A global workshop to advance the implementation of the global conservation strategy for coffee genetic resources

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Abstract

In 2017, the Global Crop Diversity Trust (Crop Trust) and World Coffee Research (WCR) published the Global Conservation Strategy for Coffee Genetic Resources (Strategy). This comprehensive study set out to identify where and how coffee diversity is being maintained around the world, including the constraints and opportunities coffee genebanks face. As a follow-up to the Strategy, the Crop Trust and WCR, with support from the United States Department of Agriculture Foreign Agricultural Service (USDA FAS), organized a virtual four-day workshop, July 12-15, 2021. The workshop gathered key stakeholders, which included 54 participants from 16 countries, to identify ways to best conserve and use coffee genetic resources. Topics included an update of the Strategy results and related sessions dedicated to a) the global system for coffee, b) in situ and ex situ collections management, c) quality management in long-term ex situ conservation, and d) use of collections. Over the four days, discussions led to the identification of priority actions with regards to financing, policy, partnership building, quality management systems, capacity building, communication and advocacy, gaps in collections, in situ and ex situ conservation and their complementarity, safety duplication, conservation of crop wild relatives, and establishment of a global platform.

Keywords: coffee genetic resources, conservation, conservation strategy, genebanks, global system

INTRODUCTION

The Global Conservation Strategy for Coffee Genetic Resources (Strategy) published in 2017 by the Crop Trust and World Coffee Research (WCR) is a comprehensive study that identifies where and how coffee diversity is being maintained around the world, including the constraints and opportunities faced by genebanks that conserve them (Bramel et al., 2017; Krishnan et al., 2018). The Strategy was developed after a thorough literature search and background study and a comprehensive survey sent to 31 coffee genebanks to understand the status of global coffee collections. Sixteen genebanks responded, and site visits were conducted to seven genebanks, an in situ forest site, and a private collection. Key findings from these activities were:

- Most of the world's coffee collections are not securely conserved or widely used;
- The collections are mostly nationally focused, serving as tools for national breeding programs;
- Most genebanks lack information systems;
- There is very limited access and exchange of material;
- There is little to no safety duplication or backup of collections;
- Most genebanks are challenged with insecure funding and land tenure issues;
- There are no standard horticultural management practices (e.g., weeding, pruning, rejuvenations, fertilization, replanting) across genebanks.

Based on the survey and site visits, six high priority action items were identified

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(Bramel et al., 2017; Krishnan et al., 2018).

1. Secure stable funding for long-term conservation. Three origin collections – a) Ethiopian Biodiversity Institute (EBI), Ethiopia; b) National Center for Applied Research and Rural Development (FOFIFA), Madagascar; and c) Centre National de la Recherche Agronomique (CNRA), Côte d'Ivoire – and an international collection (CATIE, Costa Rica) – were identified as high priority collections for which funding is needed to conserve coffee germplasm. There needs to be an annual disbursement of US$ 1 million for the four genebanks, or an estimated annual maintenance cost of US$ 250,000 each. To achieve this, the Crop Trust has established an endowment fund to raise US$ 25 million, which at 4% annual rate will allow the distribution of US$ 1 million;
2. Upgrade facilities and capacity. Operations, facilities, and capacity building need to be upgraded at these four genebanks to meet international standards;
3. Access and benefit sharing for germplasm exchange. Coffee is not a crop listed in Annex 1 of the International Treaty of Plant Genetic Resources for Food and Agriculture (ITPGRFA). Hence, for germplasm exchange, an Access and Benefit Sharing (ABS) framework for coffee that uses terms and conditions of the Nagoya Protocol needs to be developed through stakeholder consultations;
4. Link collections through partnerships and information sharing. The collaboration needs to be at a global scale. This will require sharing of accession-level information through platforms such as Genesys or GRIN-Global;
5. Safety duplication. There is an urgent need to ensure the safety duplication of all accessions in additional field sites within and outside the countries. Strategic research should explore cryopreservation and other complementary techniques. Protocols for safe transfer of planting materials should be developed;
6. Complementary in situ conservation. In countries where coffee grows naturally in national forests, genebanks should actively engage with in situ and protected area conservation. Genebank personnel expertise and germplasm materials can be used in reforestation and in situ protection.

As a follow-up to the Strategy, the Crop Trust and WCR, with support from the United States Department of Agriculture Foreign Agricultural Service (USDA FAS), organized a virtual four-day workshop, July 12-15, 2021. The main objectives of the workshop were:

- Foster communication and create cooperative relationships between nascent coffee genetic resource management efforts in the United States and those of key international cooperators;
- Allow technical experts to discuss and consider new challenges and opportunities as they relate to the global conservation strategy for coffee genetic resources;
- Update coffee genetic resource strategies and ensure complementarity.

MATERIALS AND METHODS

The workshop gathered key stakeholders to identify ways to best conserve and use coffee genetic resources. Topics included Strategy results and related sessions dedicated to a) the global system for coffee, b) in situ and ex situ collections management, c) quality management in long-term ex situ conservation, and d) use of collections. Fifty-four people from 16 countries across the globe participated, including representatives from the Origin Collections (Origin) genebanks and other national (user) collections, as well as researchers invested in the conservation of coffee genetic resources. Breakout sessions allowed for in-depth discussions among smaller groups on key topics.

Prior to the workshop, participants were sent three surveys. The first gathered information about the status of genebank collections and conservation activities. The second focused on genebanks' engagement with quality management systems (QMS). The final survey gathered information about participants' understanding and perceptions about a global system for coffee genetic resources.

RESULTS AND DISCUSSION

Through the dialogs conducted over four days, workshop participants expressed their views, shared concerns, and summarized updates on their current status and plans. One component focused on issues outlined in the Strategy to find tangible, measurable ways to develop a secure, cost-effective, and rational global coffee conservation system. This included detailed and frank discussions on everything from resource requirements to information management, from the implementation of international genebank standards to the need for proper access and benefit-sharing arrangements.

Based on discussions during breakout sessions of the workshop, priority actions for various genetic resource conservation activities were identified, as listed below.

Financing

- Use an international fund, such as the Crop Trust Endowment Fund, to allow stakeholders to contribute to the financing of genebank conservation;
- Allocate a portion of a royalty system to the genebank or solicit voluntary contributions from big companies, roasters, and even consumers;
- As part of an international fund, allow industry members or consumers to sponsor specific accessions with traits or origins of interest to be conserved in genebanks for future generations;
- Secure commitments on behalf of national governments to complement the commitment from the endowment fund.

Policy

- Build greater knowledge and understanding across the value chain of the benefits of exchange and the need to facilitate transparent and clear access and benefit sharing (ABS) framework arrangements for the long-term conservation and use of coffee genetic resources;
- Support the use of a more global system to monetize benefits for sharing germplasm and information with bylaws declaring what can and cannot be done with shared information;
- Support national legislation to encourage coffee conservation, intellectual property, and "right to use", and allow transfer of coffee material for testing in another country;
- Involve decision-makers (policy makers, coffee researchers, and coffee industry) to foster capacity building and secure funding;
- Implement policies to allow sharing of accession-level data;
- Create an information system to request accessions and share information;
- Foster multi-stakeholder sensitization on laws covering exchange of genetic resources;
- Plan a central repository to share all the laws, policies, agreements, and phytosanitary regulations related to exchange of coffee genetic resources;
- Support global engagement that focuses on conservation and use to benefit individuals and institutions.

Partnership building

- Apply the Centro Agronomico Tropical de Investigacion y Ensenanza's (CATIE's) review process and prioritization of accessions to other Origin collections and key users (Dulloo et al., 2021). This will help to rationalize the Origin collections' composition and increase the security of conservation operations, which will build evidence and increase support for action steps and associated costs;
- Increase opportunities for private industry to collaborate and build capacity;
- Use a standard genotyping platform to identify accessions' uniqueness, especially in Origin collections or other collections in East Africa with locally collected accessions; this will become the basis of a global initiative;
- Develop a standard protocol for establishment and monitoring of safety duplication sites and cryopreservation, which will become a global initiative to address the lack of

safety duplication.

Quality management systems (QMS)

- Standardize genebanks' collection management, curation, validation, and methods through global collaboration;
- Use standard language to describe and define conservation goals and operations; this will enable personnel to focus on validation versus verification;
- Develop standard operating procedures (SOPs) that are shareable and usable;
- Create operational maps for each coffee genebank that show processes, procedures, and their interconnectedness (Lusty et al., 2021);
- Conduct self-assessments against the eight essential QMS areas to aid in prioritizing activities and identifying strengths and opportunities in the QMS continuum (Lusty et al., 2021);
- Determine the amount of funding available and prioritize QMS activities;
- Initiate QMS implementation with easily completed activities that give the genebank a sense of achievement with minimum effort;
- Organize a series of capacity building workshops to provide equivalency across centers and train genebank personnel in key genebank topics;
- Select key performance indicators (KPIs) and targets that are meaningful and achievable for the coffee community.

Capacity building

- Agree upon global activities – through group training or specialized individual training – such as capacity building in barcoding, risk management, curation, and characterization;
- Set up training among coffee producing countries, applying the training program already developed for cacao to coffee conservation, if appropriate;
- Upgrade skill sets and share experiences by holding workshops to transfer technology used in Madagascar, Côte d'Ivoire, and the United States, among others;
- Set up capacity building initiative for safety duplication with cryopreservation;
- Set up capacity building to share accession-level data with standard protocols that will go beyond the passport data to facilitate use;
- Provide technical and training support on how to upload the information into global databases.

Communications and advocacy

- Promote stories to demonstrate how investments into coffee genetic resources conservation and use are contributing to future consumers' ability to enjoy coffee and giving individual industries a competitive edge in the marketplace;
- Communicate conservation goals regarding farmer and market needs (e.g., disease resistance, pest, drought tolerance, and coffee quality); these should support the national food sector or coffee sector development goals to increase resources for conservation efforts;
- Communicate the value of investments into conservation and use of coffee genetic resources – whether conservation in genebanks, protected areas, or in farmers' fields – as essential business interests to participants in the value chain;
- Communicate the importance of biodiversity conservation, such as conserving wild species (e.g., *C. stenophylla* or the wild coffees of Madagascar).

Identify gaps in collections

- Apply CATIE's approach to assess the inventory of individual collections for duplication and identify accessions at risk of loss (Dulloo et al., 2021). This could be aggregated to a global assessment;
- Establish a global platform for genotyping and sharing accession-level information to build a better picture of the phenotypic and genotypic distribution of diversity for

redundancy, as well as gaps.

Complementarity of protected sites and ex situ collections

- Initiate a global project to genotype and phenotype wild populations and those conserved ex situ to identify high priority populations in protected sites that merit backup conservation in ex situ collections;
- Support a global initiative to fund collections of high priority populations and species within countries;
- Hold a global dialog between managers of ex situ collections and in situ sites to foster greater communication, collaboration, and joint actions to secure long-term conservation.

Safety duplication at national and international levels

- Develop guidance for safety duplication of coffee genetic resources at national and international levels;
- Support a global project to secure coffee genetic resources through cryopreservation.

Conservation research in coffee and their wild relatives

- Promote a global research project on policy or governance options for the conservation and use of coffee genetic resources;
- Set up a global research project to research and develop standard protocols for collection and curation of coffee genetic resources;
- Create a global initiative to agree on standard traits and measurement for characterizing coffee genetic resources that will be applied in a core collection for participating genebanks;
- Research an initiative on the impact of climate change on coffee genetic resources that will include adaptation by wild species, identification of sites with significant threats of loss or genetic erosion, and the role of coffee in mitigation;
- Apply new advances in genotyping tools to coffee genetic resource conservation and use;
- Support global research initiative into conservation and use of wild species.

Global platform

- Set up leadership of a global platform or network, including members from the Crop Trust, WCR, the Origin collections, and some of the user collections;
- Include fundraising specialists and experts associated with the ITPGRFA or the Nagoya Protocol;
- Choose an international organization as host and a neutral leader to support a network between collections and users;
- Extend membership to researchers, staff of genebanks, government ministries, coffee industry members, and farmers;
- Establish a website to facilitate communication and interaction between global platform or network participants;
- Set up quarterly or biannual meetings for updates, discussions of workstreams and plans, and general communication;
- Promote media outreach, including policy briefs, to raise the visibility of coffee genetic resource conservation in each country, especially with policy makers;
- Establish a global baseline database to allow countries to share gaps, challenges, and successes.

CONCLUSIONS

The summary of priority actions identified above provide a roadmap to ensure the development and implementation of a comprehensive global system for coffee genetic resource conservation and use. The workshop fostered the beginning of an inclusive, community-driven process to move us all closer to upgrading genebanks, securing long-term-

funding, and the eventual sharing of these materials with the global community.

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