THE CHATHAM HOUSE DIALOGUE ON CROP DIVERSITY FOR CHALLENGING TIMES

The Role of Genebanks in Sustainable Development

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What is the future of the international genebanks managed by CGIAR?

This may be considered an odd question to ask in the middle of a pandemic, but it is in fact very timely, for both endogenous and exogenous reasons. Looking inward, the genebanks are coming to the end of a decade of secure funding and closer collaboration under the Genebank Platform, supported by CGIAR and the Crop Trust Endowment Fund. The Platform as currently configured is due to terminate at the end of 2021, coinciding with a radical, far-reaching restructuring of CGIAR as a whole, dubbed "One CGIAR." Looking outward, the pandemic has focused minds on the need to mitigate unexpected risks. The world is changing, and changing fast, in ways that are hard to predict but will surely affect agriculture and food systems everywhere, fundamentally in many cases. At the same time, equally rapid technological change presents unprecedented opportunities for agricultural research in general and genebanks in particular.

It is thus absolutely the right time to ask what lies in store for the custodians of the largest, most diverse and most widely used collections of germplasm of the world's most important crops.

That is why it has been a critical part of the work of the Genebank Platform in the past few months to commission a panel to carry out a System-level Review of Genebank Costs and Operations (GCO). A Panel was set up comprising representatives of the Crop Trust, CGIAR and the Plant Treaty Secretariat (working in their personal capacities), as well as two external experts. The GCO Panel was tasked to revisit the questions of how the CGIAR genebanks operate and what they cost, based on a recent update of the costing study originally carried out in 2009, and to provide recommendations directed at the CGIAR System and the Crop Trust for the prioritization of future operations and funding.

Genebank staff inspect *in vitro* samples at the International Potato Center (CIP) in Lima, Peru (Photo: Crop Trust).

At its first meetings it became apparent that if the Panel was to make recommendations about future priorities, it needed input from a wider range of stakeholders. It was necessary first to address the question of what the future might bring and how this might impact both the demands made of genebanks and how such demands are met. This would clearly be of interest to the whole international community working on plant genetic resources conservation, exchange and use through the Plant Treaty. From these considerations was born the idea of the "Chatham House Dialogue on Crop Diversity for Challenging Times: The Role of Genebanks in Sustainable Development."

The Dialogue comprised three separate sessions, held online on 21–23 September 2020, that aimed to build a vision of how genebanks in general, and those of CGIAR in particular, can play a fuller and more effective role in helping agriculture meet future challenges. Overall, 26 strategic thinkers with a wide range of relevant expertise took part, along with eight GCO Panel members (see Participants List at the end of this document).

The three sessions were framed around the following key questions:

1. How might food systems evolve?
2. How will technological and policy changes impact how we conserve and use crop diversity?
3. How can we ensure the CGIAR genebanks are fit for purpose in a changing world?

What follows is a summary of the discussions around each of these three topics.

How might food systems evolve?

During the first session we heard, in a stimulus talk by Prof. Tim Benton, that change is inevitable, but that we should not assume that it will simply be an extrapolation of past, or even current, trends. Rather, the times ahead will be characterized by turbulence, uncertainty, novelty and ambiguity (TUNA).[1] As agriculture and food systems change, in ways we cannot predict or even imagine, we must ensure that they do not perpetuate existing imbalances and exclusions, and in particular that they better serve the powerless and marginalized. Crucially, environmental externalities must also be properly addressed: as one participant remarked, we must not let agriculture become the "new oil" among the drivers of climate change.

A genebank technician at the International Livestock Research Institute in Addis Ababa, Ethiopia inspects one of approximately 19,000 genebank accessions (Photo: Crop Trust/Shawn Landersz).

How can crop diversity support positive change? Perhaps the most important axis of potential change ranges from food systems with a focus on calorie productivity, and high external costs on human health and the environment, at one end, to ones that provide nutrient-rich diets to all, in a sustainable way, at the other. Different parts of the world may well go in different directions, with intensification prioritized in some countries or regions and diversification in others; with a focus on calorie-rich staple crops here, and on nutrient-dense orphan crops there. Certainly, starch staple production by smallholders is likely decreasing in its importance to both the consumption and the livelihoods of the poor in many parts of the world. In the words of one participant: though starchy staples will remain important, "to the extent that our goal is to support smallholder farming systems in the developing world, we should probably be paying far more attention to the role of cash crops, horticulture crops, animal agriculture, and trees." But whichever path is taken, many participants noted, crop diversity will be equally necessary.

In these circumstances, indeed, conserving crop diversity is the ultimate option to ensure "no regrets." If it is useful in good times, it is absolutely essential under TUNA conditions. The participants could not

[1] Rafael Ramírez & Angela Wilkinson (2016) Strategic Reframing: The Oxford Scenario Planning Approach. DOI:10.1093/acprof:oso/9780198745693.001.0001

envisage any future scenario, at whatever scale, in whatever part of the world, in which agriculture's need for crop diversity—whether intra- or inter-specific—was likely to decrease. There will be changes in the nature of the demand, for sure, but not an absolute decrease. Countries, institutes and people are in fact likely to become ever more interdependent for crop diversity, and not only because of climate change, but also because of changes in pests and diseases, in consumer demand, and in trade, to name just a few major drivers. Interdependence requires shared governance and trust, which led to a plea from one participant that researchers become more politically active.

Crop diversity embodies the ability of agriculture to respond to whatever future scenario actually unfolds. At the same time, the diversity that for the time being continues to be found on some of the world's smallholdings will likely continue to disappear (one participant spoke of a "mass extinction" on farms), as climates, land use patterns and diets change.

Erosion on farms, unpredictable changes in demand: genebanks are made for this situation. And, in addition, as one participant pointed out, they can help reconnect people with local production and nature, something we all could do with. But they cannot do it on their own. They are a necessary part of the solution, but not sufficient. They need to be team players: "Genebanks cannot fix everything—they are not the silver bullet to 'transform' food, land and water systems—but they are absolutely essential to that transformation."

Certainly, the international genebanks cannot do it on their own—an active partnership with the huge diversity of national and other genebanks is necessary, implying division of labor, attention to subsidiarity, and a clear, mutually agreed strategy. The question was pointedly asked: who do genebanks serve? National genebanks must prioritize serving their countries. According to the current legal framework, the CGIAR genebanks must serve everyone.

A staff member at the International Rice Research Institute (IRRI) in Los Baños, Philippines prepares rice samples for a seed germination test (Photo: Cary Fowler/Crop Trust).

In a world where multilateral decision-making is increasingly being marginalized, and the power of national governments, individuals and private enterprise is increasing, and in which the "burning sense of injustice" (as one participant described it) felt by the global South is far from assuaged, the international genebanks remain a bulwark of multilateralism, their role embedded in international law. However, they are not immune to these trends and will have to learn to remain effective in what is likely to be an unstable and uncertain international policy environment.

How will technological and policy changes impact how we conserve and use crop diversity?

Having discussed the political, social and economic environment in which they have to operate, and the likely demands that will be placed on them, on the second day participants discussed how genebanks must change in order to stay relevant in TUNA times. On the table was a vision of the genebank of the future presented by Dr. Ruaraidh Sackville Hamilton.

The objective, he said, must be for genebanks to conserve the right resources, and deliver them in the right way. Given the speed of advance in the field in the past 30 years, Sackville Hamilton is hopeful that, in the next 30 years, genebanks will have catalogued all functional variants of all genes for all accessions in their collections. This will allow an estimation of the "future value," "heritage value" and "current value" of accessions, he said, and the tailoring of the management of different accessions to reflect these values, supported as appropriate by the automation of some key genebank operations.

This provoked much discussion in the group. Many participants agreed that the key responsibility of genebanks is to ensure that we do not lose genetic material that could prove useful in the future in ways that we could not possibly know now ("future value"). However, one participant noted that: "This role gets undervalued if we focus on the more immediate utility, or (frankly) if we allow breeders to define the role of the genebanks." On the other hand, current demand must also be satisfied, or nobody will believe that future users will be satisfied either. Optimally deploying limited resources to address this conundrum constitutes the science of running a genebank.

In vitro samples of yuca at the Internatonial Center for Tropical Agriculture (CIAT) in Cali, Colombia (Photo: Crop Trust).

In parallel to running genebanks, though, research will continue to be necessary to support optimization of genebank processes, for example on seed longevity, cryopreservation and phytosanitary issues. And, everyone agreed, genebanks must continue to remain engaged in policy discussions and responsive to any new policies adopted.

The generation and management of knowledge are thus the key drivers of the evolution of genebanks.

Start with genotyping. Although the ambition to fully sequence all the accessions in genebanks was enthusiastically endorsed—it was in fact seen as a "must-do" —there was much discussion about how the resulting data should be managed. "Genotyping data is forever," a participant said: we have to get it right, right from the start. Federated, distributed systems involving

genebanks, breeders and other researchers will be necessary, but there is little evidence that the investment to adequately develop existing systems and make them fully interoperable is forthcoming. And, as one participant pointed out, "lack of progress on policy issues is hindering innovation, despite the fact that, in many cases, wise use of technology could help meet policy goals."

Phenotyping was also much discussed. Innovations such as high-throughput phenotyping and field evaluation using robots and drones were seen as great opportunities, but there was some debate about the extent to which genebanks themselves should be the ones to take them. There has perhaps been too much ad hoc, "because-it's-there" phenotyping by genebanks in the past. "Second-guessing what users want is a mistake," one participant said. In the future, phenotyping must be more collaborative, strategic and cost-effective, and will be used in interesting combinations with genetic, geographic and socioeconomic data. In particular, genotyping needs to be used to target specific subsets of germplasm for phenotyping. Frontrunner crops will break ground, and relatively minor crops can benefit from the knowledge generated and the mistakes that will inevitably be made.

The sort of "digital genebank" all this implies will certainly facilitate use of the conserved materials by researchers and breeders; it may even be essential to fully effective use. But will it be enough?

In answering this question, it is important to first note that international genebanks are in fact already being used, and used extensively. They are demonstrably not "just museums." The fact that this tired trope is still occasionally used means that the true extent of the use and impact of genebanks needs to be better documented and communicated. Not only are genebanks being used, but they are being used by those that arguably need them most. Some 85% of distribution from CGIAR genebanks are to the public sector in developing countries and, as one participant suggested, this niche should be embraced, and indeed celebrated.

Can more be done to stimulate use of conserved diversity? Participants made a number of suggestions, ranging from knowing your "clients" better, to developing special germplasm populations through pre-breeding, to stimulating feedback of information from users, to streamlining phytosanitary processes. They agreed that there is a great opportunity for genebanks, and in particular the CGIAR genebanks, to be more proactive, and indeed show leadership, in areas such as data standards and integration, conservation research, pre-breeding, policy and advocacy. The tremendous capacity of the CGIAR in moving germplasm around the world also depends on due attention being paid to phytosanitary needs. This is emphatically not the minor, peripheral issue it is sometimes treated as.

One doubt perhaps lingered. For one participant, the bottom line was simple: "…it's about enabling [a] diversity of farmers to make informed choices on which materials, and/or combination to use." But is that something for the CGIAR genebanks? For national genebanks? Or for both?

How can we ensure the CGIAR genebanks are fit for purpose in a changing world?

On the third day of the Dialogue, participants tried to synthesize their conclusions from the previous two days and focus on what these meant for the CGIAR genebanks in particular. The genebanks need to conserve and deliver the right physical and digital resources in a way that is most helpful to those who need them, now and into the distant future. The diversity needed and the delivery mechanisms are changing rapidly and unpredictably, and CGIAR has to meet the needs of multiple—and changing—client groups. Modern technologies and management methods have the potential to contribute greatly to increasing the cost-efficiency and effectiveness of genebank operations, though deploying them entails significant upfront costs. But no genebank needs to do everything; opportunities abound for strengthened partnerships and collaboration at all levels, including private–public partnerships.

So what do the CGIAR genebanks need to do more of, and indeed less of? And how can they better work together?

We were all united that diversity among and within crops is going to be vital in any kind of future scenario we might imagine, and that genebanks, both international and national, will continue to have an important role in conserving it, adding value to it and making it easily available to users.

Probably, in fact, an increasingly important role. This may seem self-serving, but it is perhaps worthwhile to attempt the following thought experiment. Under what future scenario would one be willing to lose forever a collection of a crop, whether a starchy staple or a local fruit or vegetable? It is hard to think of one.

Rows of samples at the International Maize and Wheat Improvement Center (CIMMYT) genebank in Texcoco, Mexico (Photo: Crop Trust).

There were in fact increasing expectations as to what genebanks can, and indeed should, do. From every corner of our Zoom screens there were calls for CGIAR genebanks to play a more proactive, strategic and catalytic role—in going digital, in moving materials around the world in the face of climate change and other demands, in enabling the development of more diverse farming systems, in promoting more nutritious agriculture, in conserving diversity that is going extinct. And to do this for the whole gamut of crop diversity, from staples to underutilized crops, from cereals to vegetables, from roots and tubers to fruits. A vision started to crystallize of CGIAR managing not just long-term storage facilities for crop diversity, but also multi-crop regional distribution hubs, two-way conduits of germplasm and information to and from national genebanks and other local stakeholders.

Thinking and acting more boldly and strategically requires leadership, vision, funding, trust and a theory of change. But the demand for it is there.

However, there were careful reminders that CGIAR cannot do everything: it does not have the capacity, nor is there a need. Partnerships, distributed systems and division of responsibilities are a must. For these to work, though, the governance and policy framework must be right. And, as ever, we must find a way to better understand, quantify and communicate the value of the contents, and of the work, of genebanks.

Conclusion

The Chatham House Dialogue on Crop Diversity for Challenging Times was wide-ranging, intense, detailed, visionary, but always respectful of the often contrasting points of view of different sectors, disciplines and regions. It has been indispensable to the GCO Panel in its reflections, reinforcing some ideas, and opening up new avenues of thought.

Where does it leave the CGIAR genebanks?

As of the end of 2020, the Crop Trust has built a USD 300 million endowment that could just about cover the most critical conservation activities of CGIAR seed banks, but it is not enough for more than that. A lot of progress has been made in the conservation of crop diversity in the past several decades, but—as was made abundantly clear—we need to make more: on cryopreservation, crop wild relatives, data management, and genotyping. The CGIAR genebanks need to be doing more than the ticking along that the current level of the endowment would allow.

To secure more of the funding the genebanks require if they are to be leaders in TUNA times, we will have to make a convincing case and some difficult choices. With the reform toward One CGIAR, there is an opportunity for bold steps. The Dialogue has renewed our determination to take them.

Participants List

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GCO Panel		
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