Demand for and use of banana germplasm in Africa, Asia and the Pacific

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Introduction

Dessert and cooking bananas (*Musa* spp.) are of great importance to the subsistence and the livelihoods of people in developing countries. Around 300 million people below the poverty line in developing countries depend on roots, tubers, and banana crops for food security and income. Banana is considered to be the most produced and consumed fruit globally; the latter is especially true for the European Union and North America which are the largest banana importers. The crop originated in Southeast Asia and Melanesia and has diversified and spread throughout Asia and the Pacific, Africa, and Latin America and the Caribbean regions.

There are 75 species of banana wild relatives and more than 1,000 cultivars in the world. However, the genetic diversity of banana is threatened by various factors such as pests and disease, and environmental change. Narrowing of the crop's genetic exploitable base for poses a risk for agricultural production and food supply of present and future generations. Therefore, the conservation of *Musa* genetic diversity is a very important task.

Musa diversity can be conserved through the complementary *ex situ* and *in situ* (including on-farm) methods. *In situ* conservation is especially important for the preservation of crop wild relatives (CWR), traditional varieties and landraces because it maintains the evolutionary process under natural pressures and farmer selection practices. As a complement, over 60 institutions around the world maintain

HIGHLIGHTS

- More than 5,000 *Musa* accessions were distributed by the ITC to 50 countries in Africa, Asia, and the Pacific between 2000 to 2017. A total of 31 users from 24 countries responded to the survey, out of 81 institutes contacted.
- 13 of the 31 respondents used the germplasm for research. They produced a total of 20 scientific publications citing the use of ITC accessions. 10 respondents confirmed the adoption of ITC varieties in their local communities. 14 respondents had further distributed germplasm from ITC to farmers, universities, and research institutes.
- 275 accessions were distributed to 50 different countries in Africa, Asia and the Pacific between 2000 to 2017. Respondents emphasized the role of local partner institutes in the dissemination of knowledge across stakeholders in the *Musa* community.

BOX 1 The *Musa* Germplasm Transit Centre

The Bioversity's International *Musa* Germplasm Transit Centre (ITC) is based at the Katholieke Universiteit Leuven, Belgium, and is the world's largest banana genebank with more than 1,500 accessions. The ITC uses both *in vitro* and cryopreservation methods and is investing in conserving seeds of wild *Musa* species. All ITC material has key data and information associated with the diversity of *Musa* germplasm, which is available in the *Musa* Germplasm Information System (MGIS).

Like other genebanks, the ITC has two mandates: 1) to ensure safe and long-term conservation of a broad range of *Musa* genetic diversity and 2) to distribute virus-free material that has confirmed genetic integrity and is well documented for the benefit of all users. For many users in numerous countries, the ITC is the only source of clean and healthy *Musa* germplasm. Therefore, the ITC plays a very important role in the mobilization, improvement and adaptation of *Musa* germplasm.

PHOTO: SHAWN LANDERS/CROP TRUST

Bioversity has developed different initiatives to improve the conservation and use of *Musa* genetic resources. The Global *Musa* Genetic Resources Network, www.*Musa*net.org, for example, coordinates and strengthens the conservation and related research efforts of a worldwide network of *Musa* genetic resources and breeding experts from the public and private sector.

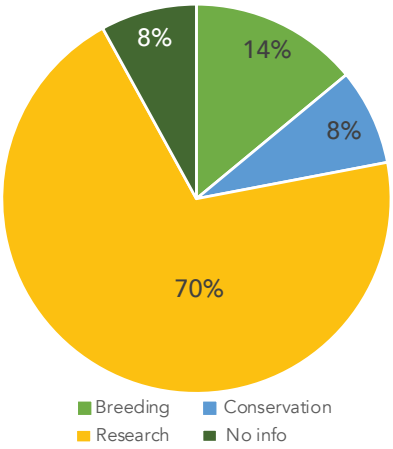

Figure 1. Total *Musa* germplasm requests according the purpose of use. Source of data: ITC germplasm distribution dataset

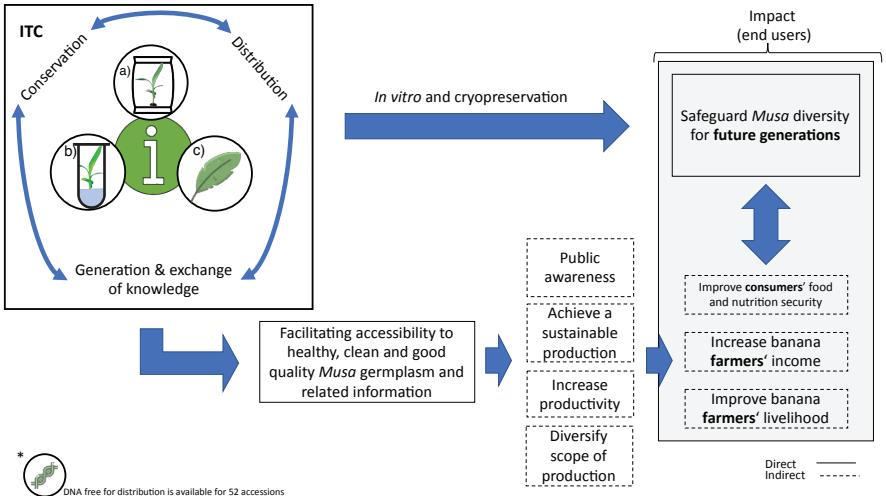

Figure 2. Impact pathways generated by the ITC. Source: Ocampo-Giraldo

ex situ Musa collections, Bioversity's International *Musa* Germplasm Transit Centre (ITC), one of the CGIAR centers, being the largest contributor.

Garmin, Roux and Van den houwe (2010) provided an overview of the impacts created by the conservation and distribution of germplasm and presented an evaluation of ITC services based on a survey of its users. This document served as background for the study summarized here. To gain an understanding of the process by which ITC generates impact, how stakeholders are involved and how requestors use accessions, Bioversity International undertook a requestor survey. The Global *Musa* Survey was sent to key *Musa* collections around the world between 2012 and 2013. Survey findings will contribute to updating the *Musa*Net Global Strategy for the Conservation and Utilization of *Musa* Genetic Resources.

This study's research questions are: 1) what is the pathway that an ITC accession follows in generating ultimate impacts? 2) who are the stakeholders that need to be involved to achieve impacts? 3) what is the value that the ITC has added to the generation of the end-user impact? 4) are the pathways context-specific or are they universal?

Data and methods

The results from this report are based on two datasets: 1) the ITC accessions distribution information from 2000-2017 and 2) the ITC *Musa* Usage Survey (MUS). The former contains the type of accessions and the information about the requester. On the other hand, we collected the latter specifically for this report by contacting institutes that had requested *Musa* germplasm during 2000-2017 located in the regions of Africa, Asia and the Pacific Islands. The aim of the survey was to identify how *Musa* genetic resources were used once they were received, the reasons for maintaining or not maintaining the accessions, and if they have been further distributed to other users.

From the 81 institutes to which the survey was sent, 31 gave their consent and replied to the survey. Institutes in Africa and Asia represented the majority of the population surveyed compared to the Pacific Islands, showing a pattern similar to the distribution data.

Main findings

Demand for ITC germplasm

The analysis of distribution data and user survey indicate that 5275 accessions were distributed to 115 institutes in 50 different countries in Africa, Asia and the Pacific between 2000 to 2017. This, combined with the fact that ITC hosts the world's largest collection of banana germplasm, demonstrates the important role it plays in not only the conservation, but the global mobilization of *Musa* germplasm.

The user survey provides illustrative information about the current use of accessions originating from the ITC in recipient countries. The majority of the institutes (27) stated they maintained the accessions they had received, although only 18 of them reported their collections in *Musa*Net. The most popular purpose for requesting ITC material is research (Figure 1). Users usually maintain the accession for breeding, evaluation of traits, and conservation (*in vivo*). The most important conservation methods are field collections (23 institutes), followed by tissue culture. Problems with diseases and lack of space suggest a need for additional training in conservation techniques in order to ensure the long-term conservation of *Musa* germplasm in local institutes. This finding underscores the potential for further collaboration between the ITC and its users.

Survey findings also demonstrate the important role that local institutes play in achieving the ITC's mandate and contributing to end-user impacts. Local partners are crucial for incentivizing the use of introduced or advanced *Musa* varieties since culture and tradition clearly influence the acceptance and adoption of varieties in communities. Finally, the relationship between ITC germplasm local institutes and end-users is very important for dynamic *ex situ* and *in situ* conservation.

Banana impact pathways in Africa, Asia and the Pacific

Figure 2 describes a pathway of impacts generated, directly or indirectly, by the ITC from the genebank to end-users. Safeguarding *Musa* diversity for future generations, either for further development or future consumption, might improve bananas farmers' livelihood and income, and reduce food and nutrition insecurity in the future. Likewise, high yielding or nutritious *Musa* varieties that improved farmers' livelihoods will be worth enough to be safeguarded for future generations.

Lastly, 15 institutes reported that they had further distributed ITC germplasm material. Table 1 shows that ten landraces, six advanced and three wild varieties were further distributed by the

BOX 2 The Genebank Impacts Fellowship

Having excellent mentors and the opportunity to build a network with different backgrounds and different nationalities was the most important part of my fellowship experience. Since the beginning of the program and in every step, the one-week bootcamp, the genebanks visits and until the end of our projects, we had experienced mentors guiding us. The network building started on the bootcamp by meeting all the fellows and the biodiversity conservation experts, followed by visiting the genebanks and the stakeholders that are part of the conservation process. All these experiences with multidisciplinary teams thought me that for the biodiversity conservation all the different types of knowledge are important and necessary.

Visiting genebanks was one of the highlights of the fellowship. I had the opportunity to visit two CGIAR centers, CIMMYT and Bioversity international, and two types of crops. Having the opportunity to learn how different processes are depending on the type of crop one is working with but understanding that conserving the crop diversity is equally important no matter with what region or crop you are working with.

During my visit to Bioversity international in Montpellier and the ITC in Belgium I learned how different the conservation processes are for *Musa* compared to other crops. Upon entering the world of banana conservation, I understood the importance of ITC for other institutes located in developing countries especially because in some cases the germplasm from ITC is the only clean and healthy source of *Musa* germplasm they have. I learned ITC should work hand in hand with local institutes in order to help farmers improve efficiency, to fight diseases and to maintain the *Musa* diversity.

users across the Africa, Asia and Pacific regions. The most common purposes for distribution were the evaluation of agronomic or other traits and conservation. Only one of the requestors declared that the distribution was to return the plants to farmers or the community of origin. According to the users, *Musa* germplasm was usually distributed to farmers, universities and research institutes.

Table 1. Number of accessions used by the requestors to achieve different types of outcomes by type of accessions

		Types of cultivar involved		
		Landrace	Wild	Advance
Outcomes after receiving ITC accessions	Research	3	3	5
	Local adoption (perceived)	3	1	1
	Further distribution	10	3	6

Source: Authors, based on survey

Lessons from banana users

The main outcomes achieved by the users after receiving ITC accessions were reported to be the generation of knowledge through research, a perception that local adoption rates rose, and further distribution of genetic material to other potential users. The outcomes are associated to different types of cultivars as shown in Table 1.

Regarding research, the results showed that 13 of the institutes have used the ITC accessions for research and developed a total of 20 articles (including both peer- and none peer-reviewed publications). Most of the research is driven by work with advanced or modern varieties, but landraces and wild varieties are also important for knowledge generation.

The adoption of varieties is an enabler in the impact pathway. Through the survey, we confirmed users' perceptions that ITC varieties have been adopted in their local communities. Ten requestors perceived that some of the ITC accessions received from 2000 onwards have been "adopted" into local markets of Burundi, Cameroon, Madagascar, Indonesia, Tanzania, Egypt, Uganda, India, Taiwan and Hawaii. Users from Asia and the Pacific Islands reported that five different accessions had been adopted in local markets, three of them landraces. For example, AAcv Rose (ITC0712) was originally from Indonesia and subsequently adopted in Taiwan.

Fifteen institutes reported they had further distributed ITC germplasm material. Ten landraces, six advanced and three wild varieties were further distributed by the users across the Africa, Asia and Pacific regions. The most common purposes for distribution were the evaluation of agronomic or other traits and conservation. Only one of the requestors declared that the distribution was to return the plants to farmers or the community of origin. According to the users, *Musa* germplasm was usually distributed to farmers, universities and research institutes.

Conclusion

This study has contributed to a better understanding of the patterns of demand for ITC germplasm, its uses and the relationship between the genebank and its users. Survey findings demonstrate the important role that local institutes play in achieving the ITC's mandate and contributing to end-user impacts. In addition, local partners are crucial for incentivizing the use of introduced or advanced *Musa* varieties since culture and tradition clearly influence the acceptance and adoption of varieties in communities.

Finally, the relationship between ITC germplasm local institutes and end-users is very important for maintaining the equilibrium between *ex situ* and *in situ* conservation. Further research should address the adoption of introduced and modern varieties and its determinants in key locations, linking this information directly to accessions received from the ITC.

Further reading

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Suggested citation

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Additional details can be found in the paper on which this brief is based: Ocampo-Giraldo, Vanessa, Ines Van den houwe, Rachel Chase, Nicolas Roux, Nelissa Jamora and Melinda Smale. 2019. The demand for Bioversity's banana germplasm in Africa and Asia. Genebank Impacts Working Paper No. 4. CGIAR Genebank Platform, Bioversity International, and the Crop Trust.

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