



ESTABLISHING A COMMUNITY SEED SUPPLY SYSTEM: COMMUNITY SEED BANK COMPLEXES IN AFRICA

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DIVERSITY: A KEY FACTOR FOR SUSTAINABLE PRODUCTIVITY

The pool of genetic variability within a species allows it to adapt to environmental changes. This has a special significance for the maintenance and enhancement of productivity in agricultural crops in a region such as Sub-Saharan Africa where the agro-climatic conditions are very varied resulting in diverse ecosystems for farmers to grow their crops. Such diversity provides security for the farmer against diseases, pests, drought and other stresses. It also allows farmers to exploit the full range of the region's highly varied micro environments differing in characteristics such as soil types, water availability, temperature, altitude, slope, and overall fertility.

Diversity among and within species is especially significant to Africa's farmers as it represents an important resource for farming communities to meet their subsistence needs. A wide variety of plant and animal species provides material for food, fibre, medicine, and other socioeconomic uses. Such diversity is crucial to sustain current production systems, improve peoples' diets and maintain life support systems essential for the livelihoods of local communities.

Maintenance of diversity both within and among species is, therefore, crucial to supporting and developing agriculture that is ecologically sustainable and helps local communities cope with the challenges of climate change. This is especially true for smallholder farmers practicing agriculture under low-input conditions on difficult, often degraded lands.

THE THREAT OF GENETIC EROSION

The broad range of genetic diversity existing in Africa, particularly in traditional and wild gene pools, is presently subject to serious genetic erosion and irreversible losses. This threat, which involves the interaction of several factors, is progressing at an alarming rate. The most crucial ones include displacement of indigenous

farmers' varieties (landraces)¹ by new, genetically uniform crop cultivars, changes in agricultural development strategies and systems and/or land use, destruction of habitats and ecosystems, and reduction in rainfall leading to drought.

The drought that prevails in many parts of the African continent has directly and indirectly caused considerable genetic erosion, and at times has even resulted in massive deaths among people, their domestic animals and plants. The famine that persisted in some parts of Ethiopia in the last two decades, for example, has forced farmers to eat their own seed to survive or to sell their seed as a food commodity. This has often resulted in massive displacement of native seed stock by exotic seeds provided by relief agencies in the form of food grains.

THE NEED FOR RESEARCH TO CONSERVE AND ENHANCE *IN SITU* DIVERSITY

In situ (on-site) conservation of farmers' varieties on smallholder farms is providing a valuable option for conserving crop diversity (Melaku Worede, 1991). More importantly, it helps sustain evolutionary systems that are responsible for the generation of genetic variability. This is especially significant in the many parts of Africa subject to drought and other stresses, because it is under such environmental extremes that variations useful for stress-resistance breeding are generated. In the case of diseases or pests, this allows for continuing host-parasite co-evolution.

Also under these conditions, access to a wide diversity in local seeds probably provides the only reliable source of planting material. The ability of such materials to survive under these stresses is conditioned by their inherent broad genetic base. This is often not the case with the more uniform, new or improved cultivars which, despite their high yield potential, are less stable and not as reliable as sources of seed under the adverse growing conditions generally present in many of the drought-prone regions of Africa.

¹ Farmers' varieties, often referred to as landraces, are crop populations that have been adapted through years of selection and innovation by farmers, their local communities and the environment to meet the conditions under which they are cultivated.

In these situations, establishment of species adapted to extreme environments in field gene banks, including semi-arid conditions, at strategic sites can provide a seed reserve for post-drought planting in places where traditional crops may have completely failed. Germplasm materials maintained in such fields could be distributed to rural farming communities, scientific institutions and others for further investigation of their potential use in plant breeding programs to improve food security.

Programmes for the evaluation and enhancement of farmers' varieties are certainly needed to stimulate the utilization of germplasm resources that are already adapted to these conditions. Also, under such extreme environments, locally adapted farmers' varieties can provide suitable base materials for institutional crop improvement programs in modern agricultural research organizations. There is, therefore, a pressing need to maintain farmers' varieties being grown under these dynamic conditions, and this is probably best achieved through farm and/or community-based conservation programs.

There are several programs in Africa that promote important community level seed activities, which have a tremendous experience and pool of expertise that should be drawn upon. The Seeds of Survival/International (SOS/I) programme initially developed in Ethiopia and supported by USC (Unitarian Service Community) Canada, for example, has done a significant amount of work in building the technical capacity of African farmers and researchers in on-farm conservation, enhancement of farmers' varieties and in community level seed production strategies. This programme still operates in countries of Eastern and Western Africa.

The Ethio-Organic Seed Action (EOSA) programme was developed from this earlier work. EOSA is an NGO promoting integrated conservation, use and management of agricultural biodiversity. With the guiding principle of "conservation through use", the programme works with community groups, government researchers, other NGOs and industry to promote greater integration, and especially the integration of producers with the market. The programme operates at local, regional and national levels and aims to help develop mechanisms to support the ability of smallholder

farmers' to manage their own resource-base through community-based seed networks, building linkages between farmers and industry through local markets and the promotion of organic agriculture. EOSA has been successful in promoting agricultural biodiversity conservation and increasing the diversity of durum wheat and other field crops in the programme areas (Anonymous, 2009).

EOSA has documented reliable experiences of effectively working on the conservation and improvement of local farmers' varieties, on community seed banking systems and seed multiplication that increase options for planting materials for farmers. It is necessary to further expand and promote such experiences through networking where a regional level of exchange of experience and expertise is possible.

LOCAL COMMUNITIES AND MAINTENANCE OF GENETIC RESOURCES

Farming communities have always implemented conservation methods known to the formal sector as *ex situ* (off-field) and *in situ* (in-field) conservation strategies. They have been preserving or conserving their local crop types and varieties in gardens, back yards, fields and in their traditional storage facilities. The farm household includes small stores (clay pots, gourds, underground pits, etc.) that represent a "de facto" *ex situ* conservation system that is probably more dynamic than the conventional one at a formal gene bank.

Traditional agro-ecosystems are sources of expertise for a sustainable, diversity-based agriculture. Many species little known to science or industrial technology are still being managed by local communities; these all together form a complex of dynamic communal gene bank systems. Endangered plant species as well as economically and ecologically useful crop types are usually included in the system as part of the community-managed environmental protection and species conservation schemes. Such species may include various wild trees, shrubs and grasses of traditional use to the communities as food, feed, medicine and sources of materials for fuel and construction.

Rural women are key members of the society in the strategy for farmer-based genetic resources conservation. They are traditionally involved in making seed selection, cleaning, storage and utilization. They are mainly responsible for the safe storage at the household level of planting materials desired for the next season.

Seed is planted in the fields, i.e. on the same farm or in neighbouring areas where it acquired its distinctive features; it is also frequently exchanged among farmers and communities to be planted across regions differing in agro-ecological conditions. This can account for the broad range of adaptability (plasticity) inherent in such material (Melaku Worede, 1988). In places like Ethiopia, individual and communal underground seed storage is also a common practice when there is a drought leading to a famine crisis. Threatened households and communities, by tradition, bury large quantities of seed before they are forced to migrate elsewhere and then reclaim this seed for planting later when the drought crisis is over, usually within a three-year period (Melaku Worede, 1993; 1997). Maintenance of genetic diversity in this way provides a wide range of options for self-reliance in food crop production and security, thereby lowering the risks of food shortage.

Farmers in many parts of Africa also traditionally intercrop varieties and species. Thus, new variations are often created as a result of crossings within the mixtures. This has always given them the option to widen the diversity in their crops and to adopt the newly formed variations useful for sustaining productivity and other requirements through changing conditions, including climate change. The knowledge and the diversity local farmers have created have served as a basis for modern plant breeding and agricultural development (Emmanuel *et al.*, 1999).

Through continuous use and evaluation they maintain the genetic value of their varieties. This varietal genetic potential includes resisting environmental stresses, pests and diseases, as well as qualities such as palatability and storability that are well understood by the farming communities, particularly by women farmers. Special names that reflect the behaviour of those genes are usually given

to these varieties. The high-lysine (an amino acid/protein deficient in most cereals) sorghum cultivar popularly known as ‘wotet begunche’ (milk in my mouth) in Wello, Ethiopia, is but one example.

Similarly, varieties resistant to birds, pests and microbes are given names, which either indicate the mechanisms of the resistance or special varietal behaviour that is responsible for that specific type of resistance. This indicates that traditional agricultural knowledge can serve as an important source of information in the improvement of agricultural productivity (Regassa Feyissa, 2000).

All modern forms of crop breeding are, in fact, for the most part, dependent on the diversity promoted and maintained by local farming communities.

SECURING A COMMUNITY-BASED SEED SUPPLY SYSTEM

The seed system used in most traditional farming systems is based on the local production of seeds by the farmers themselves. Farmers consistently retain seed as a security measure to provide a back-up in case of crop failures. They always store seeds for three main purposes:

- consumption;
- sale; and
- seed stock (for sowing in the next season).

Farmers practice seed selection, production, and saving for informal distribution of planting materials within and among the farming communities. Seed production in most cases is non-specialized; it is an integrated production of field crops, roots and tubers for consumption and marketing. This traditional seed supply system is an important backup to overall agricultural crop production in a country. It is mainly based on the farmers’ varieties with the exception of cases where the seed system depends on improved or introduced crop varieties. Usually, dependency on introduced varieties is created by the displacement of farmers’ own varieties. This is the case in many parts of Africa that have been influenced by modern commercial

crop production systems. The potential use of formal seed, which is characterized by a vertically organized production and distribution of tested seed and approved varieties, has limited adaptability under the prevailing conditions resulting from climate change.

Variety use and development, seed production and storage by farmers under local conditions, and seed exchange mechanisms still remain the important components of the dynamic system that forms the most important source of food crops for smallholder farmers.

Unfortunately, the economic value given to modern agricultural crop productivity has, for the most part, neglected the important contributions made by traditional crop improvement and seed supply systems. It has also largely ignored the steady depletion of traditional crop varieties, and has become a cause for a shortage or disappearance of locally adapted seeds.

The objective of the formal seed system in most cases remains at odds with the needs of smallholder farmers, who require multiple varieties of seed for all crops, and in small amounts, at the right time and at a reasonable cost (Regassa Feyissa, 2000). Similarly, most public and private seed enterprises do not produce and distribute seeds to meet the subsistence needs of rural households or for farmers living in economically marginal and environmentally challenging areas. The private seed companies see links with such farmers as economically unviable. Therefore, in order to ensure seed security in areas where the formal seed system is ineffective in particular, the capacity of the informal seed sector should be improved for a reliable supply of locally adapted varieties.

With the advent of the modernization of agriculture and centralization of seed supply systems, the traditional seed supply systems are likely to be disrupted even more. It is, therefore, essential to study, document and embark on enhancing such systems, building on the above mentioned areas of community seed storage, use and exchange activities to develop sustainable sources of seed operating in networks, in a more coordinated and organized way.

WHAT IS A COMMUNITY SEED BANK?

Community seed banks are often understood as community-based stores used for the distribution of seed and grain to the local communities on a loan basis. In some cases, they are designed as income generating operations where high external input seeds with chemical packages are distributed to the farming community. But, as already discussed above, a community seed bank system is and should be a part of a community-managed genetic resources conservation and utilization practice (Regassa Feyissa, 2000). It is an integral part of an overall community-driven crop production strategy which farming communities have developed as part of their traditional farming systems. Within these systems, community-managed seed banks and on-farm farmers' variety maintenance are important components that serve as a source of sustained seed supply, as well as genetic materials for improved cultivar selection and enhancement.

The community seed bank described below represents a strategy for, or a collective approach to, the maintenance of genetic diversity in crop/plant species which also serves as a back-up for local self-sufficiency in planting material by stabilizing the seed supply system in cases of crop failure. It is a repository of locally adapted crop diversity, including enhanced farmers' varieties that are competitive in yield and other desirable characteristics with high input varieties that can be poorly adapted to local conditions.

Low-cost community level seed storage facilities can help to preserve the drought and climate change mitigating characteristics of traditional varieties, while, at the same time, serving as base material for farmers to select special lines to meet their changing needs. They also play a key role in improving market outlets through enabling communities to produce crops of known quality and in stabilizing prices over changing situations. Thus, community seed bank development contributes toward promoting economic empowerment of farmers.

THE COMMUNITY SEED BANK COMPLEX

Figure 1 illustrates a scheme for a comprehensive seed supply system that could be introduced across Sub-Saharan Africa. It has been developed from a schematic plan originally proposed for Ethiopia (Melaku Worede, 1997; Melaku Worede *et al.*, 1999).

The seed bank is at the centre of the seed network and offers various community services such as seed security (storage), seed distribution and exchange, germplasm restoration and introduction. It is the key component of the community seed network, representing a low-cost and low-technology demanding system that may be owned and managed by local communities as part of existing community services including cooperatives.

The seed bank proper comprises several major components: a seed store, a germplasm repository (for local crop improvement), a herbarium and a documentation section for holding records and information on local and scientific knowledge, and an administrative and records unit.

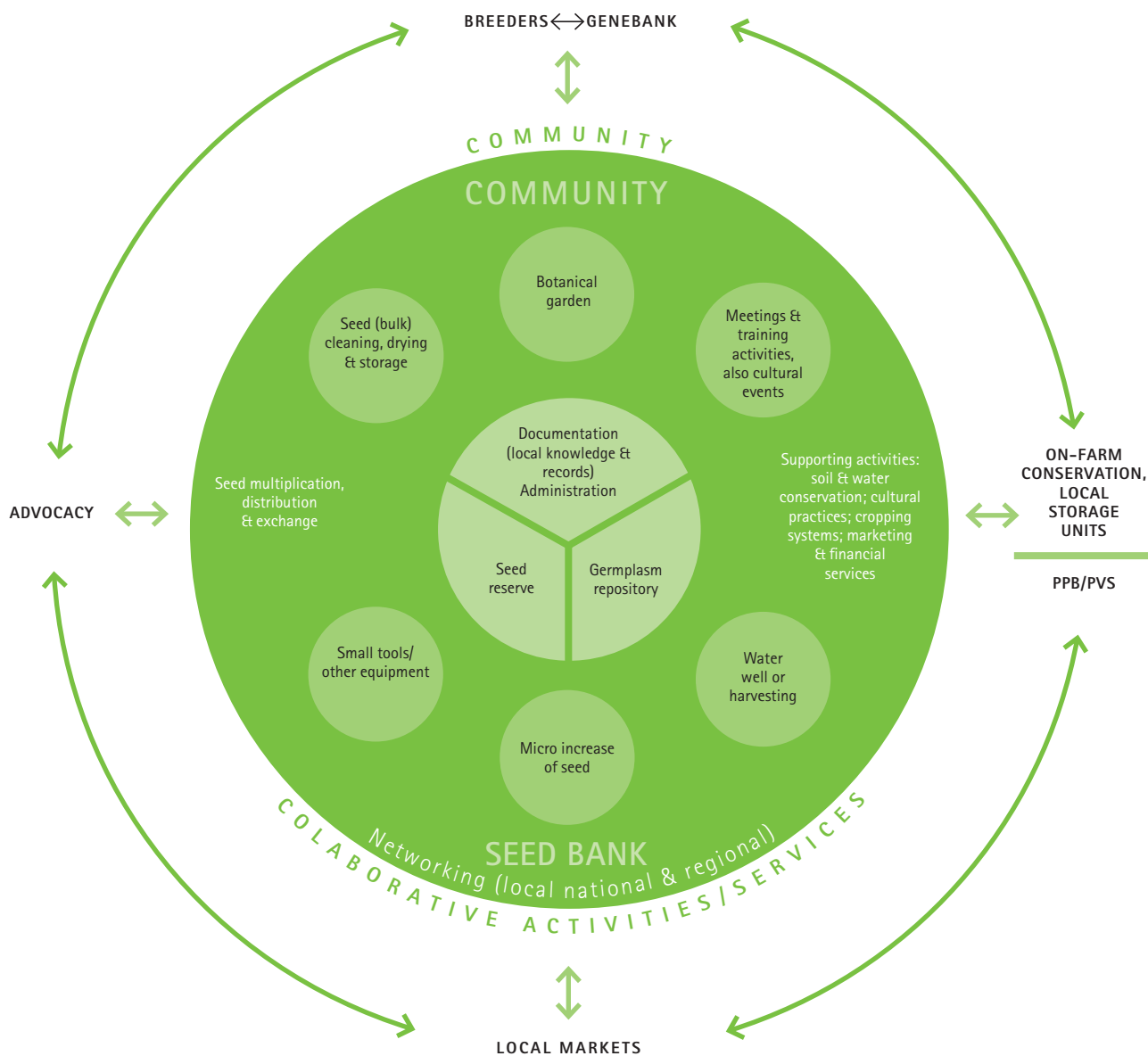
The seed store represents a seed reserve system consisting largely of local varieties, including those enhanced and/or selected and multiplied on-farm through either participatory plant breeding (PPB) and/or participatory variety selection (PVS), as well as locally adapted and adopted introductions obtained by way of exchange or from various other sources (gene banks, regional centres, donations, etc.).

Local farmers can have access to such materials on a loan basis, or through other arrangements as deemed appropriate for and by their community. The seed reserve also provides a back-stop to the local (informal) market networks where farmers traditionally exchange seeds and information.

Other components of such a seed bank system include botanical gardens, seed/plant micro-increase plots, and infrastructures for seed cleaning/processing, meeting/training facilities and, where feasible, a permanent source of water such as a well for multiple purposes. The catchment of water or other forms of water harvesting may also provide options for the supplementary watering needed for the botanical garden, off-season plant micro-increase plots, or even to ensure that plots of endangered varieties in very small quantities can mature if the rains are inadequate.

FIGURE 1

A diagram of a community seed bank complex and network for Africa



PPB = participatory plant breeding
 PVS = participatory variety selection

Community activities for germplasm conservation and seed processing at the seed bank (germplasm repository) may also include surveying/collecting and characterization of seed, involving gene bank experts and modern and traditional plant breeders. Training of local community members should be provided to carry out routine activities.

Traditional storage units such as the small storage bins, clay pots, rock-hewn mortars and undergrounds pits maintained by local farmers, which form an integral part of the local traditional seed storage systems, may be linked to the community seed bank. Improved versions of these small units, as well as materials maintained as living collections *in situ* in the field and in backyard gardens should also be considered for such purposes.

The on-farm conservation and improvement of farmers' varieties included in the community seed bank complex require a good understanding of the distinct challenges in potential programme areas, prior to initiating any activities. Farmers' objectives and needs for seed vary according to the local farming system, and this determines the strategy for on-farm management of crop diversity (Regassa Feyissa, 2000).

In cases where traditional crop genetic diversity still exists on farms, a major step in undertaking the crop management activities is to develop competitively productive forms of farmers' varieties primarily through farmer-led participatory varietal selection and/or participatory plant breeding in order to improve production and ensure conservation through continued use. It is understood that such production improvements may entail some risks of genetic erosion unless careful and systematic conservation measures are taken.

In the case where genetic diversity is threatened and farmers' options are shrinking, as has been happening in many parts of Africa for example, the main objective is to restore the lost diversity through reintroduction or exchange of material among communities and/or through national and regional gene banks, such as the SADC (Southern Africa Development Cooperation) Regional Genebank for Southern Africa. Such exchanges could be facilitated through the network of community seed bank complexes.

Through this approach, farmers will be able to continue to control their choice of crop types and cultivars while maintaining a conservation programme, and they will have ready access to planting material adapted to local growing conditions. Farmers will also be in a position to critically evaluate the relative merits of a wide range of cultivars, thereby limiting undue expansion of exotic cultivars that are costly and poorly adapted.

In order for the smallholder farmers to effectively exploit their resources and fulfil their productive potential through the seed network, they require a range of enabling services and conditions; and each service has to be sustainable. This may include measures for supporting community initiatives for sustainable financial services, establishing savings and credit cooperative societies and other forms of assistance which could be incorporated into existing community activities to sustain the seed banking, seed multiplication and distribution, processing and marketing of products.

Developing marketing strategies for farm produce and value-added products are essential for creating the incentives (or removing the disincentives) to grow a wide range of crops, and in enlarging the food resource base for both rural/farm and urban communities of target areas in order to improve the incomes of the providers of these resources.

It is equally crucial to encourage activities that ensure the sovereign rights of farmers to the materials developed and produced on their farms, or to the benefits that might accrue as a result of improved market potential (national/international) – thereby generating the financial resources needed to sustain crop productivity and improved livelihoods. This has been set out in the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, 2009). It is also important to facilitate farmer-to-farmer exchange of material and information within and among communities through networks. Farmers' systems of informal seed and information exchange provide a continuous flow of material and knowledge which go beyond geographical boundaries (often bypassing governments and formal arrangements). Such dynamic farmers' seed exchange systems are often linked to strong local plant genetic resource management and high rates of variety improvements.

The role of extension agents and grassroots workers (agricultural, socioeconomic, etc.) is also crucial in linking the development of community seed banks with other community initiatives including soil and water conservation, and understanding cultural practices in a co-operative manner.

Advocacy is another activity that is included in the seed supply network. It may be undertaken, indirectly or in a supportive manner, through community empowerment to enable farmers to improve productivity and market their products to generate sustainable incomes, have access to and control over their sources of seed and means of production, control over the use of related plant genetic diversity, etc. Concurrently, the information (facts and figures) and knowledge generated in the process provides an invaluable backup for advocacy at all levels.

NETWORKING COMMUNITY SEED BANK ACTIVITIES AT NATIONAL, REGIONAL AND GLOBAL LEVELS

There is a growing worldwide concern and interest to promote ecological agriculture in the developing world as this is seen as being able to assist poor smallholder farmers achieve sustainable development beyond their current subsistence level. Central to this move is the recognition of the key role played by indigenous seeds and traditional farming practices. It is therefore, essential to network with existing initiatives in these areas both within Africa and other developing regions, sharing experiences on the conservation and effective utilization of the rich inheritance of crop genetic resources still found with these smallholder farmers.

Developing a community seed bank complex at various strategically selected locations within the African region where community seed supply projects already exist offers a valuable starting point for achieving this task. This will provide an opportunity for networking and coordination of community seed bank activities in target areas, as well as the platform for case studies and learning or awareness creating activities at local, national and regional levels.

There is one such project already being developed in South West Wello, Ethiopia within the community seed supply programme of EOSA, supported by Seeds of Survival/International (SOS/I) and Umanitarian Service Committe of Canada (USC) (Anonymous, 2009).

Finally, success in implementing such a network of community seed banks will depend largely on the willingness of agricultural professionals and policy-makers to learn from farmers, the living repositories of indigenous knowledge, and in no small measure on close partnerships and collaboration between scientists and farmers to achieve a synthesis between modern and indigenous knowledge, thereby creating a new knowledge base for sustainable development (Melaku Worede *et al.*, 2000). The synergy resulting from the combined use of scientific and farmers' know-how is key to the enhanced management of natural resources that enables farmers to produce food crops beyond the subsistence level for national food security as well as to meet the challenges of climate change.

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