Using crop diversity to adapt to climate change: highlighting the importance of the Plant Treaty's policy support

Introduction

Climate changes are having significant, often negative, impacts on farming systems around the world. It is predicted that the tropics, in general, will suffer the most from the effects of increased and sporadic temperature spikes, and decreased and sporadic precipitation (IPPC 2007; Gornall et al., 2010). In many areas, the crop varieties and species currently grown by farmers cannot tolerate these stresses, with resultant losses in productivity, and potentially negative consequences for food security.

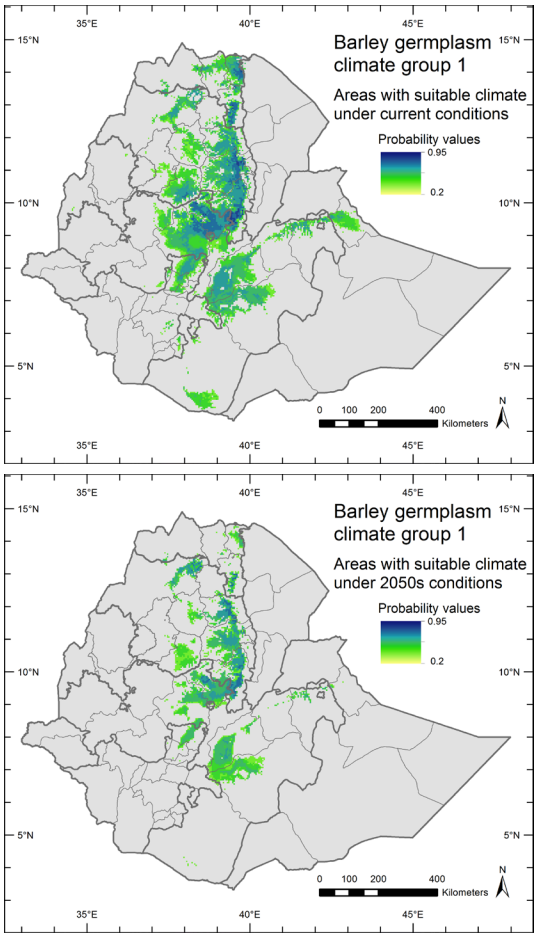
One strategy for responding to this situation is to look for adapted germplasm (in farmers' fields and genebanks) that have evolved elsewhere, under similar climatic conditions to those in areas currently under stress. Once identified and obtained, the populations, varieties or species concerned can be evaluated on site, working closely with farmers and national agricultural research organizations. Materials that perform well and are accepted by the farmers can be enhanced and made available for use.

This strategy reflects the fact that, as climate change related stresses exceed the adaptive capacity of crops grown in particularly vulnerable areas, the countries affected will become increasingly dependent on germplasm of crops, forages and wild relatives that have evolved in other parts of the world, possibly in neighbouring countries, or on other continents (Ramirez-Villega et al, 2013; Vermeulen et al, 2013). The ability of farmers, plant breeders and natural resource managers to identify and access such germplasm is becoming increasingly important as climates continue to change.

This brief highlights efforts in East Africa and in Asia, Pacific and Oceania (APO), supported by two internationally funded projects, to develop user-friendly tools and methods to identify germplasm of populations/varieties/species that are adapted to the changing climates of areas where farmers' cropping systems are already under stress. The brief highlights the importance of the Plant Treaty's policy support for these activities.

Mining genebank diversity for adaptive traits in East Africa

With support from the 'Seeds for Needs' project[1], multi-stakeholder research teams from Kenya and Tanzania, supported by Bioversity International, have been combining scaled-down (high resolution) data on climate change, with data on crop suitability, geographic information, and genebank accession collection coordinates to identify genebank materials that are good candidates for being adapted to the climatic conditions in selected, vulnerable, reference sites in Kenya and Tanzania. To date, their focus has been on the diversity of sorghum, pigeon pea and cowpea that were originally collected from within Kenya and Tanzania, and are currently conserved in their national genebanks.



Combining geographic, climatic, crop adaptation and collection data to identify clusters of barley genebank accessions in Ethiopia.

Farmers, national and international scientists at the opening of the community genebank in Kanwohe.

Farmers selecting seeds from the available stocks.

Accessions were identified as being potentially well adapted to recently changing climatic conditions in reference sites in Kenya and Tanzania. The sites were selected to cover a broad range of climatic conditions, from very dry in Hombolo (Tanzania) to mild drought conditions in Morogoro (Tanzania) and Katumani (Kenya) and to wetter conditions in Arusha (Tanzania). The goal was to identify clusters of accessions of the three crops that perform well under these different conditions. In 2013, the research teams from the two countries exchanged samples of the identified accessions, using the standard material transfer agreement (SMTA) adopted for use in the Plant Treaty's multilateral system of access and benefit sharing.

The materials have since been planted in a range of different sites, and are being evaluated by the research teams. So far, the materials have been tested over the course of just one cropping season in research stations. While it is still early days, the result are promising as different groups of accessions performed very differently in terms of germination rate, days to flowering and maturity and yield, with a clear effect of climatic conditions on those traits. These results, when further elaborated, will allow the research teams to validate the model used to identify accessions from the gene bank and to know which varieties to test with the farmers in the next trial season at the different locations.

With support from the Genetic Resources Policy Initiative[2] (GRPI 2), research teams in Uganda and Rwanda have engaged in similarly inspired work. The two countries have exchanged bean germplasm, using the SMTA, from their national genebanks, which are being subjected to trials in different agro-ecological zones. The research teams are also expanding their search for potentially adapted germplasm to *ex situ* collections hosted by the CGIAR centres, USDA, and in European countries, and a database of variety evaluation trial results (Ag Trials). The project is also working to strengthen the capacity of mixed teams of people from national researcher, farmer, civil society organizations to use the requisite tools in the future. The research teams are also investigating exchanges of adapted materials between community genebanks in the two countries. In September 2013, members of the Rubaya community genebank in Rwanda visited the Kabwohe community genebank in Uganda. Researchers, breeders, crops scientists, and climate change specialists discussed with smallholder farmers the climate-related stresses they are experiencing. Using participatory methods, they identified varieties of beans that Rwandan farmers would like to experiment with in their own sites. There are unanswered questions about the processes and permissions that the genebanks need to go through to make the exchange, since the community genebank materials are not automatically included in the multilateral system in either country. The genebanks are working with national agricultural research organizations, NGOs and national competent authorities to understand the applicable rules and processes.

Engaging farmer networks in participatory evaluation of potentially adapted materials in APO

As part of 'Seeds for Needs' in India (Mathur 2013), a range of research partners[3] are working together in seven districts in Bihar and Uttar Pradesh to introduce and evaluate several traditional and improved rice and wheat varieties which were released over the past 18 years for cultivation under different agro-climatic zones

Farmers observing performance of wheat varieties in Bihar, India.

NARI staff introducing new taro diversity to farmers in Pohom, Papua New Guinea.

of India. Wheat varieties were grown and evaluated by 30 farmers across three villages during Rabi (post rainy season) in the initial trials in 2011-12. Based on the success of these initial farmers' field trials, in 2012-13 the farmers' networks increased to 800 wheat farmers in the Rabi trials and 1200 rice farmers in the Kharif (rainy season) trials. The number of varieties tested is increasing every year by adding new varieties for testing and rejecting varieties that farmers have screened-out through participatory varietal selection (PVS). Data collected from the trials shows that most of these varieties are performing on par with, or better than, the recommended varieties that farmers had been growing in recent years. Training of farmers for quality seed production and establishment of community seed banks are in progress, which will strengthen local seed system.

In Papua New Guinea, a 'Seeds for Needs' initiative has helped local farmers adapt to climate change related stresses to taro and sweet potato production systems (in Intoap and Pohom, and Ifiufa and Aseranaka, respectively). Climate-matched varieties were provided by the National Agricultural Research Institute (NARI) for on-farm trials and subsequent enhancement by farmers, successfully linking *ex situ* material to on-farm conservation. 'Seeds for Needs' initiatives are also being piloted in the Mekong River basin of Cambodia and Laos to help local farming communities adapt to climate change by identifying resilient varieties of relevant crops like taro, sweet potato and cassava in Cambodia, and rice, maize and mungbean in Laos. It is anticipated that climate ready varieties will be exchanged between Papua New Guinea and other Melanesia countries. Similarly it is expected the exchange of germplasm between Cambodia and Laos will follow the identification of useful, adapted materials.

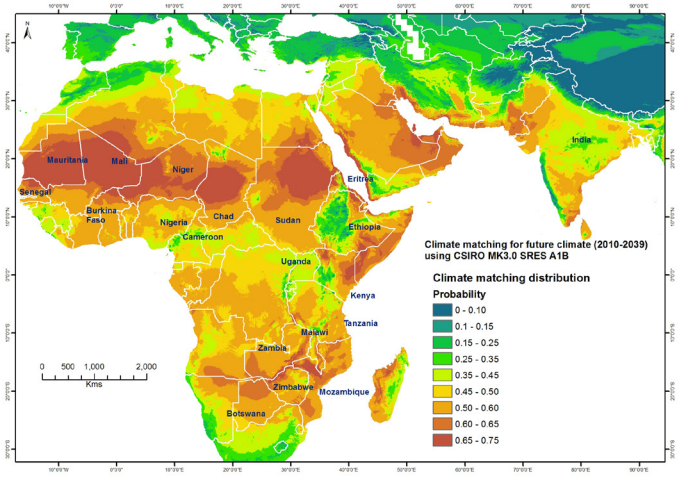
An intercontinental, south-south, technology transfer initiative

The Indian Council of Agriculture Research (ICAR), the National Bureau of Plant Genetic Resources (NBPGR) and Bioversity International are currently exploring development of a south-south technology transfer initiative, to identify PGRFA from India that may be adapted for use in parts of Africa where climates are becoming more similar to the conditions under which the Indian germplasm evolved (and/or for which it was bred). Initially, the focus will be on small millets, pearl millet, sorghum, beans and minor pulses. In the initial stage, geo-reference data is being assigned and mapped. Thereafter, accessions from the geo-referenced database will be identified that match the growing conditions in different regions in Africa following similar a 'clustering' methodology described for work in East Africa and South Asia above. The seeds of those populations/varieties that are available from matched climate sites in India can then be transported to Africa for testing. Most of the PGRFA concerned will be part of the multilateral system and will therefore be transferred using the SMTA. Modalities for transfer of non-Annex 1 materials are yet to be determined.

The importance of the Plant Treaty's policy support

The activities described above involve combinations of sustainable use, complementary *in situ* and *ex situ* conservation, farmers' rights, technology transfer, climate change adaption, access and benefit sharing, and international cooperation. On one hand, as such, they explore and promote mechanisms for the implementation of articles 5, 6, 7, 8, 9, and part IV of the Plant Treaty within the countries and subregions concerned. On the other hand, these projects simultaneously benefit from the profile, 'political space', policy support and momentum that attends a country ratifying the Treaty, even though most countries are still in early stages of implementing it.

The projects position vis-à-vis the multilateral system illustrates this point. The uses of PGRFA in the 'Seeds for Needs' initiatives fall squarely within the purposes of the multilateral system of access and benefit sharing. It is enormously helpful to the research partners involved to know that their governments (and their partners' governments) have already committed themselves to participating in the multilateral system, and that it is a relatively simple matter to confirm – as an incident of



Map showing similar climate conditions across Africa and South Asia in 2020s

the project – that the material they are providing and receiving can/should be transferred using the SMTA. While the projects have provided contexts for some of the countries concerned to make progress implementing aspects of the multilateral system (for example, using the SMTA for the first time), the projects have simultaneously benefited from the existence of the multilateral system. In the absence of the multilateral system, it would have taken a lot more time and effort to launch these activities, or it may have been impossible. As more countries make more substantive progress implementing the multilateral system, it will become still easier to develop truly international projects with countries exchanging and using crop diversity to respond to climate change related challenges.

In closing, it is important to point out that some of the earlier piloting of the 'Seeds for Needs' concept was in India, with support of two grants from the Treaty's International Benefit Sharing Fund. Again, the project helped to identify/define useful ways for mixed teams of international and national researchers, farmers and CSOs to promote sustainable uses of crop diversity to address climate change. At the same time however, it was the existence of the BSF, and the categories of proposals that it called for that set the stage, and supported the subsequent work.

End notes

1. The first 'Seeds for Needs' activities in East Africa were in Ethiopia, where research teams identified candidate varieties in the Ethiopian genebank for evaluation in vulnerable areas within the country. More recent 'Seeds for Needs' work has expanded in scope to work at a sub-regional level, for example, the joint work of partners from Tanzania and Kenya described above. Bioversity International provides technical support for the 'Seeds for Needs' project activities as part of the CGIAR's Consortium Research Programme on Climate Change, Agriculture and Food Security. For more information about 'Seeds for Needs projects in East Africa and Asia, Pacific and Oceania, see http://www.bioversityinternational.org/research-portfolio/adaptation-to-climate-change/seeds-for-needs/
2. The GRPI 2 project supports research and capacity strengthening of eight countries -- Uganda, Rwanda, Cote d'Ivoire, Burkina Faso, Costa Rica, Guatemala, Nepal and Bhutan -- to implement and participate in, the multilateral system of access and benefit sharing of the Treaty. As part of their work, partners are researching the extent to which their countries concerned are already, and are likely to become even more, dependent on foreign-sourced germplasm as a result of climate change, identifying potentially useful adapted germplasm, and seeking to obtain and evaluate it through the multilateral system. For more about GRPI 2 see http://grpi2.wordpress.com/about/grpi-2/
3. 'Seeds for Needs' initiatives in India are coordinated by Bioversity in partnership with the Indian Agricultural Research Institute (IARI), National Bureau of Plant Genetic Resources Institute (NBPGR), Humana People to People India (HPPI), Gene Campaign and several small, local organizations.

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