

Conserving crop diversity: navigating politics and climate change to create a global system

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INTRODUCTION

One should always beware uttering the words, “it’s different this time.” And yet, we might be forgiven for believing that the long list of serious challenges confronting agriculture today does constitute an historically unique situation. The world’s population is still rising, and significant portions have become more affluent, putting additional demands on the agricultural system, in particular on grain production. Increasing demand, problems with productivity and low stockpiles are combining today to create what the media and politicians call a world “food crisis.” And yet, looking into the distance, one could make the argument that the situation could deteriorate further.

WATER

Agriculture faces unpredictable, and in many areas, declining availability of water. Aquifers are being emptied at rates far in excess of replenishment in important farming regions around the world. One hundred million people in China are already fed by food produced with the water drawn from aquifers in excess of replenishment rates [1]. A harbinger of the future, Saudi Arabia is poised to abandon wheat growing 2016 when the underground aquifer it has been mining dries up. Every aquifer, however, has its own “countdown to extinction,” as Fred Pierce notes.

ENERGY

Energy prices are historically high. Rapid and steep increases have sent a shock wave throughout the agricultural system, as they directly affect everything from inputs such as fertilizer to food processing and transportation. While energy prices may dip at some point in the future, supply/demand imbalances seem certain to make the price trend upwards over time. Remaining supplies will be harder to extract, demand will rise. It seems unlikely, therefore, that we will ever return to the era of cheap fossil fuels. Thus, agriculture will need to adjust and adapt to expensive energy and even to constraints in supply.

CLIMATE CHANGE

Finally, there is the matter of climate change. Extremes in temperature and rainfall (or lack thereof) consistent

with commonly accepted models of climate change have already created serious problems for farmers from Australia to the U.S., to China, to Ethiopia. Models for 2030 and beyond indicate that climate change will – unless measures are taken to prevent it – lead to substantial productivity declines in southern Africa [2]. Well before the end of the century, the bell-shaped range of average growing season temperature in many countries will not overlap with those of the last 100 years [3].

Existing crop varieties will not simply migrate to new regions in search of more favorable temperatures. Were they to do that they would likely encounter different photoperiods, different rainfall patterns and quantities, and differences in soils, pests, diseases, and in farming cultures and knowledge. Instead, new varieties – radically new varieties in some instances – will be required for the transition. This will be particularly difficult to achieve with the so-called minor crops in which the number of breeders is small. The task for all breeders will be further complicated if genetic resource collections are not complete, well documented and available.

CROP DIVERSITY – TOWARDS A RATIONAL SYSTEM

Regions, countries and even individual crop improvement efforts are strikingly interdependent in regards to the crop diversity that underpins agricultural systems and breeding programs. No country is self sufficient in terms of the genetic resources it is employing today or is likely to need in the future. Even large genebank collections typically contain only a small portion of the number of samples held globally. Australia is a good example. Its collections hold 3% of the wheat samples found in genebanks globally. Ask anyone here whether they are confident that Australian wheat production could continue to be on a sound footing were it to be based solely on this 3%, and the response would certainly be “no.”

Not surprisingly, flows of genetic resources between countries are significant, though in recent years political and legal impediments have combined to complicate and impede these flows.

Given the importance of plant genetic resources to agriculture and the high level of interdependence, one

could expect that their conservation and availability would be systemized and ensured. And yet, viewed from a global perspective, one finds a plethora of uncoordinated, *ad hoc* activities. There are more than 1000 institutions/collections globally. Few have ever engaged with each other in an exercise aimed at rationalizing their holdings or coming to an agreed division of labor, expect perhaps within national borders. This situation is not only unfortunate; it is dangerous and unsustainable.

Since 1980, the number of institutions engaged in conservation work has increased substantially. The number of samples held has increased dramatically – tripling in this period – despite the fact that only a small portion of the increase can be attributed to collecting. In other words, duplication – intended and unintended – accounts for most of the growth in numbers of stored samples in the last 30 years. Most collecting these days is done by email.

Unfortunately, newly established national genebanks often discover that it is easier to obtain funding to build an impressive new facility and to stock it with materials accessed from others than it is to secure the funding to keep the facility running, to perform regeneration and seed increase, to characterize and evaluate holdings, to construct a documentation system that serves the interests of breeders and researchers. All too often one sees the results of a noble idea gone sour: a decaying facility incapable of providing long-term conservation for its crop diversity and equally incapable of supplying materials to users. The problem is not that “biopirates” are sneaking in the back door (they aren’t); it’s that no legitimate users are coming in the front! One wonders when someone from the Finance Ministry will appear to pull the plug. The lights are rarely turned off, but they are dimmed. Chronic underinvestment in such facilities leads to a certain amount of desperation on the part of genebank managers, and this in turn helps fuel political calls for the international community to “do something” (provide funding) that national authorities are unwilling or unable to undertake – funding to maintain facilities that are not used, to maintain samples held by other better maintained genebanks.

This is perhaps a harsh assessment. There are exceptions – good facilities, and hard-working professionals functioning well in difficult circumstances. But, this is not the norm. And the situation is deteriorating. FAO surveys of genebank managers provide quantitative evidence of this.

We should be asking, therefore, whether the problem lies in the lack of funding for all the individual facilities, or whether instead it lies in the lack of a coherent vision and plan for a rational, effective, efficient and sustainable system. Would more funding of the *ad hoc* approaches we have now produce “success?” Is it even feasible that this scale of funding could be obtained? If it

is not, what are the “opportunity costs” of pursuing current unworkable approaches at the expense of developing a more rational and coordinated global system?

At the Global Crop Diversity Trust, we have roughly estimated that an endowment of \$300 million would generate enough income to ensure the conservation and availability of the diversity of major crops, in perpetuity. There are caveats. One is that funding would not be needed to finance conservation activities undertaken by developed countries. Meeting national needs in such countries has the additional benefit of serving global needs without recourse to sparse international funding.

The other big caveat is that the global system would be built around conserving and making available “unique” germplasm in as effective and cost-efficient manner as possible. In other words, the system would not attempt to ensure the continued existence of all crop diversity by guaranteeing the continued existence of all current and future institutions calling themselves genebanks. Nor would it necessarily attempt to conserve each distinct genotype, particularly in the case of clonally-propagated crops where per-accession conservation costs are especially high.

The Trust estimates that a strategy based on underwriting all (non-developed country) institutions currently housing collections and all of the many duplicate accessions (some duplicated 200 times or more) would require an endowment of approximately \$13 billion. Clearly, crop diversity can be conserved long-term and provided to users by fewer than 1000 institutions.

Adopting a strategy requiring a \$13 billion endowment is not an option, when a more effective and sustainable option exists for a fraction of the cost – literally 2 to 3% of the cost. It not an option when we don’t have the option of failing to get our collections and agriculture ready for climate change, ready to feed a growing world population.

The good news is that steps are now being taken, building on the previous work of collectors, genebank managers, information specialists, plant breeders and policy makers – and farmers – to construct a real system that really works.

Step one involves making an initial assessment of where the most important and vulnerable collections are, crop-by-crop, and taking immediate measures to regenerate, safety duplicate and secure this diversity. The Trust has provided support to experts in more than 20 crops to develop global strategies, including identifying such collections.

Step two involves identification of equally endangered diversity found typically in smaller numbers in smaller collections. Crop and regional networks are well placed to work with national programs and to prioritize activities. The Trust is providing financial and technical support to regenerate samples held in priority collections and those identified through networks.

Step three involves development of appropriate information and information systems. This means learning more about the genebank accessions themselves – an exercise that could, where feasible, be focused on traits of high priority (e.g., heat and drought resistance). It also means developing the software tools – for genebank management, and for globally searching of multiple genebank holdings – that will facilitate good management and effective use. Again, the Trust is providing support for such initiatives.

Finally, secure conservation requires secure funding. Secure funding can only come through a financial mechanism such as an endowment that generates income reliably and consistently. The Trust is structured as an endowment. The current size of this endowment allows the Trust to provide almost \$2 million annually in grants for long-term conservation. Additional, project funding from the Trust (not drawn from the endowment) is financing the other activities (steps 1-3) outlined above.

CONCLUSION

If agriculture does now face an historically unprecedented combination of challenges, and if, as I have argued, the agricultural community is not fully prepared to meet these challenges, then it behooves us to focus, set priorities and rigidly adhere to pragmatic approaches. In the area of crop diversity, this means constructing a global system that is based on cooperation and a rational division of labor. Anything beyond this is a luxury we most certainly cannot afford.

With the new International Treaty on Plant Genetic Resources, we now have the legal framework for a global system. The technology exists to conserve the diversity of most crops very efficiently. Institutions are in place. The insurance policy for genebanks, the Svalbard Global Seed Vault, is operating. And, we are building the political will and the financial resources to get the job done – to finish and fund a global system. With perseverance, we will succeed, and we will help ensure that agriculture is ready to promote development, provide food security, and help humanity adapt to climate change and a new age of resource constraints.

REFERENCES

- 1 Pearce, F. 2006. *When the Rivers Run Dry: what happens when our water runs out?* London: Transworld.
- 2 Lobell, D., et al. "Prioritizing Climate Change Adaption Needs for Food Security in 2030." *Science*. Vol. 319. No. 5863. 1 February 2008. Pp. 607-610.
- 3 Naylor, R., et al. *Conservation of Global Crop Genetic Diversity in the Face of Climate Change. Summary Statement from a Bellagio Conference. 3-7 September 2007.* Co-published by Stanford University, Global Crop Diversity Trust and the Rockefeller Foundation.