Management of Crop Diversity

KEY PRACTICES
for DRR Implementers

Humanitarian Aid
and Civil Protection

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Management of Crop Diversity: Key Practices for DRR Implementers

ISBN 978-92-5-108330-7 (print)
E-ISBN 978-92-5-108331-4 (PDF)

Author	Johannes Engels, Stefano Diulgheroff and Javier Sanz Alvarez
Series coordinators	Javier Sanz Alvarez and Erin O´Brien
Photographs	© FAO/Javier Sanz Alvarez
Design and layout	Handmade Communications, design@handmadecom.co.za

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This brief is part of the series, *A Field Guide for Disaster Risk Reduction in Southern Africa: Key Practices for DRR Implementers*, coordinated by the FAO Subregional Office for Disaster Risk Reduction/Management for Southern Africa. This series has been produced with contributions from COOPI, FAO, OCHA and UN-Habitat, and comprises the following technical briefs:

- Information and Knowledge Management (COOPI)
- Mobile Health Technology (COOPI)
- Safe Hospitals (COOPI)
- Disaster Risk Reduction for Food and Nutrition Security (FAO)
- Appropriate Seed Varieties for Small-scale Farmers (FAO)
- Appropriate Seed and Grain Storage Systems for Small-scale Farmers (FAO)
- Farmer Field Schools (FAO)
- Irrigation Techniques for Small-scale Farmers (FAO)
- Management of Crop Diversity (FAO)
- Community-based Early Warning Systems (OCHA and FAO)
- Disaster Risk Reduction Architecture (UN-Habitat)

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Foreword by ECHO

The southern Africa and Indian Ocean region is extremely vulnerable to cyclones, floods, droughts and tropical storms. These recurrent climate-related shocks negatively affect the highly sensitive livelihoods and economies in the region, and erode communities' ability to fully recover, leading to increased fragility and vulnerability to subsequent disasters. The nature and pattern of weather-related disasters is shifting, becoming unpredictable, and increasing in frequency, intensity and magnitude as a result of climate change. Vulnerability in the region is further compounded by prevailing negative socio-economic factors, such as high HIV rates, extreme poverty, growing insecurity and demographic growth and trends (including intra-regional migration and increasing urbanization).

The European Commission's Office for Humanitarian Affairs (ECHO) has actively engaged in the region through the Disaster Preparedness ECHO (DIPECHO) programme since 2009, supporting multi-sectorial disaster risk reduction interventions in food security and agriculture, infrastructure and adapted architecture, information and knowledge management, water, sanitation and hygiene, and health. This programme operates with two objectives, notably:

- Emergency preparedness by building local capacities for sustainable weather-hazard preparedness and management, including seasonal preparedness plans, training, emergency stocks and rescue equipment, as well as Early Warning Systems.
- Empowering communities through multi-sectorial and multi-level approaches with DRR mainstreamed as a central component and improved food and nutrition security as an outcome.

This is done in alignment with national and regional strategies and frameworks.

For DIPECHO, one of the main measures of success is replicability. To this end, technical support through guidelines established for DRR implementers is a welcome output of the DIPECHO interventions in the region. ECHO has supported regional partners, namely COOPI, FAO, UN-Habitat and UN-OCHA, to enhance the resilience of vulnerable populations in southern Africa by providing the funding to field-test and establish good practices, and to develop a toolkit for their replication in southern Africa. It is the aim of the European Commission Office for Humanitarian Affairs and its partners to fulfil the two objectives sustainably and efficiently through the practices contained in this toolkit to ensure the increased resilience of the most vulnerable populations in the region.

Cees Wittebrood
Head of Unit, East, West and Southern Africa
Directorate-General for ECHO
European Commission

Foreword by FAO

The southern Africa region is vulnerable to a diverse array of hazards, largely linked to environmental causes (such as drought, cyclones and floods); human, animal and plant diseases and pests; economic shocks; and in some areas socio-political unrest and insecurity, among others. The region's risk profile is evolving, with new factors becoming gradually more prominent, including a trend towards increased urbanization, migration and mobility, among others. Natural hazards will be progressively more influenced by trends in climate change. Disasters in the region are often composite and recurrent, and have a dramatic impact on livelihoods and on southern African countries' economy and environment, often undermining growth and hard-won development gains.

Increasing the resilience of livelihoods to threats and crises constitutes one of the Strategic Objectives of FAO's Strategic Framework (Strategic Objective 5, or SO5). FAO specifically aims at building resilience as it relates to agriculture and food and nutrition security, which are among the sectors most severely affected by natural hazards. The impact of shocks and disasters can be mitigated and recovery can be greatly facilitated if appropriate agricultural practices are put in place; improving the capacity of communities, local authorities and other stakeholders is therefore central to resilience building.

Together with partners, FAO is undertaking intensive work in southern Africa to consolidate the resilience of hazard-prone communities; this is leading to an improved knowledge base and to documentation of good practices. This toolkit purports to disseminate improved methods and technologies on key aspects of agriculture, such as appropriate seed varieties, irrigation, storage systems, land and water use and Farmer Field Schools, in the hope that they may serve different stakeholders to improve their resilience-building efforts. A multi-sectoral approach and solid partnerships are seen as key to the success of resilience-building work. For this reason, this toolkit also includes non-agricultural aspects of good resilience practices, contributed by FAO partners: the UN-OCHA, UN-HABITAT and COOPI, which certainly strengthen this collection.

David Phiri
Sub-Regional Coordinator
FAO Sub-regional Office for Southern Africa
Harare

Mario Samaja
Senior Coordinator
FAO Sub-regional Office for DRR Southern Africa
Johannesburg

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Acronyms and Abbreviations

CSB ..... integrated community seed/gene bank

DRR/M ..... disaster risk reduction/management

FAO ..... Food and Agriculture Organization of the United Nations

NGO ..... non-governmental organization level)

NUS ..... neglected and underutilized species or crops

PGRFA ..... plant genetic resources for food and agriculture

SADC ..... the Southern African Development Community

SSSA ..... Seed System Security Assessment

1. Introduction

Crop diversity, also referred to as plant genetic resources for food and agriculture (PGRFA), embraces the diversity within and among crops, their wild relatives and wild edible plant species. This diversity has evolved over thousands of years in a dynamic interaction between nature and humans, as part of their agricultural activities. It provides the biological foundation for food production and food security and contributes to economic development (Second Global Plan of Action, FAO, 2011). The conservation and management of agricultural crop diversity is a key issue in the struggle to achieve food security both locally and globally. However, despite the importance of PGRFA, these resources are seriously threatened by a number of factors, including land-use intensification, demographic pressure, structural changes in the agricultural sector, invasive species, climate change, replacement of traditional crops and varieties. Also, natural and human-made disasters can have a significant impact on crop diversity, particularly on local and traditional crops that depend on farmers and communities for their management.

In recognition of these threats to crop diversity, and of its related economic, food security and cultural implications, the need to conserve these genetic resources and encourage their sustainable use are issues that have come to the fore over the past 50 years.[1] A number of international conventions and agreements have been established to this effect, through which countries have recognized the need to establish conservation strategies to develop inventories and to provide for policies that regulate the exchange of these resources. Yet, this crop diversity remains under severe threat. An example is the continuous and widespread loss of landraces, defined

1 To counterbalance the drastic replacement of landraces by so-called high-yielding varieties, the collecting of these threatened resources was coordinated worldwide in the 1970s and 1980s by the International Board for Plant Genetic Resources (IBPGR). The International Treaty for Plant Genetic Resources for Food and Agriculture (established in 2006) provides the legal framework, and the Second Global Plan of Action for PGRFA (adopted in 2011) a set of priorities to conserve, exchange and sustainably use these PGRFA.

as traditional, locally adapted crop varieties with historical origin and cultural significance and containing high genetic diversity.

Within traditional agricultural production systems, farmers use a wide crop diversity, which act as 'sustainability insurance' to meet their food and income needs and preferences in a variable – and sometimes unpredictable – socio-economic context. Through on-farm management of crop diversity, there is a continued adaptive evolution of this diversity to changing conditions that can be extremely useful in present and future crop improvement programmes. The results of this evolution can serve as building blocks for farmers and breeders to develop new plant varieties. In addition to the diversity of crops and varieties themselves, the related traditional knowledge on how to grow, use and maintain them is of extreme importance and needs to be conserved as well. Consequently, it is very important to pay due respect to the existing social and cultural systems and structures, especially at the family and community level, when intervening at the production level.

Although modern production systems are more specialized using typically more uniform commercial varieties, and are generally more productive, they often require the use of external inputs (seeds, fertilisers, pesticides, etc.), which may not be available or accessible to small-scale farmers. Traditional varieties, often used in mixtures, on the other hand, may have a lower yield potential, but they are usually more stable in constrained conditions (e.g. water stresses), and generally require limited or no inputs. This keeps farmers independent to a large extent from the local or national agricultural supply chains.

Objective of this technical brief

This technical brief explores the management of crop diversity by small-scale farmers in southern Africa. Its objective is to guide DRR practitioners through some basic principles to plan and implement agriculture and food security interventions that make farmers more resilient to natural hazards by including aspects of management of crop diversity. Special attention is given to activities that help farmers strengthen the sustainable use of this crop diversity. For example, the production and management of seed and planting material is a good example of how farmers manage the genetic diversity of the crops and varieties they use as part of their agricultural production system.

In recognition of the fact that a combination of traditional and modern varieties often occurs on the same farm, both the formal and informal seed systems and their potential role in facilitating the management and conservation or crop diversity are addressed in the document. Finally, it also integrates the potential for economic development that can result from the improved management of crop diversity.

This technical brief can be of particular use to the following users:

- DRR/M practitioners who support farmers and farmers' organizations with traditional (often subsistence) farming systems to cope with shortages or lack of adequate seed or planting material, and to enable and facilitate the farmers to continue to rely on crop and varietal diversity for their food security.

- Extension services to gain information on how farmers and farming communities can maintain diversity and benefit from its sustainable use; and to create awareness about the importance of crop diversity in (traditional) agriculture to cope with disasters.
- Policy decision-makers to provide them with explanations to support the maintenance and management of crop diversity in the production systems as well as in gene banks, and to justify these practices as a sustainable and wise investment in order to improve food security and livelihoods of hazard-prone rural people.
- Plant genetic conservation programmes with an interest in strengthening their on-farm and *in-situ* conservation approaches, especially those that have yet to collaborate directly with farmers and farming communities in this regard.

What is crop diversity?

Crop diversity (PGRFA) refers to crops and varieties that farmers cultivate and use as part of their subsistence. They consist of local farmers' varieties (landraces), modern varieties of traditional crops bred by commercial seed companies, introduced crops (like maize and cassava), as well as the crop wild relatives, weedy forms of crops and wild species used by communities for food and agriculture.

Figure 1: Harvest of Moringa leaves (*Moringa oleifera*) for household consumption

Appropriate conservation (both *ex situ* and *in situ)* implemented in a complementary manner, is fundamental to safeguard this rich biodiversity and to avoid the extinction of these crops and varieties.

- *Ex-situ* conservation consists of collecting representative samples of seed and planting material from different sources including farmers' fields, adequately preparing these samples, and conserving them in collections under conditions that ensure their viability after long periods and their prompt access by users. Thus, *ex-situ* conservation is done in facilities away from where these crops and varieties are being cultivated or, in the case of their wild relatives, grow naturally. Gene banks are facilities where the collected genetic resources are stored as dried seeds, maintained in fields, or preserved as tissues in laboratories with the objective of conservation. Most countries have established gene banks at the national level to cater for the entire country; however, more recently, gene and seed banks have also been created at the community level.
- *In-situ* conservation is the process of ensuring that original populations of targeted species are maintained in the farmers' fields where they are being cultivated (also known as on-farm conservation) or, in the case of wild species, in the natural habitats where they obtained their characteristics. Arrangements can be made with farmers to maintain the traditional resources in their fields or with curators to manage them actively in natural habitats. Besides the continuous use of traditional crops and varieties, involving farmers in crop improvement and plant breeding is a 'natural way' of actively contributing to the management and maintenance of crop diversity within the production system.

Why is crop diversity important?

In most southern African countries, farmers rely on different combinations of a few major (staple) crops grown on relatively large areas by most households (e.g. white and yellow maize, white sorghum, millet, cassava and groundnuts) and a large number of crops grown on small areas (e.g. pumpkin, peas, beans, vegetables, tobacco, potatoes). Within this system, increasing the diversity of varieties of a given crop in a farmer's field improves the chances that the crop will cope better with insects, diseases or environmental stresses such as drought, heat or floods. The different characteristics of the diverse varieties can potentially reduce the losses as a result of these hazards, whereas when only one plant variety is grown, the vulnerability of the crop to the hazards becomes higher. The expected climatic and environmental changes will place unprecedented stress on agricultural systems and, as a result, the most diverse cropping systems, (i.e. those with the widest genetic diversity) are likely to be the most adaptable.

An adequate range of crop and varietal diversity allows farmers to undertake practices that protect them against different hazards and risks, and provide them with a kind of insurance against the unknown, as such farmers and farming systems become more resilient to natural hazards. For instance, with crop and varietal diversity, farmers can:

- stagger their planting and harvest to avoid peak hazard periods or to recover from a hazard;
- ensure consistent availability and a wider variety of food;
- spread labour requirements in the field; and
- adapt to new environmental situations, the market system and/or evolving local needs.

Neglected and underutilized species (NUS) share important characteristics. NUS are:

- represented by wild species, ecotypes and landraces;
- highly adapted to agro-ecological niches and marginal areas;
- cultivated and utilized based on indigenous knowledge;
- important in local consumption and production systems;
- under-represented in *ex-situ* gene banks;
- characterized by fragile or non-existent seed supply systems; and
- overlooked by policy-makers and research and development agendas, and scientific information and knowledge about NUS are scant.

Figure 2: Some examples of underutilized species in Southern Africa. Left, Sesame seedlings (*Sesamum indicum*); centre, Paracress (*Acmella oleracea*); and right, Bambara nut (*Vigna subterranea*)

Figure 3: Farmer with cassava cuttings used for planting

The conservation and management of plant genetic resources in the form of traditional as well as modern varieties and their availability to and use in agricultural production systems is the axis of food production.

In traditional production systems, an important group of species, is made up by the so-called neglected and underutilized species or crops, i.e. neglected by research and governmental support and underutilized in terms of their economic, nutritional or agronomic potential in sustainable agriculture. These crops often play an important role in the agricultural, socio-economic and cultural practices of many communities. Wild but edible species such as indigenous plants or fruit trees, whether cultivated or harvested in the wild, represent yet another group of species that contribute to food and nutrition security in areas practising subsistence farming. These species can also be relevant sources of income in times of crisis, and efforts should be made, where possible, to domesticate, cultivate, improve and commercialize these neglected but valuable resources.

Ensuring farmers' access to agricultural crop diversity: formal and informal seed systems

Ensuring farmers' access to appropriate seed and planting material is one of the key issues in the management of crop diversity in the production system. Farmers have formal (commercial) and informal (community-based) avenues to access seed and planting material,

that frequently exist parallel to each other. Better collaboration and links between these two sourcing channels, leading to an integrated seed sector, can be very helpful for farmers to benefit from the many complementary aspects of both formal and informal sectors. Interaction among these sectors offers different opportunities to farmers, increases the flow of diversity as well as the access to modern varieties, and promotes the use and preservation of these genetic resources.

Indeed, in most southern African countries a composite seed sector reflects the reality at field level, as farmers normally source their seed through different systems depending on the crop:

(international) commercial seed for vegetables; national commercial seed (from international or public research) for maize; local semi-commercial sources for groundnut seed; and farm-saved seed for mainly home-consumed crops like sorghum, millet, beans, cowpeas and many more traditional crops. Therefore, seed sector development needs to take into consideration the crop-specific and socio-economic reality and be approached accordingly, with public, private, community-based or NGO stakeholders assuming specific responsibilities in the different seed value chains (Louwaars & de Boef, 2012).

The formal seed system is characterized by the commercial production of seeds of modern crop varieties that are highly homogeneous and, under conducive and stable conditions, can give farmers yield increases when compared to landraces. This system often is the result of collaborative efforts between the public and private sector, and supported by governments through research, variety protection, testing and certification schemes. Small-scale farmers in southern Africa have often little access to commercial seeds. Most frequently this is because they cannot afford to buy commercial seeds or other inputs (e.g. fertilizers) that these improved varieties require to reach their full yield potential. In some cases, farmers' physical isolation (living in remote areas) and poor agrodealer networks further limit farmers' access to commercial seed.

The informal seed system refers to a system at household and community level. It is typically operated by farmers themselves and/or supporting partners and is geared towards ensuring access to seed

and planting materials. The informal seed system – often the only source of seed for small-scale farmers – is embedded in the local crop production; a farmer usually reserves a part of the harvest to be used as seed for the next season, and often exchanges or sells a proportion of it with/to other farmers. This way, farmers produce grain and seed while at the same time they maintain crop genetic diversity in the production system. Thus, they are key players in the management of agricultural crop diversity, as they possess the knowledge to cultivate and use traditional crops in the form of landraces or local varieties, which are usually well-adapted to the local conditions.

Notwithstanding the important role that local farmers' seed systems play in seed security as well as in sustainable access, availability and preservation of crop diversity, they seldom receive support for this from the government or public institutions. Increasing the farmers' role in the management of crop diversity through strengthening traditional informal seed systems can be a central mechanism for the sustainable production, marketing and acquisition of seed and planting material, which can contribute to development of more adapted and sustainable agriculture, as well as the reduction in the impact of natural disasters, allowing an early recovery after the shock.

Although informal seed systems have very tangible benefits, they also have considerable limitations: seed may be available for only a few crops and varieties; they are often of substandard quality (i.e. poor or irregular viability and reduced physical and varietal purity) leading to weaker yields over time; and, overall, informal seed systems tend to limit innovation.

Linking the formal and the informal systems: the integrated seed system

The integrated seed system would significantly help small-scale farmers access more varied crops and varieties, improve the quality of the seed, inject more genetic diversity or new varieties into the agricultural sector at community level, and increase productivity sustainably.

The informal seed sector permits the conservation of varieties that often have varied and unique characteristics adapted to the local agro-ecology, require fewer inputs than commercial varieties and can prove more durable in times of climate stresses (floods, drought, pests, etc.). Further, it preserves the knowledge honed over time to use these varieties. At the same time, the formal system has much to offer to local systems in terms of improvements in technology and genetic diversity. Good quality seed is essential, and the transfer of technology in improved commercial seeds is key for increasing productivity and production. This is regarded as being of fundamental importance to disaster risk reduction, with newly released improved varieties such as short-cycle, drought-resistant or disease-resistant varieties playing an important role.

Establishing effective links between the formal and informal systems appears challenging, but there are opportunities, such as the promotion of smallholder seed enterprises, the establishment of community seed banks or local gene banks, the promotion of seed fairs or an increased role of small farmers in crop improvement.








Figure 4: Main crops cultivated in southern Africa, from top to bottom and left to right; Sorghum (*Sorghum bicolor*), Pearl millet (*Pennisetum glaucum*), Sweet potato (*Ipomoea batatas*), Rice (*Oryza sativa*), Cassava (*Manihot esculenta*), Maize (*Zea Mays*), Cabbage (*Brassica oleracea*) and Amaranth (*Amaranthus* sp.)








Figure 5: From top to bottom and left to right; Pigeon pea (*Cajanus cajan*), Yam (*Dioscorea* sp.), Taro (*Colocasia esculenta*), Groundnut (*Arachis hypogaea*), Soya bean (*Glycine max*), Cowpea (*Vigna unguiculata*) and Okra (*Abelmoschus esculentus*)

KEY PRINCIPLES FOR THE MANAGEMENT OF CROP DIVERSITY

- Respect farmers' culture and traditions, their traditional crops and common varieties, cultivation practices, food traditions and capacities when implementing measures to strengthen their capacities to cope with threats to their resource base.
- Involve farmers from the planning phase onwards in activities related to increasing the resilience and robustness related to the management of crop diversity.
- Understand the local seed system, including traditional uses, identifying the points that need attention, i.e. testing seed quality, lengths of storage and main storage pests.
- For sustainability of the activities, processes and procedures make sure that the farmers and the farming communities are in full agreement and accept the specified responsibilities. It also should be made clear that these activities are of a long-term nature and will not produce 'instant' benefits. They are like an insurance against food insecurity.
- Governments' inputs and participation are required for setting up comprehensive and sustainable arrangements and to ensure an adequate flow of material and information between the various stakeholders involved.
- A national approach/programme to reinforce the crop genetic resources base is necessary. This includes raising public awareness on the importance of crop diversity for sustainable production; inventories and assessments of the existing resources; traditional knowledge; identification of the most suitable approaches and solutions for the conservation of traditional plant genetic resources; and a close collaboration between the national and community conservation levels.

2. Key Activities for the Conservation of Crop Diversity at Community Level

It is neither efficient nor cost effective to store all relevant crop-genetic diversity in *ex-situ* conservation facilities (gene banks); therefore management of genetic diversity needs to be also enhanced in natural and protected ecosystems (*in situ*) and on-farm. The concept of a more dynamic maintenance of traditional and well-adapted crop diversity in local production systems has fostered a link between resource management and rural development. In southern Africa, where local genetic resources are highly threatened, it is very important to link these concepts of management and development, particularly in areas that harbour valuable crop diversity in the form of minor crops, NUS, crops grown in association with their wild relatives, as well as areas where agriculture is changing rapidly.

On-farm management of plant-genetic resources aims to maintain sufficient and relevant crop diversity in the local production systems as a basis for sustainable development. A range of activities such as crop development, seed supply, seed marketing, farmer training and awareness-raising contribute to this twofold objective of management of agro-biodiversity, through the continued cultivation of existing and possibly newly introduced plants, as well as community development.

Raising awareness on the importance of crop and variety diversity

Traditional production systems have evolved over centuries to form a unique culture based on the close connection between traditional crops and the related knowledge for their cultivation and use. Farmers and farmers' communities play a key role in the maintenance of traditional crops and crop varieties, through their continued cultivation, contributing to the conservation of this crop diversity that is fundamental to a sustainable and balanced agriculture.

It is important to raise awareness about the importance of crop diversity as an essential part of small-scale farmers' production systems, using media such as the press, radio or TV to communicate to the broader public, but also through activities, such as field days among farming communities. Relevant topics and means to increase public awareness include:

- Promotion of traditional cuisine to increase knowledge about the nutritional value of traditional crops and varieties (baby food, health food, snacks, etc).
- Promotion of the importance of NUS as well as minor, semi-cultivated and wild species as nutritional sources with valuable genetic diversity and potential for development.
- Recognition of farmers' efforts to maintain traditional crop and variety diversity at various levels. Close collaboration with extension services and the national PGRFA programme is imperative for the success of these activities.
- Organization of 'open village/local community days' as platforms for discussion, knowledge sharing and awareness-raising on crop diversity, its management, the establishment and management of community gene banks, food security, etc. Gathering farmers from neighbouring villages to visit the facilities or to observe demonstration plots as part of community-initiated activities can also be very helpful.
- Establishment of home gardens which are especially convenient for growing vegetables and spices, and are a potential repository of valuable local agricultural biodiversity.
- Development of school gardens as an important means to teach children how to cultivate (traditional) food crops, as well as raising awareness of their nutritional and cultural importance. School gardens will thus contribute to the conservation of traditional knowledge and can also serve as demonstration sites for those interested in home gardens.

Conducting crop diversity inventories

One of the essential steps in the conservation of crop diversity is to conduct inventories of existing crops and varieties, and knowledge appraisals at the community level. Agrobiodiversity inventories are fundamental reference points to monitor the loss of genetic resources, also called genetic erosion. These inventories identify the species and varieties that occur in a given area, describe them, and note their distribution and uses; traditional and scientific knowledge held in the community about these resources can be documented in a complementary Community Biodiversity Register. These registers are created with the community's help to document and conserve both the biodiversity that is being used within the area of the community and the relevant knowledge about it. Registers have sometimes been established with the intention of protecting a community's 'ownership and property rights' over the genetic material.

Like the registers, inventories can be established collaboratively, using participatory approaches such as group discussions, resource mapping, transect-walking tours, etc. These approaches can help build a community's awareness about the richness and significance of the crop diversity at their disposal; this understanding can in turn encourage community members to support the inventories and help keep them up-to-date.

Improving access to quality seed and planting material of traditional crops and varieties

Improving access to seed and planting material at the farming community level is central to the development and maintenance of a more sustainable and productive agricultural sector. The predominant channel for small-scale farmers to access seed and planting materials of traditional crops and varieties is through informal, intra-village seed exchange amongst themselves. These traditional community seed-exchange mechanisms are vital for healthy agricultural production and for the conservation of crop diversity, and can be strengthened by the activities elaborated below.

Training small-scale farmers on the production of seed and planting material: technical advice and assistance to farmers to improve their local practices for the on-farm production of quality seed and planting material is a very important step to ensure their seed security for the next growing season. It also reduces their dependence on external, commercial seed.

Traditional crops consist of well-adapted local farmers' varieties that sometimes involve many different plant types – it is this diversity that enables such varieties to cope with change. Farmers can be trained to maintain this diversity, by teaching them how to identify plants that best represent the original variety, and how to select healthy and vigorous individual plants that will be used for seed production, in order to get the best quality seed. Increasing

farmers' capacities for on-farm seed production of traditional crops and crop varieties will therefore have a positive impact in the preservation of crop diversity.

The promotion of smallholder seed enterprises: farmers that specialize in producing high quality seed, which is either sold or exchanged for grain within the community, will be able to develop a profitable economic activity, while strengthening the local seed system. The quality of the seed can be improved through quality control by the communities, undertaking trials to compare local versus new varieties, field days and capacity building for enterprise management. Trials, field days and well-managed enterprises can present interesting possibilities for collaboration between the formal and informal seed systems.

Introduction of quality seed: the introduction of quality seed of traditional varieties can help to maintain genetic diversity and reduce risks of genetic erosion of underutilised crops and crop varieties, and refresh the genetic base. The introduction of commercial or improved varieties can also help to increase the yield at community level or to introduce varieties that are less affected by pests or disruptive situations, such as floods or droughts. The brief *Appropriate Seed Varieties for Small-scale Farmers* in this same series gives detailed information on the considerations to be

Figure 6: Different varieties of Cassava (*Manihot esculenta*)

USE OF EDIBLE PLANTS COLLECTED FROM THE WILD

Another dimension of crop diversity in traditional agricultural production systems is the use for food of plants or plant parts harvested 'from the wild', in natural habitats. In southern Africa, edible plant products from the wild are an important coping strategy, providing food supply during times of severe food shortage.

Establishing inventories of these wild species, their characteristics, distribution and uses will be important steps to facilitate their sustainable use and make sure that the local knowledge about their uses is not lost. A useful step towards the recognition of the role that these nutritious wild plants can play in rural communities would be the establishment of local field collections that could function at the same time as demonstration plots to create awareness of these important resources amongst farmers and the need to protect them from overexploitation in the wild.

Figure 7: Some edible plants collected from the wild in Southern Africa. Left, wild grass (*Gramineae*) named 'Lole' in South Malawi and eaten in the lean period; centre, edible fruits of Cattley guava (*Psidium cattleianum*), an invasive bush in Madagascar and Comoros; and right, unidentified leafy wild plant.

taken when introducing a new variety. A thorough understanding of the local seed system is very important when aiming at effectively introducing quality seeds and seed of new varieties in a community. A strategy needs to be developed defining factors such as the type of seed/variety to diffuse, the volumes of seed to introduce, the price, the farmers to work with and possible follow-up procedures to assess the impact.

The distribution of small packages of seed with one or more varieties can be an efficient way to stimulate farmers' interest and variety diffusion. Demonstration plots with a range of planted varieties can be used to showcase forgotten traditional varieties or to introduce new adapted materials into local seed systems. Allowing farmers to take home seeds or planting material from these demonstration plots for further experimentation has proven to be particularly effective.

Seed fairs: a seed fair is an event where local seed producers and commercial seed sellers and traders come together to sell or exchange their seeds, preferably along with the associated knowledge. Seed fairs can be useful for the preparation of local inventories of crop diversity and provide an excellent opportunity to distribute new or old varieties or genetic diversity in general. Seed diversity competitions can help to raise local awareness of the richness and significance of local crop genetic diversity.

Seed fairs are most suitable for subsistence grain crops and in situations where access to seed is a major problem. For example, in emergency situations, seed fairs are frequently combined with the distribution of seed vouchers to affected farmers who cannot afford to pay for seeds. However, seed quality, considering biological, physical and genetic properties, is a main concern and needs to be carefully monitored in seed fairs.

The establishment of community seed banks (CSB) or local gene banks: small-scale farmers usually do not have access to national or provincial gene banks. To overcome this gap, the establishment of community seed or gene banks (CSB) and communal seed-store facilities used for the conservation of local germplasm collections at local level, can contribute in the following ways:

- Improve the local access to quality seed and planting material of traditional crops and varieties. This can lead to improved access, availability and use of local varieties in particular, a revival and re-invigoration of local cultivation practices, diversification of production and consumption, and the generation of income (Vernooy, 2013).
- Safely conserve local crop diversity in the production system. CSBs contribute to safeguarding, maintaining, restoring, sharing, improving and increasing crop diversity close to the fields where these plants are grown.
- Safely store seed reserves that can be used in cases of crop failure or for the distribution/introduction of new varieties of seed. CSBs can be used as a better option to individual household storage, and can also serve as a timely source of seed in emergencies. This is particularly important in hazard-prone areas, where farmers may lose their seed reserves as a result of floods or cyclones.
- Facilitate the reintroduction of lost or threatened crops and varieties.
- Create opportunities to exchange knowledge and diversity among farmers, and serve as a potential platform for crop improvement and variety selection. CSBs can also create awareness and build community capacities in management and preservation in a local *ex-situ* situation. The cooperation and

effective flow of genetic materials between the national gene banks and the CSBs is of key importance, especially in flood- or cyclone-prone areas where local gene banks and germplasm collections can be lost and national institutions can provide safety duplicates of material for its re-introduction.

Strong outside support to farming communities is needed to establish and manage CSBs. Local CSB management committees must receive capacity building in order for them to run the facility properly and take important decisions, such as the management of a replenishment or revolving fund (i.e. a fund established with external assistance and, as financial resources or seed are withdrawn, needs to be replenished within an agreed time period by those making the withdrawal), the introduction of new genetic material (including through participatory plant breeding activities), or the production of quality declared seed.

Key aspects in the management of a CSB include maintaining an inventory, monitoring, development of a regeneration strategy, and development and implementation of multiplication protocols or coordination of the seed distributions to farmers. Farmers involved in a CSB should be trained on the importance of germplasm and its management, the value of indigenous knowledge and practices, the community's rights, the seed multiplication procedures (including seed selection, drying and storage techniques), the gender dynamics in agricultural biodiversity conservation, etc.

In Ethiopia, for example, a CSB is responsible for the management of strategic seed reserves. Such reserves were established by collecting indigenous landraces and subsequent storage at a community seed bank. In this way, a sustained supply of adapted seeds was ensured and channelled through the informal market system, thus averting the potential loss of genetic diversity.

Participatory variety selection and breeding efforts

Aside from managing and exchanging seed and planting material, farmers can also participate in improving traditional varieties. Participatory approaches to variety selection of preferred types and plant breeding, including crossing of plant types or even varieties, can be used to ensure farmer engagement. Although these participatory initiatives should be supported by researchers and plant breeding institutions, farmers hold vast traditional knowledge of great significance to the improvement of traditional varieties, as well as in the production of modern varieties. Farmers can also contribute to establishing research priorities.

Crop improvement approaches at the farming community level may allow farmers to accelerate the selection of varieties that are adapted to their local conditions, and to be better adapted to marginal and heterogeneous conditions, such as those perpetuated by natural hazards. Furthermore, through the characterization and

even evaluation of local crop genetic resources, whenever possible in farmers' fields and by involving plant breeders, a more effective use of local diversity in breeding can be achieved. The insertion of breeding materials into the local system is a common strategy for participatory crop improvement; it can also build farmers' ability to select quality seed by increasing the range of diversity from which they can select (De Boef & Ogliari, 2008). Because participatory crop improvement approaches will help farmers to improve their crops, to produce quality seed and to better manage their seed and planting material from one season to the next, it may eventually lead to commercial production of seed from local crops and varieties, therefore helping to maintain the diversity in the local production systems.

The interaction and collaboration between farmers and researchers can be strengthened through a number of interactive agricultural extension approaches to train farmers on crop diversity issues related to crop improvement. The inclusion of farmers in on-farm and local breeding efforts can be done through Farmer Field Schools and farmer-to-farmer programmes (for more information, see the *Farmer Field Schools* brief in the present series). To ensure the sustainability of these efforts, government, extension and NGO staff working together with farming communities should also be sensitized and trained through specialized courses on topics such as community conservation and management of traditional and modern crop genetic resources. Further, they should also participate in training on the management of any facilities established, so that they can monitor and support the application of core principles in the long term.

Linking local and national gene banks to facilitate germplasm flow is critically important to promote community level crop diversity conservation initiatives. It also improves the protection of these resources through establishing a back-up at national level, which is very important in flood- or cyclone-prone areas. In general, national gene banks are in a better position to:

- coordinate conservation activities;
- assist local conservation efforts among others through the longer-term conservation of local germplasm;
- provide training, advice and assistance to local conservation initiatives;
- provide a conduit for germplasm from other countries; and
- promote the diversification of crop production and broadening crop diversity as well as the genetic base of crops for a more sustainable agriculture.

These capacities make the link between local and national conservation initiatives all the more important and attractive.

3. Integrating Crop Diversity Considerations into Seed Relief Operations

While seed system interventions in response to emergencies can include direct seed distribution, seed vouchers, seed fairs, etc., the most common approach to seed relief is the direct distribution of seed from locally grown crops which have been purchased from the formal sector in the same or similar agro-ecological regions of the country. However, the informal seed sector can also provide a dynamic, flexible and accessible system of seed supply, usage, handling, trade and exchange in response to a crisis, playing a central role in supplying seed required for distribution. However, because of the limited recognition afforded to informal seed supply systems and locally adapted varieties, farmers may be discouraged from strengthening their local seed supply.

When rural communities have lost their harvest due to a natural disaster, it is very important to re-establish their productive capacity

as soon as possible, taking into consideration that a second lost harvest may have a severe impact on food security, creating the need for a longer-term humanitarian response. In addition, during natural hazards such as floods and cyclones, important quantities of quality seeds from community reserves, private seed suppliers or public breeders, can be lost. Thus, seed distribution will play a critical role to facilitate an early recovery. In this context, seed relief interventions by definition imply a stringent response timeframe to rapidly assist people in need; as a result, these responses are often done with little knowledge of the local seed systems and the genetic resources therein. As seed relief can have a significant impact on the informal seed systems and local agricultural diversity, it is important that such relief actions are aligned with the national PGRFA strategy and follow national policies.

Seed relief interventions can be unsuccessful or even harmful if they distribute varieties that are not well adapted to the local conditions of the distribution area, including specific cultivation conditions, as well as the local preferences. Before taking any relief action, it is important to be fully aware that wrong decisions can damage local seed systems and even contribute to the loss of local valuable crop diversity. This can be particularly important in protracted emergencies with sustained humanitarian support. Consequently, when formulating DRR programmes, or when preparing humanitarian responses, it is of critical importance to involve the farmers and farming communities, to make them part of the decision-making process, to assign clear responsibilities to individual or collective farmers and groups of farmers, to respect and build on their traditions and to create awareness of the important role

that crop diversity, as well as their own knowledge play in creating better agricultural systems for the future.

Seed relief should gradually evolve towards seed development orientated programmes, where the relief will act as a catalyst to stimulate agricultural recovery and local enterprise development. At the same time, governments and research organizations may use seed relief programmes to introduce new technologies and varieties into disaster affected areas. There are several guidelines available to help donor agencies, government ministries, NGOs and individuals charged with agricultural relief and recovery assess farmers' seed system security (for example see FAO, 2010; Sperling, 2008).

Seed System Security Assessment (SSSA)

Seed System Security Assessment (SSSA) developed by Sperling et al. (2008), is a specialized assessment methodology for seed systems at the local level. This tool can be useful to plan seed-related assistance in emergency situations, promote strategic approaches to seed relief, recovery and develop planning. SSSA aims to strengthen and integrate the different seed systems (formal and informal) on which farmers rely, by assessing quality seed availability and access, the impact of crisis on seed systems and specific features that foster or undermine resilience. Some of the elements of SSSA that can help to enhance seed system resilience (McGuire & Sperling, 2013) are:

- Identifying germplasm suitable to different scenarios, which can be revitalized quickly and which are available through 'crop/seed systems in reserve'.
- Enhancing availability of this germplasm by broadening initial formal and informal seed supplies and multiplication possibilities.
- Securing access to diverse seed through multiple channels, including local markets, and planning to encourage access by more vulnerable groups in particular.
- Fostering information systems that strengthen capacity for tailored responses at different levels, including at the farmers' level.
- Enabling systems to evolve to capture new repertoires and capitalize on opportunities. Link seed systems to dynamic elements, particularly those that open up commercial opportunities such as new markets, or those which might cross geographic boundaries.

SSSA cases developed in Zimbabwe, South Sudan and eastern Kenya, have shown that informal seed systems prove to be relatively resilient to crises, at least in terms of meeting farmers' planting needs for the upcoming season. While informal seed systems are fairly resilient to crisis, formal seed systems should play a more catalytic and supportive role through local markets and their traders with a clear focus on resilience response.

SOME GENERAL CONSIDERATIONS ON EFFECTIVE AND SUSTAINABLE SEED RELIEF ACTIVITIES ARE:

- Seed relief interventions must be based on an understanding of seed systems and the dimensions of seed availability, seed access and seed quality.
- The seed fair and vouchers approach should build on local systems, facilitate farmers' choices and benefit farmers and traders, including women. It can also stimulate the local economy in the longer term. Some issues that merit further examination involve scaling-up, institutionalization, seed quality and cost effectiveness.
- Where seed-related needs are apparent, they may reflect poverty rather than a shortage of seed per se. It is therefore necessary to look at seed relief within the broader context of food and livelihood security.
- Local markets have a crucial importance as a source of seed for farmers, especially in difficult times. Analysis of market functioning should be a key component of needs assessments. Interventions should seek to strengthen such markets and not undermine them.
- Appropriate seed-based interventions can have impacts beyond seed delivery, including strengthening of the local seed system; stimulating entrepreneurial activity; empowering farmers, traders and rural communities, including women; and making use of and maintaining agricultural biodiversity. Effective seed relief activities should build on the coping capacities of communities and avoid creating dependency on repeated input-based relief.
- A specific needs assessment should be undertaken in relation to seeds; seed needs cannot be simply extrapolated from food aid needs, as is current practice. Instead, there needs to be a diagnosis of the problem and an analysis of the causes.
- The choice of intervention should be based on the assessed needs and local context. There are a number of possible seed-related interventions, including food aid to protect seed, direct seed distribution, provision of vouchers or cash to farmers, seed fairs, local seed production, support to local grain traders and markets, access to or development of better varieties, and improving farmers' seed quality.
- Seed relief interventions should take into consideration that capacity to implement these options is limited, and these restricted capacities and other implementation constraints need to be addressed in the interventions. More attention needs to be given to the institutionalization of approaches and to capacity building at local and national levels.
- Beneficiary targeting of seed relief interventions need to be improved. Activities should be designed to address explicitly the needs of women.

Source: FAO, 2004

4. Support Required for Seed Policies

At present, most policies and regulations devised by governments in southern Africa primarily target the functioning of the formal seed system, with a focus on plant breeding, quality testing and phytosanitary control programmes limited to commercially marketable crops (e.g. maize, wheat and soy beans). Little attention is given to informal seed systems, and to traditional crops and varieties. This can easily lead to a general discouragement among farmer groups to become involved in commercial seed supply and use of local crops and varieties.

Seed and variety regulation varies among countries, with different systems of seed quality control, variety registration and protection in place. Some countries have minimal or no regulations, whereas other countries have formulated very strict controls under which, officially, all varieties need to be approved and all seed has to be certified. Where they exist, most seed regulations currently allow farmers to freely use their own on-farm produced and saved seed, including that of varieties which are granted plant variety protection. This 'farmers' privilege' is, however, currently under pressure with

Figure 8: Common cash crops in southern Africa. Left to right: Tobacco (*Nicotiana tabacum*), Cocoa (*Theobroma cacao*) and cotton (*Gossypium* sp.)

the implementation of stricter variety protection systems, like the 1991 UPOV (Union for the Protection of New Varieties of Plants) regulation, or even further constraint when a patent protection of varieties is allowed.[2]

Through the Convention on Biological Diversity, countries are expected to pay due attention to the protection of traditional knowledge and implement intellectual property regulations. However, the policy framework for the conservation of local landraces, farmer varieties and crop diversity in general, is often insufficiently developed. Commercialization of farmer-produced seed may be restrained by requirements of seed quality control, as well as the commercialization of local varieties that are usually not registered.

The African Union, through the African Seed and Biotechnology Programme established in 2008, promotes the development of an integrated seed system to support both, the formal and informal systems. The Southern African Development Community (SADC) is in the process of implementing the Harmonized Seed Regulatory System that should ease the flow of seed between countries in the region through the use of a common seed variety catalogue as well as a harmonized seed certification scheme and phytosanitary standards. SADC-wide legal frameworks on seed should also include acts or legally binding clauses to defend seed security and farmers' rights to continue customary practices to save, use, exchange or sell farmers' varieties of seeds that contribute significantly to food security (Mulvany & Mpande, 2013).

Another aspect that also impacts on crop diversity conservation is the presence or absence of policies for the conservation of plant genetic resources at the community level. Whenever possible, local farmers should be invited to participate in consultation processes on such policies, among others, to avoid unforeseen and unwanted negative effects on crop diversity at the production level and on farmers' activities to manage their local genetic resources.

2 Under the UPOV 1991 Act, the 'farmers' privilege' has been put at the discretion of Contracting Parties and its scope has been narrowed down: farmers may re-use only seed and other propagating material planted on their own holdings for planting them on their own holdings. The non-commercial exchange of seeds 'over the fence' that is quite common among farmers in many regions is no longer permissible. In addition, governments granting a 'farmers' privilege' have to ensure that it applies 'within reasonable limits' (e.g. to limited size of holding/crop area/crop value) and that the legitimate interests of the breeder are safeguarded (e.g. through measures, such as reseeding fees). Moreover, the 'farmers' privilege' does usually not apply, if seeds or other propagating material are subject to patent protection.

5. Conclusion

The conservation and use of crop diversity are issues of utmost importance for the improvement and sustainability of small-scale agriculture in southern Africa – particularly in hazard-prone areas, where genetic resources are threatened by human-made as well as natural hazards. In all aspects of management of crop diversity, there is a need to integrate both the formal and the informal seed production systems, as the complementarities in these systems allow for improved practices and increased access to a wider range of species and varieties overall.

Facilitating effective links between the informal and formal seed systems is central to the conservation and sustainable use of crop diversity. Linking farmers with agrodealers, research institutions and government, is a 'win-win' situation, increasing farmers' access to a wider variety of seeds and planting materials that can help make them more resilient to shocks and hazards. Likewise, this link is beneficial to agrodealers and researchers who can learn from the natural adaptations of the local traditional varieties to the prevailing conditions to help them develop locally relevant, improved varieties.

Similarly, establishing community seed and gene banks with inventories and registries that document varieties, characteristics, uses and knowledge related to these resources is extremely useful for the conservation of crop diversity, and can increase farmers'

access to improved varieties or adaptations of local varieties. Furthermore, in a context of disaster risk reduction, resilience and possible emergency response, having these materials and the related knowledge documented and on hand can facilitate a timely response, avoid local seed market saturation and the introduction of inappropriate seeds or planting materials as a result of hurried planning and implementation.

Linking these community-based seed banks or gene banks to national conservation systems and facilities can help raise awareness at national level of the crop diversity that exist, where it is found, how it is used, and to what extent it is important to small-scale farmers' livelihoods. These linkages can also raise the profile of those crops, species and varieties that have been neglected, underused or side-lined in the formal system, generating more awareness and possible interest for research or extension programmes towards these critical resources. Raising the profile of these resources can also help them to be integrated positively in legal frameworks, policies and regulations under development, in so far as including intellectual property rights for communities that have developed these resources over time, while also protecting the informal sector from over-regulation, which would drastically impact the main sources of crop diversity that is available and accessible to the majority of small-scale farmers in southern Africa.

By providing practical planning and implementation considerations to DRR/M practitioners, this brief aims to shed light on technically sound and socially responsible options for seed and planting

material interventions. Central to the conservation of crop diversity in southern Africa, is limiting the losses experienced as a result of recurrent natural hazards by establishing the relevant integrated systems within farming communities in the long term. Training farmers to improve their traditional practices in seed multiplication/ production, selection and improving the facilities in which they store their PGRFA and the related systems is critical. Obtaining buy-in and support, as well as providing the relevant technical skills to supporting partners (NGOs, governments, private sector) can help the sustainability of crop diversity efforts in the long term.

Finally, in any aspect of a PGRFA intervention, local farmers must be involved, not only as beneficiaries, but as central stakeholders, throughout. Starting with the consultation phases in planning interventions, contingency plans, development programmes or policies to regulate crop diversity, farmers have a critical understanding and knowledge base, particularly on traditional local varieties and their manifold uses, honed through generations of farming. The importance of this knowledge and know-how cannot be overlooked when trying to preserve the integrity of 'informal' seed systems, PFRGA conservation practices, or when attempting to rejuvenate the genetic base of seed and planting material by integrating complementary 'formal' practices. Integration, in all levels of the management and conservation of crop diversity, will prolong the sustainability of the intervention, as well as that of the genetic resources overall.

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ISBN 978-92-5-108330-7

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I3767E/1/04.14