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A Resource Manual for Resilient Seed Systems

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Smallholder Farmers' Seed Systems under Pressure

Have you ever wondered how farmers in developing countries get their seed? If, in your imagination, you see them buying certified seeds from what is known as the 'formal seed system', you are very likely to be wrong. Estimates suggest that 60-90% of the seeds on which smallholder farmers in developing countries depend is saved *on-farm* or obtained through local distribution channels, such as exchanges between farmers, community sharing systems, and local markets. Women farmers play key roles in farmer seed systems, although they are often overlooked by researchers and development personnel, policies, and programmes.

This enduring high level of seed flows among farmers masks the fact that, almost everywhere, local seed systems face challenges. Agricultural intensification and commoditization, privatization of natural resources, and the strong concentration and expansion of corporate power in the life science industries (including the seed industry) are contributing to a decline in collective local management of plant genetic resources for both conservation and sustainable use.

Many farming households have become more individualised in terms of decision-making and deployment of knowledge, labour, capital and seeds. Traditional seed exchange relationships have become weaker in many areas. Farming practices are becoming more market oriented, and this increased involvement in markets has both benefits and costs depending on local context. Large-scale rural-to-urban migration is contributing to a decline in farming in many countries or transforming small-scale family farming into contract farming. It is also leading to the feminization of agriculture, increasing the workload and responsibilities of women in many regions. These trends are affecting local seed production, selection, storage, distribution, and exchange practices, for example, through substitution of local varieties with hybrids that can be easily purchased at local markets.

Climate change has begun to put additional pressure on farmers' seed and food production systems and on the multiple functions that they fulfill. In many areas, farmers continue to maintain crop diversity, but a significant reduction in the number of crops as well as area planted is occurring. Findings from the field indicate a decline in diversity of local varieties in many countries. 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.

Resilient Seed Systems

Bioversity International supports research on resilient seed systems to address a number of challenges: food insecurity, malnutrition, poverty, and climate change (Vernooy *et al*., 2016).

Research results from around the world suggest that providing farmers with better access to crop and varietal diversity can strengthen their capacity to adapt to climate change. Under supportive policy and socio-economic conditions, such strengthened capacity could contribute to greater food availability throughout the year, the production of more nutritious and healthy crops, and income generation.

Climate and crop modeling tools are increasingly used to predict the adaptive capacity of a given crop to expected changes in climate. The results of these modeling exercises can be used to design strategies to access and use crops and crop varieties that are expected to be better adapted to future climate changes in specific locations. The results of these modeling exercises, complemented by additional research (e.g., local crop pest and disease studies, lessons learned from past crop-improvement efforts, technology adoption studies) will help researchers, gene bank managers, extension agents, and farmers gain access to potentially useful plant genetic resources through the multilateral system of the International Treaty on Plant Genetic Resources

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for Food and Agriculture or other means. Once obtained, these "new" plant genetic resources can be evaluated in target environments through on-farm experimentation over one or more cycles.

Over the past three years Bioversity International has collaborated with partners in various countries to design and implement a comprehensive capacity-building strategy to access and use plant genetic resources more effectively in the context of climate change adaptation. Countries include Benin, Bhutan, Burkina Faso, Costa Rica, Côte d'Ivoire, Guatemala, India, Madagascar, Nepal, Rwanda, South Africa and Uganda. This led to the development of a resource manual for resilient seed systems.

Content

The methodology for building more resilient seed systems includes the following eight steps; for each one the manual includes a specific module:

- Module 1: *Situational analysis and planning*– explains how to work with farmers and other stakeholders to determine baseline conditions in a community in terms of seed systems and climate change; how to set priorities and objectives; and how to plan research into development intervention.
- Module 2: *Data preparation and selection of software*– introduces useful tools, such as DIVA-GIS, Maxent, and Climate Analogues, and explains how to prepare relevant data for a comprehensive climate change analysis.
- Module 3: *Climate change analysis and identification of germplasm*– describes the steps in climate change analysis in the context of impact on agriculture and seed systems and how to identify germplasm suitable for the future climate.
- Module 4: *Germplasm acquisition*– introduces the International Treaty on Plant Genetic Resources for Food and Agriculture, and explains how to acquire new germplasm while protecting traditional knowledge and taking into account the phytosanitary aspects of seed production and distribution.
- Module 5: *Field experimentation*– presents a number of methods for participatory crop evaluation with the newly acquired germplasm in local environments and farmers' fields.
- Module 6: *Germplasm conservation*– discusses specific aspects of the conservation of the newly tested germplasm and the various ways in which it can be multiplied.
- Module 7: *Participatory evaluation*– presents a global method for evaluating the research process with farmers, gene bank managers, extension agents, and other stakeholders.
- Module 8: *Knowledge sharing and communication*– is about sharing research results with the participants as well as with others involved or potentially interested in the results.

Users and Uses

The resource manual is intended for:

- Plant breeders, researchers, gene bank managers, and policymakers with an interest in plant genetic resources
- University lecturers and advanced students with an interest in agricultural development, adaptation to climate change, and seed systems
- Others involved in the strengthening of farmers' seed systems and their capacity to adapt to climate change

The resource manual can be used as:

- *A one-stop shop*– for finding selected, easily accessible resources to support research on climate change adaptation by strengthening seed systems
- *A learning aid*– to build capacity in facilitating, conducting, and participating in such a research process
- *Pedagogical material*– for higher education classes or on-the-job training workshops

The interactive web-based version of the manual is available at: http://www.seedsresourcebox.org. The hardcopy version is available at: http://www.bioversityinternational.org/e-library/publications/detail/resource-box-for-resilient-seed-systems-handbook/.

Experiences from the Field

In Burkina Faso, researchers from the Université de Ouagadagou used parts of the manual to obtain to acquire new millet accessions that are better adapted to the changing climate. They are currently planning on-farm experiments in three contrasting agro-ecological regions of the country and have already mobilized farmers interested to take part in the research. They have collected weather data of the last 30 years to underpin

their analysis about future trends. They are now in the process of identifying promising new accessions from both inside and outside Burkina Faso that respond to current and future climate changes.

In Bhutan, the country's two only plant breeders and staff of the National Biodiversity Centre identified five different agro-ecological sites in the country for the analysis of future climate changes based on the presence of weather stations (availability of longer term weather data) and on-farm conservation programmes implemented in the past or present (availability of farmers interested and experienced in on-farm crop experimentation). Based on the new knowledge and skills acquired, they recently completed climate change scenario analyses using DIVA-GIS and the climate analogue tool for each site for the major crops in Bhutan (rice, maize, potato and chilli) taking 2030 as reference year. The team is producing a synthesis of the results at this moment to decide about which possible analogue sites to target for further analysis and possible acquisition of promising germplasm.

In Guatemala, staff of the Instituto de Ciencia y Tecnología Agrícolas (ICTA) has used the new knowledge and skills gained to realise collection, characterisation and conservation projects for bean, maize, *Amaranthus*, *Capsicum*, cassava and several tubers. They also produced distribution maps of the accessions collected in the country and maps of potential collection sites of accessions still to be collected. These maps will be used for the planning of future collection misions.

In Rwanda and Uganda, following the training in the classroom, a team of scientists and extension agents interacted with farmers and their communities in selected sites to identify local climate related challenges. Climate change scenario analysis resulted in the identification of present and future analogue sites. Using DIVA-GIS and crop suitability modelling applied to beans (a key crop for farmers' livelihoods) the team then identified bean accessions with good climate adaptation potential from three sources: (i) the national gene banks in Rwanda and Uganda, (ii) communities in both countries, and (iii) international genebanks. In 2014, the first phase of participatory field trials with farmers was done using materials from the national genebanks and locally adapted material was realised. A total of 20 varieties in each country were evaluated (and ranked) by farmers for climate resilience and other desirable traits. Accessions from international genebanks have been requested and once acquired will be multiplied and tested in the field hopefully in 2015. In addition, farmers from community seedbanks in Rwanda and Uganda organised an exchange visit during which they identified varieties of beans that they would like to exchange. Modalities for this exchange are still being worked out by the two countries.

Providing Feedback

The Bioversity International research team that developed the resource manual would be very pleased to receive your feedback on the content and practical use you have made of the manual. Please send your comments to bio-policy@cgiar.org

Reference

Vernooy R, G Bessette, P Rudebjer and G Otieno (eds) (2016) Resource box for resilient seed systems: handbook. Bioversity International, Rome, Italy. http://www.bioversityinternational.org/e-library/publications/detail/resource-box-for-resilient-seed-systems-handbook/.