Darwin Initiative Main & Extra: Final Report

To be completed with reference to the "Project Reporting Information Note":
(https://www.darwininitiative.org.uk/resources/information-notes/).
It is expected that this report will be a **maximum of 20 pages** in length, excluding annexes.
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Darwin Initiative Project Information

Scheme (Main or Extra)	
Project reference	29-025
Project title	Sweetpotato, a model for food security and long-term conservation of biodiversity
Country(ies)	Kenya, Madagascar, Peru, and Zambia
Lead Organisation	Global Crop Diversity Trust (Crop Trust)
Project partner(s)	Fiompiana Fambolena Malagasy Norvéziana (FIFAMANOR) International Potato Center (CIP) Lima and Nairobi The Zambia Agriculture Research Institute (ZARI)
Darwin Initiative grant value	GBP 600,000
Start/end dates of project	1 June 2022 – 31 March 2025, Final Report
Project Leader name	Sarada Krishnan
Project website/blog/social media	https://www.croptrust.org/work/projects/darwin-initiative-funded-sweetpotato-project/ https://www.croptrust.org/news-events/news/chill-solution-for-meeting-future-demand-of-sweetpotato/
Report author(s) and date	Crop Trust and CIP, June 2025

1 Project Summary

Sweetpotato, a starchy root crop, is sometimes referred to as a "3-in-1" product, due to its integration of the qualities of cereals (high starch), fruits (high vitamin and pectin content), and vegetables (high vitamin and mineral content). Sweetpotato roots contain macronutrients such as starch, dietary fiber, and protein, in addition to a broad range of micronutrients, such as manganese, copper, potassium, iron, vitamin B complex, vitamin C, vitamin E, and provitamin A (as carotenoids, in yellow and orange-fleshed varieties). Sweetpotato is thus considered a functional food rich in phytochemical compounds such as carotenoids, tocopherols, phenolic compounds, tannins, flavonoids, saponins, and anthocyanins. In developing countries, sweetpotato is the fifth most important staple crop, after rice, wheat, maize, and cassava. Among the root and tuber crops, sweetpotato is the second after cassava in importance for human survival. African countries rank 2nd, 3rd, and 4th as the world's leading sweetpotato producing nations. Sweetpotato is drought tolerant and is thus critical for improving food and nutrition security in rain-fed agriculture conditions in the developing world, where droughts severely affect yields of other staple crops. It is estimated that more than 2 billion people in Africa, Asia, and Latin America depend on sweetpotato for food[1].

[1] Amagloh FC, Yada B, Tumuhimbise GA, Amagloh FK, Kaaya AN. The Potential of Sweetpotato as a Functional Food in Sub-Saharan Africa and Its Implications for Health: A Review. Molecules. 2021 May 17;26(10):2971. doi: 10.3390/molecules26102971

Unfortunately, the unique diversity of sweetpotato landraces in low-income countries is poorly conserved and declining. This project introduces a multifaceted robust methodology to conserve and use sweetpotato genetic diversity as a model for the long-term, secure conservation of clonal crops in general, many of which are essential to smallholder farmers for increased sustainability and livelihoods.

The project concept is termed *Sweetpotato Clean and Share*, which clearly reflects the project objectives, which are to collect sweetpotato landraces from Madagascar and Zambia, clean the sweetpotato landraces of all diseases, repatriate the phytosanitary cleaned material to smallholder farmers in Madagascar and Zambia for enhanced productivity, while also securely conserving this material long-term under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) for use by future generations. The project worked in collaboration with, and benefitted from, the Seeds for Resilience Project (SFR) in Zambia and a USAID-funded BHA-project in Madagascar, both of which also supported the complementary collection of sweetpotato landraces.

The project involved and/or oversaw the collection of farmers' sweetpotato landraces in Madagascar (Annex 5.1a. map of Madagascar collection sites) and Zambia (Annex 5.1b. map of Zambia collection sites) and the shipment of these landraces as living vines to the International Potato Center (CIP) in Nairobi, Kenya. Once the vines arrived in CIP-Nairobi, they were placed in pots to root and grow, and once sufficient new growth had occurred (4-8 weeks), shoot tips were surface sterilized and put into *in vitro* culture. Phytosanitary cleaning was done in CIP-Nairobi using thermotherapy and meristem culture (isolation and culture of ~0.5mm shoot tips). The *in vitro* material was then multiplied, checked for disease-free status with RT-PCR and phytosanitary clean material was repatriated to the countries of origin for mass vine multiplication prior to distribution of the cleaned vines to farmers for planting. At harvest, surveys were conducted using interviews and small focus groups to assess farmers' impressions and satisfaction with the planting of the clean material. In parallel with these activities in Madagascar and Zambia, CIP-Nairobi shipped the collected *in vitro* sweetpotato landraces to CIP-Lima for long-term secure conservation in the global sweetpotato collection held for use by humanity under the auspices of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The landraces from this project are available from CIP-Lima under the ITPGRFA and will be conserved for future generations in cryopreservation as part of the Global Plant Cryopreservation Initiative.

2 Project Partnerships

The project team included:

- **The Zambia Agricultural Research Institute (ZARI)**, a department of the Ministry of Agriculture and Livestock housing the Zambian National Plant Genetic Resources Center, was the lead partner from Zambia. In collaboration with ZARI, the project also included the Zambian Department of Agriculture (DoA), the National Agriculture Information Services (NAIS), commercial vine multipliers, district and community leaders, and farmers.
- **Fiompiana Fambolena Malagasy Norvéziana (FIFAMANOR)**, a national institution working in Rural Development and Applied Research, was the lead partner from Madagascar. In addition to FIFAMANOR, the project also included CIP-Madagascar, commercial vine multipliers, community leaders, and farmers.
- **The International Potato Center (CIP-Lima) in Lima,** Peru, worked in close harmony with CIP-Nairobi in Kenya, stationed at the Kenya Plant Health Inspectorate Service (KEPHIS) in Muguga, as the lead partner from CIP. CIP worked closely with ZARI and FIFAMANOR for the collection of sweetpotato landraces in each country, the shipment of the landraces to CIP-Nairobi for placement into *in vitro* tissue culture and phytosanitary cleaning, the repatriation of the landraces back to the country of origin, and the shipment of the landraces to CIP-Lima for long-term conservation in cryopreservation. CIP-Lima was also the coordinator for the generation and analysis of DNA fingerprints for the material. DNA fingerprinting was done using DArTseq markers by Diversity Arrays, Canberra, Australia.
- **Crop Trust** was the overall lead administrative organization for the project.

Partners remained in close contact throughout the entire project period via 31 monthly Zoom project meetings (Annex 5.2.a-c.), as well as email, WhatsApp, and text messaging. All partners contributed to the preparation of this final report with the submission of individual reports to the Crop Trust, which

formed the basis of this consolidated document. Collaboration between partners will extend beyond the official close of the project. For example, the Crop Trust continues to support Zambia's genetic resources conservation program through its partnership with ZARI, and the primary contact at FIFAMANOR on this project is now working with CIP on a separate initiative. Since 2019, the Crop Trust has also supported the national genebank of Zambia through the Seeds for Resilience project, with funding support from the Federal Government of Germany (BMZ), through the German Development Bank (KfW). Communication among project partners is expected to continue through the end of 2025, as work on DNA fingerprinting to identify putative duplicates is still ongoing. Additionally, the team plans to prepare a paper for submission in a refereed scientific journal to share results from the project.

3 Project Achievements

Summary of project outputs

Indicator	Zambia	Madagascar	Total	Target
# landraces collected and sent to CIP-Lima	254	75	329	50
Arrived in Lima in good condition	234	70	304	50
Lost or in poor condition	20	5	25	No target
# landraces phytosanitary clean	28	29	57	50
#l landraces in cryo			30	25
# landraces repatriated	27	29	56	50
# landraces multiplied	27	29	56	50
# vines distributed	66,450	40,000	106,450	60,000
# communities reached	8	11	19	No target
# farmers reached	60	295	355	120
# female farmers	38	77	115	No target
% female farmers	63%	26%	31%	No target

3.1 Outputs

As summarized below, the project successfully achieved or exceeded all intended outputs outlined in the logframe.

Output 1. 50 sweetpotato landraces from partner countries are processed for long-term conservation in the global sweetpotato collection at CIP in Lima, Peru.

With 254 sweetpotato landraces collected and in process of storage in Lima, Peru from Zambia (through the Seeds for Resilience project) and 70 sweetpotato landraces collected and in process of storage in Lima, Peru from Madagascar (8 through the BHA-USAID Program), the first measurable indicator for this output, **60 sweetpotato landraces collected in Zambia and Madagascar** was considerably exceeded. Annexes 5.1a. and 5.1b show the locations in both countries where the collections occurred and Annex 5.3 contains a list of the landraces collected. It is important to highlight that, prior to this project, the global sweetpotato collection held under the auspices of the ITPGRFA at CIP-Lima, contained only two accessions from Madagascar and four accessions from Zambia. As a result, this project increased the global collection of farmers' sweetpotato landraces from these two countries more than 35-fold – representing a major contribution to the Multi-Lateral System of conservation and availability of sweetpotato genetic diversity.

Genetic fingerprinting using DArTseq markers from 229 sweetpotato landraces from Zambia and 70 landraces from Madagascar clearly shows genetic distinctness, with very few exceptions, of sweetpotato from the two countries (Annex 5.4). Initially, ZARI provided leaf material which had been dried over silica gel to Diversity Arrays in Australia for DNA extraction. Although DNA of marginally good quality was obtained from most of the samples, DNA quality from 80 samples was not of good enough quality to generate genetic fingerprints. Hence, DNA was reisolated from the landraces at CIP-Lima, where good experience and quality control measures for DNA extraction were in place. In the end, 299 landraces (70 from Madagascar and 229 from Zambia) had adequate DNA for analysis and these data yielded 2,382 common markers which were used to compare to generate the dendrogram in Annex 5.4.

The next step was to determine how many of the collected landraces could be considered duplicates. To establish a threshold for identifying duplicate accessions, a technical analysis was conducted using

biological replicates. A group of 11 accessions (22 samples in total) was selected, each with two independent extractions of high-quality DNA. The analysis was based on 2,382 markers, and the maximum observed genetic distance between replicates was 2.5%. Based on these results, a threshold of a 2.5% genetic distance was set to identify potential duplicates. Pairs with distances above this threshold were considered genetically distinct. From the 299 landraces with adequate DArTseq data, 179 were considered unique while the other landraces clustered into 22 different groups based on the 2.5% threshold (Annex 5.5). If we take a single landrace from each of the 22 clusters, this would result in a total of 201 genetically unique landraces, 60 from Madagascar and 151 from Zambia, which were collected as part of this project.

The final analysis was to do a comparison of the sweetpotato collection already at CIP to determine which of the 201 unique landraces collected in the project would add diversity to the global sweetpotato collection and which were already represented in the collection. This analysis used 691 common markers shared between the project dataset and CIP accessions. Due to the reduced number of markers, the 2.5% threshold was not considered reliable for duplicate identification for this second analysis. Instead, cluster grouping was used to define putative duplicates. As a result, 96 accessions were grouped with existing CIP accessions, forming 12 clusters. These groupings suggest that a portion of the Madagascar or Zambia landraces may already be represented in the CIP genebank. As would be expected, the majority of CIP accessions within these clusters originated from other African countries.

A total of 56 landraces, 29 from Madagascar and 27 from Zambia, were phytosanitary cleaned based on RT-PCR analysis by CIP-Nairobi (housed at KEPHIS) and repatriated to their respective countries for vine multiplication and distribution to farmers. Unfortunately, subsequent, much more sensitive virus screening using high-throughput sequencing (HTS) of the plants indicated that the majority of these putatively phytosanitary clean landraces were still infected by one or more viruses. This was an important lesson: although RT-PCR has been used for decades for virus detection, and still is, it is not sensitive enough to be used for a definitive determination of whether plant material is completely free of viruses or not. However, an important factor to consider is that the cleaning process conducted at CIP-Nairobi likely reduced the number of viruses, as well as the virus titre, and most of the samples cleaned by CIP-Nairobi had only a single or double virus infection, which can explain the positive results seen by farmers in their fields (see below). The samples identified as positive for viruses will undergo an additional cleaning procedure before being transferred to the global collection and cryopreserved.

A total of 75 samples collected from Madagascar (the collection of six landraces was in collaboration USAID-BHA) and 254 landraces collected from Zambia (collection and shipment in collaboration with the Crop Trust's Seeds for Resilience project) were shipped to CIP-Lima through CIP-Nairobi. The material was shipped to CIP-Lima as *in vitro* cultures in two shipments, the first on March 21, 2023, and the second on January 31, 2024. Once at CIP-Lima, the landraces underwent post-entry quarantine under the supervision of the National Agrarian Health Service of Peru (SENASA). Accessions that showed bacterial contamination and/or poor development were separated from other materials and subjected to recovery treatments. All other accessions are undergoing virus elimination treatment (thermotherapy followed by meristem isolation), and after regrowth, one tube of each accession will be provided to the CIP Health Quality Unit (HQU) for virus cleaning confirmation. Once confirmed, another tube will also be sent to the cryopreservation laboratory to initiate the cryopreservation process.

To date, 28 accessions have been successfully cryobanked. Initial screening was delayed due to quarantine and virus eradication; however, 28 accessions were initially screened using CIP's routine sweetpotato cryopreservation protocol to validate their feasibility for successful cryobanking. The screening is performed with a single replicate of 10 shoot tips. If the full-plant recovery rate after removal from liquid nitrogen is equal to or higher than 10%, the accession qualifies for routine cryopreservation. Of the 28 tested accessions, 20 successfully passed the screening process, with recovery rates ranging from 10% to 90%. Additionally, eight accessions were directly processed for routine cryobanking without prior screening to meet the project's timeframe.

Output 2. 60,000 cleaned vines (planting materials) of 50 sweetpotato landraces are made available to smallholder households in Zambia and Madagascar

A total of 56 sweetpotato landraces (29 landraces from Madagascar and 27 landraces from Zambia) were repatriated to their respective countries (Annex 5.6). The repatriation of landraces to Madagascar was done as *in vitro* plants (1-2 plants/vial) in four separate shipments from May 2023 to March 2025.

A total of 568 *in vitro* vials were shipped to Madagascar, with the number of vials per accession varying from 3 (for 2 landraces) to 39 (for one landrace), with an average of 19 vials per landrace. The repatriation process to Zambia occurred in three shipments from June 2023 to January 2025. A total of 804 *in vitro* vials were shipped to Zambia, with no fewer than 13 vials per landraces shipped, with an average of 30 vials per landrace.

Shipment of repatriated landraces proved to be problematic as shipments by commercial carriers, such as DHL, were often delayed, causing severe stress, damages, and death to the plant materials. Hence, for all but one shipment, the partners in Africa (CIP-Nairobi, FIFAMANOR, ZARI) arranged for repatriation shipments to be hand-carried by staff passing through Nairobi en route to either Madagascar or Zambia. Although the hand-carrying of living *in vitro* materials required more coordination and caused delays in some shipments, as there was not always someone traveling at the appropriate time through Nairobi to Madagascar and Zambia, this method proved successful, and phytosanitary cleaned materials were repatriated, multiplied, distributed to farmers, and harvested in both target countries.

Repatriated *in vitro* materials were acclimated to greenhouse or screenhouse environments and grown out in nurseries prior to distribution to vine multipliers. One challenge encountered in both countries was aligning receipt of materials and vine multiplication with the planting seasons, as each region has its own planting calendar based on agroecological conditions. The misalignment temporarily affected the readiness of multiplication activities at the stations. However, the use of *in vitro* multiplication, along with the active involvement of district-specific vine multipliers in the field, helped mitigate these constraints. Also, both FIFAMANOR and ZARI were able to maintain materials *in vitro* until the timing was appropriate for acclimatization and distribution to vine multipliers.

ZARI provides a good example of how the basic process worked in both countries. ZARI established initial nurseries in a screenhouse and subsequently shared the 25 landraces with 20 vine multipliers (Annex 5.7a, 5.7b). The Department of Agriculture (DoA), coordinating with ZARI, selected vine multipliers and beneficiary farmers. In each district (Maisaiti, Kapiri, Choma, Monze) , ZARI partnered with DoA to identify 15 households as beneficiary farmers, taking into account gender and age segmentation. By December 2022, the selection of 20 vine multipliers and 60 beneficiary farmers had been completed. A total of 46,200 vines were distributed from 5 to 17 January 2024 during the 2023/2024 farming season, and 20,250 vines were distributed during the 2024/2025 farming season for a total of 66,450 vines to 60 farmers. The 20 vine multipliers in Zambia produced 66,450 vines, which exceeded the project target for vine distribution (40,000 vines) in Zambia by over 50%.

In Madagascar, the involvement of the Regional Bureau of Agriculture in the South-East was instrumental in strengthening community engagement. Throughout Madagascar, district vine multipliers and local communities played a crucial role in the project's success, although they are not formally listed as project partners. Also, CIP's staff based in the southern region of Madagascar facilitated connections between FIFAMANOR and district vine multipliers. Multiplication in Madagascar was done by farmer groups on-farm and over 24,400 vines were distributed to farmers in the 2023/2024 season and over 16,000 vines were distributed to farmers in the 2024/2025 season for a total of 40,000 vines distributed to 295 farmers (Annex 5.7c, 5.7d).

Of particular note in both countries was the occurrence of secondary vine distribution, where farmers voluntarily shared the repatriated materials with other farmers in their community. While this positive outcome was acknowledged, no systematic effort was made to track or quantify the secondary distribution of vines.

Thus, in total, over 100,000 total vines were distributed to over 350 farmers by the project, far exceeding our targets.

Output 3. Capacity of national genebanks in Zambia and Madagascar strengthened to conserve diversity and support its use by farmers

At the outset of the project, neither national partner had adequate capacity for handling or multiplying phytosanitary clean materials. Throughout the project, numerous training and capacity-building activities were conducted to strengthen technical knowledge, foster collaboration, and enhance skills across participating institutions and stakeholders.

Regular project meetings served not only as coordination platforms but also as valuable learning opportunities. For example, key technical topics such as DNA marker analysis, clean planting strategies, *in vitro* plant culture, and the shipment and exchange of plant genetic materials, were discussed during project meetings.

In the first year of the project, two capacity-building workshops were conducted. The first was a virtual photography training led by the Crop Trust for partners in Madagascar and Zambia, aimed at enhancing documentation of project activities. The second was an in-person technology transfer session between CIP-Nairobi and CIP-Lima, focused on *in vitro* technologies, including multiplication, phytosanitary cleaning, and record-keeping. Technicians from FIFAMANOR were trained on the use of the ODK tool for data collection.

Additionally, a session on anti-bribery and corruption policies was held to ensure that all team members were informed about the ethical standards, reporting mechanisms, and procedural safeguards in place. The interaction among partners also helped the project team gain a deeper understanding of each other's expertise and operational contexts.

In response to a comment by a reviewer of the project proposal regarding safeguarding, or the prevention of harm to people, and the environment, in the delivery of development and humanitarian assistance, a dedicated online training session was held on 25 July 2024 with project partners. The session reinforced our commitment to safety, equity, and inclusion among smallholders in Madagascar and Zambia, covering both foundational and project-specific safeguarding principles. A safeguarding video was shared, along with resources from the Safeguarding Resource and Support Hub (RSH), providing practical tools and case studies for fieldwork. This training clarified roles and procedures, establishing a solid basis for ongoing safeguarding efforts throughout the project.

In addition, two virtual capacity-building workshops were organized to disseminate technical knowledge more broadly:

- Virtual workshop on the analysis of DArTseq sweetpotato marker data (17 October 2023): This two-hour session attracted 29 participants (48% female) from 10 countries, including representatives from NARS, NGOs, and universities. The workshop provided a comprehensive introduction to interpreting and analyzing sweetpotato DNA marker data and is available online at https://www.youtube.com/watch?v=DRCpaDdGNS0.
- Sweetpotato viral disease management workshop (12 December 2023): This session focused on on-farm strategies for managing viral diseases in sweetpotato cultivation. It was attended by 25 participants (40% female) from nine countries, representing NARS, NGOs, and one private sector entity and is available online at https://youtu.be/jJFhUSCeWdk?si=6BB3FGkIqIWcnF-Q..

These activities reflect the project's strong commitment to capacity development and knowledge sharing among partners and the broader agricultural research and development community.

Output 4. Cryopreservation protocol refined and optimized specifically for sweetpotato diversity

For cryopreservation, CIP standard operating procedures require that only disease-free material with verified identity is eligible for cryopreservation. Thus, 28 sweetpotato accessions were selected and screened for cryopreservation feasibility using CIP's routine sweetpotato cryopreservation protocol. Screening was performed with a single replicate of 10 shoot tips and if the full-plant recovery rate after removal from liquid nitrogen is equal to or higher than 10%, the accession qualifies for routine cryopreservation. Plants were assessed 20–40 days after thawing, and only complete, normally appearing *in vitro* plants (with functional apex, stem, leaves, and roots) were considered recovered. Of the 28 tested accessions, 20 successfully passed the screening process, with recovery rates ranging from 10% to 90%. An additional eight accessions were directly processed for routine cryobanking without prior screening due to the project's timeframe.

To date, 30 new landraces from the project have been successfully included in the CIP-cryobank. Thus, this output is fully achieved.

3.2 Outcome

The activities implemented in Zambia and Madagascar made significant contributions to the overarching goal of ensuring "long-term access for smallholder farmers in Sub-Saharan Africa to phytosanitary clean sweetpotato diversity as a means of addressing future climate change and related challenges". This was accomplished through a comprehensive "Clean and Share" approach, which included the targeted collection of local landraces, disease cleaning, the reintroduction of clean planting material to farmers, and the long-term storage of these landraces in cryopreservation under the auspices of the ITPGRFA, ensuring their availability to humanity for generations. These efforts directly supported food security, enhanced climate resilience, and contributed to poverty reduction in vulnerable communities.

Notably, prior to the project, the global sweetpotato collection held at CIP-Lima under the ITPGRFA contained only two accessions from Madagascar and four from Zambia. This project significantly increased the number of accessions from both countries, representing a major advance in the conservation and global availability of sweetpotato genetic diversity. By the end of the project, over 100,000 vines were distributed to more than 300 farmers in the two partner countries, far surpassing the original target of 60,000 vines to 120 households.

To assess farmer engagement and early outcomes of the project, surveys and focus group discussions were conducted in both Madagascar and Zambia in 2024 and 2025 (see Annexes 7a and 7b). In Madagascar, FIFAMANOR led the data collection through a combination of 15 individual farmer interviews and three focus group discussions held in September 2024 and March 2025. Each discussion group comprised 6 to 10 participants, resulting in a total of 39 farmers consulted across eight villages in four districts: Vohipeno, Farafangana, Beloha, and Betioky. In Zambia, ZARI conducted seven focus group discussions in September 2024, reaching 54 farmers (20 men and 34 women) from seven villages in the districts of Monze, Choma, Kapiri-Mposhi, and Masaiti. Together, these surveys provided a snapshot of the project's reach, the varieties introduced, and how farmers in different contexts responded to the intervention.

Evidence on the intended outcome of "increased sweetpotato yields for smallholder farmers in Zambia and Madagascar" is still limited. FIFAMANOR reports that, on average, farmers indicated a 30–40% yield increase. ZARI noted that the major benefits were increased yields and better-looking tubers free of scars, which improved market value and, consequently, incomes. However, the survey data were patchy. The survey data confirmed that 71% of Zambian respondents ranked yield as their top priority when selecting sweetpotato varieties. However, due to funding and timing constraints, the project was unable to collect consistent and reliable multi-year data to confirm a 20% yield increase by the project's end. Variability in planting and harvesting periods across communities also created logistical challenges for coordinated data collection and farmer surveys.

Nevertheless, the surveys revealed an interesting fact: farmers value a diverse range of traits beyond yield alone. Farmers in Madagascar placed greater emphasis on non-yield qualities such as the appearance and strength of stems and leaves, cooking characteristics, and reduced pest presence. This reflects a more holistic approach to varietal selection, which prioritizes overall performance, adaptability, and individual preferences in specific contexts. These findings underscore the importance of continuing to support the development and dissemination of diverse sweetpotato varieties that align with the practical needs and priorities of smallholder farmers, including but not limited to yield.

3.3 Monitoring of assumptions

One key assumption that was not fully met by the project was that yield data would be consistently collected from experimental plots. This problem was communicated by partners during the virtual project meetings. While we have anecdotal evidence indicating that sweetpotato yields have increased by more than 20% in several project areas, we were unable to capture actual yield data from experimental plots in the time available. Due to limitations in staffing, budget, and differing harvest times across four districts in Madagascar and four in Zambia, harmonized yield data during the actual harvest period proved difficult to obtain.

Additionally, partners had limited time to gather data at the farmer level, both because of the short timeframe allocated for this activity and delays in vine multiplication and distribution in Madagascar caused by drought and cyclones. This problem was communicated by FIFAMANOR in the previous annual report. Although the survey included questions on the quantity of sweetpotato harvested and land

area cultivated, the data collected on these variables were inconsistent and often incomplete, making it difficult to produce robust yield estimates.

As a result, the information gathered serves more as a rapid assessment rather than a thorough impact evaluation. These gaps in quantitative data, especially regarding yield and household characteristics, highlight the challenges and limitations inherent in the rapid assessment approach used. Conducting a proper impact study would require more time (multiple-year assessments) and resources. Nevertheless, this approach provided key initial insights through initial farmer feedback, particularly on preferred varietal traits.

3.4 Impact

The stated impact from our original proposal was "Smallholder farmers in Sub-Saharan Africa have long-term access to phytosanitary clean sweetpotato diversity and other clonal crop diversity as a means to address future climate change and other challenges."

While the project duration was only three years, it successfully laid a strong foundation for long-term conservation and use of sweetpotato biodiversity. Over 300 unique sweetpotato landraces were collected across Madagascar and Zambia, an unprecedented effort in clonal crop conservation within such a timeframe. These landraces were genetically fingerprinted and are now securely conserved in the global sweetpotato collection at CIP-Lima. Importantly, they are available for global use under the Standard Material Transfer Agreement (SMTA) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). This ensures that the biodiversity conserved through the project is not only protected but also accessible to researchers, breeders, and farmers worldwide, including those from the project countries.

The project contributed to poverty reduction by supporting smallholder farmers' access to more resilient and locally adapted sweetpotato varieties. Surveys and focus group discussions conducted with participating farmers indicated perceived improvements in yield, pest resistance, and cooking quality. Importantly, farmers valued traits beyond yield, such as vine vigor, storage root characteristics, and cooking performance—highlighting a more nuanced, locally informed approach to variety adoption. This aligns closely with climate-resilient agriculture goals.

Furthermore, the project strengthened national capacities for conservation and use of sweetpotato diversity through targeted training, infrastructure improvements, and technical support. National partners now possess enhanced capability to identify, manage, and utilize local diversity in breeding and distribution efforts. By building local capacity in clean planting material production and varietal selection, the project has enabled farmers and partners to continue improving access to diverse, high-quality sweetpotato planting materials, essential for food security and livelihood stability in the face of climatic and economic shocks.

4 Contribution to Darwin Initiative Programme Objectives

4.1 Project support to the Conventions, Treaties or Agreements

The activities undertaken in this project conform to and support the relevant national action plans in both countries where collections have taken place (Madagascar's National Strategy and Action Plan on Plant Genetic Resources for Food and Agriculture 2018-2025 and Zambia's Second National Biodiversity Strategy and Action Plan 2015-2025).

Sweetpotato is listed Annex 1 of the ITPGRFA and all 300+ sweetpotato landraces sent to CIP under this project were transferred with the ITPGRFA's Standard Material Transfer Agreement (SMTA). Long-term conservation of all collected landraces was ensured by inclusion of the collected landraces in the global sweetpotato collection which is held in-trust for humanity under the auspices of the ITPGRFA in CIP-Lima.

Further, the principal partner for the project from Zambia, Graybill Munkombwe from ZARI, is the country focal point for the ITPGRFA for Zambia and has been in contact with his national counterparts on the CBD and Nagoya Protocol. making all relevant parties aware of the project and its goals. In Madagascar, the principal partner for the project, Noroseheno Ralisoa from FIFAMANOR, has been in contact with

the relevant national focal point, who approved the issuance of the SMTA for the transfer of the sweetpotato landraces to CIP.

In summary, all genetic resources collected under this project are conserved under the auspices of the ITPGRFA, with the full knowledge and approval of the appropriate national authorities in Madagascar and Zambia.

4.2 Project support for multidimensional poverty reduction

In Zambia, ZARI reported an increase in the area under sweetpotato cultivation in the project areas, which can partly be ascribed to access to more diverse and clean planting materials, which had previously been limited. Also, awareness of sweetpotato as a drought-tolerant crop and its benefits for household food security grew among farmers in the project sites. For example, farmers severely affected by drought during the 2023/2024 season were able to harvest between 5 and 10 bags (50 kg each), some of which were sold, generating income and contributing to household food security. Moreover, some farmers saved sweetpotato vines from the 2023/2024 season for replanting. The nurseries supplied sufficient planting materials, further supporting the project's overarching goals. One female beneficiary in Kapiri district expanded her sweetpotato field to half a hectare in the 2024/2025 season, and shared vines with four other farmers in her community, amplifying the impact on local food and nutrition security. Another farmer increased their cultivated area to 1.5 hectares and is expected to produce at least 100 bags (25 kg each), potentially adding over US $1,200 to the family's income.

In Madagascar, FIFAMANOR reported positive contributions to agricultural development and poverty alleviation through improved productivity and increased farmer incomes. During meetings with farmers, respondents noted visible improvements in the quality of their harvests, observing fewer disease and insect attacks compared to previous seasons. As a direct result of the improved yields, farmers have reported a marked improvement in food security. Nearly 75% of farmers indicated that they now have a more consistent supply of sweetpotato throughout the year, reducing reliance on external food sources.

Across both countries, farmers demonstrated a strong interest in accessing new sweetpotato diversity, especially varieties perceived to be clean, high-yielding, drought-tolerant, and disease-resistant. The planting materials distributed through the project were generally well-received. Farmers consistently noted positive attributes, such as attractive tuber appearance, good stem and leaf quality, and shorter maturity periods. In both Zambia and Madagascar, the majority of respondents expressed an intention to continue cultivating the distributed varieties in the following planting season, citing motivations such as improved food security, better crop performance, and potential for income generation.

4.3 Gender Equality and Social Inclusion (GESI)

GESI Scale	Description	Put X where you think your project is on the scale
Not yet sensitive	The GESI context may have been considered but the project isn't quite meeting the requirements of a 'sensitive' approach	
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of women and marginalised groups and the project will not contribute to or create further inequalities.	
Empowering	The project has all the characteristics of a 'sensitive' approach whilst also increasing equal access to assets, resources and capabilities for women and marginalised groups	X
Transformative	The project has all the characteristics of an 'empowering' approach whilst also addressing unequal power relationships and seeking institutional and societal change	

Gender equality has been a regular focus in our monthly project meetings and collecting gender-disaggregated data whenever possible has been essential to monitor equality and identify areas needing improvement.

Women represented 48% and 40% of participants in our virtual workshops on DArTseq marker data and sweetpotato disease management, respectively. In Year 2, we tracked the percentage of women receiving disease-free sweetpotato vines. At that time, 63% of recipients were women in Zambia, while in Madagascar, only 26% were women. This underscored the need for continued efforts, including women-only focus groups and awareness campaigns, to improve gender inclusion. At the end of the project, farmers receiving clean materials from FIFAMANOR were 47% male and 53% female.

During the farmer surveys in 2024, FIFAMANOR engaged 34 female farmers (63%) out of a total of 54 farmers. For Madagascar, there has been a stronger push to include women, which resulted in 39% of female farmers interviewed.

4.4 Transfer of knowledge

At the start of the project, both FIFAMANOR and ZARI had limited capacity to manage, clean, and multiply phytosanitary clean planting materials. Through a series of targeted training sessions, hands-on exchanges, and virtual workshops, 234 sweetpotato landraces from Zambia and 70 from Madagascar have now been successfully processed and secured for long-term conservation at the global sweetpotato genebank at CIP-Lima. This represents a major step in both the conservation and availability of African sweetpotato diversity. Data and information generated through the project was shared across multiple platforms, facilitating sustainable opportunities for knowledge sharing.

Special mention goes to Noroseheno Ralisoa from FIFAMANOR, a Humphrey Fellowship alumna, who was invited to present the “Sweetpotato Clean and Share” project during an international event held in Dar es Salaam to celebrate the 35th anniversary of the Humphrey Fellowship Program. This opportunity provided valuable international exposure and facilitated connections with other experts in rural development.

4.5 Capacity building

Capacity building was a core pillar of this project, with a strong focus on empowering national partners with the technical expertise needed for the long-term conservation and sustainable use of sweetpotato genetic diversity.

The following is a complete list of the project’s capacity building activities:

Name of indicator using original wording	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total
Farmer training on sweetpotato production and practices. *Country included: Zambia*	Men Women	25 35	0		60
Monthly virtual project team meetings. *Countries included: Kenya, Peru, Germany, Madagascar, Zambia*	Men Women	48 78	48 78	65 56	373
Methodology for in vitro rapid multiplication of sweetpotato training. *Countries included: Kenya, Peru*	Men Women	1 1	0		2
FIFAMANOR staff training on the use of ODK tool for sweetpotato landrace collection. *Country included: Madagascar.*	Men Women	4 2	0		6
Photography workshop on documenting project work and efforts visually. *Countries included: Kenya, Peru, Germany, Madagascar, Zambia*	Men Women	2 4			6
Virtual Workshop on the Analysis of DArTseq Sweetpotato marker data *9 countries included*	Men Women		15 14		29
Virtual Workshop on Sweetpotato Viral Disease Management *9 countries included*	Men Women		15 10		25
Hardening of sweetpotato *in vitro* plantlets *Countries included: Zambia, Kenya*	Men Women		3 2		5
Safeguarding training *Countries included: Kenya, Peru, Germany, Madagascar, Zambia*	Men Women			5 6	11
Antibribery and corruption policies training *Countries included: Kenya, Peru, Germany, Madagascar, Zambia*	Men Women		6 7		13
Crop management, rapid multiplication *Country included: Madagascar (Vohitrindry South East Region)*	Men Women			8 5	13
Rapid multiplication and protection against virus infection *Country included: Madagascar (Ampangabe Vakinankaratra)*	Men Women			4 8	12

Rapid multiplication and protection against virus infection *Country included: Madagascar (Antsoantany Madagascar)*	Men Women			0 18	18
Sensitization about virus infection on sweetpotato *Country included: Madagascar (Mahavokatra Vakinankaratra)*	Men Women			7 15	22
Evaluation with focus group in Tameantsoa *Country included: Madagascar (Tameantsoa South West Region)*	Men Women			3 7	10

Special mention goes to Noroseheno Ralisoa from FIFAMANOR, a Humphrey Fellowship alumna, who was invited to present the "Sweetpotato Clean and Share" project during an international event held in Dar es Salaam to celebrate the 35th anniversary of the Humphrey Fellowship Program. This opportunity provided valuable international exposure and facilitated connections with other experts in rural development.

5 Monitoring and evaluation

The M&E plan did not change over the project reporting period and was useful in ensuring results were achieved on schedule. All partners shared the M&E workload through email exchanges and virtual team meetings, fostering transparency and collaboration for a robust M&E system. The partners met monthly for project meetings via Zoom (31 project meetings from June 2022-March 2025), during which all phases of the project were discussed and coordinated. Minutes from the meetings were distributed to all attendees for future reference with action items highlighted and followed up in subsequent meetings until they were completed (Annex 5.2.a.-c. examples of project team minutes). This was a critical forum where any challenges encountered were brought up and resolved as a group. Additionally, the Project Coordinator (David Ellis) met in person with the CIP partners in Kenya in 2022 and the CIP partners in Peru in 2023, the Project Leader (Sarada Krishnan) met in person with the ZARI partners in Zambia in 2024, and both the Project Leader and Project Coordinator met in person with FIFAMANOR partners in Madagascar in 2025.

6 Lessons learnt

Both ZARI and FIFAMANOR reported that monthly project meetings were instrumental in addressing implementation challenges, monitoring progress, and fostering collaboration among partners.

ZARI highlighted the success of vine multiplication, with 20 multipliers producing and distributing 66,450 sweetpotato vines to 60 farmers, surpassing targets. However, identifying multipliers was difficult due to irrigation challenges and limited disease knowledge, and engaging commercial multipliers was not feasible due to cost. A significant delay in repatriating vines from CIP-Nairobi pushed planting into Zambia's cold season, underscoring the need for temperature-controlled greenhouses in future similar projects to avoid seasonal delays. Additionally, the extreme weather variability in southern and central provinces requires preparedness for both drought and floods. Key lessons from ZARI include the importance of frequent communication among partners and consultants, close coordination to prevent mixing of diseased and clean planting materials, and recognition that youth participation may be limited due to the demographics of sweetpotato growers.

FIFAMANOR echoed the value of regular monthly meetings in strengthening partner collaboration and project oversight. They noted that farmer surveys were sometimes biased by project staff presence, suggesting that more objective methods, such as farmer-led field trials, would yield better data, though requiring more resources and time. The lengthy cleaning process for planting materials also demands adequate time allocation in project planning to enable effective distribution and evaluation of landraces under real farming conditions.

Another key takeaway from the project is the importance of enhancing capacity in farmer survey methodology, particularly in the design and implementation of quantitative data collection strategies. Although the survey template included questions on the amount of sweetpotato harvested and the area cultivated, the resulting data was often incomplete and inconsistent, making it difficult to generate reliable yield estimates. This highlights a significant skills gap among partners in the area of survey design and implementation.

Other lessons learned included:

- The need to hand-carry plant samples between countries to ensure survival and arrival of good quality materials. Thus, good and constant communication among partners is key in the movement of planting materials.
- Lyophilized leaf materials are not reliable for high throughput sequencing (HTS) for virus detection in plant materials. In this project, fresh material was needed for verification of phytosanitary cleaning.
- Leaf tissue dried over silica gel by partners not familiar with the requirements for DNA stability was not reliable for the generation of good quality DNA for fingerprinting. Although a written protocol was provided, there are numerous steps in the process where DNA can be degraded (handling of material pre-exposure to silica gel, incomplete drying over silica gel, rehydration after drying, extreme temperatures during shipping, etc.) and it was not possible to determine where the DNA could have been compromised. In the future, DNA for fingerprinting should be extracted from fresh tissue in a lab with experience in handling large DNA samples.

7 Actions taken in response to Annual Report reviews

The primary comment in the previous annual report reviews was the lack of accessible means of verification for the claimed results. Significant efforts were undertaken to enhance transparency and accountability through direct engagement with implementation partners. As detailed above, site visits by the Project Coordinator and Project Leader provided critical opportunities to observe project activities firsthand, verify reported results, and strengthen collaborative relationships, directly addressing the concerns raised regarding verification.

All sweetpotato landraces collected from partner countries can also be verified as available for distribution and use in the global sweetpotato collection at CIP in Lima, Peru. These accessions are fully curated, available in the Multilateral System (MLS) of access and benefit sharing under the Plant Treaty, and can be requested for use by breeders, scientists, and farmers under the Standard Material Transfer Agreement (SMTA).

8 Risk Management

Throughout the project, partners encountered a range of context-specific risks and challenges that informed adaptive strategies. These issues were discussed during monthly meetings and partners were able to share challenges in project implementation, and their proposed responses. No major risks were reported during the final phase of the project, aside from difficulties related to data collection during farmer surveys.

One of the most significant obstacles during the project was the logistical difficulty in transporting plant materials within Africa. In both Zambia and Madagascar, no reliable courier services were available to ship plant materials to regional hubs, requiring partners to hand-carry materials to and from Kenya. This caused substantial delays, particularly as shipments had to align with the limited planting windows, putting pressure on the overall project timeline.

Community engagement during landrace collection also surfaced as a critical area. The concept of long-term conservation in distant locations, such as at CIP-Lima, was unfamiliar and occasionally met with resistance. This highlighted the importance of building trust through early and transparent communication, facilitated by trusted local intermediaries, and ensuring that prior informed consent (PIC) is fully understood and documented.

Language barriers were another notable challenge. Project materials and instructions that were not provided in local languages limited comprehension and participation in some areas. Ensuring all communications are translated into the appropriate languages is essential for effective outreach and adoption of best practices.

Environmental risks also affected implementation. In Madagascar, cyclones and other extreme weather events disrupted field activities in 2024, as did a severe drought in parts of Zambia. These natural disasters serve as a reminder that climate-related disruptions are frequent and must be anticipated. Flexibility in scheduling and contingency planning are crucial to minimizing their impact.

Other implementation hurdles included delays in the procurement of capital equipment and difficulties in establishing reliable field contacts to introduce partners to local communities. In these instances, early planning and coordination with local agricultural institutions proved essential for progress.

The main risk mitigation strategy proved to be strong communication among partners. Regular meetings enabled quick responses to emerging issues and helped sustain momentum. Moving forward, the establishment of a more centralized, facilitated system for preparing and transporting plant materials around the region, particularly for *in vitro* processing and conservation, would greatly enhance efficiency and sustainability.

9 Scalability and Durability

Both ZARI and FIFAMANOR have taken important steps to ensure that the achievements of the project continue beyond its formal end. In Zambia, the sweetpotato vines distributed to farmers will serve as planting material for future seasons. Beneficiary farmers have been trained on how to maintain the phytosanitary quality of these materials, ensuring their continued use and dissemination within their communities. Extension staff from the Ministry of Agriculture, who worked closely with the project team, will continue to support farmers, as part of their mandate to provide technical assistance.

The project's contribution also aligns with national policy priorities on crop diversification and climate adaptation, particularly in promoting root and tuber crops such as sweetpotato as resilient options for food and income security in drought-prone areas. In this regard, the project has created lasting momentum for integrating sweetpotato more prominently into government-supported agricultural programs.

Institutionally, both ZARI and FIFAMANOR staff have benefited from strengthened technical skills and improved collaboration with other stakeholders. These gains will continue to support sweetpotato work at the national level. The infrastructure developed during the project, including facilities for vine multiplication and conservation, will remain in use for ongoing vine production.

In support of this institutional legacy, the Crop Trust is currently working with Zambia's national genebank under ZARI through the Seeds for Resilience project. This complementary effort reinforces the outcomes of the present project by building capacity for the long-term conservation of sweetpotato and other clonal crops. The technical and infrastructural investments made through this project, such as skills in phytosanitary management and improved germplasm handling, directly contribute to ZARI's broader mandate and readiness to conserve clonal crops more effectively.

To sustain project gains, FIFAMANOR is in ongoing discussions with the Centre Technique d'Agriculture Sud (CTAS), a local partner involved in landrace seed production. The goal is to integrate sweetpotato vine production into their ongoing activities, leveraging existing infrastructure and networks to ensure continued availability of quality planting material at the local level.

Together, these efforts reflect a strong foundation for the long-term conservation and sustainable use of sweetpotato genetic resources in both countries, positioning national partners to carry forward the project's legacy through institutional, policy, and community-based pathways.

10 Darwin Initiative identity

The Crop Trust website has a dedicated webpage for this project, recognizing the UK Government's Darwin Initiative as the donor. To publicize the project, partners are regularly reminded to use the Darwin Initiative and Crop Trust logos in publications, presentations, and events. For example, in multiplier farmers' fields across Madagascar, signs with all of the partner logos showcased the different landraces.

CIP has been promoting the project to visitors at the CIP genebank in Lima, which has been a very effective strategy to promote the importance of long-term conservation of sweetpotato diversity and linkages with farmers. The key messages relate to strengthening partnerships, enhancing collaboration with NARS, and promoting capacity building and repatriation of clean planting materials to farmers. In

June 2025, CIP published and promoted a video highlighting the project and the Crop Trust communications team has been in touch with them to amplify this further.

The Crop Trust's communications team additionally supported the project and publicize the Darwin Initiative as follows:

Outreach and Communications
Since the launch of the Darwin Initiative-funded Sweetpotato Project in 2022, the Crop Trust has built a robust and evolving communications campaign to promote its objectives, showcase progress, and connect project outcomes to broader global agendas. Through digital content, media outreach, institutional reporting, and visual storytelling, the project has remained highly visible among donors, partners, and the global conservation community.

Digital Platforms
Project Webpage:
In 2022, the Crop Trust launched a dedicated project webpage introducing the initiative, outlining goals, and profiling partner institutions (CIP, ZARI, and FIFAMANOR). The page has been continuously updated with stories and achievements and will serve as a legacy page beyond the project's close.

Social Media Outreach
The Crop Trust promoted the project extensively across X (formerly Twitter), LinkedIn, Facebook, and Instagram:

- July 2023 (X)
- July 2023 (Facebook)
- July 2023 (LinkedIn)
- February 2025 (Instagram)
- October 2024 (Instagram)
- April 2025 (X)
- April 2025 (Instagram)

Media & Publications

- Crop Trust News (Oct 2024)
- Darwin Initiative Newsletter (Oct 2024)
- CGIAR News (Jan 2025)
- 2022 Annual Report
- 2023 Annual Report
- 2024 Annual Report
- GROW Webinar (2023)

Visual Content & Events

- Virtual Photography Training (2022): A virtual photography training for partners in Madagascar and Zambia strengthened local photo documentation.
- Content Gathering Mission (Feb 2025): A Crop Trust communications staff member visited Madagascar to collect interviews, photos, and video footage.
- Global Crop Diversity Summit (Nov 2023): Partners ZARI and CIP were featured in printed posters displayed at the summit in Berlin.

Looking Ahead
In summer 2025, the Crop Trust communications team will consolidate all outreach efforts into a final visibility campaign to mark the close of the Sweetpotato Project. This will include a comprehensive blog post summarizing achievements and lessons learned, targeted outreach to media with final results, and a coordinated social media campaign to amplify visibility. The project webpage will be updated as a legacy landing page containing final outcomes, successes, and links to content. A short video will also be produced to document the project's journey and impact, ensuring its legacy is accessible to future partners and funders.

11 Safeguarding

[redacted]

12 Finance and administration

12.1 Draft Project expenditure

Project spend (indicative) since last Annual Report	2024/25 Grant (£)	2024/25 Total actual Darwin	Variance %	Comments (please explain significant variances)
Staff costs (see below)	[redacted]			
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items (see below)				
Others (see below)				
TOTAL	**240,858**	**240,858**		

Staff employed (Name and position)	Cost (£)
Sarada Krishnan/ Project Coordinator GCDT	[redacted]
Finance Officer/ Financial support GCDT	
Rosemary Gatimu/ Jr. Researcher - Coordination of shipping, TC, phytocleaning/ CIP	
Andrew Waweru/ Researcher - TC, greenhouse/ CIP	
Project Support/ Administration and finances/ CIP	
RALISOA Noroseheno/ Supervision, field work, vine multiplication, distribution, assessment/	
RAHANTANIRINA Alice Marie/ Expert, field work, distribution/ FIFAMANOR	
FANJANIAINA Marie Lucia/ Expert, field work, farmers assessment/ FIFAMANOR	
Technicians (6)/ Collecting, shipping, receiving, TC, multiplication, distribution, assessment/ FIFAMANOR	
TOTAL	

Capital items – description	Capital items – cost (£)
Genetop Shaker Phytosanitary Cleaning CIP-Kenya (Adjustment)	[redacted]
TOTAL	

Other items – description	Other items – cost (£)
Audit costs (refer to T&Cs for requirements) GCDT	[redacted]
Supplies for cleaning/protection plant materials in Kenya (CIP)	
Supplies for cleaning/protection plant materials in Peru (CIP)	
Development of clonediag virus testing in Kenya	
Supplies for farmer planting/assessment & distribution in Zambia	
Supplies for greenhouse & multiplication in Zambia	
Supplies for collection, distribution, farmers and TC in Madagascar	
Greenhouse supplies; supplies multiplication Madagascar	
TOTAL	

12.2 Additional funds or in-kind contributions secured

Matched funding leveraged by the partners to deliver the project	Total (£)
Sarada Krishnan/ Project Coordinator	[redacted]
Luigi Guarino/ Director of Science	
Nelissa Jamora/ M&E Specialist	
Program Management Officer/ Administrative support	
Finance Officer/ Financial support	
Data Information System Officer/ Genebank Information Support	
Communication	
Overhead	
Jan Low - Senior Project Advisor / CIP	
Vania Azevedo - Head of CIP-Genebank / CIP	
Rainer Vollmer - Supervisor - cryopreservation / CIP	
Technicians (4) - Cryopreservation / CIP	
Operating Costs - Multiplication in Zambia / CIP	
Overhead / CIP	
TOTAL	

Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project	Total (£)
TOTAL	

12.3 Value for Money

The project has made significant strides in both Madagascar and Zambia, demonstrating how crop diversity conservation can contribute to food security, farm resilience, and economic development. In Madagascar, the initiative helped shift perceptions: crop diversity conservation is now increasingly seen as a practical and impactful approach to identifying, preserving, and enhancing the value of landraces. About 300 farmers benefited from the distribution of more than 40,000 virus-free sweetpotato planting

materials, representing over 25 landraces. This milestone not only demonstrates the project's success but also signals strong potential for continued impact and the value for future donor support.

In Zambia, the project exceeded its ambitious targets: 25 landraces were characterized, cleaned of viral diseases, and multiplied. Some 40,000 disease-free planting materials were distributed to 60 households, and farmers were trained in disease recognition and vine maintenance. Further, early feedback from farmers suggests potential to sustain and expand these gains. Dalitso Mumba, a single mother in Kapiri District, planted 0.5 hectares from her initial 650 vines and shared planting materials with 10 other farmers. Similarly, Getrude Mumba and her husband Abel Chitomfwa from Zambia cultivated 1.5 hectares and are preparing for the next season, despite drought challenges.

13 Other comments on progress not covered elsewhere

n/a

14 OPTIONAL: Outstanding achievements of your project (300-400 words maximum). This section may be used for publicity purposes.

I agree for the Biodiversity Challenge Funds to edit and use the following for various promotional purposes (please leave this line in to indicate your agreement to use any material you provide here).

The Darwin project entitled *Sweetpotato, a model for food security and long-term conservation of biodiversity* far exceeded project goals and contributed significantly to a lasting availability, for humanity, of invaluable sweetpotato genetic resources. The project collected over 300 sweetpotato farmer landraces from Madagascar and Zambia, phytosanitary cleaned (verified by RT-PCR) a subset of over 50 landraces, repatriated the landraces to the countries of origin where they were multiplied by in-country partners to yielded over 100,000 phytosanitary clean vines which were distributed and planted by over 350 small holder farmers. All landraces are safeguarded as part of the ITPGRFA global in-trust sweetpotato collection, ensuring long-term conservation and use to aid in securing food security for generations into the future. Additionally, the landraces were genetically fingerprinted (DArTseq markers) and to ascertain secure long-term conservation they are being placed them into cryopreservation as part of the Global Plant Cryopreservation Initiative.

The truly remarkable part of this project is that from collection to phytosanitary cleaning, repatriation, multiplication, distribution to farmers, planting and harvesting the sweetpotato from the phytosanitary vines, the entire timeframe for the project was only three years, proving the efficacy of the “Clean and Share” model for conservation and use of plant genetic resources for humankind. Prior to this project, the global in-trust sweetpotato collection contained only two accessions from Madagascar and four accessions from Zambia, thus the project increased the sweetpotato genetic diversity conserved for future generations by over 35-fold!

Farmers, however, were the immediate beneficiaries. Farmers from both countries expressed a strong interest in accessing new sweetpotato varieties, especially clean, high-yielding, drought-tolerant, and disease-resistant varieties. Farmers consistently noted positive attributes such as increased yield, attractive tuber appearance, good stem and leaf quality, and shorter maturity periods. While the harvested sweetpotato from the project in Madagascar was generally for household production, indicating a more subsistence contribution from the project, while in Zambia, farmers were able to produce enough to sell commercially suggesting that the project contributed significantly to household income. Farmers in both countries overwhelmingly confirmed the value that the project provided, both in training and in the introduction and availability of increased genetic diversity on their farms. There is good consensus that the project will provide benefits well into the future for these farmers.

[redacted]

Annex 1 Report of progress and achievements against logframe for the life of the project

Project summary	Progress and achievements
Outcome: Increased sweetpotato yields for smallholder farmers in Zambia and Madagascar as part of a "Clean & Share" approach to conserve, and provide clean planting material, of RTB diversity.	
Outcome indicator 0.1 By the end of the project, sweetpotato yields have increased 20% for farmers that received clean planting material for 50 high-value sweetpotato landraces	While we have anecdotal evidence indicating that sweetpotato yields have increased by more than 20% in several project areas, we were unable to capture actual yield data from experimental plots in the time available. The challenge in collecting precise yield data stemmed from the short timeframe for this activity and the variation in planting and harvesting seasons across communities, which made it logistically difficult to coordinate consistent, timely measurements. Although our farmer surveys included questions on total sweetpotato production and area planted, the responses varied widely in quality and completeness, making it difficult to produce robust yield estimates. Given these constraints, the perception of increased yields reported directly by farmers was perhaps a more reliable source of insight. While not quantitative, this feedback supports the hypothesis that the project is contributing meaningfully to productivity gains on the ground.
Outcome indicator 0.2 The "Clean & Share" conservation approach and its potential application to other countries or clonal crops documented and broadcast	Although this project represents the first to use the term "Clean and Share" for a conservation approach, the concept has successfully been practiced with potato in the Peruvian Andes since 1997 (Luttinghaus et al. 2021). To our knowledge, this is the first application of the approach for sweetpotato, and also the first on the Africa continent. We have also successfully implemented it in a relatively small timeframe (3 yrs), from collection of the landraces to farmers harvesting crops from phytosanitary clean materials, and have provided anecdotal evidence, complete with farmer testimonials, of the benefits accruing to local communities from the approach.
Output 1. 50 sweetpotato landraces from partner countries are processed for long-term conservation in the global sweetpotato collection at CIP in Lima, Peru.	
Output indicator 1.1 By the end of year 1, 60 sweetpotato landraces are selected and collected in Zambia and Madagascar	254 sweetpotato landraces were collected and are in process of long-term conservation in Lima, Peru from Zambia (through the Seeds for Resilience Program) and 70 sweetpotato landraces were collected and are in process of long-term conservation in Lima, Peru from Madagascar (8 through the BHA-USAID Program). Annexes 5.1a. and 5.1b show the locations in both countries where the collections occurred and Annex 5.3 contains a list of the landraces collected. This project increased the global collection of sweetpotato landraces from these two countries more than 35-fold, representing a major contribution to the ITPGRFA's Multi-Lateral System.

Output indicator 1.2 By the end of year 2, 60 sweetpotato landraces are genetically characterised	Genetic fingerprinting has been completed using DArTseq markers from 229 sweetpotato landraces from Zambia and 70 sweetpotato landraces from Madagascar and these data clearly show genetic distinctness, with very few exceptions, of sweetpotato from the two countries (Annex 5.4). By determining a threshold of 2.5% difference, preliminary analysis has determined that an estimated 201 of the collected landraces are genetically unique, while the remaining 98 are duplicates forming 22 groups. A comparison of the 201 putative genetically unique accessions collected in this project with the existing collection at CIP-Lima has identified 96 accessions whose genetic diversity may already be represented, albeit from other countries. That means over 100 new unique accessions will be added to the MLS.
Output indicator 1.3, By the end of year 1, 50 sweetpotato landraces are cleaned of yield-limiting viruses and other pathogens at KEPHIS, Kenya	A total of 56 landraces, 29 from Madagascar and 27 from Zambia, were phytosanitary cleaned based on RT-PCR analysis by CIP-Nairobi and repatriated to their respective countries for vine multiplication and distribution to farmers. Unfortunately, subsequent much more sensitive virus screening using high-throughput sequencing (HTS) of the plants indicated that the majority of these putatively phytosanitary clean landraces were still infected by one or more viruses. This was an important lesson that RT-PCR is not sensitive enough to be used for a definitive analysis of virus-free status, despite its continuing use. However, an important factor to consider is that the cleaning process conducted at CIP-Nairobi likely reduced the number of viruses, as well as virus titre, and most of the samples cleaned by CIP-Nairobi had only a single or double virus infection, which can explain the positive results seen by farmers. The samples identified as positive for viruses will undergo an additional cleaning procedure before being transferred to the global collection and cryopreserved.
Output 2. 60,000 cleaned vines (planting materials) of 50 sweetpotato landraces are made available to smallholder households in Zambia and Madagascar	
Output indicator 2.1. By July 2023, vine multipliers in Zambia and Madagascar receive 10+ clean cuttings/in vitro plants of 25 landraces from CIP-Kenya for multiplication and multiply them to 1400 samples per landrace	A total of 56 sweetpotato landraces, 29 landraces from Madagascar and 27 landraces from Zambia, were repatriated to their respective countries (Annex 5.6). Repatriated *in vitro* materials were acclimated to greenhouse/screenhouse environments and grown out in nurseries prior to distribution to vine multipliers. In Madagascar, all 29 sweetpotato landraces underwent multiplication, while in Zambia 25 landraces were multiplied by 20 vine multipliers. The average number of vines multiplied per landraces were ~1380 and ~2,650, respectively in Madagascar and Zambia.
Output indicator 2.2. By December 2023, 60,000 sweetpotato disease-free vines distributed to a minimum of 120 farmer households	In Madagascar over 24,400 vines were distributed to farmers in the 2023/2024 season and over 16,000 vines in the 2024/2025 season, to exceed the project target of 40,000 vines distributed in Madagascar. Some 295 farmers received vines. In Zambia, 46,200 vines were distributed to 60 farmers in the 2023/2024 farming season, and 20,250 vines during the 2024/2025 farming season, for a total of 66,450 vines distributed to over 60 farmers. In total, over 100,000 vines were distributed to over 300 farmers in the two partner countries, far exceeding our target.

Output indicator 2.3. By the end of the project, yield data and focus group data are collected and summarized	Farmers' surveys in project areas in Madagascar and Zambia provided a snapshot of the project's reach, the varieties introduced, and how farmers in different contexts responded to the intervention. While we have anecdotal evidence indicating that sweetpotato yields have increased in several project areas, we were unable to capture accurate yield data from experimental plots in the time available. Due to limitations in staffing, budget, and differing harvest times across four districts in Madagascar and four in Zambia, harmonized yield data during the actual harvest period proved difficult to obtain. Although the survey included questions on the quantity of sweetpotato harvested and land area cultivated, the data collected were inconsistent and often incomplete, making it difficult to produce robust yield estimates. As a result, the information gathered serves more as a rapid qualitative assessment rather than a thorough impact evaluation.
Output 3. Capacity of national genebanks in Zambia and Madagascar strengthened to conserve diversity and support its use by farmers	
Output indicator 3.1. By the end of the project, National genebanks in Zambia and Madagascar are strengthened through bi-monthly project meetings and three workshops on 1) conservation techniques, 2) analysis of molecular data and assessment of benefits at the farmer level	Capacity building was a core pillar of this project, with a strong focus on equipping national partners with the technical expertise needed for the long-term conservation and sustainable use of sweetpotato genetic diversity. Staff from FIFAMANOR and ZARI and sweetpotato farmers from Madagascar and Zambia lacked sufficient capacity to manage and propagate phytosanitary clean materials at the start of the project. Over the course of the project, a range of training and capacity-building efforts were carried out to improve technical expertise, promote collaboration, and build skills among partners. These efforts not only enhanced institutional capacity but also promoted regional collaboration and increased the confidence and competence of individual staff members.
Output indicator 3.2. By December 2023, vine multipliers, NARS and farmers in Zambia and Madagascar receive training on disease recognition, disease management, and multiplication of clean planting material	A virtual sweetpotato viral disease management workshop was held 12 December 2023. This session focused on on-farm strategies for management of viral diseases in sweetpotato cultivation and included segments on disease recognition, disease management, and multiplication of clean planting materials. The workshop was attended by 25 participants (40% female) from nine countries, representing NARS, NGOs, and one private sector entity and is available online. Additionally, multiplication or clean planting stock and the on-farm management of diseases was a frequent topic at our monthly meeting, as well as on-site visits.
Output 4. Cryopreservation protocol refined and optimized specifically for sweetpotato diversity	
Output indicator 4.1 By the end of the project, experiments to improve cryopreservation protocol for sweetpotato undertaken	CIP has established a standard screening protocol for sweetpotato to identify landraces amenable to cryopreservation. Screening is performed with a single replicate of 10 shoot tips.
Output indicator 4.2 By the end of the project, protocol pilot tested on 25 sweetpotato accessions	28 sweetpotato landraces from the project were selected and screened for cryopreservation using CIP's protocol. Of the 28 tested accessions, 20 successfully passed the screening process, with recovery rates ranging from 10% to 90%. Additionally, eight accessions were directly processed for routine cryobanking without prior screening. To date, 30 landraces from the project have been successfully cryopreserved at CIP.

Annex 2 Project's full current indicators of success as presented in the application form (unless changes have been agreed)

Project summary	SMART Indicators	Means of verification
Impact: Smallholder farmers in Sub-Saharan Africa have long-term access to phytosanitary clean sweetpotato diversity and other clonal crop diversity as a means to address future climate change and other challenges		
Outcome: Increased sweetpotato yields for smallholder farmers in Zambia and Madagascar as part of a "Clean & Share" approach to conserve, and provide clean planting material, of RTB diversity.	0.1 By the end of the project, sweetpotato yields have increased 20% for farmers that received clean planting material for 50 high-value sweetpotato landraces 0.2 The "Clean & Share" conservation approach and its potential application to other countries or clonal crops documented and broadcast	0.1 Yield data gathered from farmers' groups and NARS experimental plots 0.2 Publications, presentations and workshops on the reciprocal conservation approach Plant Treaty's Global Information System lists new sweetpotato landrace accessions available worldwide for research, breeding and training
Outputs: **1.** 50 sweetpotato landraces from partner countries are processed for long-term conservation in the global sweetpotato collection at CIP in Lima, Peru	1.1 By the end of year 1, 60 sweetpotato landraces are selected and collected in Zambia and Madagascar 1.2 By the end of year 2, 60 sweetpotato landraces are genetically characterised 1.3 By the end of year 1, 50 sweetpotato landraces are cleaned of yield-limiting viruses and other pathogens at KEPHIS, Kenya By the end of year 1, 50 sweetpotato landraces are shipped to CIP-Lima for processing into the collection and ultimately for cryopreservation in the global collection at CIP-Lima.	1.1 Images, reports, delivery of accessions in Kenya 1.2 Data provided as part of reports and/or science papers 1.3 Phytosanitary and import permits, confirmation of disease-free status at CIP New accessions are reported via the online portal, Genesys (www.genesys-pgr.org, and through assignment of digital object identifiers to each accession in the Plant Treaty's Global Information System
2. 60,000 cleaned vines (planting materials) of 50 sweetpotato landraces are made available to smallholder households in Zambia and Madagascar	2.1 By July 2023, Vine multipliers in Zambia and Madagascar receive 10+ clean cuttings/in vitro plants of 25 landraces from CIP-Kenya for multiplication and multiply them to 1400 samples per landrace 2.2 By December 2023, 60,000 sweetpotato disease-free vines distributed to a minimum of 120 farmer households 2.3 By the end of the project, yield data and focus group data are collected and summarized	Import permits, images, reports Data and images gathered on cleaned vines at multiplication sites Data collected from small focus groups to assess satisfaction, opinions and suggestions of farmers

3. Capacity of national genebanks in Zambia and Madagascar strengthened to conserve diversity and support its use by farmers	3.1 By the end of the project, National genebanks in Zambia and Madagascar are strengthened through bi-monthly project meetings and three workshops on 1) conservation techniques, 2) analysis of molecular data and assessment of benefits at the farmer level 3.2 By December 2023, Vine multipliers, NARS and farmers in Zambia and Madagascar receive training on disease recognition, disease management, and multiplication of clean planting material	3.1 Workshop reports and photos Training materials made available online 3.2 Screenhouses, equipment installed, training reports

Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

1.1 Collection and selection of 60 sweetpotato landraces in Zambia and Madagascar (targeted collecting from diverse habitats and of valuable landraces in Zambia and Madagascar, preparation of vines for shipment to Kenya, shipment of vines to Kenya) (Q1 Year 1)
1.2 Data collected and analyzed from DArTseq genetic characterization of 60 sweetpotato landraces (Q2 Year 2)
1.3 50 sweetpotato landraces phytosanitary cleaned of yield-limiting viruses and other pathogens via thermotherapy and meristem isolation at CIP-Kenya (Q4 Year 1)
1.4 50 sweetpotato landraces packaged and shipped to CIP-Peru with all necessary paperwork including an SMTA for processing into the in trust collection and ultimately for cryopreservation in the global collection at CIP-Peru (Q4 Year 1)

2.1 Disbursement of 10+ clean cuttings/in vitro plants from CIP-Kenya of 25 landraces each to vine multipliers in Zambia and Madagascar for multiplication to 1600 samples per landrace (Q1 Year 2)
2.2 60,000 disease-free vines sweetpotato distributed to a minimum of 120 farmer households (Q3 Year 3)
2.3 Yield data and focus group data collected and summarized (Q1-Q4 Yr 3)

3.1 Carry out bi-monthly meetings to discuss progress, challenges, needs and logistics with project leads from the national partners in Zambia and Madagascar and coordinate and hold three workshops on 1) conservation techniques (disease-free maintenance of plant materials in the field, in vitro culture, transfer in vitro material into greenhouses), 2) analysis of molecular data (virtual workshop to use data from the project demonstrating how to interpret the data using R-Script to identify unique and similar material) and 3) assessment of benefits at the farmer level (virtual + hands on workshop on techniques collect data and conduct surveys assess benefits and farmer feed-back) (Q4 Year 3)
3.2 Carry out training on disease recognition, disease management, and multiplication of clean planting material for vine multipliers, NARS and farmers in Zambia and Madagascar (virtual training workshop on recognition of sweetpotato diseases, how the diseases are spread, how to limit the spread of the diseases and principals of positive and negative selection for disease management) (Q2 Year 2)

4.1 Undertake experiments to improve cryopreservation protocol for sweetpotato (lab-based experiments in mother plant treatments, genotype screening, composition and exposure time to loading solutions and PVS2, recovery of plants from cryo) (Q4 Year 3)
4.2 Test protocol pilot on 25 sweetpotato accessions (develop and test a ‘best-bet” method based on the experiments from activity 4.1) (Q4 Year 3)

Important Assumptions

Outcome: Long-term conservation (cryopreservation) protocols are sufficiently effective; Working conditions and travel remain sufficiently flexible for project implementation in project countries.

Output 1: All collected landraces have minimum passport data associated with them required for assigning DOIs. To this end, we will ensure that partners assume accountability for obtaining this information. Countries transfer the landraces with a standard material transfer agreement. In discussions with partners, we have been assured that this will not be an issue. Not all landraces adapt quickly to in vitro culture and some are problematic for phytosanitary cleaning (need 2 or more rounds of cleaning). Thus, the number collected is 5 landraces more than the target of 25 landraces repatriation to ensure success with deliverables. Sweetpotato materials are successfully imported to Peru without losses. Advances in successful shipments from Kenya to Peru have progressed over the past couple of years and most recently we have developed a system that ensures success by improved packaging and communication with Peru's phytosanitary authority.

Output 2: Experienced vine multipliers are identified and willing to collaborate. Several vine multipliers have already been identified in each country so that we have several options. Small-holder households are organized to receive and plant disease-free materials. We will start the organization of farmers with advance printed announcements of the availability of clean planting materials.

Output 3: NARS or NGOs in target countries organize appropriate, gender-balanced participation for capacity building events and knowledge is put to use.

Output 4: Complementary research on cryopreservation at CIP and other CGIAR Centres is supported and underway.

Annex 3 Standard Indicators

Table 1 Project Standard Indicators

Please see the Standard Indicator Guidance for more information on how to report in this section, including appropriate disaggregation. N.B. The annual total is not cumulative. For each year, only include the results achieved in that year. The total achieved should be the sum of the annual totals.

DI Indicator number	Name of indicator	If this links directly to a project indicator(s), please note the indicator number here	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total achieved	Total planned
	Farmer training on sweetpotato production and practices. *Country included: Zambia*		1	Men Women	25 35	0		60	
	Monthly virtual project team meetings. *Countries included: Kenya, Peru, Germany, Madagascar, and Zambia*		31	Men Women	48 78	48 78	65 56	373	
	Methodology for *in vitro* rapid multiplication of sweetpotato training. *Countries included: Kenya, Peru*		1	Men Women	1 1	0		2	
	FIFAMANOR staff training on the use of ODK tool for sweetpotato landrace collection. *Country included: Madagascar.*		1	Men Women	4 2	0		6	
	Photography workshop on documenting project work and efforts visually. *Countries included: Kenya, Peru, Germany, Madagascar, and Zambia*		1	Men Women	2 4			6	
	Virtual Workshop on the Analysis of DArTseq Sweetpotato marker data 9 countries included		1	Men Women		15 14		29	
	Virtual Workshop on Sweetpotato Viral Disease Management 9 countries included		1	Men Women		15 10		25	
	Hardening of sweetpotato *in vitro* plantlets *Countries included: Zambia, Kenya*		1	Men Women		3 2		5	
	Safeguarding training		1	Men Women			5 6	11	
	Antibribery and corruption policies training		1	Men Women		6 7		13	
	Crop management, rapid multiplication *Country included: Madagascar (Vohitrindry South East Region)*		1	Men Women			8 5	13	
	Rapid multiplication and protection against virus infection *Country included: Madagascar (Ampangabe Vakinankaratra)*		1	Men Women			4 8	12	
	Rapid multiplication and protection against virus infection *Country included: Madagascar (Antsoantany Madagascar)*		1	Men Women			0 18	18	
	Sensitization about virus infection on sweetpotato *Country included: Madagascar (Mahavokatra Vakinankaratra)*		1	Men Women			7 15	22	
	Evaluation with focus group in Tameantsoa *Country included: Madagascar (Tameantsoa South West Region)*		1	Men Women			3 7	10	

Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the **correct template** (checking fund, scheme, type of report (i.e. Annual or Final), and year) and **deleted the blue guidance text** before submission?	
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	
Is your report more than 10MB? If so, please consider the best way to submit. One zipped file, or a download option, is recommended. We can work with most online options and will be in touch if we have a problem accessing material. If unsure, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	
If you are submitting photos for publicity purposes, **do these meet the outlined requirements** (see section 14)?	
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	
Have you provided an updated risk register? If you have an existing risk register you should provide an updated version alongside your report. If your project was funded prior to this being a requirement, you are encouraged to develop a risk register.	
Have you involved your partners in preparation of the report and named the main contributors	
Have you completed the Project Expenditure table fully?	
Do not include claim forms or other communications with this report.	