

PHOTO: MICHAEL MAJOR

Revival and Survival of Repatriated Potato Landraces in the Andes

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Potato landraces (*Solanum* spp.) are not only crucial for food security and sustenance in Andean communities, but also are deeply rooted in the local culture. Potato was domesticated in the Peruvian Andes, where a great amount of genetic diversity still exists on farmers' fields. However, due to abiotic, biotic, and other stress factors, the farming communities which are the custodians of this crop have lost certain landraces which once belonged to their ancestral potato portfolios. Therefore, local communities and the genebank of the International Potato Center (CIP) partnered to re-establish these landraces into the communities.

The CIP genebank is located at the CIP headquarters in Lima, Peru and

HIGHLIGHTS

- The genebank of the International Potato Center redistributes potato landraces as part of their repatriation program. Repatriation is the process of returning native germplasm back to the farmers in its place of origin.
- Between 1997–2020, 14,950 samples were distributed to 135 communities in Peru.
- This study is the first to assess the repatriation program and the on-farm survival time of repatriated landraces.
- Most households (56%) abandon the repatriated material by the fourth year after receiving it, but the *in situ* survival probability of the remaining material stabilizes between 36% in year 5 and 18% in year 15.
- Households where the plot manager is over 60 years or female were more likely to plant the landraces for longer periods of times. Other factors that are related to increased survival times include: higher levels of education, labor force, wealth, food insecurity, and geographic location (southern part of Peru).
- Most farmers reported nutritional and cultural benefits from the repatriated landraces.

maintains clonal and seed collections of potato, sweetpotato, and Andean roots and tubers, and has one of

the world's largest *in vitro* genebank (Box 1). The germplasm is maintained as a global public good under

BOX 1 The International Potato Center (CIP) Genebank

The International Potato Center (CIP) contributes to making the diversity of potato, sweetpotato, and other Andean roots and tubers available for food security. The CIP genebank, located in Lima, Peru, holds an *ex situ* collection composed of wild relatives, landraces, advanced lines, and improved varieties. The CIP genebank has one of the largest *in vitro* collections in the world, which is maintained and distributed thanks to the genebank know-how. Germplasm is distributed for research, training, and breeding, using the Standard Material Transfer Agreement (SMTA).

The CIP genebank employs various conservation strategies to conserve true-to-type potato germplasm. Potato plants produce true botanical seeds (coming from fruits) that are easily conserved, but the traits of the plants are extremely variable compared to their mother plant. On the other hand, potato tuber seeds are identical to the mother plant (clonal), but their conservation for very long periods is not feasible. Due to this scenario and to the importance of having true-to-type germplasm for different traits, the CIP genebank uses seed conservation, cryopreservation, and *in vitro* conservation and



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propagation. These strategies consist of processes that follow high-quality standards that guarantee the current and future availability of diverse true-to-type and pathogen-free potato germplasm.

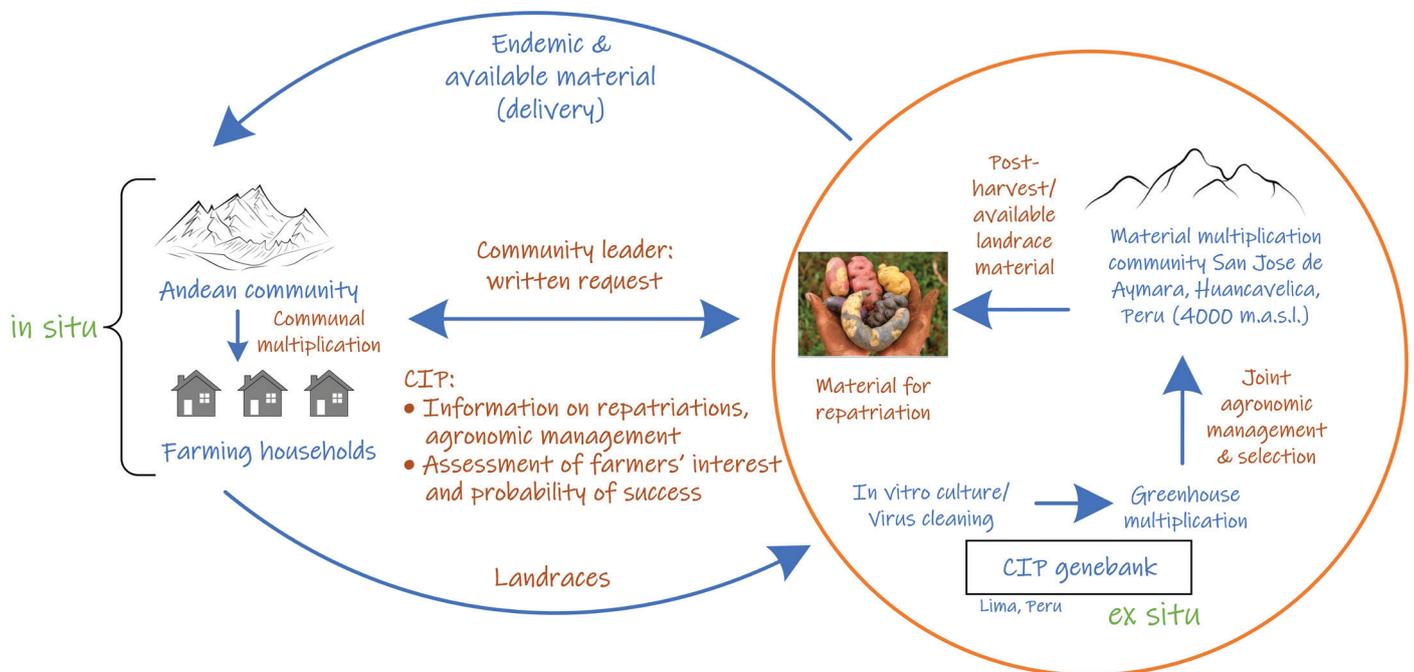


Figure 1. Scheme of the repatriation program. On the left part the repatriation process and on the right in a orange circle the conservation, cleaning, and multiplication process to generate material for repatriation.

the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and it is available for distribution freely for research, education, and breeding purposes.

The genebank also distributes material to farmers under the scheme of repatriation, supplying clean seed potatoes to farmers who pursue subsistence agriculture in the Peruvian Andes. The genebank was established with material that was collected in the last century in potato diversity hotspots in the Andes, within traditional farming landscapes. Hence this redistribution of landraces is a dynamic exchange of landrace material from ex situ to in situ conditions. Over time, the CIP genebank created a repatriation program that carries out the redistributions and whose scope is unique amongst CGIAR centers. Repatriation is the process of returning native germplasm back to the farmers in its place of origin. Since the program was established in 1997 the repatriation program has provided Andean farmers with landrace material increasing their on-farm diversity.

Closing the research gap

Despite these longstanding repatriation activities, to date no comprehensive analysis of CIP's repatriation activities and the on-farm survival of the repatriated landraces has been done. To close this research gap, we use genebank data on the repatriated accessions, a household survey (n=301) and expert interviews to pursue this task. First, we describe the scheme of the repatriation work and further explain its history and outcomes (Figure 1). Also, we provide an overview of the repatriated accessions and the reasons why the communities applied for the program. As a second step, we use a duration model to explore the on-farm survival of the material and the factors that influence it. The third part of

the study consists of a benefit and change analysis investigating the changes reported by the surveyed farmers and why some abandon the repatriated landraces.

Between 1997 and 2020, 14,950 samples were distributed to about 135 communities in the Peruvian Andes

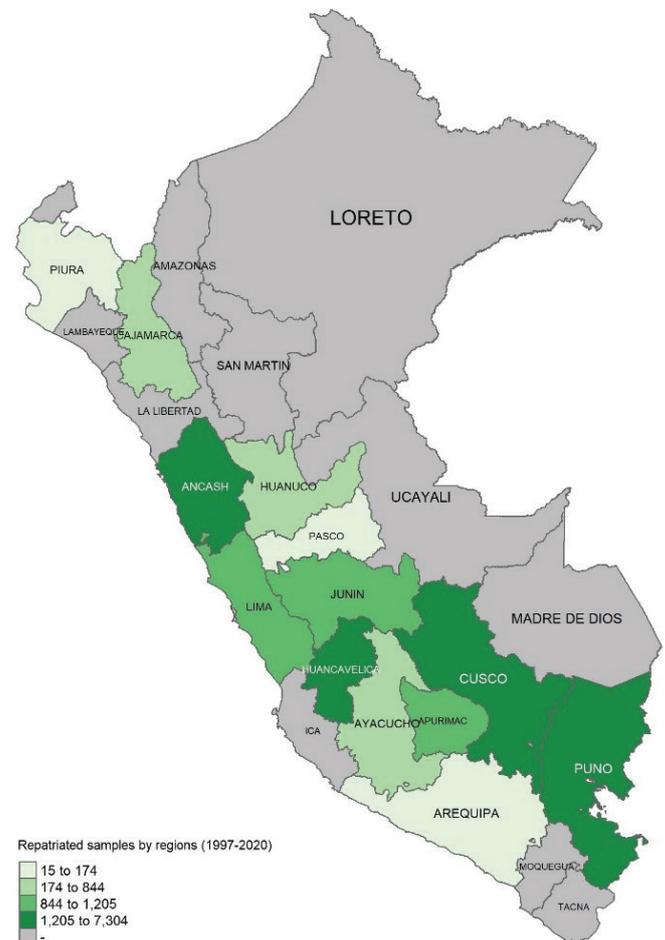


Figure 2. Map indicating the number of repatriated landrace samples per department.



Figure 3. Repatriation of potato landraces to Ancash, Peru (13/08/2015). The five community representatives hold their list of repatriated landraces, which are packed in the boxes in the foreground.

(Figure 2). These samples constitute 1,519 unique landraces. Within the general work of the genebank, the material repatriated comes from virus-cleaned material that has gone through a seed multiplication process to produce tubers suitable for repatriation. Then it is shipped to the receiving communities, whose farmers start then their own multiplication cycle to distribute tubers to their farming households (Figure 3).

Overall, a third of all interviewed participating farmers still conserve the repatriated landrace material. The duration analysis shows that most households (56%) have abandoned the material in year 4 after receiving it. The *in situ* survival probability of the material stabilizes in later years, where it decreases in a relatively narrow range from 36% (year 5) to 18% (year 15) (Figure 4). Households headed by females or adults over 60 years are more likely to plant the landraces for longer times. Further, a higher level of education and food insecurity increases the survival times. Households located in the southern part of Peru are also more likely to hold the repatriated

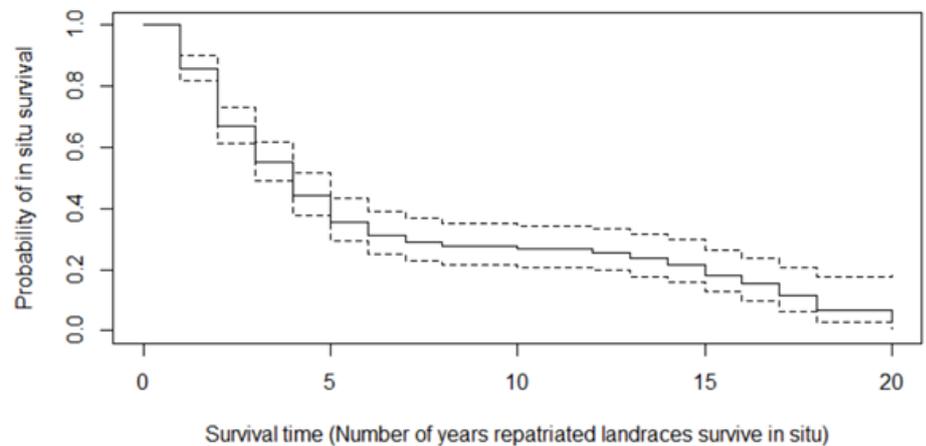


Figure 4. Kaplan-Meier survival curve displaying the survival probability of the repatriated material at each successive year after the repatriations.

landraces for a longer period, also those with relatively more wealth and labor force, although the impacts are smaller. On the contrary, household heads who are male or under 29 years are more likely to abandon the landrace earlier.

Most farmers perceived nutritional and cultural benefits from growing repatriated landraces. For example, farmers reported that the program increased their food security and diversity of potato tastes and textures. It also created a healthier

feeling, and a union of traditional and scientific knowledge. Further, the repatriated potatoes enable the farmers to conserve potato diversity and to re-establish and broaden culinary diversity and traditions. Therefore, most farmers confirm that the main objectives of the repatriation program are fulfilled (restore lost landraces, increase food security and landrace diversity conserved *in situ*). Nevertheless only a third of the participating and interviewed farmers continue to maintain the repatriated material. Reasons for loss are insuf-



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The repatriation program has provided Andean farmers with landrace material increasing their on-farm diversity.

efficient labor force and knowledge as well as abiotic and biotic stress factors.

Results

Our results led to two main recommendations to improve the visibility and effectiveness of the repatriations. First, the repatriation activities should be institutionalized as a program within the genebank. In that manner, its visibility could be better enhanced and documented, including improved cost accounting and routine participatory workshops that would allow a direct attribution of the repatriation activities to its outcomes. Second, a follow-up

exchange between the receiving farmers and the repatriation staff after redistributing the landraces in a regular and institutionalized manner would sustain the benefits of the program. As the duration analysis has shown, a follow-up is crucial in the first four years following a repatriation and could be achieved in cooperation with community elders, an intergenerational apprenticeship or network farmers.

In comparison to its estimated costs (<\$5,000 USD per year), the repatriation program has a high return on investment. Our study describes the vast scope of the program and

its benefits, and hence, provides an evidence base for continued support and funding for repatriation, ultimately providing food security and livelihoods in the Andes and beyond.

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Additional details can be found in the paper on which this brief is based: Lüttringhaus, Sophia; Pradel, Willy; Suarez, Victor; Gomez, Rene; Ellis, David; Anglin, Noelle L.; Manrique-Carpintero, Norma C.; Hareau, Guy; Jamora, Nelissa; Smale, Melinda. 2021. Revival and Survival of Repatriated Potato Landraces in the Andes – On-farm Maintenance and Benefits. Genebank Impacts Working paper No. 14. CGIAR Genebank Platform, International Potato Center, and the Crop Trust.

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