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Healthy food systems require resilient seed systems

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KEY MESSAGES:

- → **Resilient seed systems contribute to greater food availability throughout the year, the production of more nutritious and healthy crops, income generation and a sustainable resource base. These outcomes together contribute to greater resilience of food systems.**
- → **Farmers obtain seeds from diverse sources through different mechanisms. There are many actors involved in producing and distributing seeds, and they face many constraints, from climate change to poor quality seed and inefficient delivery systems.**
- → **Core elements of a comprehensive strategy for resilient seed systems include: smarter ways of addressing climate change, identifying best-bet portfolios, novel and efficient distribution, innovative business models and value chains, empowerment of farmers, and local implementation of international and national policy.**
- → **We illustrate these core elements with examples of success.**

Seed actors and their roles

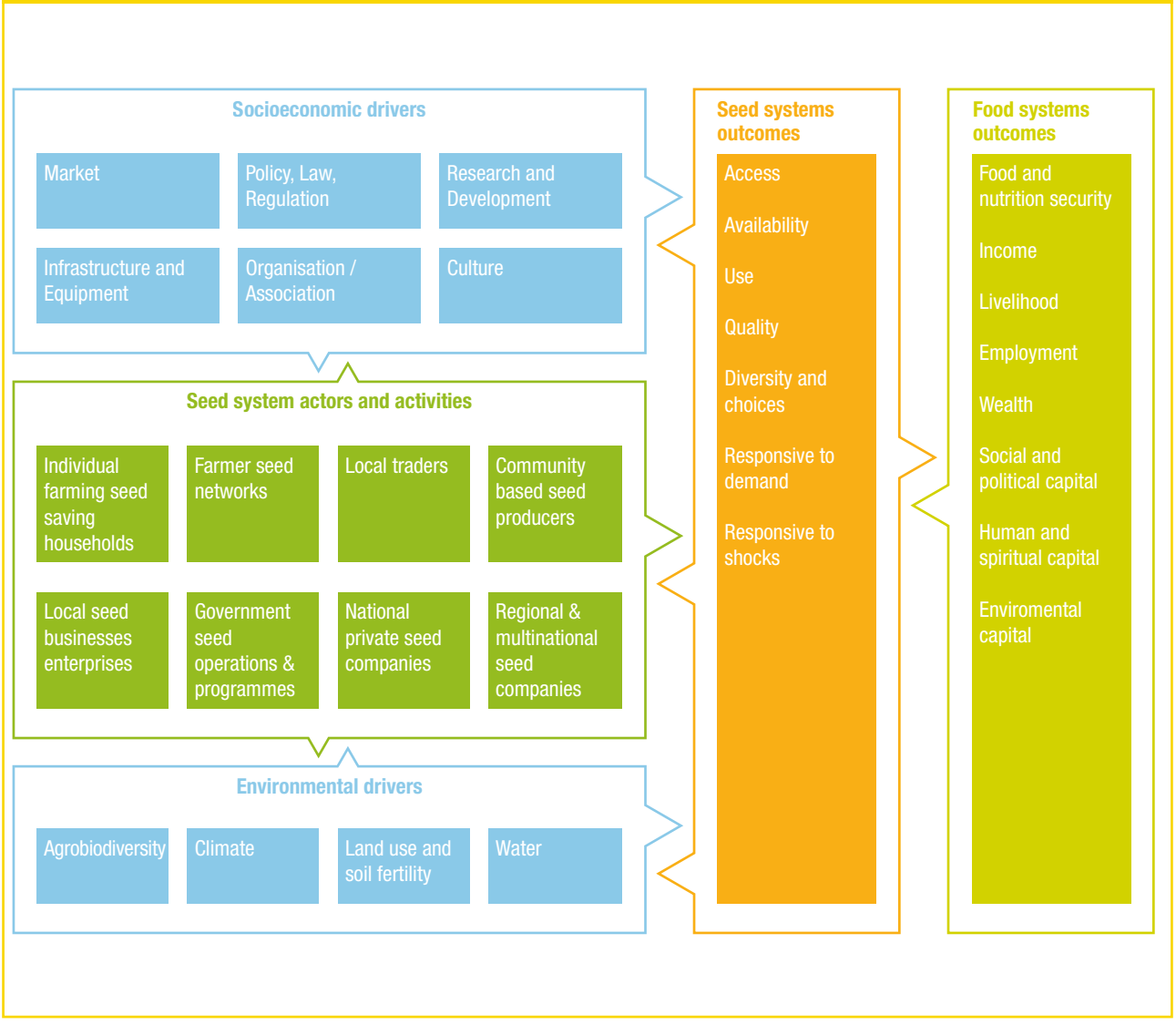
In many countries around the world, farmers obtain seeds from a diversity of seed production sources – these can be local, regional, national or international (1). In any given year, a farming household might use their own saved seed for crops such as bean, finger millet, (traditional) maize varieties, rice and sorghum; buy groundnut seed at the local market; obtain seed of improved or hybrid maize from national public research institutions through government extension services or international aid distribution programmes; and buy seed of exotic vegetables from national or international commercial companies. The following year, the farming household might decide to change the mix of crops and their seed sources.

Mechanisms to obtain seeds vary and include monetary and non-monetary transactions. Very often seed transactions are embedded in the fabric of socioeconomic relationships in the community and beyond. Thus, seeds are not only planting material (i.e. physical capital), but social capital as well. Women farmers play key roles in farmer seed systems (2), although they are often overlooked by researchers and development personnel, policies and programmes.

Social actors engaged in producing and distributing seed include:

- Individual farming seed saving households
- Farmer seed networks
- Community-based seed producers (e.g. a community seedbank with a seed-production arm)

FIGURE 1 – Framework for resilient seed systems for healthy food systems



Source: Adapted and expanded from (4).

- Local traders
- Local seed enterprises (business) catering to local markets in low volumes
- Government seed operations or programmes
- National private seed companies
- Regional and multinational private seed companies (1).

60%–90% of the seeds which smallholder farmers in low-income countries depend on is saved on farm or obtained through local distribution channels, such as exchanges between farmers, intra- and inter-community sharing systems, agrodealers and local markets. Seeds obtained at local markets are often unlabelled, but in many countries play a very important role in the supply system (3). This is particularly important after natural disasters, such as droughts, earthquakes and hurricanes, when farming communities can lose most or all of their stored seeds (3).

Many factors influence the operations of seed producers and distributors, whether or not these operations are integrated in one enterprise or organization. They include history, objectives, types of crops and crop varieties, types and levels of investment (science and technology, capital, human resources), scale, size, type and density of seed networks, whether or not intellectual property rights are used and if so what type, and the policy and legal context. Policies and laws regulate who can produce and sell which kind of seed, how quality assurance is organized, and how rewards and support are allocated. Regulatory frameworks vary between countries, though efforts are underway to make them more harmonized. They usually have a significant influence on how the seed sector has evolved, how power and influence are distributed and in what direction the sector will go. Besides socioeconomic and political factors, environmental factors are also important, including climate change. Figure 1 represents a framework to analyze seed system–food system components and interactions.

Resilient seed systems

Under supportive policy and socioeconomic conditions, a diversity of seed production and distribution practices make up a resilient seed system. A resilient seed system contributes to greater food availability throughout the year, the production of more nutritious and healthy crops, income generation and a sustainable resource base. These outcomes together will contribute to greater resilience of food systems.

Our definition of a resilient seed system, based on research and our experience, is one which:

- Relies on the ability of seed system actors to absorb disturbances, regroup or reorganize, and adapt to stresses and changes caused by a perturbation (5)
- Results from multiple seed and knowledge interactions and continuous learning among seed system actors and related institutions (6)
- Is demand driven and responsive to differentiated needs and interests supporting all users and farming systems
- Recognizes, respects and supports the key roles played by women farmers as seed custodians, managers, networkers and entrepreneurs.

Resilient seed systems reduce vulnerability by:

- Ensuring access to seeds in terms of preference, affordable price and availability when needed
- Ensuring availability in terms of production and distribution
- Guaranteeing seed quality in terms of adaptability, safety and longevity (7)
- Guaranteeing seed choice and diversity
- Producing crops which underpin a healthy diet
- Recognizing and respecting seed as social and spiritual capital.

Ultimately, farmers should benefit from a secure and diversified supply of quality seeds suitable for local conditions and which contribute to healthier diets, more sustainable livelihoods and stronger capacity to adapt to climate change. Useful and timely information should accompany seeds, for example, with regard to the nutritional value of the variety, capacity to withstand drought, and recommended management practices.

Bottlenecks: seed practices under stress

Almost everywhere, local seed practices are under stress (8). Urbanization, agricultural intensification and commoditization and privatization of natural resources are contributing to a decline in collective local seed management. Farmers are substituting local varieties with hybrids that can be easily purchased from agrodealer shops or at local markets. Traditional seed exchange relationships have become weaker in many areas. In some countries, they are becoming

criminalized due to new revised seed policies or laws. Recent studies reveal that the legal operating space for farmers and communities to save, produce, exchange and sell seed is being reduced and related farmer practices of sharing and distributing seed, criminalized (9, 10). Only in a few countries, such as Bolivia, Ethiopia, Nepal and Uganda, are farmer-centred seed production and exchange practices obtaining increased recognition and support.

One major challenge farmers face in producing and obtaining seed is poor quality. Quality control of farmer-saved seed is largely based on trust embedded in social relationships, while quality control of seed produced by the other social actors is often subject to external written rules and regulations. How much actual quality control takes place is, however, a moot point. In many rural communities, poor storage practices and facilities affect seed quality. Farmers everywhere complain about the sale of 'fake' seeds, for instance grain sold as seed or non-certified, low-quality seed sold as 'improved' seed. Fake seeds have direct negative impacts on crop productivity and farmer income.

Another major challenge is that in many countries it is very difficult to obtain new varieties of interest to farmers due to poorly developed or badly supported delivery systems. Farmers often do not know about which other crops or crop varieties they could grow on their farm and have no or poor access to new and improved crop diversity.

This obstacle seriously hinders farmers' efforts to adapt to climate change. Climate change has begun to put additional pressure on farmers' seed and food production systems and on the multiple functions that they fulfil. Future impacts of climate change are expected to become more pronounced in many parts of the world, forcing farmers to change their practices and causing them to search for information about crops and varieties better adapted to new weather dynamics. Access to quality seeds will become even more important.

Women farmers are often interested in different portfolios of crops and crop varieties, for example, requiring less regular labour inputs, easier to transport, with a longer shelf life and with a high nutrient density. Resilient seed systems should be gender responsive and support women's agency, and their ability to make decisions about how to successfully manage their farms and gain access to the resources they need including seeds.

Opportunities: pathways to resilience

It is important that farmers continue to maintain crop diversity individually and collectively (for example, in community seedbanks (11)), Resilience at scale requires concerted efforts. Core elements of a comprehensive strategy are (12, 13):

- Smarter ways of addressing climate change
- Identifying best-bet portfolios
- Novel and efficient distribution
- Innovative business models and value chains
- Empowerment of farmers
- Local implementation of international and national policy

Smarter ways of addressing climate change

Much faster and cheaper ways of gathering, compiling, analyzing and sharing information about relevant (anticipated) climate changes and climate-induced stresses, for example, through the use of climate analogues (13).

National research teams including government officials, public-sector researchers, university professors and non-government researchers from Bhutan, Burkina Faso, Costa Rica, Côte d'Ivoire, Guatemala, Nepal, Rwanda and Uganda have designed new strategies to identify and access germplasm that is better adapted to climate changes.[i] The teams assessed the changing needs for national and foreign-sourced plant genetic resources for food and agriculture by analyzing past, current and future climate patterns in their national contexts. They have integrated these needs into new research and development strategies of national organizations responsible for the conservation and use of agrobiodiversity and climate change adaptation. As an example, in Burkina Faso, researchers acquired millet accessions better adapted to the changing climate based on an analysis of weather data collected over the last 30 years. They planned experiments, mobilized farmers and are now testing with farmers a number of promising new accessions from inside and outside Burkina Faso for current and future climate changes. In Uganda, a research team obtained bean and millet accessions with good adaptive potential from Kenya and Tanzania for on-station and on-farm testing.

Identifying best-bet portfolios

More efficient ways to identify 'best-bet' portfolios of diverse crops and crop varieties that are potentially adapted to changing conditions, can be produced sustainably and satisfy dietary demand.

'Seeds for Needs' is an innovative approach which introduces and tests demand-led crop diversity.[ii] A first step in this approach is identifying a range of varieties, sourced from international and national genebanks, breeding programmes, community seedbanks and farmers' fields, that could potentially be acceptable and suited to a given agroecological region. Farmers then test these varieties using a crowdsourced, citizen science approach called 'tricot' (triadic comparisons of technologies). Farmers receive packages of seeds with three different varieties and rank them as best, middle and worst for different traits. Each package contains a different combination of varieties. Simple formats and digital technologies mean that large numbers of farmers can participate in trials without being supervised. The farmer-generated data are then combined with environmental and socioeconomic data and analyzed using specific, novel statistical methods. The tricot approach has demonstrated how different varieties are differentially adapted to different growing conditions across large areas (14). Farmers are now adopting these better adapted varieties. The approach has been adopted by a number of large-scale initiatives in South Asia, East Africa (e.g. the Integrated Seed Sector Development programme in Ethiopia supported by the Dutch government) and Central America.

Novel and efficient distribution

Novel ways to efficiently distribute promising materials in sufficient quantities to large numbers of farmers for evaluation, adoption and adaptation.

Between 2013 and 2017, the genebank of the World Vegetable Center and national partners distributed more than 42,000 seed kits of traditional African vegetables containing more than 183,000 vegetable seed samples to smallholder farmers in Tanzania, Kenya and Uganda. The seed kits contained seed samples of promising accessions and open-pollinated breeding lines of 23 traditional African vegetables, and to a lesser degree tomato, Capsicum pepper and soybean, usually enough to plant in a home garden (15). World Vegetable Center research teams are conducting seed tracer studies to determine by whom and how the seeds are used. The results of these studies will inform planned follow-up activities with farmers and national agricultural organizations to strengthen local seed systems, breeding efforts and seed production.

Innovative business models and value chains

Innovative seed business models and innovative seed value-chain mechanisms to respond to the demand for crops and crop varieties that create work and income generation opportunities, for example, through young seed entrepreneurship.

One of the major bottlenecks limiting farmers' access to good-quality seed for food crops in Uganda is the shortage of early generation seed (breeder and foundation)[iii] to produce sufficient quantities of certified or quality-declared seed to satisfy the needs of farmers. The Integrated Seed Sector Development (ISSD) programme in Uganda[iv] aims to increase the income of smallholder farmer households, especially women and youth in those households, and improve their household food and nutrition security. ISSD Uganda is focusing on piloting and scaling out new innovative public–private business models in a commercially sustainable manner. The programme is working with local seed businesses to produce quality seed of locally adapted crops and varieties for local markets. The programme has supported the development of guidelines of Quality Declared Seed (QDS)[v] for the marketing of seed produced by local seed businesses. To date, more than 260 local seed businesses have been established.

Empowerment of farmers

Empowerment of farmers and their organizations and effective implementation of their rights, to make their voices, needs and interests heard in national and international decision-making processes related to the management of plant genetic resources, seed system development, agricultural production and livelihoods.

The first community seedbank in Nepal was established in 1994 in Dalchowki, Lalitpur, with the support of USC Canada–Nepal.[vi] Currently there are 46 operational community seedbanks supported to varying degrees by national and international non-government organizations and by the government of Nepal. Networking among community seedbanks began about five years ago and members of several community seedbanks established an informal national community seedbank association. But in recent years the pace has been slow. In 2018, following the second national community seedbanks workshop in the country, Bioversity International and the leading Nepalese biodiversity research organization, the NGO Local Initiatives for Biodiversity, Research and Development (LI-BIRD), joined forces to strengthen the network, legalize it as an association, build its organizational capacity and develop a strategy and action plan. The government of Nepal has invited the association to formulate a number of policy recommendations that would create a more enabling

institutional context for community seedbanks and their roles as key actors in the seed sector. Improved networking aims to address: the lack of coordination and mutual learning among key actors involved, the challenge of sustainability of community seedbanks, and the challenge of mainstreaming community seedbanks in national policy and law.

Local implementation of international and national policy

The effective implementation from community to subregional levels of international agreements and national policies and laws governing access to genetic resources and benefit sharing, seed production and trade, and intellectual property in ways that support resilient seed systems in practice and not just on paper.

Resilient seed systems require revisions of current seed policies and laws in many countries that hinder, obstruct or criminalize farmer-led initiatives (9, 12). South Africa's Department of Agriculture, Forestry and Fisheries (DAFF), through the National Plant Genetic Resources Centre (which houses the country's national genebank) with technical support from Bioversity International, has initiated the implementation of a national strategy to establish and support community seedbanks. The aim is to support local smallholder communities to revive and improve their traditional seed-saving practices, add value to their local seeds (e.g. through seed production and marketing) and strengthen their food security, sustainable agriculture, conservation of agricultural biodiversity and adaptation to climate change. To date three pilot community seedbanks have been established managed by community members (16). The community seedbanks are securing improved access to and availability of diverse, locally adapted crops and varieties, and revaluing related indigenous knowledge and skills in planting management including seed selection, treatment, storage, multiplication and dissemination. They are effective means to implement the country's national agrobiodiversity conservation policy.

In the coming years, the initiative will establish more new community seedbanks throughout the country supported by the National Plant Genetic Resources Centre. DAFF is using the achievements and lessons learned from the pilot phase to develop policies such as the 'National plan for conservation and sustainable use for plant genetic resources for food and agriculture'. Its 'Departmental strategy on conservation and sustainable use of genetic resources for food and agriculture' proposes active roles for community seedbanks as part of a comprehensive strategy for conservation and sustainable use of plant genetic resources for food and agriculture. Adaptation to climate change is one of the government's concerns regarding sustainable use. The government's overall climate change response strategy has been laid out in a 2014 National Climate Change Response Plan White Paper. The White Paper identifies involving local communities as one of the priorities.

Conclusion

Globally, there are strong voices and movements that demand healthier food systems. Healthy food systems depend on resilient seed systems. Such systems require much stronger support for farmer-based seed efforts along the whole seed value chain, development of best-bet portfolios of crops and crop varieties, innovative seed business models, novel and efficient seed distribution mechanisms, empowered farmers, and effective local implementation of global and national policies. Policymakers can use the concrete examples described in this chapter to make changes in seed systems towards resilience.

Notes

[i] This research was conducted in the context of a project supported by Bioversity International and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) (2011–2017).

[ii] www.bioversityinternational.org/seeds-for-needs/

[iii] Breeder seed: seed produced, usually in small quantity, by breeders based on own breeding efforts. Foundation seed: the offspring of breeder seed produced by a recognized seed producing unit in the public or private sector, usually in large quantity, for further testing on a large scale.

[iv] The Integrated Seed Sector Development programme is led by the Wageningen Centre for Development Innovation, Wageningen University and Research, and aims to support the development of a vibrant, pluralistic and market-oriented seed sector. The programme operates in several regions of Uganda, in close collaboration with the National Agricultural Research Organization and various partners.

[v] QDS, first introduced in 1993 by the Food and Agriculture Organization of the UN, are seeds subject to an alternative seed-quality assurance process, particularly designed for countries with limited resources, which is less demanding than full seed-quality control systems, but yet guarantees a satisfactory level of seed quality. For more information: http://www.fao.org/3/a0503e/a0503e00.htm and http://www.fao.org/3/a-i4916e.pdf

[vi] For the history of the Dalchowki community seedbank: https://www.bioversityinternational.org/fileadmin/user_upload/online_library/publications/pdfs/Community_Seed_banks/24.Nepal_Dalchowki_seedbank.pdf

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Indian farmers winnowing millet. Adapted to a range of marginal growing conditions, these minor millets mature quickly, are able to withstand climatic stress, and grow in a variety of soils. High in a range of micronutrients, millets also offer a balance of essential amino acids, the building blocks of protein.
Credit: Bioversity International/S. Padulosi

This thought-piece is part of the Agrobiodiversity Index Report 2019: Risk and Resilience.
The perspectives presented in the thought pieces are the authors' own and do not necessarily reflect those of Bioversity International.

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ISBN: 978-92-9255-125-4