4. Awareness and support for genetic resources conservation and utilization at policy, scientific and community levels increased.

5.0 Core Values

Partnership

The strategy will be implemented through partnership with communities and different governmental and non-governmental organizations.

Equity

The strategy will enhance equity in access and sharing of benefits from use of genetic resources.

Honesty

The strategy calls for honesty and openness in all matters of conservation and use of genetic resources.

Transparency

The strategy will be implemented with transparency at all levels.

6.0 Target Groups

The key target groups are farmers and community level actors who are the main beneficiaries of genetic resources. The other target groups include scientists, conservationists and other stakeholders involved in the research and development continuum from conservation to utilization of genetic resources. The policy makers and other government decision makers are also targeted as they will need to be informed and involved in the development of policies and availing financial resources to implement the strategy.

A group discussion with farmers and local administration officers

7.0 Guiding Principles

The following are the guiding principles in implementation of the strategy;

1. Genetic resources are central to ensuring food security, sustainable livelihoods, resilience to climate change and socio-economic development.
2. Genetic resources are a biological heritage that needs to be conserved and sustainably utilized by the present and future generations for posterity.
3. Strong and harmonized institutional, policy and legal frameworks for regulating access and use of genetic resources are central to effective biodiversity conservation and sustainable economic development.
4. Farmers are the primary conservators of biodiversity and require due recognition in legislations and structures governing access to genetic resources and sharing of benefits accruing from utilization of the resources.
5. Tapping of different comparative advantages among stakeholders and building on complementarities advances the cause of genetic resource conservation and sustainable economic development.

8.0 Context and Situational Analysis

8.1 Genetic Resources Situational Analysis

Kenya's Endowment of Genetic Resources

Kenya is endowed with a diverse heritage of plant and animal genetic resources due to its location in the tropics, varied relief, landscapes and habitats. The altitude stretches from sea level at the Indian Ocean in the East, to 5,193 m above sea level at the peak of the snow-capped Mount Kenya. It rapidly descends westwards from Mt. Kenya and abruptly broken by the Great Rift Valley whose floor has non-draining saline lakes as well as several geysers, which are home to unique flora and fauna adapted to varied habitats. The coast is hot and humid while the mountains are temperate. Western and Central Kenya enjoy an equatorial climate while the North and North eastern parts of the country are hot and very dry. This varied relief, bio-climate, soils and resulting habitats create suitable habitats for diverse organisms.

Syzygium cordatum - (Hochst.), fruits edible and a medicinal plant for stomach ache and diarrhoea

Carissa edulis (Forssk.) Vahl, a wild plant species with edible fruits, Roots are medicinal used to treat kidneys and stomach upset

Kenya has a rich plant diversity within its range of habitats. According to International Union for Conservation of Nature (IUCN), there is an estimated total of 7,500 plant species growing naturally in the country. GeRRI in partnership with the National Museums of Kenya, the Royal Botanic Gardens, Kew of the United Kingdom, and Kenya Forestry Research Institute, working under the auspices of the Seeds for Life Project, have recently described some more than 10 plant species that are new to science. In addition to this sterling performance, this collaborative initiative collected and banked close to 1,000 plant species that are new to ex situ conservation in Kenya.

Of the 7,500 species reported by IUCN, about 475 are national endemics while 258 are threatened. Kenya, like many other countries relies only on a few plant species for food. These include: maize (*Zea mays*), wheat (*Triticum aestivum*), common bean (*Phaseolus vulgaris*), peas (*Pisum sativum*), banana (*Musa spp.*) and potato (*Solanum tuberosum*), among others. Maize is the principal staple food of Kenya and it is grown in 90% of farms in the country while the common bean is the most important legume in Kenya. The main agricultural export products

are tea (Camellia sinensis), coffee (*Coffea arabica*), pyrethrum (*Chrysanthemum cinerariifolium*), sisal (*Agave sisalana*) and horticultural produce (fruits, vegetables and floricultural crops). Based on the number of released varieties, maize has the highest diversity of modern varieties, followed by tea, pyrethrum, common beans and sorghum (*Sorghum bicolor*)

As earlier stated, genetic resources are of immense economic and environmental significance to Kenya. They are mainly used as a source of food for humans and animals, in breeding programmes to enhance agricultural, forestry and livestock productivity and as raw materials in the medicinal, food and timber industries. However, in order to ensure ongoing sustainable use of these genetic resources, diversity needs to be maintained to ensure a broad base from which selection can be made to develop improved, better adapted crop varieties that can cope with changes in the environment.

Problem of Genetic Erosion

Kenya's genetic resources heritage is faced with genetic erosion as a result of anthropogenic activities including pollution, destruction of natural habitats, changes in land use, ethnic conflicts, drought, floods and ironically, the advancement in agricultural development. Introduction of new plants, including invasive species, have further contributed to the decline of the indigenous flora and fauna. Although no comprehensive study has been undertaken to quantify the level of genetic erosion, reports indicate that over the last decade, a significant degree of genetic erosion has taken place mainly due to replacement of traditional varieties as well as animal breeds and other socio-economic factors. In recent years, human population increase and subsequent demand for more land for settlement and farming have resulted in direct loss of forest area at a rate of 5,000 ha per annum. Today some ecosystems are severely disturbed to the point that species diversity extent and quality of these habitats are severely eroded. The IUCN (2006) Red list and assessments by the National Museum of Kenya (NMK) identified several threatened species including 147 vascular plants, 51 mammals and 24 birds. With the national GDP growth rate largely lower than the population growth rate, the pressure on natural resources has remained high to the extent that several species of plants and animals are greatly threatened. It is imperative that appropriate mechanisms are employed to safeguard this valuable resource from imminent irreversible loss.

Overgrazing and change of land use" after this paragraph and caption it as "Overgrazing and change of land use is a major threat to Genetic sustainability

Destruction of natural habitats by heavy rains

In situ and on-farm conservation instruments have unfortunately not been fully utilized to enable the conservation of existing diversity. For instance, increases in human population and subsequent rise in demand for plant-based products and land for settlement and farming continues to threaten wild flora thereby rendering these conservation strategies ineffective. Adoption of elite varieties of the main crops has led to a decline in crop diversity of especially traditional varieties although a significant number are being conserved *ex situ*. Some of the traditional varieties that are reported to have disappeared include "Githigu" (Kikuyu) and "Makondo" (Luhya), which were very popular traditional maize varieties in central and western Kenya. Some important wild species that have been used as leafy vegetables and which are increasing becoming rare in their natural habitats include *Erythrococa atroviriens*, *Basella alba*, *Crotalaria ochroleuca* and *C. brevidens*. The main neglected and underutilized crops have been identified as sesame (*Sesamum indicum*), bambara nut (*Vigna subterranea*), yams (*Dioscorea spp*), taro (*Colocasia esculenta*) and various medicinal plants.

A scientist harvesting a plant variety for conservation

A taxonomist preparing a herbarium voucher specimen

Genetic Resources Conservation and Associated Problems

Ex situ and in situ conservation initiatives in Kenya are undertaken by institutions such as the Genetic Resources Research Institute (GeRRI) of the Kenya Agricultural and Livestock Research Organization (KALRO), National Museums of Kenya (NMK), Kenya Forestry Research Institute (KEFRI),

public universities, Kenya Forest Service (KFS) and to a small extent, private organizations. Ex situ conservation involves use of such specialized facilities as cold stores or chest freezers. Alternatively, materials may also be conserved as living collection in field gene banks, botanic gardens or arboreta. The National Gene Bank of Kenya, now operating under the auspices of GeRRI, is the only long-term ex situ conservation facility in the country which currently holds a repository of about 50,000 plant accessions representing 165 families, 893 genera and 2,000 species. These materials have been assembled through both in-country collecting expeditions and donations from within and outside Kenya.

At the GeRRI Gene bank, effective management and enhanced use of the existing ex situ collections is hampered by various constraints including the following: a) inadequate scientific knowledge on seed storage behaviour of some wild species, b) shortage of scientific staff with specialized training in various core disciplines on gene banking, c) inadequate seed storage capacities, d) insufficient capacity to regenerate stored germplasm to raise viability levels and adequate sample sizes. Other problems include inadequate information on the diversity and potential value of the conserved germplasm, lack of information on appropriate seed testing protocols and limited capacity to conduct seed germination tests. In order to address these problems, it is imperative that Kenya strengthens its technical and physical capacity both at the GeRRI Gene bank and other collaborating national institutions. Some specific disciplines that need strengthening are plant taxonomy, plant health, information technology including Geographical Information Systems (GIS), biotechnology, expansion of the conservation infrastructure, establishment/enrichment of field gene banks and botanic gardens for vegetatively propagated and recalcitrant seeded plants such as yam (Dioscorea spp.), cassava (Manihot esculenta), banana (Musa spp.), sweet potato (Ipomoea batatas) and taro (Colocasia esculenta). In addition, GeRRI also requires to be capacitated to conserve other components of genetic resources including animal and microbial genetic resources.

Due to shortage of scientific staff, a lot of the conserved materials have not been characterized. Out of the 2,000 species conserved at the GeRRI gene bank, only 144 have been characterized, none of which has been comprehensively evaluated for biotic and abiotic stresses. Breeders have shown a justified preference for materials that have undergone pre-breeding analysis and whose evaluation data is available. A majority of materials at the GeRRI Gene bank lack this vital information and hence the low demand. In order to enhance utilization of the stored germplasm, capacity of the GeRRI Gene bank to characterize and evaluate this material needs to be improved.

Staff of of the Genetic Resources Research Institute

Distribution and Use of Germplasm

Only 4,000 accessions out of the more than 50,000 conserved at the GeRRI gene bank have been distributed for utilization in the last 15 years, of which a total of 3,189 accessions have been distributed over the last 5 years. This is partly because less than 10% of the accessions have been characterized and evaluated due to insufficient scientific staffing and financial constraints.

Distributed materials have mainly been utilized in breeding programmes where they have served to develop improved varieties, specifically in developing improved varieties of maize, sorghum, safflower and French bean. A few have gone into direct use by farmers while others have been utilized in other research programmes. Overall, utilization of the germplasm conserved at the GeRRI Gene bank has remained relatively low, though this could be explained by the availability of similar materials as active collections in most of the research centres. Other reasons that have contributed to this low uptake include inter alia (i) the inadequate passport and evaluation data of the distributed material regarding their adaptability to biotic and abiotic stresses, and (ii) the small sample sizes offered.

The seed system in Kenya comprises public sector agencies, private agencies and multinationals. The industry was liberalized in 1996 and currently there are over 40 registered seed companies. The seed sector is serviced by a well-established formal crop improvement sector that combines conventional plant breeding techniques as well as advanced state-of-the- art methodologies and skills. The main institutions involved in plant breeding are KALRO with its associated institutes, public universities and private seed companies.

Institutional and legal frameworks

Until recently, there was no formal national institutional framework for conservation of genetic resources. The enactment of the Kenya Agricultural and Livestock Research (KALR) Act 2013 has however changed this scenario having established the Genetic Resources Research Institute that is responsible for the conservation of all components of genetic diversity. A national workshop on plant genetic resources held in 1988 with the intention of establishing and formalizing a national Plant Genetic Resources (PGR) programme made recommendations that never got to be officially adopted. Nonetheless, *an ad hoc* PGR Committee has been operating though without a policy or legal basis. It mainly comprises of GeRRI and a number of institutions and stakeholders including, KALRO research centres, KEFRI, NMK, Kenya Wildlife Service (KWS), government ministries and departments such as Ministry of Environment and Natural Resources, Ministry of Agriculture, Livestock and Fisheries, the KFS, as well as local public universities, Community Based Organizations (CBOs), Non-Governmental Organizations (NGOs) and farmer groups. These institutions largely implement activities in line with their mandates and have formed both formal and informal partnerships. Whereas they collaborate at institutional and individual levels in the implementation of specific genetic resources activities, overall coordination among them is lacking. There is no particular institution or agency charged with the responsibility of coordination. Hopefully, with the establishment of GeRRI by the KALRO Act 2013, coordination of genetic resources activities shall improve.

From left to right: Ms. Ann Onyango – Director, Agricultural Policy, Research and Regulations (MoALF – SDA); Dr. Eliud K. Kireger – Director General, KALRO; Dr. D.O. Nyamongo – Director, GeRRI and Dr. Victor Wasike – Centre Director, Plant Genetic Resources Research Centre. During a session with the Parliamentary Select Committee on Agriculture presenting a bill on The Kenya Agricultural and Livestock Research (Conservation, Access and Benefits sharing of Plant Genetic Resources) Regulations, 2015

Kenya has fragmented policies that are largely silent on access to genetic resources. Currently, more than 77 statutes governing conservation and management of the environment, including climate change, biodiversity and genetic resources exist. The most significant ones include: the Government Fisheries Protection Act (Cap 379, 1962); the Fish Industry Act (1983); Environment Management and Coordination Act (EMCA,1999); Industrial Properties Act Cap 509 (2001); the Water Act (No. 2 of 2002); the Forestry Act (2005); the National Biosafety Act (2009); the Land Act (No. 2 of 2012); Seeds and Plant (Amendment) Act 2012; Crops Act No. 16 of 2013; Wildlife Conservation and Management Act (No. 47 of 2013); the Science, Technology and Innovations Act (2013); Kenya Agricultural and Livestock Research Act No. 17 of 2013; National Policy on Traditional Knowledge, Genetic Resources and Traditional Cultural Expressions; the Environmental Management and Co-ordination (Conservation of Biodiversity) Regulations (2006); the National Biotechnology Development Policy (2006); Kenya National Seed Policy (2010); the National Biodiversity Strategy and Action Plan (NBSAP) (2000); the National Environment Action Plan (NEAP) (2009). Other proposed ones include: the Kenya Climate Change Authority Bill (2014); Kenya Climate Change Draft Policy (2014); Food Security Bill (2014); Natural Resources Bill (2014) and Environment Management and Coordination Act (Amendment) Bill (2014).

The only comprehensive legislative measure that had been put in place thus far is the Environment Management and Coordination Act, 1999 which is a general environmental law. Though a lot of efforts have been put in developing a regulatory framework on Access and Benefit Sharing (ABS), the framework is perceived to be unclear. This situation is exacerbated by poor institutional structures, overlapping mandates and lack of clear institutional policies on germplasm exchange thus leading to uncertainty in sharing of germplasm. Cases of bio-piracy which have often been given extensive media coverage and publicity have led to wrong attitudes. This has given rise to widespread perception that other countries are taking advantage of the country's genetic resources hence prompting protectionist tendencies in germplasm exchange. Again, implementation of the KALR Act 2013 may assist to remove the existing confusion.

Kenya is a signatory to a number of international environmental treaties, agreements and conventions that have a direct or indirect implication on genetic resources. The most relevant for plant genetic resources include: the Convention on Biological Diversity, Cartagena Protocol for Biosafety; the Kyoto Protocol, United Nations Framework on Climate Change; the World Trade Organization's Trade Related Intellectual Property Rights (WTO's-TRIPS), the International Union for the Protection of New Varieties of Plants (UPOV) and the International Treaty on Plant Genetic Resources for Food and Agriculture

(ITPGRFA). In 2003, the country adopted and ratified the ITPGRFA. The objective of the treaty is conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits arising out of their use. The treaty covers all plant genetic resources for food and agriculture, while it's Multilateral System of Access and Benefit-sharing covers a specific list of 64 crops and forages. There are efforts to implement the Global Plan of Action for the conservation and sustainable utilization of plant genetic resources for food and agriculture. Kenya has ratified most of these international treaties, conventions, agreements and protocols related to environmental protection and the conservation of natural resources. All these concerns are geared towards addressing the country's key components of biodiversity conservation including genetic resources. However, the ones most relevant to genetic resources such as the Convention on Biological Diversity (CBD) and the ITPGRFA have not been domesticated due to lack of national policies and legal frameworks.

Kenya is also a party to several regional initiatives such as the Eastern Africa Plant Genetic Resources Network (EAPGREN), Intergovernmental Authority on Development (IGAD), Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC) and NEPAD, ASARECA and other networks.

Advocacy and Awareness Creation

Though some efforts have been made to raise the profile of genetic resources, there is still insufficient awareness and inadequate appreciation of the value of genetic resources and their potential in contributing to increased productivity and food security. As a result, genetic resources are not adequately integrated into key economic sectors such as agriculture, science and technology. The lack of appreciation masks the importance of genetic resources and its links to key developmental issues such as poverty alleviation, food security, nutrition and health, displacement of landraces by improved varieties at community level and loss of wild relatives and forest resources through land conversion, besides other activities. This loss of genetic diversity underscores the need for more policy advocacy and creation of awareness on the importance and value of genetic resources to socio-economic development. Awareness needs to be created at all levels including farming communities, scientists and policy makers. This can be done using diverse strategies such as mass media (television, print), open days, workshops, seminars, participation in agricultural shows and community seed fairs and national farmers' conferences.

8.2 Climate Change Situational Analysis

Empirical Evidence of Climate Change

Kenya has a land mass of 582,350 km2 with only 17% of arable land while 83% consists of arid and semi-arid lands (ASAL). As alluded to earlier, data on temperature and rainfall from the Kenya Meteorological Department over the last fifty years, as well as annual State of the Environment Reports, provide clear evidence of climate change in Kenya. An evident trend is the variability and unpredictability of climate patterns and climate extreme events. Evidence of climate change is based on statistical analysis of past trends in observable changes in climate, and can be grouped into key areas of temperature, rainfall, sea level rise, mountain glacier coverage, and climate extremes. Though not overly significant, lower rainfall levels have been observed in annual rainfall, in the 24-hour intensity as well as in relation to the 'Long Rains' which usually contribute a significant percentage of the annual rainfall. There has also been a notable trend of temperature increases over most of the country between 1960 and 2006 as shown in Table 1.

Table 1. Observed temperature changes 1960 – 2006

Region	Minimum (night) temperature		Maximum (day) temperature	
	Trend	Magnitude/°C	Trend	Magnitude/°C
Western	Increase	2.9 – 0.8	Increase	2.1 – 0.5
Northern & N. Eastern	Increase	1.8 – 0.7	Increase	1.3 – 0.1
Central	Increase	2.0 – 0.8	Increase	0.7 – 0.1
South Eastern	Increase	1.0 – 0.7	Increase	0.6 – 0.2
Coast	Decrease	1.0 – 0.3	Increase	2.0 – 0.2

Source (GoK, 2013a)

Institutional and Policy Framework for Climate Change

The Ministry of Environment and Mineral Resources (MEMR) is the lead agency on climate change issues. It has a Climate Change Secretariat tasked with coordinating implementation of the action plan operationalizing the

National Climate Change Response Strategy (NCCRS). Other agencies include the National Environmental Management Authority (NEMA) which is the designated national authority with responsibility for approving Clean Development Mechanism (CDM) projects; the Kenya Meteorological Department whose mandate is research, prediction and dissemination of climate change information as well as issuing early warning of extreme weather events; and the Department of Resource Survey and Remote Sensing (DRSRS) charged with continuous monitoring of natural resources in Kenya. Other government ministries and agencies that have climate change units include the Office of the President (OP), KWS, the Carbon Finance Unit (CFU) under the Ministry of Finance, Planning and National Development, Vision 2030, Ministry of Agriculture Livestock and Fisheries, KALRO and the Ministry of Development of Northern Kenya and other Arid Lands. There is minimal coordination of activities and involvement between and among these institutions occasioning duplication and redundancies. So far, there have been no deliberate efforts to integrate climate change activities with those of genetic resources and vice versa. The Climate Change Bill 2014 has proposed the establishment of the National Climate Change Council (NCCC) to coordinate climate change issues on policy frameworks, research and development, international agreement and public education. The Bill covers climate change adaptation and mitigation from a governance and institutional framework perspective but it is yet to be enacted into law. One glaring omission is that it makes no direct reference to the role of biodiversity and/or genetic resources in climate change adaptation and mitigation. It is imperative that this omission is addressed.

Climate change is not only a problem of environmental management, but affects the whole national development agenda. Therefore, response to impacts of climate change at all levels including national, county and community must be guided by a coherent and coordinated regulatory framework. It is the absence of internal coherence in laws and policies that has occasioned duplicity and overlap in execution of institutional mandates. Various sector laws, policies and institutional mandates that define roles and functions in relation to interventions required for climate change response should therefore be harmonized to avoid duplication of efforts and to enhance synergy.

The changes to the national governance framework in 2010, which introduced National and County levels of government call for prompt internal coherence and proper coordination of functions. Devolved governments present an opportunity to diversify and implement appropriate climate change responses to build resilience, as each level of government performs distinct functions while deliberately pursuing cooperation. Although devolved government presents challenges regarding fragmented policy responses that lack coherence, these can be mitigated through clear policy guidelines, sound coordination and effective oversight.

Mainstreaming Climate Change in National Development Plans

The benefits of climate change mainstreaming approach are manifold: it ensures vulnerability assessments are integral to major policy decisions; it facilitates a coordinated and comprehensive policy response across sectors and administrative levels; and ensures Kenya's prosperity in the context of a changing climate by explicitly linking climate change response to sustainable development. It is necessary to equip various coordinating and sectoral agencies of the national and county governments with necessary tools to effectively respond to complex challenges of climate change. Therefore mainstreaming implies the integration of climate change policy responses into national, county and sectoral planning and management processes. Accordingly, climate change mainstreaming requires cross-sectoral policy integration that operates horizontally by providing an overarching guide for all sectors; and vertically, by requiring all sectors and levels of government to implement climate change responses in their core functions.

The Medium Term Expenditure Framework (MTEF) for budget making is a critical process for converting policies and plans into expenditure and action. It encourages cooperation across government departments in long term planning. The Vision 2030, the current development master plan for Kenya, and its Medium Term Planning (MTP) framework also present opportunities to mainstream climate change into national planning. County governments are required by law to prepare and implement County Integrated Development Plans (CIDP), through which climate change actions can be mainstreamed. It is therefore imperative to have a mechanism facilitating linkages and exchange of climate change information and data with planning processes across all levels of government. Climate change mainstreaming therefore provides an opportunity to reconfigure national planning processes to ensure that climate resilience and low carbon development are effectively integrated.

9.0 Strategic Objectives

9. 1 Strategic Objective 1: Promote *in situ* Conservation of Plant, Animal, Aquatic and Microbial Genetic Resources in the Context of Climate Change

Key Issues

In situ conservation entails preserving the diversity of genetic resources in habitats where they naturally occur: national parks, national reserves, conservancies, heritage sites, water bodies, wetlands, in soils and in the case of agricultural biodiversity, on-farm. Valuable genetic resources are conserved *in situ* and these include wild relatives of crops, medicinal plants, under-utilized food and beverage plants, fodder and forage plants, as well as a wide range of other economically important plants and microbial organisms. *In situ* conservation strategy ensures better adaptation of target organisms to the ever changing environment by allowing natural evolutionary process. It enhances ecosystem support in the area of conservation through provision of associated goods and services such as pollination, biological control, nutrient recycling, and water purification. In addition to economic benefits such as tourism, *in situ* conservation also allows communities within those ecosystems to directly benefit from the conserved biodiversity. Furthermore, *in situ* conservation is essential as it provides a fall back for recollection of lost genetic resources in *ex situ* conservation areas/facilities. *In situ* conservation sites provide a platform for biodiversity utilization research and studies on ecosystem changes, including biodiversity population dynamics as influenced by such factors as climate change, environmental pollution and human activities. More importantly, a reservoir of genetic resources in form of landraces, cultivars and farmer varieties that exist in agricultural landscapes needs to be conserved on-farm in order to provide a continuous source of farmers' breeding material for farmer preferred traits as well as providing resilience to agricultural production systems.

The Constitution of Kenyan (2010) provides an enabling environment that can be used in in situ conservation of agro-biodiversity. Agriculture has been devolved to County governments which will develop strategies for enhancing productivity of the sector. It will be to the benefit of the county to conserve and utilize available biodiversity for the development of the county. In addition, protection of the environment is paramount in the new constitution and there are policies that encourage at least 10% tree cover that can be of diverse species

in each household. Such species could include medicinal plants, trees for carving wood and those that can be used as source of food such as fruits. For example, it would create corridors and nesting grounds for pollinators and natural enemies within farmscapes. In addition, this offers opportunity to reintroduce native biodiversity to ecologies from where they have become extinct.

Constraints

There are various challenges and threats to genetic resources conserved *in situ*. These include destruction of natural habitats due to agricultural expansion and socio-economic developments, over-harvesting of specific plants, displacement of indigenous plants by alien and invasive species and climate change. Some communities are known to unsustainably harvest wild plant and animal biodiversity including insects. There is need for urgent steps to widen knowledge on utilization and management of genetic resources for enhanced food security, nutrition security and improved incomes of Kenyans while conserving the biodiversity.

Strategic Actions

1. Establish *in situ* conservation and management of wild relatives and wild food plants,animal, microbial, and aquatic genetic resources to ensure continued and long term availability of their germplasm under changing climatic conditions.
2. Conduct surveys and develop GIS based inventories in partnership with relevant agencies, to determine the distribution and extent of economically and ecologically important fauna and flora in order to inform *in situ* conservation strategies.
3. Work with institutions responsible for *in situ* conservation to restore eroded genetic resources in natural habitats, nature reserves and other protected areas for enhanced ecosystem resilience and restitution of biodiversity.
4. Establish and enhance on-farm conservation of genetic resources to ensure continued availability of traditional farmer varieties for broadening of genetic base and increasing resilience of agricultural production systems.
5. Conduct scientific studies on the effects of climate change on genetic resources conserved *in situ* in order to assess the level and extent of threat of genetic erosion and inform development of mitigation strategies.
6. Collect, collate and document indigenous knowledge of economically important plants and animal species as a basis of tapping the inherent economic potential.
7. Increase capacity in the use of GIS in diversity distribution and climate modeling, early warning systems and genetic erosion studies.

9.2 Strategic Objective 2: Enhance *ex situ* Conservation of Plant, Animal, Aquatic and Microbial Genetic Resources in the Context of Climate Change

Key Issues

Ex situ conservation strategies ensure continued survival of genetic resources by conserving them away from erosion agents. This requires that genetic resources are systematically collected and conserved in protected *ex situ* sites/facilities including seed banks, field gene banks, botanic gardens and *in vitro* collections. Another value of *ex situ* conservation is the provision of genetic resource for reintroduction to areas of their natural occurrence once there has been genetic erosion and loss. *Ex situ* conservation area(s) provide opportunities for extensive research on survival and utilization of the collected biodiversity. *Ex situ* conservation sites/facilities also provide a pool of genetic resource for use in development of innovative solutions to food and nutrition security and improvement of household incomes.

Genetic resources conserved *in situ* continue to face erosion due to natural calamities and pressure from anthropogenic activities. Thus *ex situ* conservation compliments and enhances conservation of genetic resources that would otherwise get lost. With the continued biotic and abiotic pressures to genetic resources, including climate change, there is a possibility of losing genetic resources whose potential is yet to be known. To mitigate this, *ex situ* conservation ensures collection and preservation of all genetic resources from areas of natural occurrence. By employing a precautionary principle whereby materials are collected and stored, it provides opportunities for future generations to use such material for their wellbeing. This is in appreciation that technology generation is continuous, thus expanding the value and potential utilization of biodiversity.

Constraints

Availability of and access to genetic resources for utilization in agricultural research is a major challenge to the scientific community. There is need for steady supply of genetic resources from *ex situ* conservation facilities if generation of technologies that are "climate ready" and that can contribute towards increasing the resilience of agricultural production systems are to be efficiently effected. However, at the national level, there are insufficient *ex situ* conservation facilities to ensure adequate preservation of the wide spectrum of genetic resources. The recent establishment of GeRRI is an indication of the government's commitment to conservation and sustainable use of genetic resources which are critical for the country's economic development. However, GeRRI's infrastructural and institutional capacity to fulfil its mandate is currently quite limited. There is urgent need to strengthen the

institute's capacity for *ex situ* conservation to complement *in situ* conservation approaches in response to the diverse breeding systems, propagation methods seed storage behaviour and conservation requirements of different species. For GeRRI therefore, to fulfil its national mandate in conserving the country's genetic diversity, it is necessary to adopt and expand different forms of *ex situ* conservation strategies. The current seed handling and storage capacity needs to be strengthened through provision of seed laboratory equipment, expansion of cold room facilities as well as installation of cold store power back-up system. In addition, *in vitro* conservation facilities need to be strengthened and field gene banks established in different agro-ecological zones to cater for conservation of a wider spectrum of vegetatively propagated species such as yams, cassava, banana, sweet potato and taro. To enhance germplasm value addition, strengthening of the molecular laboratory would be an important pre-requisite. Since GeRRI's mandate is not limited to plant genetic resources. The lacking infrastructural capacity for *ex situ* conservation of animal and microbial genetic resources need to be provided. Enhancing human resource capacity is required in all areas of *ex situ* conservation but more so in seed technology, *in vitro* conservation, application of molecular markers in characterization and evaluation of germplasm conserved *ex situ* as well as genetic diversity analysis and marker assisted selection. The ultimate goal is to capacity build GeRRI in order to meet its obligations to conserve *ex situ* in Kenya's entire flora and fauna diversity spectra.

Strategic Actions

1. Conduct gap analysis in order to indentify germplasm collection gaps and inform *ex situ* conservation priorities and strategies.

2. Collect and conserve Kenya's plant of wild relatives of crops, underutilized crops, landraces rare, threatened and endangered species from difficult and inaccessible landscapes.

3. Establish *ex situ* conservation facilities of animal, aquatic and microbial genetic resources.

4. Increase and equip cold room facilities, field gene banks and *in vitro* conservation laboratories to cater for a wide spectrum of Kenya's species diversity.

5. Training and capacity building in taxonomy seed technology; application of molecular markers in germplasm characterization, evaluation and genetic diversity studies.

6. Improve the capacity and facilities of the seed and molecular biology laboratories at GeRRI in order to enhance *ex situ* conservation research capacity and add value to germplasm.

9.3 Strategic Objective 3: Strengthening Policy and Institutional Frameworks

Key Issues

The success of a national strategy on genetic resources conservation depends on the establishment of a high-level policy and institutional framework devoted to genetic resources management, with representatives designated by each of the key stakeholders. In 1988, the Government of Kenya and development partners established the National Gene Bank under the then Kenya Agricultural Research Institute (KARI) within the Ministry of Agriculture. The main objective was to contribute to sustainable crop production by ensuring availability of a broad genetic base and preserving the country's crop genetic heritage and the associated traditional practices and indigenous knowledge systems. The national stakeholders, both public and private, some of whom were members of the national PGR working group, were involved in the implementation of the genetic resources activities.

Kenya has signed and/or ratified several international instruments related to genetic resources, including the Convention on Biological Diversity, the Intergovernmental Panel on Climate Change (IPCC), the Cartagena Protocol on Biosafety, and the International Treaty on Plant Genetic Resources for Food and Agriculture. To meet its international obligations, the country has been developing and implementing national regulations and policies that cover conservation and utilization of genetic resources, seed laws, varietal registration and release, intellectual property regimes, farmers' rights, access and benefit sharing, nature reserves, biosafety frameworks, among others. This is meant to enhance domestication of the international treaties and conventions and also provide a national policy framework to ensure the effective and efficient conservation and utilization of genetic resources including addressing sustainability issues. The country has so far developed relevant policies and laws on agriculture including the Seeds and Plant Varieties (Amendment) Act 2012 and the Kenya Agricultural and Livestock Research (KALR) Act 2013. The country has also developed a National Biodiversity Strategy and Action Plan (NBSAP), which highlights *ex situ* conservation as a strategy for achieving the conservation of genetic diversity of agro-biodiversity. A more recent development is the on-going review of the National Biodiversity Strategy and Action Plan which presents a good opportunity in strengthening the policy and institutional framework for genetic resources, that are a key component of biodiversity. The Environment Management Coordination Act (EMCA, 1999) is currently under review through the Environment Management Coordination (Amendment) Bill (2014) which has already gone through the first reading in

Parliament. The Bill aligns the previous Act with the Constitution of Kenya and proposes new definition of terms as well as new institutional structures in line with the devolved County Governments governance system.

A Food Security Bill (2014) was developed and introduced in parliament. The Bill proposes the establishment of a National Food Security Authority which will enhance activities to promote food security at both National and County levels. The Authority has also been mandated to support the domestic production of diverse foods including the cultivation of traditional crops and also to promote traditional and other practices and technologies of food production that ensure the conservation of biodiversity. The Natural Resources Bill (2014) is an Act of Parliament to establish a system of benefit sharing in resource exploitation between resource exploiters, the national government, county governments and local communities and to establish the Natural Resources Benefits Sharing Authority. The Act does not, however, cover genetic resources and biodiversity explicitly but includes forests, wildlife and fisheries resources. There is an ongoing process to finalize the Bioscience Policy and Bill under National Council for Science and Technology (NACOSTI) to establish a National Biosciences Research Centre which will be autonomous with a mandate for conservation of biodiversity in its entirety including plants, microbial organisms, aquatic life forms as well as both domestic and wild animals. This will enable sustainable exploitation of the country's large and diverse biological and genetic resources in accordance with the Sustainable Development Goals, Vision 2030 and the Constitution of Kenya. The ongoing initiative to amend the Seed and Plant Varieties Act so as to accommodate anchorage of the Conservation and Benefit Sharing Regulations of Plant Genetic Resources for Food and Agriculture is also an effort in the right direction. The enabling policy, legislative and institutional framework environment being put in place shall enhance accountability and transparency, and hinder misuse of research and illegal access to biological resources which may pose a threat to the economy and national security. It also focuses on creating opportunities for capacity building so as to generate a critical mass of scientific and technological expertise in the subject matter.

Constraints

The current genetic resources conservation governance structure and coordination mechanism is weak and lacks policy and legal backing. The *ad hoc* structures such as the national PGR working group currently in place lack resources to support their functions. Furthermore the structure does not have a strong national genetic information sharing mechanism and the range of institutions represented is quite narrow given the diversity of stakeholders in the country. Despite the noted efforts in development of agricultural and genetic

resources related Acts, there are still major gaps that need to be addressed. There needs to be a comprehensive and harmonized policy and legal framework governing the conservation and sustainable utilization of genetic resources in its entirety other than having piecemeal references to it in various policy legal and instruments.

Another constraint is insufficiency of the requisite institutional structure and human resource expertise to manage biodiversity across. The GeRRI, which is mandated under the Kenya Agricultural and Livestock Research Act 2013, to take charge of genetic resources activities in the country is inadequate in infrastructure and has human resources constraints at all levels - scientific, technical and support staff. A survey of the several local organizations engaged in genetic resources work indicates that research capacity is lacking. Some well trained personel are available in KALRO, NEMA, KEFRI and Kenya Marines and Fisheries Research Institute (KEMFRI) but their institutional tasks may not neccesarily be in biodiversity research. The wrong deployment of professional staff or transfers and resignation to join NGOs and international organizations for greener pastures is a major drawback to conservation efforts.

Strategic Actions

The following actions are therefore needed in order to streamline coordination activities and enhance efficient implementation of the national strategy and action plan:

1. Carry out a genetic resources stakeholder analysis in order to determine the diversity of institutions involved in genetic resources and hence ensure their adequate representation in the national institutional framework for genetic resources conservation and use.

2. Create a national genetic resources and climate change adaptation strategy stakeholder's forum for discussions and information exchange.

3. Strengthen the National Information Sharing Mechanisms (NISM) as a platform for stakeholders to share and exchange information on genetic resources and climate change adaptation, as well as updates on on-going and planned activities for complementarity and creation of synergy.

4. Establish a functional national genetic resources conservation coordination mechanism with wide representation of stakeholders and essential elements of an integrated national programme including. It is proposed that GeRRI be elevated and given autonomy to enhance stakeholder confidence and resources mobilization. This could be accomplished through the NACOSTI Bioscience Policy and Bill which is currently undergoing a review.

5. Develop a comprehensive, all-encompassing and harmonized policy and legal framework specifically for the conservation and sustainable utilization of genetic resources in its entirety as proposed in the NACOSTI Bioscience Policy and Bill.

6. Examine and adapt the existing legislation on the protection of forests and wildlife for possible use of *in situ* conservation of genetic resources especially the wild crop relatives.

7. Develop policies for institutionalizing of the national strategy on genetic resources conservation including provision of financial and human resources for its implementation.

8. Mobilize financial and human resources for implementation of the national strategy on genetic resources. Possible sources of funding include the Government, development partners such as Swedish International Development Cooperation Agency (SIDA), United States Agency for International Development (USAID), CIDA-Canada, GEF and Foundations such as Bill and Melinda Gates Foundation and McKnight Foundation. Human resources and technical expertise could be mobilized from national and international institutions including specialized line departments.

9.4 Strategic Objective 4: Improve Access and Sustainable Use of Germplasm

Key Issues

The people of Kenya derive most of their food, medicines and industrial products from both wild and domesticated components of genetic resources. The resources consist diverse genetic material contained in traditional varieties and modern cultivars grown by farmers as well as crop wild relatives and other wild plant species that can be used as food, medicines, essential oils, gums, resins, fodder/forages, fibres, shelter, timber and fuel wood among others. The conservation and utilization of this vital component of biodiversity is important for sustainable livelihood, agricultural productivity and economic development. It is therefore critical that these genetic resources are accessible and used to address challenges of food security besides meeting other socio-economic needs.

Constraints

Access to and use of the genetic resources reservoir is constrained by a number of issues including; 1) Limited knowledge and awareness of existence and functions of the National Gene Bank and other national *ex situ* conservation facilities; 2) Lack of adequate information on taxonomy, passport data, performance records, characterization and evaluation data. While the GeRRI Genebank has made considerable efforts in documentation, characterization and evaluation of germplasm, a lot still needs to be done since only 18,303 accessions representing about 37% of the germplasm holdings at the GeRRI Gene bank have been characterized for agro-morphological traits, and none using molecular markers. The available data is neither well analyzed nor in a suitable format for immediate and direct use, especially by breeders. Information on germplasm held by the GeRRI Gene bank and information/data on characterization and evaluation are generally not readily available to breeders and subsequently many of them have the perception that the conserved material are inappropriate for immediate use. Breeders often prefer working with value added germplasm in order to reduce time required to develop new varieties, 3) Poor linkages between the Gene bank and potential users due to limitations of funding, the Gene Bank has not been able to establish strong links with the potential users of the germplasm especially breeders and farmers. This limits its ability to provide information on germplasm holdings and value added data and how it can be easily accessed. The linkages between gene banks and breeders are still weak. Breeders have been undertaking their own germplasm collections completely oblivious of the range of germplasm available in the GeRRI Gene bank. Permits to gain entry into protected areas such as parks and national reserves are given by KWS and may sometimes involve lengthy and bureaucratic procedures in addition to being costly.

Available information from both the discussions held with scientists and literature suggest that one of the key constraints and limitations to breeding is inadequate numbers and critical mass of breeders. The young and upcoming scientists do not find breeding attractive enough both scientifically and in monetary terms in the wake of proliferation of technological advances in all research and development sectors. Though the government has made efforts to build capacities, a lot more still needs to be done to invest in agricultural research and development, particularly to create an enabling environment to make breeding attractive to young scientists.

Strategic Actions

1. Develop a national genepool-specific networks comprising a wide range of specialists including breeders, conservationists, agronomists, farmers, pathologists, and seed technologists.

2. Establish a National Platform of Germplasm Resources and Innovations for genetic resources related information exchange as well as awareness raising on available germplasm.

3. Strengthen linkages between conservation, crop improvement, seed sector and extension components for effective development and delivery of elite germplasm.

4. Increase efforts on germplasm characterization and evaluation – including availability of data and germplasm repository catalogues to catalyze technology and innovation generation.

5. Enhance participatory breeding and field demonstration for farmer-preferred and climate change adaptive traits.

6. Establish community gene banks for conservation of farmer preferred varieties in different agro-ecological zones.

7. Review and simplify procedures and processes for access to genetic resources conserved *in situ*.

9.5 Strategic Objective 5: Enhance Knowledge Management and Information Dissemination

Key Issues

Public awareness is key to mobilizing popular opinion and to generating and sustaining appropriate political action nationally, regionally and internationally. Therefore, effective communication about the benefits that genetic resources can bring to food security and sustainable livelihoods is critical to the success of any conservation programme. A well targeted public awareness programme can promote the development of international links and collaborative mechanisms such as networks involving different sectors, agencies and stakeholders. Public awareness can support efforts to involve the private sector, indigenous and local communities, and local and non-governmental organizations in national

genetic resources activities, thus ensuring a broader base for conserving and sustainably using genetic resources. Working with the media at local and national levels is a crucial aspect of raising awareness. The creation of strong links between public awareness campaigns implemented by various national stakeholders can increase their effectiveness and reduce costs. An enhanced level of the perceptions of ownership is critically important for the successful, sustainable and result-oriented management of genetic resources. In this regard, the institutionalization of measures for creating awareness through appropriate media on the values and value addition implicit in the conservation and sustainable use of genetic resources is crucial.

Constraints

Though some efforts have been made to raise the profile of genetic resources conservation, there is still insufficient awareness and inadequate appreciation at all levels of the value of genetic resources. Their potential in contributing to increased productivity, food security and techonology generationhas not been adequately integrated into key economic sectors such as agriculture, science and technology. This lack of appreciation masks the importance of genetic resources and their potential to address developmental issues such as poverty alleviation, food security, nutrition and health. At community level, lack of appreciation of genetic resources leads to genetic erosion through displacement of landraces by improved varieties, loss of wild relatives and forest resources through land conversion, besides other activities. This loss of diversity underscores the need for more policy advocacy and creation of awareness on the importance and value of genetic resources to socio-economic development. This awareness needs to be created at all levels including farming communities, scientists and policy makers using diverse strategies such as the mass media (television, print), open days, workshops, seminars, participation in agricultural shows and community seed *fairs* and national farmers' conferences.

Strategic Actions

The following actions are proposed:

1. Carry out national awareness campaigns on the value of genetic resources directed at sensitizing traditional farmers, user community at large and policy makers, affected government ministries and other stakeholders. The specific interventions for creating awareness at various levels include:

Policy level – The most effective awareness creation channels should include but not limited to:

(i) Sensitization meetings including workshops targeting specialized line committees of parliament, Principal Secretaries of relevant ministries and County Governments.
(ii) Policy briefs
(iii) Raising the profile of genetic resources at the policy level; it would be prudent to set up a task force on genetic resources comprising of Principal Secretaries from ministries responsible for Science and Technology, Environment, Finance and Agriculture to facilitate mobilization of resources for implementation of genetic resources activities.

Scientific level – Awareness creation channels should include:

(i) Training workshops targeting technical staff
(ii) Seminars on pertinent genetic resources topics
(iii) Collaborative implementation of activities involving multiple stakeholders
(iv) Review and planning meetings involving multiple stakeholders.
(v) Information dissemination through specialized associations such as Agricultural Information Centre, KENFAP and other agricultural-related bodies
(vi) Discussion through social media

Community/Public level – Awareness should be created through the following channels

(i) Mass media including local radio stations, all print and electronic media
(ii) Organization of diversity seed fairs, farmer field schools, field days and food fairs
(iii) Demonstration plots
(iv) Community meetings and farmer training workshops.

2. Produce and disseminate educational, training and awareness creation materials on genetic resources, including posters, pamphlets, brochures and audio-visuals.

3. Disseminate research findings and technical information in peer reviewed journals, technical reports and technical bulletins.

4. Develop appropriate genetic resources curricula for primary, secondary and tertiary educational institutions.

5. Develop and strengthen relationships with the local media and encourage them to cover genetic resources issues on a regular basis, involve them in communications workshops and meetings to gain a better understanding of the subject area.

10.0 Implementation Plan and Institutional Framework

The National Strategy on Genetic Resources is a five year initiative, with the implementation responsibility largely lying with GeRRI but working closely with key stakeholders including NMK, KWS, KEFRI, KMFRI, CAGRI, MAL&F, Ministry of Environment, Universities and NGOs. It is proposed that GeRRI plays the coordinating role. The allocation of responsibilities to implement the different components of the strategy needs to recognize the specific roles which other sectoral ministries and organizations are best suited to undertake given their comparative advantage through their specific mandates and specializations.

Currently the institutional frameworks for climate change and those of genetic resources are entirely independent with no mechanisms for cross-fertilization of ideas, information exchange and/or complementarity. The recently established GeRRI presents an excellent opportunity for coordination of genetic resources activities in the country within the context of climate change since its mandate is not limited to plants but to genetic resources in their entirety. One of the key objects of KALRO as specified in section 5(1) is to- (a) promote, streamline, co-ordinate and regulate research in crops, livestock, genetic resources and biotechnology in Kenya. GeRRI has therefore been established to operationalize the genetic resources component of this function. The KALRO Act further specifies that each of the Institutes, including GeRRI, under the organization will have a Scientific Advisory Committee to guide its activities. Therefore the proposed institutional framework that encompasses and integrates climate change adaptation and mitigation is as follows.

1. Review the current policies with implications on genetic resources coordination in particular the Seeds and Plant Varieties (Amendment) Act 2013 and the Kenya Agricultural and Livestock Research Organization Act 2013. These reviews should focus on the establishment of a Genetic Resources Research Institute, an autonomous national centre with a mandate for conservation and sustainable use of genetic resources integrating the four major categories viz Animal Genetic Resources, Aquatic Genetic Resources, Plant Genetic Resources and Microbial Genetic Resources. It is proposed that GeRRI be domiciled and anchored under a relevant ministry with an overarching mandate.

2. Establish the proposed GeRRI Advisory Committee to replace the current National PGR Programme Coordinating Committee. The Advisory Committee should then be expanded and have representation from the

key stakeholders and institutions implementing genetic resources and climate change activities in the country. In order to integrate climate change activities, the Advisory Committee should have a representative from the proposed National Council for Climate Change and also from the Kenya Climate Change Working Group which is a coalition of non-governmental and civil society organizations involved in climate change activities. The Advisory Committee should comprise the following institutions/ disciplines:

- Expert in Animal Genetic Resources
- Expert in Microbial Genetic Resources
- Expert in Aquatic Genetic Resources
- Expert in Plant Genetic Resources
- National Climate Change Secretariat
- Intellectual Property Rights
- Non-Governmental Organization involved in biodiversity and genetic resources conservation
- One representative from a University
- Genetic Resources Policy Expert/Analysis
- National Museums of Kenya

3. The Advisory Committee should then have specialized sub-committees as follows:
   - Conservation
   - Genetic resources access and utilization
   - Information and knowledge management
   - Capacity building
   - Policy and legal frameworks
   - Climate change

4. The specialized sub-committees should comprise not more than five members drawn from key stakeholders and institutions involved in conservation and sustainable use of genetic resources.

5. The Chair of the Advisory Committee should be a renowned and well accomplished personality in biodiversity and genetic resources.

6. The Director of GeRRI should serve as the Secretary of the Advisory Committee.

7. The Climate Change Policy (Section 4 (1)) proposes to establish the National Council for Climate Change mandated with a wide range of functions and operating under the auspices of the Office of the President. They include advise and coordination of legislative and technical matters to the

national and county governments as well as coordination of climate change research at local, regional and international levels. It is recommended that the National Council for Climate Change facilitates the establishment of Climate Change Coordination Units (CCCUs) at the County level. GeRRI in collaboration with relevant ministries/departments will then establish partnerships and collaboration with the County government's CCCUs to ensure that genetic resources are well integrated and mainstreamed in all climate change activities at the county level.

8. It is also recommended that the Director of GeRRI sits in the Advisory Committee of the National Council for Climate Change to ensure that genetic resources concerns and imperatives are well integrated in all national strategies, actions plans and activities developed and/or implemented by the National Council for Climate Change.

11.0 Monitoring and evaluation

A national strategy needs committed action and dedicated human and material resources for its implementation and should also be periodically reviewed in order to address changing needs and priorities as necessary. The national strategy will therefore identify the indicators and prescribe a monitoring system to measure the progress made in its implementation. It will also devise a mechanism to adjust its priorities and measures in line with the national needs.

Monitoring of the National Strategy implementation will be carried out regularly by a multi-disciplinary team led by KALRO GeRRI. The strategy will also be monitored for attainment of the overall objective, which is the conservation and sustainable use of Kenya's genetic resources. The monitoring of verifiable indicators will focus on assessment of progress made and will be carried out jointly by the responsible agencies. This aspect of monitoring will be a continuous activity whose main focus will be self-monitoring and evaluation aimed at improving performance and strategy implementation. The responsible agencies and Chairpersons of the sub-Committees will report on progress regularly to the Advisory Committee through the Secretariat. The specific objectives and implementation modalities of progress monitoring will be developed by the responsible executing agencies and sub-Committees assisted by technical experts that may be co-opted from NGOs, private sector agencies, research and academia.

11.1 Monitoring Indicators

Table 2. Monitoring indicators for genetic resources activities

Objective statement	Objectively verifiable indicators	Means of verification	Key assumptions
Strategic goal			
A vibrant and well-coordinated genetic resources conservation agenda servicing food security, climate change resilience and economic prosperity initiatives developed .	• Number of integrated genetic resources and climate change plans and strategies in place and operational • Level and extent of genetic resources and climate change action plans mainstreamed in different economic sectors • Number of target stakeholders benefitting from genetic resources related technologies	• Government reports • Technical reports	• Governments continue to support agriculture and poverty reduction as priorities • Political stability prevails
Outputs			
In situ conservation of genetic resources in perspective of climate change promoted.	• At least two *in situ* conservation sites each for animal, microbial, aquatic and plants established by year 5 • At least twenty distribution maps of at least 10 priority fauna and flora species of economic importance generated by year 3 • At least four eroded genetic resources sites restored in natural habitats, nature reserves and other protected areas by year 4 • At least four on-farm conservation sites established in at least four agro-ecological sites by year 5 • At least four scientific studies conducted on the effects of climate change on genetic resources/species by year 4 • At least four databases on indigenous knowledge of economically important plants and animal species developed by year 4	• Conservation site plans • Distribution maps • Scientific papers • Technical reports • Annual reports • Reports generated from databases	• Institutional mandates are agreed upon • Farmers and communities are willing to establish on-farm conservation sites

Objective statement	Objectively verifiable indicators	Means of verification	Key assumptions
Ex situ conservation of plant, animal, aquatic and microbial genetic resources in the context of climate change enhanced.	• Gap analysis in order to indentify germplasm collection gaps and inform *ex situ* conservation priorities and strategies undertaken by year 1 • At least 90% of Kenya's orthodox seeds species conserved *ex situ* by year 5 • At least one type of *ex situ* conservation facilities for animal, aquatic and microbial genetic resources developed and used by year 5 • At least one *in vitro* conservation facility established and functional by year 5 • At least four field gene banks for at least four crops/gene pools established in at least three agro-ecological zones by year 5 • At least one more cold room for *ex situ* conservation of seeds developed and functional by year 5 • At least 10 people trained at PhD and/or MSc level in taxonomy seed technology; application of molecular markers in germplasm characterization, evaluation and genetic diversity studies • The capacity of the seed and molecular biology laboratories at GeRRI increased through additional equipment and facilities by year 4	• Conservation strategies • Gene bank records • Germplasm catalogues • *Ex situ* germplasm management plans • Field gene bank lay out plans • Educational certificates • MSc and PhD theses • Scientific papers • Technical reports • Annual reports	• Conducive weather • Adequate infrastructure is available and maintained
Policy and institutional frameworks Strengthened.	• Genetic resources stakeholder analysis undertaken by year 1 • A National Genetic Resources Stakeholders Forum established and functional by year 1 • The National Information Sharing Mechanism strengthened and functional by year 2 • The national genetic resources coordination mechanism in place and functional by year 3 • A comprehensive genetic resources policy and legal framework developed and in place by year 4 • The national strategy on genetic resources institutionalized by year 1	• Technical reports • Annual reports • Reports of stakeholders meetings • Minutes of genetic resources coordination meetings • Policies • Gazettes	• Political goodwill and policy enabling environment exists

Objective statement	Objectively verifiable indicators	Means of verification	Key assumptions
Access and use of germplasm increased.	• At least five crop-specific gene pools established and functional by year 4 • One National Platform on Genetic Resources and Innovations developed and functional by year 2 • At least 4,000 accessions comprising at least 10 species/crops/varieties characterized, evaluated and utilized in restoration and production intiatives by year 4 • At least 5 improved varieties and/or elite germplasm with climate change adaptive traits developed and in use by year 5 • At least three community gene banks established in at least three agro-ecological zones and functional by year 5 • A simplified procedure for access to germplasm conserved *in situ* developed and in use by year 3	• Minutes of meetings • Technical reports • Annual reports • Scientific papers • Guidelines and procedures • Gene bank management plans	• No new outbreak of pests and diseases • Seeds of identified varieties available • The germplasm with specific traits are available • Political stability prevails • Extension services are active and effective
Knowledge management and information dissemination enhanced	• At least three different types of national awareness campaigns organized by year 3 • At least five different types of public awareness materials developed and disseminated by year 2 • At least five different types of pathways (mass media, website, workshops) used for information dissemination and awareness creation • At least three types of genetic resources curricula developed and used in primary and tertiary educational institutions by year 4 • At least ten technical publications (scientific papers, technical reports, technical bulletins). developed and published by year 5 • At least three partnerships developed with the media by year 3	• Technical reports • Annual reports • Media articles • Genetic resources curricula • Scientific papers • Technical reports • Posters • Fliers • Brochures	• The media appreciate the importance of information on agriculture and livestock Research for Development (R4D) • Stakeholders' willingness to contribute time and information to the platforms • The socio-environment is conducive and supportive of information sharing

12.0 Summary Financial Plan

Action	Budget estimate
Conservation *in situ* and *ex situ* in perspective of climate change 1. Conduct gap analysis in order to indentify germplasm collection and conservation gaps 2. Collect and conserve germplasm of wild relatives of crops 3. Collect and conserve germplasm of landraces in difficult and inaccessible areas 4. Conduct inventories, collect indigenous knowledge and engage in research and development of under-utilized plants	US$ 800,000
Policy and institutional framework 1. Genetic resources stakeholder analysis 2. Strengthen the National Information Sharing Mechanisms (NISM). 3. Establish a functional national genetic resources coordination mechanism 4. Develop a comprehensive, all-encompassing and harmonized policy and legal framework 5. Mobilize financial and human resources for the implementation of the national strategy on genetic resources.	US$ 700,000
Knowledge management and information dissemination – awareness, information management 1. Carry out national awareness campaigns 2. Produce and disseminate educational, training and awareness creation materials 3. Develop appropriate genetic resources curricula for primary and tertiary educational institutions 4. Strengthen media relations	US$ 500,000
Access and use of germplasm 1. Develop national crop-specific networks 2. Establish National Platform of Plant Germplasm Resources and Innovations 3. Strengthen the linkages between the conservation, crop improvement, seed sector and extension components 4. Increase efforts on germplasm characterization and evaluation 5. Enhance participatory breeding and field demonstrations 6. Establish community gene banks 7. Review and simplify procedures and processes for access to genetic resources	US$ 900,000
Capacity building 1. Establish *ex situ* conservation of animal, aquatic and microbial genetic resources 2. Expand the current *ex situ* conservation facilities (increase cold room facilities, field gene banks and *in vitro* conservation laboratories) 3. Improve the facilities and capacity of the seed laboratory at GeRRI	US$ 1,600,000
Monitoring and Evaluation	US$ 500,000
TOTAL BUDGET ESTIMATE	**US$ 5,000,000**

Bibliography

CBD. 2008. Access and Benefit-Sharing in Practice: Trends in Partnerships across Sectors. Secretariat of the Convention on Biological Diversity Montreal, Technical Series No. 38, 40 pages.

CBD. 1992. Convention on Biological Diversity (CBD) http://www.biodiv.org/default.aspx

FAO. 2004. International Treaty on Plant Genetic Resources for Food and Agriculture, Food and Agriculture Organization of the United Nations, Rome Italy.

FAO. 2015. Coping with Climate Change: the roles of genetic resources for food and agriculture.

GoK. 1999. Environment Management and Coordination Act (1999), no. 8 of 1999. Ministry of Environment and Natural Resources.

GoK, 2000. The National Biodiversity Strategy and Action Plan. Government Printers, Nairobi.

GoK, 2003. Economic Strategy for the Revitalization of Agriculture. Government Printers, Nairobi.

GoK. 2005. The Forests Act of 2005. Ministry of Environment and Natural Resources

GoK. 2006a. Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations. Legal Notice No. 160.

GoK. 2006b. The National Biotechnology Development Policy.

GoK. 2007a. Kenya Vision 2030: A Globally Competitive and Prosperous Kenya. Ministry of Planning and National Development and National Economic and Social Council. Government Printer.

GoK. 2007b.The Wildlife (Conservation and Management) Bill 2007. Ministry of Tourism and Wildlife.

GoK. 2009a. The National policy on traditional knowledge, genetic resources and traditional cultural expressions

GoK. 2009b. The Seeds and Plant Varieties Act, 1971 as in UPOV Gazette, No. 94.,December 2002. Kenya Gazette Supplement No.12

GoK. 2009c. The Seeds and Plant Varieties (National Performance Trials) Regulations, 2009, Kenya Gazette Supplement No. 12, Legal Notice No. 25.

GoK. 2010a. The National Seed Policy. Ministry of Agriculture and Livestock Development.

GoK.2010b. The Constitution of Kenya. National Council for Law Reporting – Kenya, The Official Law Reports of the Republic of Kenya. Accessed at www.kenyalaw.org

GoK. 2012a. Government of Kenya Adaptation Technical Analysis. Technical Report 1: Risk Assessment Report

GoK. 2012b. The Seeds and Plant Varieties (Amendment) Act, 2012

GoK. 2013a. National Climate Change Action Plan 2013 -2017. Ministry of Environment, Water and Natural Resources

GoK. 2013b. The Kenya Agricultural and Livestock Research. Kenya Gazette Supplement No. 29 (Acts No. 17)

GoK. 2013c. Crops Act No.16. National Council for Law Reporting

GoK 2014a. National Environment Policy. Ministry of Environment, Water and Natural Resources

GoK. 2014b. Climate Change Bill. Kenya Gazette Supplement No.3 National Assemblies Bill No.1)

GoK. 2014c. Draft National Climate Change Framework Policy. Ministry of Environment, Water and Natural Resources

GoK. 2014d. The Forest Conservation and Management Bill. Ministry of Environment, Water and Natural Resources

GoK. 2014e. Food Security Bill. Kenya Gazette Supplement No.81 (Senate Bills No.23).

GoK. 2014f. Natural Resources Bill. Kenya Gazette Supplement No.137 (Senate Bills No.34).

GoK. 2014g. Environment Management and Coordination (Amendment) Bill. Kenya Gazette Supplement No. l14 (National Assembly Bills No. 31

IEA.2011a. Biodiversity Cosnervation in Kenya. Trade Notes. Institute of Economic Affairs, Nairobi, Kenya.

IEA. 2011b. Institutional Framework For Implementation of National Legislations for Biodiversity Conservation and Bio-prospecting. Media Notes Issue 10. Institute of Economic Affairs

Kamau, EC. 2009. Facilitating or Restraining Access to Genetic Resources? Procedural Dimensions in Kenya 5/2 Law, Environment and Development Journal (2009), p. 152, available at http://www.lead-journal.org/content/09152.pdf

Kariuki, P.M. and Simiyu, S. 2005. CBCMP Technical report on the Conservation Assessment and Management Planning (CAMP) Workshop, 3 – 5 April 2005. Machakos District, Kenya. Unpublished report, IDRC/National Museums of Kenya, Nairobi. 34 pp

Kiambi, D.K and K. Atta-Krah. 2003. Plant genetic resources in the global and African setting. Proceedings of, 'The 'First Plant Resources of Tropical Africa (PROTA) International Workshop', 23rd to 25th September 2002, Nairobi, Kenya. University of Wageningen.

Kiambi DK, Attere AF and Mgonja M. 2010. Plant Genetic Resources in Africa: Opportunities, Challenges and Priorities. Paper presentation for the 5th Agricultural Science Week and FARA General Assembly, held on 19-24th July 2010, Ouagadougou, Burkina Faso.

MEMR. 2009b. National Climate Change Response Strategy Ministry of Environment and Mineral Resources.

Mutegi E., Muthamia Z.K., Mutisya J. and Muoki S. 2005. Study on the extent of utilization of plant genetic resources in Kenya. Agricultural Research Centre, Muguga South. Annual Report. 2005. Kenya Agricultural Research Institute.

Mwenda A and Thomas N. Kibutu. 2012. Implications of the New Constitution on Environmental Management in Kenya', 8/1 Law, Environment and Development Journal p. 76, available at http://www.lead-journal.org/content/12076.pdf

Nnadozie, K; Robert Lettington, Carl Bruch, Susan Bass and Sarah King. 2003. African perspectives on genetic resources – a handbook on laws, policies and institutions. Environmental Law Institute, Washington DC

NGBK. 2009. National Gene bank of Kenya Database. Kenya Agricultural Research Institute

Nyamongo D.O, Muthoka P.N & Mutegi E. 2003. Proceedings of the first national workshop on information sharing mechanism for GPA implementation

Nzau, M. 2013. Mainstreaming climate change resilience into development planning in Kenya.

IIED country report. IIED, London

Opole, M J. Chweya, J and Imungi. 1991. In cultivating local knowledge: Genetic Diversity,

Farmer experimentation a. Walter de Boef, Kojo Amanor and Kate Wellard, with Antony Bebbington

Schillinga J, Elise Remling. 2005. Local Adaptation and National Climate Change Policy in Kenya: Discrepancies, Options, and the Way Forward. Hamburg University, Germany

Sikinyi, E.O. 2010. Baseline study/survey report on the seed sector in Kenya. African Seed Trade Association.

UNDP. 2007. Sustainable development in Kenya: stocktaking in the run up to Rio+20

Wambugu P.W., Muthamia, Z.K. and Mungai P. 2006. Proceedings of a National Stakeholders Workshop on Strengthening of National Information Sharing Mechanism (NISM) on GPA Implementation in Kenya

Wambugu P.W. and Muthamia Z.K. 2009. The state of plant genetic resources for food and agriculture in Kenya. KARI

About this publication

Genetic Resources (GR) consist of all material that have genes of known or potential value for humans. The components include plants, animals, microbes and marine resources. They form the basis of food security and directly or indirectly support livelihoods of the human race in various ways. In recent years, greater attention has been made to address the strong nexus between climate change adaptation and biodiversity, focusing on genetic resources conservation, climate change adaptation/mitigation and improvement of agricultural productivity, environmental conservation.

Unfortunately, these genetic materials are on the decline due to various factors hence the need to urgently take appropriate steps to stem genetic loss. However, there exist barriers and gaps in policy and institutional frameworks governing conservation of genetic resources, especially under current threats posed by climate change and variability. These need to be addressed if the full potential of genetic resources is to be realised.

This National Strategy and Action Plan on genetic resources is an effort to define and address the barriers and gaps in conservation, demonstrate the link between genetic resource conservation and climate change adaptation and suggests pathways for integrating conservation aspects into climate change adaptation/ mitigation planning.

The strategy draws out key messages targeting decision makers and necessary to ensure effective conservation of genetic resources it documents the outcomes to be achieved in the short and long term upon its implementation. These outcomes include increased accessibility to and availability of genetic resources, increased support for genetic resources conservation and utilization, enhanced human, institutional and financial capacities for conservation and sustainable use of genetic resources and institutionalization and mainstreaming of genetic resources conservation into climate change strategies and action plans.

KALRO
Kenya Agricultural & Livestock Research Organization

Genetic Resources Research Institute (GeRRI)
P.O. Box 781 - 00902 Kikuyu, Kenya
Tel: 020 - 2025539
Email: director.grri@kalro.org
http://www.genetic.kalro.org

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