

New strategies and partnerships for the sustainable use of plant genetic resources

Ronnie Vernooy, Michael Halewood, Isabel López-Noriega and Gea Galluzzi

Policy Unit, Bioversity International

The challenge

Estimates suggest that globally 80% of the seeds on which smallholder farmers in developing countries depend are produced by the farmers themselves or obtained through informal channels. This high level of farmer seed autonomy masks the fact that almost everywhere local seed systems and the diverse agricultural production practices that depend on them are under some form of stress. Factors impacting on local seed systems include pests and diseases, loss of soil fertility and droughts and floods. Other factors include socio-economic and institutional forces, such as the inefficiency or absence of agricultural research and extension services, and formal seed systems that are unable to cater to the needs of smallholder farmers who depend on diversity and locally adapted cultivars. Although in many regions of the world farmers continue to try to maintain a diversity of crops and crop varieties, there are concerns that this diversity is declining in terms of both number of species and area sown or planted. These changes are taking place at a time when farmers are increasingly exposed to the impacts of climate change (Yadav et al. 2011).

Some research organizations are developing research strategies and partnerships aimed at keeping farmer seed systems healthy and addressing some of the challenges they face, particularly in regions

where the formal agricultural research and seed systems are not able to deliver effective support. These new initiatives aim to contribute to ensuring dynamic and resilient use of plant genetic resources, improving food security and promoting viable rural livelihoods, while also supporting farmers to respond to the stresses climate change places on agriculture. They address the viability of seed systems in a broad sense, including germplasm exchange practices, plant breeding and variety dissemination and availability of quality seed.

This paper presents a number of these initiatives for consideration by the Ad Hoc Technical Committee on Sustainable Use of Plant Genetic Resources for Food and Agriculture of the International Treaty on Plant Genetic Resources for Food and Agriculture¹ as it develops a program of work on sustainable use for consideration by the Treaty's Governing Body.

Broadening access, benefit-sharing and sustainable use

Successful adaptation of agricultural production systems to changes in climate will depend upon greater access to and improved use of genetic diversity than is currently the case. This is particularly true given predictions that climate variability and extreme climatic events will increase globally, leading to greater risks to agricultural production. The need for improved access and use has been clearly

Box 1: Changing agricultural systems

Smallholder agricultural systems in many parts of the world are increasingly exposed to the forces of globalization. Agricultural intensification and commoditization, privatization and overexploitation of natural resources, population pressures, and concentration of corporate power in the life-science industries (which include the seed industry) are among the forces putting stress on traditional practices of both conservation and production of seeds and other planting material (van der Ploeg 2009). Farming households are becoming more individualized in terms of decision-making and deployment of knowledge, labour and capital. Genetic diversity has declined in a number of crops, regions and countries (FAO 2010). Worldwide, large-scale rural-to-urban migration is contributing to the depopulation of farming areas, the transformation of small-scale family farming to contract farming and the ageing and feminization of the agricultural labour force (Song and Vernooy 2010). Farming is also becoming more dependent on markets for both inputs (e.g. fertilizers and technical knowhow) and outputs.

recognized by the international community in the revised Global Plan of Action for Plant Genetic Resources for Food and Agriculture (FAO 2011), the International Treaty on Plant Genetic Resources for Food and Agriculture and, more indirectly, in the Nagoya Protocol on Access and Benefit-sharing.

The strategies highlighted here involve an explicit broadening of the concept of access or availability of plant genetic resources. Of concern is not only access to diversity from other places and their sustainable use, but also functional availability for sustainable use of locally available plant genetic resources. Such strategies include enhancing local varieties/populations with particularly useful traits, working with farmers and NGOs to multiply quality seed of those varieties, and deploying crop diversity to better withstand extreme weather events and pests and diseases whose migration has been

facilitated by climate change⁴. Novel strategies in this direction are based on both the timely identification of and broad experimentation with varieties and populations currently found in farmer communities (in the field and/or in community gene and seed banks), in the wild, and in *ex situ* gene banks. The involvement of farmers and local communities in identifying stresses, potentially useful sources of germplasm and evaluating its performance is a central feature.

New strategies and partnerships

In recent years, many of the centers of the CGIAR have adopted new, collaborative approaches to germplasm improvement and diffusion involving a wide range of partners. Participatory approaches to crop improvement have made some inroads, in particular through participatory variety selection in collaboration with national research

partners, non-governmental organizations (NGOs) and farmer groups. Some CGIAR centers and partners are working directly with farmers' organizations to select the most useful plant material and multiply and distribute quality seed of open-pollinated varieties (OPVs). This way of working is necessary because the public or private sectors lack the capacity to ensure that quality seed of the crops concerned reaches farmers in those regions.

Some CGIAR centers are experimenting with new ways to link both the CGIAR and national genebanks to farmers, with the latter becoming the direct recipients and sometimes the evaluators of the germplasm. An example of this approach is the Seeds for Needs project carried out in Ethiopia and Papua New Guinea by Bioversity International and national partners. In Ethiopia, researchers work with women farmers to identify current

Novel seeds for climate-change adaptation

Bioversity International and a number of national research partners, in cooperation with the CGIAR Research Program on Climate Change, Agriculture and Food Security, are assessing the changing needs for foreign-sourced plant genetic resources for food and agriculture (PGRFA) in the context of adaptation to climate change.² This involves training national partners to use climate-change modelling tools, such as climate analogues,³ so that they can assess the implications of a range of climate-change scenarios for variety adaptation in various crops and the associated PGRFA requirements (Vernooy and Halewood 2012). Research teams will assess their changing needs for PGRFA to be able to adapt to stresses associated with climate change. The research hypothesis is that countries will be increasingly dependent on germplasm from foreign sources as climate changes require them to look further afield for useful adaptive traits or adapted species. Once the needs analysis has been carried out, research teams will attempt to identify and gain access to potentially useful PGRFA through the multilateral system, evaluate the performance of this germplasm and decide about uptake and dissemination strategies.

Participatory plant breeding builds bridges between seed systems

In 2000, in China's remote and agro-ecologically fragile Guangxi province, the Center for Chinese Agricultural Policy, the Guangxi Maize Research Institute, extension agents and farmers from six villages piloted participatory plant breeding by establishing cooperative and complementary relations between the formal seed system and farmers' seed systems. Farmers, in particular women, are active partners in plant breeding, on-farm biodiversity conservation, seed production



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and small-scale seed marketing. The work aims at identifying parental materials (through participatory variety selection), improving populations (involving genetic material from the local and formal seed systems)

and selecting further to obtain individual varieties. Based on 10 years of experimentation, five farmer-preferred varieties of maize have been selected and released in the six research villages: four open-pollinated varieties (OPVs) and one hybrid variety. These new materials have also spread beyond the six villages. In addition, five maize varieties from the International Maize and Wheat Improvement Center (CIMMYT) released in the 1980s have been crossed with locally adapted varieties and are gaining wide acceptance. Another five landraces from the six villages have been improved thanks to the joint efforts of farmers and formal breeders. Agronomic traits, yields and palatability of all these varieties are satisfactory and they are better adapted to the local environment and the changing climate.⁵

Strengthening local seed systems

In India, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and its partners have developed

and future climate changes, access 'novel' durum wheat and barley seeds from a range of sources within and beyond the local communities where adaptation needs are identified, and develop new farming practices based on existing indigenous adaptation strategies.⁶

Other strategies include large research consortia in which the CGIAR centers partner with public and private organizations, wherein public organizations are involved in developing and promoting OPVs and companies are involved in the development and diffusion of hybrids. These recent partnerships with the private sector are leading to uptake and diffusion of improved materials that were otherwise difficult to produce. These public-private partnerships, with their often wide range of partners and shared roles and responsibilities, are occurring with increasing frequency.

National agricultural research organizations, international and national NGOs and farmer groups, in some cases in cooperation with CGIAR centers, have developed a large number of new seed initiatives. Most of these are based on novel forms of collective action, such as partnerships between professional and farmer breeders (Ruiz and Vernooy 2012). These initiatives have tried to conserve, restore, revitalize, strengthen and improve local seed systems in a variety of ways. They focus particularly, but not solely, on local varieties of a wide range of crops, including major and minor crops, and neglected and underutilized species. They also address food security and food and seed sovereignty, including the protection of farmers' rights. Overall, the initiatives have sought to regain, maintain and increase farmers' and local communities' control over seeds and strengthen or establish dynamic forms of cooperation among

farmers, and between farmers and others involved in the conservation and sustainable use of agricultural biodiversity.

These initiatives include establishing and supporting numerous activities, such as community genebanks and seed banks, local farmer research groups or committees, participatory plant breeding teams, farmer and community agricultural biodiversity committees, seed-saver clubs and networks, seed exchange networks, seed production cooperatives and networks of custodian farmers. These new and emergent groups have developed an extensive menu of tools and methods to support their activities, such as community biodiversity registers, diversity blocks, participatory plant breeding trials, biodiversity fairs and festivals, folk theatre and local access and benefit-sharing agreements (Jarvis et al. 2011).

a method that allows farmers to produce enough good-quality and true-to-type groundnut seed to meet their needs (Deshmukh et al. 2001). In Asia and Africa, ICRISAT has distributed simple seed-production kits to farmers in areas that are not served by either formal public or private channels selling and distributing seed. These kits contain high-quality seeds of cowpea, sorghum, beans, pigeon pea, millet and maize adapted to local conditions and low-input conditions, together with information on how best to grow them.⁷ In Rwanda, the International Center for Tropical Agriculture (CIAT) and its partners have observed that different bean-seed procurement mechanisms (farm-saved, local seed purchase and/or seed or labour exchange) used by farmers operate reasonably well. They have therefore focused their efforts on fostering linkages between seed producers, local seed markets and local research stations, supporting community-based seed multiplication, providing training and involving farmers in participatory plant breeding and variety selection. This work is expanding to other countries in Africa (Rubyogo et al. 2010). The International Potato Center (CIP) is involved in seed systems in the Andes working with producer groups or NGOs to multiply potato seed; the seed is certified through various schemes such as quality declared seed, which was developed by the Food and Agriculture Organization of the UN (FAO).⁸

Community seed banking for food and seed security

Community seed banks have contributed to maintaining, restoring and increasing genetic diversity at local and national levels, improving access to and availability and use of local varieties in particular, reviving and reinvigorating traditional cultivation practices, diversifying production and consumption,

and generating income. For example, the Jogimara community seed bank in central Nepal, established in 2009 with the technical support of the Nepalese NGO Local Initiatives for Biodiversity, Research and Development (LI-BIRD), maintains varieties of the major crops in the area, including 11 varieties of irrigated rice, five upland rice varieties and two maize varieties. It also maintains a large collection of neglected and underutilized species, including several types of minor millets, beans, gourds, oil crops, cowpea and pumpkin. Farmers managing the seed bank place high value on these crops. For example, finger millet has a high iron content which is good for pregnant women. There are also local crops that are drought tolerant and others that improve soil fertility. Seed conservation and exchange practices are supported by new agricultural management practices, such as integrated pest management and the production of home-made pesticides. In 2012, farmers in Jogimara discovered another utility of the community seed

bank: many hybrid maize plants died because of drought, but the local varieties still stood. Following the drought, the demand for seeds of local maize varieties surged.⁹



Conclusion

This brief has highlighted a nascent trend in the creation of novel research strategies and related partnerships to sustainably use plant genetic diversity to address challenges associated with rural development and climate change. These initiatives can involve international research organizations working in close partnership with farmers' and community organizations (along with national agricultural research organizations) to support them make the most of locally-sourced diversity or obtain and use improved materials from outside their local seed systems. They are also often community developed and led. The cases highlight diverse ways of sustainably using plant genetic diversity to adapt to climate change and to involve local people in such activities. They also highlight the importance of strengthening and building upon local institutions, capacities and priorities as part of promoting sustainable use of crop diversity. We hope that the programme of work on sustainable use developed by the Ad Hoc Technical Committee on Sustainable Use, for consideration by the Treaty's Governing Body, will reflect these initiatives and the forward-looking manner in which they promote sustainable use of plant genetic resources.

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Endnotes

- 1 The paper builds on research that the authors and partners are carrying out on the impact of changes in climate and policies on the flows and uses of plant genetic resources around the world. See López-Noriega et al. (2012)
- 2 See ccaafs.cgiar.org/.
- 3 See ccaafs.cgiar.org/our-work/research-themes/progressive-adaptation/climate-analogues.
- 4 For examples, see: <http://agrobiodiversityplatform.org/cropbiodiversity/>.
- 5 For more details about the research in Guangxi, see Song and Vernooy (2010), Li (2012) and Vernooy (2012).
- 6 See http://www.bioversityinternational.org/announcements/seeds_for_needs.html.
- 7 See: <http://www.trust.org/alertnet/blogs/climate-conversations/reaching-small-farmers-with-innovations-they-can-afford/>.
- 8 See: <https://research.cip.cgiar.org/confluence/display/redlatinpapa/Inicio>.
- 9 See the full Jogimara story at: <http://www.bioversityinternational.org/index.php?id=6686>.