

Darwin Initiative Main Annual Report

To be completed with reference to the “Project Reporting Information Note”:
(<https://www.darwininitiative.org.uk/resources-for-projects/information-notes-learning-notes-briefing-papers-and-reviews/>).

It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

Submission Deadline: 30th April 2022

• Darwin Initiative Project Information

Project reference	26-015
Project title	Traditional African vegetables strengthen food and nutrition security in Madagascar
Country/ies	Madagascar
Lead partner	World Vegetable Center
Project partner(s)	World Vegetable Center, Centre National de la Recherche Appliquée au Développement Rural (FOFIFA), Université d’Antananarivo (UA), SEMANA
Darwin grant value	£ 319,800
Start/end dates of project	16 May 2019 – 15 May 2022
Reporting period (e.g. Apr 2021 – Mar 2022) and number (e.g. Annual Report 1, 2, 3)	1 April 2020 – 31 March 2022, Annual Report 3
Project Leader name	Sognigbe N’Danikou
Project website/blog/social media	-
Report author(s) and date	Sognigbe N’Danikou, Rabary Bodovololona, Denis Randriamampionona, Lalaina Ranaivoson, Tatiana Rakotoson, Tendro Radanielina, Juvet Razanameharizaka, Hery Andriamazaoro, Ritha Luoga, Rosina Wanyama, Maarten van Zonneveld, Fekadu Fufa Dinssa, Pepijn Schreinemachers 29 April 2022

1. Project summary

Madagascar, a historic cross-road of African and Austronesian settlers, is home to many traditional African vegetables (TAVs), such as African eggplant, African nightshade, and *Vigna* legumes. TAVs have the potential to diversify Malagasy farming systems and therefore secure benefits of biodiversity for the poor. TAVs are nutritious, easy to grow, are often hardy, and better adapted to climate variability than many global crops. Recognizing this potential, the Darwin Initiative supported the scoping study DARSC182 led by WorldVeg that aimed to understand the diversity of TAVs used by Malagasy farmers; their conservation status and explore opportunities for income and increased consumption. The scoping study resulted in two major findings: i) Malagasy farmers still maintain a high diversity of traditional vegetables but production and consumption of these TAVs are low. Low usage makes traditional vegetables vulnerable to local or national extirpation under pressure of land-use change and crop replacement; ii) A modest

investment in seed systems and increased awareness of benefits for nutrition, income, and climate change adaptation would lead to greater utilisation of traditional vegetables. During the scoping study women farmer groups expressed great interest to grow TAVs. This confirms WorldVeg experience in other African countries about the potential of traditional vegetables to empower women in farming businesses.

This project aims to secure benefits of agrobiodiversity (ABD) for poor farmer households in two vegetable producing regions: Itasy and Antsirabe (Figure 1). The project is supporting Malagasy women farmers with practice-oriented research to grow traditional vegetables. This will make farming systems more resilient to a more variable climate, secure increased income for women farmers, and improve food and nutrition security of Malagasy households. To sustain current and future use of traditional vegetables, the genetic resources of traditional vegetables will be conserved *ex-situ* and in parallel grown in school gardens together with other food plants to raise awareness about Malagasy food plant diversity.

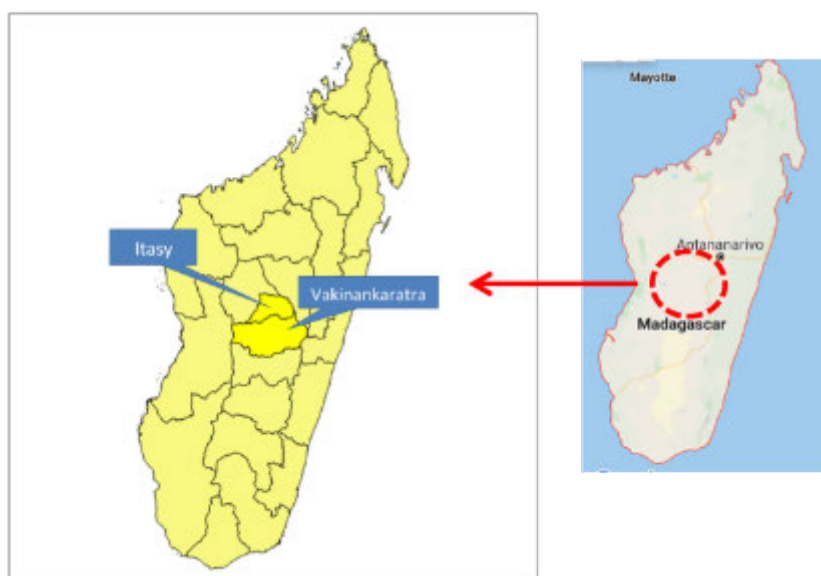


Figure 1. Map of project sites in Itasy and Vakinankaratra (Antsirabe) regions in Madagascar

2. Project stakeholders/ partners

The partners include the World Vegetable Center, FOFIFA, University of Antananarivo (UA) which are public research and development institutions, and a private partner SEMANA. FOFIFA and UA participated in the scoping study and also have experience with farmer training. SEMANA is a partner of the French seed company Technisem, and produces vegetable seeds for local use and export. The [Access to Seeds Index](#) identified SEMANA as the principal seed company in Madagascar for vegetables. During the scoping study, women farmers expressed high interest in growing traditional vegetables. Therefore, the partnership was based on a demand stemming from stakeholders in the host country in order to safeguard the genetic resources and to increase production and consumption of TAVs. Through the partnership, awareness was raised among the stakeholders on the importance of TAVs, through the stakeholders' workshop and farmer training and capacity building for university students in project year 1 and 2. The partnership has also gained from the support of the plant genetic resources policy makers (e.g. the focal points of the ITPGRFA under the ministry of Agriculture and Nagoya Protocol under the ministry of environment), who were involved with project activities as resource persons. Over the last year existing partnerships were furthered with CEFFEL, a local NGO which manages a training centre specialised in organic farming. The project has partnered with CEFFEL to train the beneficiary women farmers, but also received TAV seeds for testing and for training purposes (see section 3.5. of Appendix 8). Partnerships also were established with Agricultural and Livestock Research and Rural Development Center (FIFAMANOR) who supported good agricultural practices trainings, the local governments at project sites in Itasy and Antsirabe regions to scale up the promotion of TAVs in these regions (see section 3.5. of Appendix 8).

3. Project progress

3.1 Progress in carrying out project Activities

Output 1: Good understanding of the status of agro-biodiversity in Malagasy food systems.

- Hotspots of traditional vegetable diversity were mapped in year 1 and were reported in the annual reports of year 1 and 2. The study of the diversity and conservation status of traditional vegetables of Madagascar was part of a continental analysis of patterns of the distribution of 126 selected vegetable crops. This study was published in *Diversity and Distributions* ([van Zonneveld et al. 2021](#)). The study showed that at country level, Madagascar has a relatively high richness in domesticated traditional vegetables compared to other countries in Sub-Saharan Africa, but low observed richness of semi-domesticated and wild vegetables cultivated or harvested. This indicates historic introductions by settlers from Africa and Asia resulting in a unique set of local varieties for a wide range of crops. Hotspots of diversity (blue colour) can be found in the North, South and East of Madagascar (Figure 2). Madagascar also harbours several relevant endemic wild relatives of vegetable crops, such as *Vigna keraudrenii*, a close relative to cowpea, and three wild relatives of Malabar spinach (*Basella alba*). In this project we focused on *V. keraudrenii* considering that this species is endangered according to the IUCN Red list and considering its potential for cowpea breeding globally. We found 12 georeferenced historic herbarium records in the Global Biodiversity Information Facility (GBIF) of *V. keraudrenii*. The Google Earth map shows the locations of these sites in Madagascar. The plan was to revisit these locations to find this threatened species for monitoring in-situ conservation and collect seed for ex-situ safeguarding.

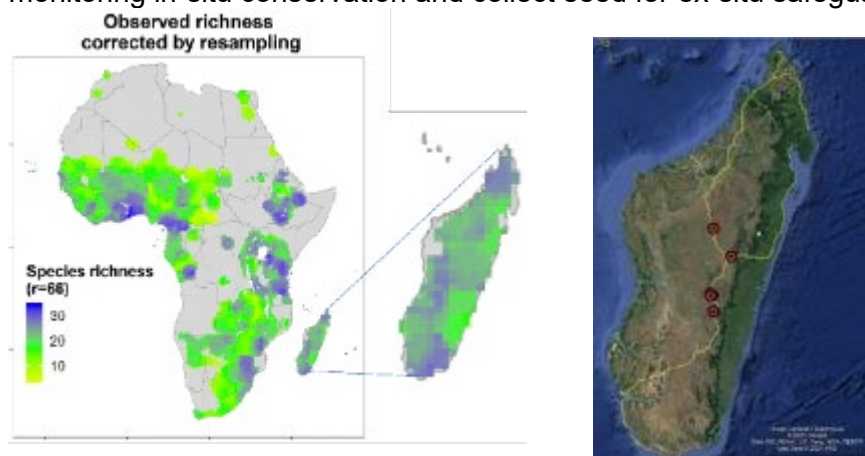


Figure 2. (Left) Map indicating hotspots of vegetable biodiversity in Madagascar. Source: van Zonneveld et al. (2021). Diversity and conservation of traditional African vegetables: priorities for action. (Right) Map of *Vigna keraudrenii* presence records from herbarium in Madagascar.

- Agrobiodiversity (ABD) four-cell assessments were conducted in eight sites in total in year 1 and 2 and reported in the previous year. The ABD assessments were initially planned to take place in at least six communities in different agroecological zones (AEZs). Because of the high diversity of AEZs within each region, project partners decided to increase to eight communities (Figure 3). The collected data are currently compiled and analysed. Four MSc students graduated in 2021, and four other students will graduate in 2022 (Appendices 3 and 4). The ABD data helped to understand the current use and conservation status of traditional vegetables and other Malagasy food plants. The results were presented at the [Power On Your Plate Summit](#) organised by the World Vegetable Center and its partners, as reported in the previous year. The data also feed the development of the ABD catalogue, which is now finalised (Appendix 2). Collected herbarium specimens during the inventories were deposited in the national herbarium of Madagascar as reference specimens for future studies.

Output 2: Protected and characterised genetic resources of vegetable diversity.

- Collecting of vegetable germplasm was conducted in year 2 resulting in 611 new accessions of TAVs collected at the project sites. After seed testing and cleaning in year 3 only 501 had viable seeds and 437 with enough seed available for sharing with WorldVeg. In addition, data of the germplasm were recorded, including the local name, the source of seed, name of the

provider, location plus geographical coordinates, local use, etc. All accessions were collected following the national regulations on access and benefit sharing. Collecting permits were obtained and documents stating the prior informed consent were signed (Appendix 7). The materials have been multiplied, dried and packed into air-tight aluminium bags and are conserved at the FOFIFA genebank in Madagascar. Seeds of 437 accessions of 45 selected traditional African vegetables have been forwarded to the WorldVeg genebank in Tanzania by FOFIFA under a Standard Material Transfer Agreement. (Figure 4, and section 2.1 of Appendix 8). Also, in year 3 the team was able to find one population of *Vigna keraudrenii*, a red-listed endangered endemic species and a wild relative of cowpea in Madagascar (Figure 3). Individuals of this species were only found at one out of 12 previously recorded sites (please refer to output 1) in the highland forests of the Amoron'i Mania region. This population is being monitored for *in situ* conservation and to collect and safeguard seeds in 2022 for *ex situ* conservation.

- **Seed multiplication:** other 250 seed kits (5 crops, 14 varieties, in total 11 kgs seeds) were produced by WorldVeg and sent to FOFIFA in project year 3 for on-station characterization and seed increase by FOFIFA, and to continue on-farm evaluation by 200 trained beneficiary women farmers. This increases the total number of seed kits sent by WorldVeg to the partners in Madagascar to 750 (32 kgs). The imported WorldVeg seeds were sampled by the national Plant Quarantine Service (SIQV) for laboratory tests, were certified to be free of diseases and an authorization was granted to distribute the seed to the beneficiary farmers (see Appendix 5, and section 2.2. of Appendix 8).
- **Characterization and evaluation of genetic resources** of 14 varieties of African vegetables (amaranths, African nightshade, African eggplant, Ethiopian mustard, and pumpkin) along with two local checks continued in year 3 in FOFIFA's research station in Antsirabe (Table 1, and Figures 5; see also section 2.2. of Appendix 8). Seeds of these materials were also increased in order to have enough seeds for research and distribution by FOFIFA.

Table 1. List of the TAV crops evaluated by FOFIFA in year 3

No.	Crops	Species	Entry Name	Variety name
V1	African nightshade	<i>Solanum villosum</i>	RC 18-ES13-3	Ambureni
V2	African nightshade	<i>Solanum scabrum</i>	RC 10-ES13-3	Malala
V3	African nightshade	<i>Solanum scabrum</i>	BG 16-Sel	Nduruma
V4	African nightshade	<i>Solanum scabrum</i>	SS 49-Sel	Olevolosi
V5	Amaranth	<i>Amaranth cruentus</i>	PARIS (A)-Sel	Akeri
V6	Amaranth	<i>Amaranth hypochondriacus</i>	AH-TL-Sel	Poli
V7	Amaranth	<i>Amaranth dubius</i>	UG- AM -9-ES13-2	Nguruma
V8	Amaranth	<i>Amaranth cruentus</i>	Ex Zim -Sel	Madiira 1
V9	Amaranth	<i>Amaranth cruentus</i>	AM 38-Sel	Madiira 2
V10	African eggplant	<i>Solanum aethiopicum</i>	DB3-Sel	DB3
V11	Ethiopian mustard	<i>Brassica carinata</i>	ML EM 1-Sel	Rungwe
V12	Ethiopian mustard	<i>Brassica carinata</i>	ST 3-Sel	Arumeru
V13	African eggplant	<i>Solanum aethiopicum</i>	OFORIWA'A	Oforiwa'a
V14	Pumpkin	<i>Cucurbita moschata</i>	Gkk 174 Sel	Gkk 174
T1	African nightshade	<i>Solanum sp</i>	Local landrace	Anamamy
T2	African eggplant	<i>Solanum sp</i>	Local landrace	Angivy



Figure 3. Collecting of *Vigna keraudrenii* in Madagascar.



Figure 4. Seed collector in the field (left), dried and packed seeds of the collected accessions in aluminium bags ready to be shipped to the WorldVeg genebank in Tanzania through an SMTA as part of the germplasm exchange between FOFIFA and WorldVeg.



Figure 5. Evaluation of 14 imported and 2 local TAV varieties at FOFIFA Antsirabe research station, Madagascar.

Output 3: Malagasy extension workers and women farmers trained on seed saving and production of traditional vegetables.

- 25 extension workers (68% women) and 200 small-scale women farmers attended the annual 3-day training course in Itasy and Antsirabe regions (Figure 6, see section 3.1. of Appendix 8). For the last year of the project, extension officers and the women farmers were trained together. This allowed for experience sharing and further interaction among the groups. The training followed the same agenda as last year. During the training the participants first reviewed the achievements, the challenges and lessons learnt from the second project year.

The training started with the review of previous' achievements, challenges, solutions and proposals for improving vegetable and seed production in project sites.

- The women farmers voluntarily shared their experiences and stated that they became much more experienced in TAV production and seed saving compared to the previous years. The session concluded with the overall review of vegetable cultivation techniques and seed saving. New seed kits with new materials were then distributed to the beneficiaries (Figure 6, section 3.1 of Appendix 8).



Figure 6. Training sessions for extension workers and beneficiary women farmers

- 200 small-scale women farmers received one 3-day training in year 3. The 200 beneficiary women farmers were trained on how to make compost and botanical pesticides. The women farmers were trained by an expert of FIFAMANOR making vermicompost and botanical pesticides using locally available ingredients (Figures 7,8,9, see section 3.2. of Appendix 8).
- 250 seed kits (44g per kit) of 13 improved lines of amaranths, African eggplant, African nightshade and Ethiopian mustard and one promising accession of pumpkin were developed by WorldVeg, imported to Madagascar and distributed to the 200 beneficiary women farmers, school gardens and for on-farm evaluation. The farmers have raised the nurseries and the crops have been transplanted in the field, under the supervision of extension workers and FOFIFA (Figure 8, Appendix 5; section 3.3. of Appendix 8).
- Training on cooking methods that preserve nutrients of TAVs. The objective of this training was to teach the women how they can preserve nutrients during cooking of vegetables. The training started with a recall of the advantages and benefits provided by vegetables. Then several traditional vegetable recipes were presented to the women. The farmers learned different culinary preparations of traditional African vegetables, cooking and consumption. It is a common practice that the women were used to cooking vegetables with a lot of water (sauce), with or without meat. During this training, they learned and practised other ways of preparing vegetables with other ingredients, which they appreciated and will put into practice.
- Participatory evaluation by 200 women farmers: The beneficiary women farmers have grown and evaluated the varieties that they received in project year 3. Despite some challenges related to climatic hazards in Madagascar this year, about 89% of the women were able to grow the vegetables. The results of the participatory on-farm evaluation confirmed previous years' findings that Madira 1 (amaranth variety) and Nduruma (nightshade variety) were the tastier and most preferred varieties by the beneficiaries. Also, Madira 1 appeared to be one of the most resistant TAV varieties to pests and diseases, followed by other amaranth varieties (Akeri and Poli). (Figures 10; section 3.3. of Appendix 8)



Figure 7. Cooking demonstration to women farmers in Betafo (right) and in Arivonimamo (left)



Figure 8. Trained women farmers received seed kits in Arivonimamo (left) and Betafo (right)



Figure 9. Women farmers trained on compost making in Betafo (left) and in Arivonimamo (right)



Figure 10. Beneficiary women farmers receiving the follow up visits and advice of the team (African eggplant left, African nightshade right).

- Seed network analyses were conducted in the Itasy and Antsirabe regions respectively to understand flow of seeds supplied to women farmers within communities in year 3. The survey findings indicated that the seeds are being spread by the beneficiary farmers. In Itasy alone the beneficiaries shared seeds for free to 1,668 indirect beneficiary farmers outside the project beneficiaries (16.6 kg), and sold 6.2 kg to another 626 buyers in year 1 and 2 as part of the development of their seed businesses (Figure 11, Appendix 8). In Antsirabe the surveys have not been completed yet, though 2,224 farmers have received seeds for free since the launch of the project. This makes a total of at least 4,518 indirect beneficiary households (1,668 + 2,224 + 626 = 4,518 indirect households) reached by the project in three years.

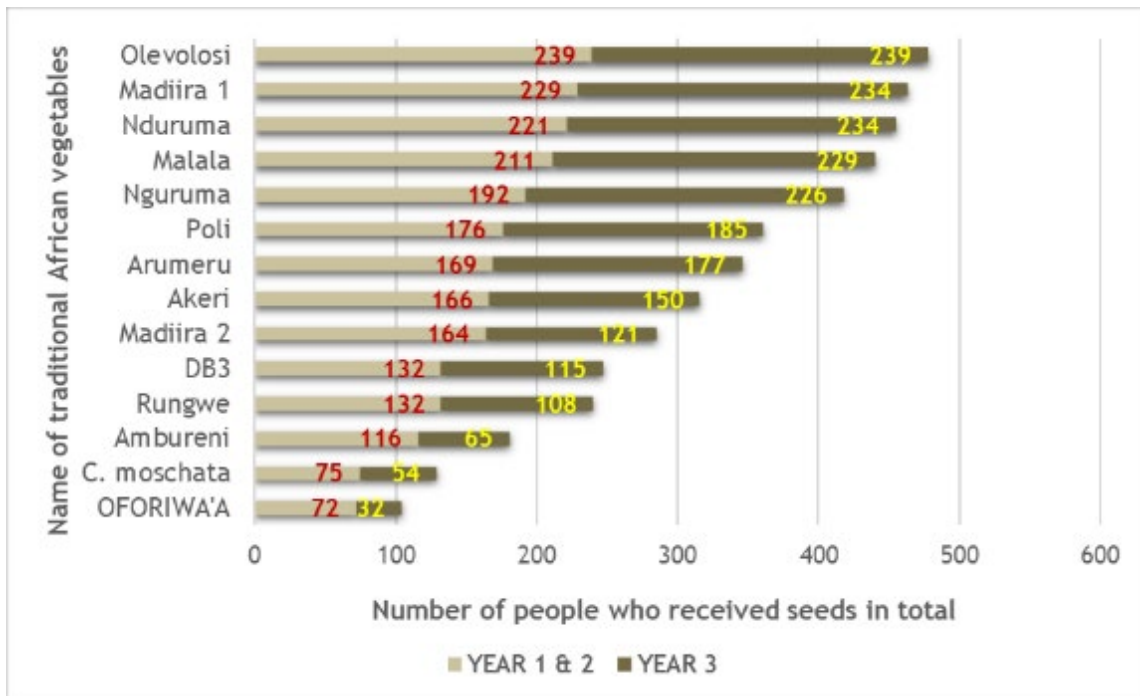


Figure 11. Distribution and sales of TAV seeds by the project beneficiaries in Madagascar. Data disaggregated by vegetable variety. Total new indirect seed recipients is 4,718 farmer households.

- Household surveys for monitoring and evaluation conducted. In year 3, a survey was conducted in order to assess the impact of adoption and utilisation of traditional African vegetables on outcome and output level indicators (Appendix 6). It also evaluated vegetable seed production and exchange by the trained farmers to other community members. Comparing the baseline data among the intervention (200 farmers) and control groups (200 farmers) the findings indicated a significant increase in the proportion of farmers producing

TAVs (Figure 12). The significant changes in the proportion of households cultivating TAVs can be largely attributed to the project interventions as most of the households cultivating these vegetables are in the intervention group. For instance, 99% of intervention households reported cultivation of African nightshade, 96% households cultivated African eggplant, 86% amaranth leaves, and 84% amaranth leaves. The scenario is different in the control group where less than 1% of the households are cultivating these vegetables. While most women were focused on production of the leafy vegetables, some farmers also harvested seed. In year 3, 84% of households of the intervention group shared these seeds with 12 other farmers on average. This means that 2,016 (=200 x 0.84 x 12) other farm households, who were not part of the project, have also benefited indirectly in year 3. The impact assessment study showed that overall, there is an increase in the production, consumption, and sales of TAVs in the project sites (Figure 12, Table 2, Appendix 6). There was a significant impact of the intervention whereby growing TAVs has significantly increased the income earned from vegetable sales, as compared to the control group.

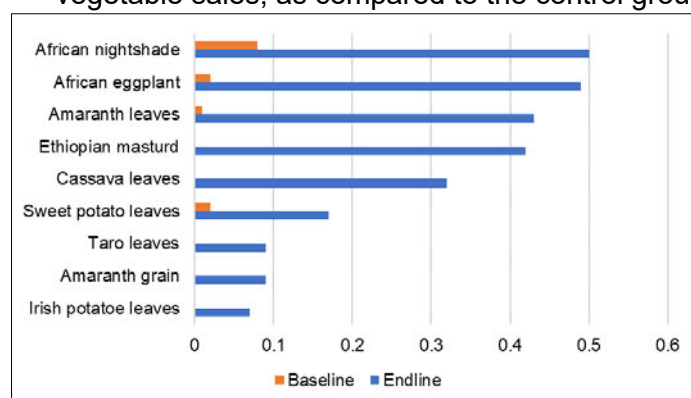


Figure 12. Proportion of households producing traditional African vegetables disaggregated by survey year (all households)

Table 2. Summary of key outcome indicators disaggregated by survey year

Variables	Endline (2022)				Baseline (2021)				Difference‡
	Total	Intervention	Control	Difference†	Total	Intervention	Control	Difference†	
Quantity consumed of vegetables (gm/person/day)	46.85	46.11	47.59	-1.48	31.60	30.49	32.71	-2.22	15.25***
	(34.67)	(35.05)	(34.36)	(3.57)	(36.25)	(30.50)	(41.25)	(3.63)	(2.54)
Yield (ton/ha)	16.34	21.28	10.52	10.76***	20.04	19.37	21.18	-1.82	-3.70*
	(22.72)	(26.37)	(15.65)	(2.35)	(32.59)	(32.07)	(33.59)	(4.27)	(2.24)
Area under vegetables (hectares)	0.06	0.02	0.11	-0.09***	0.86	0.82	0.91	-0.09	-0.80***
	(0.15)	(0.03)	(0.20)	(0.01)	(1.66)	(1.58)	(1.81)	(0.21)	(0.09)
Daily income per capita	0.20	0.19	0.21	-0.02	0.12	0.10	0.13	-0.03***	0.09***
	(0.22)	(0.21)	(0.22)	(0.02)	(0.11)	(0.10)	(0.12)	(0.01)	(0.01)
Poverty gap	0.89	0.90	0.89	0.01	0.94	0.95	0.93	0.02***	-0.05***
	(0.11)	(0.11)	(0.12)	(0.01)	(0.06)	(0.05)	(0.06)	(0.01)	(0.01)
Number of observations	382	193	189	382	400	200	200	400	782

Notes: Means with standard deviation in parentheses. †, difference between intervention and control tested with t-test (standard errors in parentheses). ‡, difference between endline and baseline tested with t-test (standard errors in parentheses). Significant difference denoted by: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Output 4: Regional school garden programs strengthened to promote conservation and use of agro-biodiversity.

- Focus-group discussions (FGDs) with school children and caretakers were organized in year 3. The methodology followed was the same as described in the previous annual report. As

explained in year 1 and 2 annual reports, the team increased the number of schools from five to eight. In total eight FGDs were carried out at the project sites, with 12 school children per school. Two FGDs were conducted in each school, with separate discussions with teachers and the school children. Twelve school children participated in each FGD, to collect data on their awareness, knowledge, and perceptions about traditional vegetables. The findings indicated that the children had better knowledge of the importance of vegetables compared to year 1 and 2. The children now know a long list of vegetables including traditional vegetables, and cited them along with their health benefits. The children liked to work in the school gardens and have acquired a good experience producing the TAVs at school. They enjoyed eating the vegetables harvested from the gardens (Figure 12, section 4.2 of Appendix 8).

- Biodiversity-rich school gardens established in eight primary schools in year 3. The project team continued the trainings for the school children and their caretakers on school gardening and nutrition education, the benefits and nutritional value of vegetables. The partners used the training manuals and videos developed by the project as reported in previous annual report. They were taken through the different steps of vegetable cultivation in a school garden. The harvested vegetable from the garden is cooked and eaten at school (Figure 13, section 4.2 of Appendix 8).



Figure 12. Focus group discussion with school children in Vakinakaratra and Itays regions



Figure 13. Activities of the biodiversity-rich school gardens in Antsirabe and Itasy, Madagascar

- Agrobiodiversity catalogue of Malagasy vegetables developed. The agrobiodiversity catalogue was drafted in year 2 and finalised in year 3 (Appendix 2). This Volume 1 is published in French and assembles traditional vegetables of Itasy and Antsirabe regions. Subsequent volumes of the catalogue will be published in the future as new data from other regions of the country become available.
- Regional workshops and national conference on how to incorporate TAVs and threatened food plants in regional school garden programs. The project organised 2 regional workshops (Antsirabe and Itasy) and a national conference (Antananarivo) in year 3 to discuss among researchers, practitioners, policy makers, farmers organizations and Madagascar-based donors how to incorporate local food plant diversity in regional school garden programs. FOFIFA used the seed kits developed by WorldVeg and local varieties to successfully

establish biodiversity-rich school gardens in eight primary schools to teach children and their families about the relevance of African vegetables for diets, identity, and biodiversity. The World Food Programme (WFP) and the Food and Agriculture Organization (FAO) endorsed this approach during the first national school garden conference held in Madagascar, organized by FOFIFA and WorldVeg in November 2021. Already two NGOs (Agrisud and CEFFEL) and three local governments are interested in using the seed rescued in Madagascar to establish biodiversity-rich gardens in other schools. Agrisud requested 8,000 seed kits and will collaborate with FOFIFA and the women farmers to develop the seeds. CEFFEL requests collaboration with FOFIFA to train at least 20 primary schools and to supply TAV seeds to these schools under their European Union funded project in which they have the creation of school gardens (See Figure 14 and section VI of Appendix 8). FOFIFA and WorldVeg are working with the Ministries of Education and Agriculture to engage with more NGOs and local governments that are interested in adopting this approach and access seed.

Output 5: Malagasy women farmers trained on seed production for commercialization.

- The training of 11 progressive women farmers on seed production and commercialization took place in year 3. As explained in the previous annual report, the team has trained 11 progressive women farmers against 10 planned by the project. However, there was an unexpected change which is to mention. The contact person of the project at SEMANA, Ms. Isabelle country Director of SEMANA retired in 2021 but her position was filled. Instead, the SEMANA headquarters recruited two technicians with no decision power. Therefore, the project could not have SEMANA to train the women farmers this year but rather had to outsource from MIKASA, a business organisation. This has also affected the initial plan of establishing business contracts between SEMANA and the trained women farmers for seed business. Nonetheless, alternatives were found to connect these women to the seed market as highlighted above, through development projects and programs which are now requesting seeds that the women farmers cannot meet the demand for the time being. Trained women farmers have started to commercialise seeds (see section 5 and 6 of Appendix 8).



Figure 14: Regional and national workshops on biodiversity-rich school gardens, Madagascar.

3.2 Progress towards project Outputs

1.1 Progress towards project Outputs

Output 1: Good understanding of the status of agrobiodiversity in Malagasy food systems.

Baseline: Limited information on the biodiversity, geographical patterns and the conservation status of traditional vegetables in Madagascar

Change to date: A GIS analysis was conducted which estimated that from a list of 126 selected TAVs on the basis of their popularity in different African regions, 83 species were observed in Madagascar. Of these 83 species, for 39 species no germplasm has been conserved yet *ex situ* (46%). The ABD four cells analysis is completed in eight sites vs six initially planned. The ABD assessments data collected in year 1 and 2 provide information on the TAV species used by communities, and the levels of threats. This guided the identification of popular promising vegetable species on one hand, and prioritize food plant conservation actions on the other hand. Eight MSc have been trained on the topic of ABD four-cell assessments.

Source of evidence: refer to Figure 2 in: [van Zonneveld et al., 2021](#), database and field report of the ABD four-cells assessments on TAV biodiversity, and ABD catalogue (see appendix 2).

Output 2: Protected and characterized genetic resources of vegetable diversity.

Baseline: There is a gap in the conservation and characterization of traditional vegetable genetic resources.

Change to date: Germplasm collecting missions were organised in project year 2 and 3, and 437 accessions of TAVs have been shared with WorldVeg's genebank in Tanzania for ex-situ conservation (Appendix 7). Seeds of 14 WorldVeg varieties of amaranth, African nightshade, African eggplant, Ethiopian mustard and pumpkin were multiplied and sent to partners in Madagascar and were evaluated (Appendix 5). These materials have been evaluated for adaptation and their performance compared with popular Malagasy vegetable landraces.

Source of evidence: Copy of the authorization to collect germplasm granted by the National Competent Authority; copy of seed import permits; photos of the trials; photos of the collecting missions; passport data of collected germplasm, germplasm exchange documentation (SMTA, see Appendices 5, 7).

Output 3: Malagasy extension workers and women farmers trained on seed saving and production of traditional vegetables.

Baseline: Lack of technical capacity of Malagasy women farmers in Itasy and Antsirabe regions on seed multiplication and production of African vegetables.

Change to date: Three annual training courses have been organised. The existing WorldVeg seed saving and vegetable production videos and leaflets were translated into Malagasy and used in trainings and also disseminated to farmers. The capacity in quality seed saving and vegetable production of 25 extension workers (68% of women) and 200 beneficiary women farmers were strengthened in year 1, 2 and 3. Seven hundred and fifty seed kits have been developed and 600 of them were distributed to the 200 women farmers for seed and vegetable production and on-farm evaluation in the last three consecutive years. The other 150 kits were used i) for on-station characterization/evaluation trials, ii) for the establishment of the school gardens, and iii) for distribution to new partners in the project, like CEFFEL. The women trained in home gardening and seed saving have conducted three cropping seasons and have evaluated 14 promising varieties; plus popular landraces of their choice.

Source of evidence: Lists of training participants; copies of signed receipts of leaflets by farmers; copy of training report, copy of sales book of farmers, copy of seed import permit; photos of the trials.

Output 4: Regional school garden programs strengthened to promote conservation and use of agro-biodiversity.

Baseline: School children and their caretakers have limited knowledge on the production of TAVs, and there is low biodiversity of TAVs in school gardens in Itasy and Antsirabe regions.

Change to date: A national stakeholder conference was organised in year 1 to sensitise actors to the potential of TAVs to combat child malnutrition and demonstrating to the young generation ingredients for a healthy diet through school garden programs. Eight initial FGDs were completed in year 2 to collect baseline information on school gardens which were presented in the previous annual report. After this situational analysis, school children and their caretakers were trained and eight school gardens (initially five planned) were established in Itasy and Antsirabe regions to strengthen the school garden program. Two regional workshops and one national conference on school garden programs were organised in year 3. The national conference was endorsed by key stakeholders in Madagascar including FAO and WFP. Many organisations (e.g. Agrisud, CEFFEL) are now partnering with FOFIFA and the trained women farmers to promote TAVs in Madagascar. A project closing workshop is being organised on April 28 and will seek the endorsement of the government and raise interest of Malagasy-based donors to invest in TAVs conservation and sustainable use to contribute to SDG 1, 2, 3, and 15.

Source of evidence: List of selected schools; FGD reports; training reports; photos of school gardens, workshop participants list, conference report.

Output 5: Malagasy women farmers trained on seed production for commercialization.

Baseline: Malagasy women farmers are willing to invest in vegetables, but lack technical capacity in seed production and business skills.

Change to date: 200 women farmers received 2-day intense training in year 1, 2 and 3, and evaluated 14 promising vegetable varieties. Eleven progressive women farmers were trained by the private seed company SEMANA on commercial vegetable seed production and seed business development. Business contracts are being established with NGOs to buy seed from the trained women farmers.

Source of evidence: Training reports; sales books of trained farmers; photos of seed production plots, seed network analysis report.

3.3 Progress towards the project Outcome

Baseline: Genetic resources of TAVs are threatened and have very minor contribution to food consumption and income for the smallholder households in the project sites.

Change to date:

- In year 1, 2 and 3, 200 women farmers received three 3-day trainings on seed saving and production of 14 promising TAV varieties. The trained women farmers have grown the varieties in their home gardens and farms. They have consumed the produce in their households. The surplus was sold within and beyond their communities (see section 3.1 above). The findings of the seed network analysis revealed that 4,718 new beneficiaries were reached over the 3 years of the project. The baseline survey revealed that the average household size in the project area is 4.5 persons. Thus 21,231 people have been reached with nutritious traditional African vegetables [(200 direct households + 4,718 indirect households) X 4.5 average household size = 21,231 people reached in total].
- Income generated from vegetable sales significantly increased to over 100%. With the training and the linkages with the private partners and NGOs, it is expected that the sales will see further increases in years to come.
- From a target of 400 accessions, the project has collected a total of 501 TAV accessions in Madagascar, of which 437 have been shared with WorldVeg's genebank in Tanzania for ex-situ conservation using an SMTA. The endangered and endemic *Vigna keraudrenii*, was found back in one site in the highland forests of Amoron'i Mania region. This population is being monitored for *in situ* conservation and to collect and safeguard seeds for *ex situ* conservation in the genebank of FOFIFA and with a back-up in WorldVeg.
- Eight school gardens have been established, the school children and their caretakers trained and produced vegetables which are being included in school meals. The vegetables are contributing to improve the diets of the children, which are mainly rice-based at the project sites. A total of 1,380 school children were reached by school activities. This is a major achievement, especially with respect to the ongoing COVID-19 pandemic.

Source of evidence: Reports of baseline and endline surveys; Progress M&E report; Participants list to the trainings on seed saving, and seed business; passport data of collected germplasm.

3.4 Monitoring of assumptions

Assumption 1 related to the outcome: The project estimates to indirectly impact 15,000 Malagasy people on the basis of the following assumptions: For each of 1,000 farmers growing traditional vegetables in the Itasy region, at least 3 households with on average 5 household members will increase their consumption of traditional vegetables because of improved access to the vegetables. 3 households x 5 members x 1,000 farmers = 15,000 Malagasy people.

Comments: Assumption 1 was reviewed as follows: for each of 200 direct beneficiary farmers, at least 5 new households are reached every year and will increase their consumption of traditional vegetables (200 x 5 = 1,000). The 1,000 farmer households refer to the number of farmers who have received seeds from the project. They will in turn share with at least 3 other households. The project has reached 21,231 by year 3, exceeding the assumption of 15,000 people.

Assumption 2: Communities can be accessed for, and are willing to participate in the agrobiodiversity four-cell assessments. Related to output 1: Good understanding of the status of agrobiodiversity in Malagasy food systems.

Comments: Assumption 2 held true. Communities were accessible to conduct baseline and endline socio-economic surveys, ABD four-cell assessments and training of the extension workers and farmers. Despite the COVID-19 pandemic the project activities were not impacted negatively. The main reason is that the main implementing national partner, FOFIFA, is based at one of the project sites outside the capital city Antananarivo and could continue to operate, while Antananarivo itself went through several lockdowns.

Assumption 3: FOFIFA will obtain permits with the corresponding national authorities in consultation with the ITPGRFA focal point to collect and ship seeds to the WorldVeg genebank of traditional African vegetables in Arusha, Tanzania. Related to Output 2: Protected and characterized genetic resources of vegetable diversity.

Comments: Assumption 3 held true and the permits to collect were issued and the germplasm was collected and exchanged following national regulations and international agreements on access and benefit sharing in the context of the Nagoya Protocol of the CBD and the ITPGRFA.

Assumption 4: Communities can be accessed by extension workers and MSc students to support capacity development of women farmers and to support school gardens and other agro-biodiversity activities in primary schools. Related to output 3: Malagasy extension workers, trained on seed saving and production of traditional vegetables.

Comments: Refer to the comments above on Assumption 2.

Assumption 5: School directors give permission to establish school gardens. School directors and caretakers give permission to interview school children. Students and teachers maintain school gardens. Related to output 4: School garden programs strengthened to promote conservation and use of agro-biodiversity.

Comments: The assumption held true. The project was able to establish and support 8 school gardens (initially only 5 were planned) and many other schools are requesting the project to help them to have their own school gardens. Collaborations are being discussed between FOFIFA, NGOs and the women farmers who have been empowered by the project.

Assumption 6: Progressive women farmers are interested to develop seed businesses.

Comments: The Assumption 6 held true. From 10 initially planned, the project has enrolled 11 progressive women farmers, and they collaborate with local NGOs to further develop their businesses. Related to output 5: Malagasy women farmers trained on seed production for commercialization.

3.5 Impact: achievement of positive impact on biodiversity and poverty alleviation

The project has collected 501 accessions of TAVs, including rare landraces. These materials are conserved in the genebank at FOFIFA out of which 437 accessions sent for conservation and duplication in the WorldVeg genebank in Tanzania. *Vigna keraudrenii* is found back in one site. This has been one of the targets in this project and is a great achievement for biodiversity conservation and cowpea breeding as this crop wild relative from the secondary genepool of cowpea is endemic to Madagascar and at risk of extinction. The 200 trained beneficiary women farmers are growing 14 promising varieties of African vegetables which they are consuming in their household and selling to other community members and beyond. Eleven seed women farmers were trained on seed business and over 6kg seeds of TAVs have been sold by five women farmers in Itasy, attracting some USD 303 overall. The trained farmers recognize the value and the potential of TAVs, as they provide household cash flow and nutritious food. They have spread this information to more farmers. Increased use of TAVs strengthens their conservation. Biodiversity-rich school gardens have been established and school children are eating healthy foods at the pilot schools. The results have been presented to actors at national level, and received a lot of interest from regional governments and NGOs to implement these gardens in other regions as well. In total the project has reached 21,231 farmers through seeds distributed by farmers and 1,380 school children through the school garden

activities. All together these results contribute to improving household nutrition, child welfare, poverty alleviation, and biodiversity conservation, and provides a basis for further scaling.

4. Project support to the Conventions, Treaties or Agreements

International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA): By distributing 750 seed kits of 14 vegetable varieties developed by the World Vegetable Center (using WorldVeg's Material Transfer Agreement [MTA] for direct cultivation) to FOFIFA and to 200 farmers in Madagascar in year 1, 2, 3 for evaluation and direct use by farmers, the project is contributing to Article 7 on national commitments and international cooperation, and to Article 10 of the ITPGRFA on the Multilateral System of Access and Benefit Sharing. As indicated in WorldVeg's MTA for direct cultivation by farmers and schools, subject to applicable laws and where recipient and/or subsequent recipients are farmers, the progeny of the genetic material that they receive may be saved, used, exchanged and/or sold as farm-saved seeds in accordance with the provisions on farmers' rights of the ITPRGFA.

Convention on Biological Diversity (CBD): A GIS analysis in year 1 identified a collection gap for 39 vegetable species of 83 documented TAVs in Madagascar for which no germplasm has been conserved *ex situ*, and three African vegetable biodiversity hotspots in Madagascar. The Malagasy Ministry of Environment, through the Directorate of Renewable Natural Resources and Ecosystems issued collecting permits which allowed the collection of 501 TAV accessions for *ex-situ* conservation, and possible to find back *Vigna keraudrenii* an endemic, and endangered wild relative of cowpea. The found population of *V. keraudrenii* is being monitored and seeds will be collected for *ex-situ* conservation. This undertaking contributes to the Articles 9 and 10 of the CBD. By organizing ABD assessments in eight communities in different agroecological zones to identify the threatened TAVs for conservation, the project is contributing Article 13 of the CBD.

Nagoya Protocol on Access and Benefit Sharing (ABS): Prior informed consent (PIC) was obtained from local communities before conducting the ABD assessments and the baseline household survey on the current status and utilization of the TAVs. PIC was also obtained before collecting vegetable landraces from farmer communities. The permit to collect TAV germplasm issued by the Malagasy NCA contributes to the implementation of the policy framework that was supported by the successful Darwin Initiative project titled "Mutually supportive implementation of the Nagoya Protocol and Plant Treaty", ref 22017. The permit provides that collectors obtain prior informed consent and negotiate mutually agreed terms with local and national authorities. The distribution of 750 seed kits of improved vegetable varieties to women farmers and their training on vegetable and seed production also contribute to sharing the benefit.

5. Project support to poverty reduction

As stated under Section 3.5 above, vegetable and seed sales increased contributing to increased household income among the beneficiary group over the three years. With the awareness campaigns and trainings for the women farmers, the sales have risen beyond 100% in year 3 of the project. This is contributing to poverty alleviation of resource-poor female farmers. The trained progressive women farmers in business development are already seizing market opportunities in their regions and in Antananarivo to increase and stabilize their income from the sales of African vegetables and seeds. The endline household survey conducted in February 2022 is being analysed and will provide evidence of positive progress, as compared with the household baseline data collected in January 2020.

6. Consideration of gender equality issues

As previously reported, the baseline surveys in year 1 indicated that in more than 70% of households, women are the ones who make decisions about the choice and consumption of vegetables, while men decide on staple and other commercial crops. This confirmed the results of the scoping study prior to the project and also justifies the importance of strengthening smallholder women's capacities on the production of African vegetables. By targeting the women farmers, the project builds gender equality by providing new income opportunities for the women, while strengthening food and nutrition security in their households.

7. Monitoring and evaluation

The project Steering Committee comprising project focal persons at the World Vegetable Center, FOFIFA, University of Antananarivo, and SEMANA monitors and evaluates progress of the project activities and deliverables, and takes important decisions about how to address the challenges as they arise during implementation. The project Steering Committee meets periodically to monitor progress (Appendix 1). Ad-hoc meetings were also organized to discuss and take decisions regarding some challenges needing urgent action. An Experts Guidance Group has also been created and includes, in addition to the Steering Committee members, WorldVeg's agrobiodiversity expert, TAV breeder and impact evaluation expert, and the national focal points of ITPGRFA and the Nagoya Protocol as resources persons. The Experts Guidance Group gives technical backstopping to the project steering committee. A total of three online and one face to face meetings were organized by the Steering Committee during year 3. There was no further revision to the M&E plan during the project year 3. Household endline data was collected among the women farmers on the contribution of the project to household consumption of vegetables, the changes in vegetable sales, how many other community members have they shared vegetable seeds with, the current status of vegetable production in school gardens, their contribution to school feeding, and attitude of the children regarding nutrition, taste and consumption of the TAVs. The M&E also documented the progress with germplasm collection and conservation.

8. Lessons learnt

A good partnership, commitment and adaptive management are essential for successful project implementation. The collaboration between WorldVeg, FOFIFA, University of Antananarivo and SEMANA was successful because of shared vision of safeguarding TAVs and increasing consumption of these crops and the commitment of each partner to achieve planned objectives. Despite COVID-19 pandemic has impacted international travels, the project team made suitable arrangements in order to continue with the implementation of project activities, including increased online meetings, distance trainings provided by WorldVeg and the use of app-based survey tools to collect M&E data. Thus, all the planned activities for year 3 were successfully implemented thanks to the good working relationship with the national project partners.

The project also strengthened the existing partnerships over the course of the project, including with the local government (Mayors of the different municipalities where we worked), and local and national NGOs (CEFFEL, Agrisud), which have raised the project profile in the region and at national scale. These partnerships have strengthened the project implementation to increase awareness of the nutritional potential of the TAVs in Madagascar.

The seed fairs were not planned in the project, but were inspired by the national partners to reach further audiences beyond the project communities, to create awareness on the potentials of TAVs for food and income. Through participation in the fairs and raising awareness through radio and TV programs, more organizations have become interested on TAVs.

As presented in the previous annual report, the involvement of national focal points of the ITPGRFA and the Nagoya Protocol as resource persons in the Expert Guidance Group was essential for the project progress. The focal points understand better the project activities and expected impact. This has facilitated communications with the national competent authority for access to collect the germplasm of TAVs.

9. Actions taken in response to previous reviews (if applicable)

Comments from previous review and the actions taken

Comment 1: Link assumptions explicitly to Outputs, to ensure that assumption analysis feeds into a clear understanding of which particular Output 'pathways' are impacted by changes in these assumptions, and the likelihood of the project to comprehensively achieve its Outcome and Impact (given strong Activity/Output progress).

Action taken: The assumptions have been linked with the assumptions (see section 3.4 above).

Comment 2: Broaden analysis on project contribution to the SDGs by explicitly reporting against SDG indicators, and widening to other SDGs.

Action taken: The project has significantly contributed to SDG targets, especially on ending poverty (SDG 1), ending hunger and malnutrition (SDG 2), biodiversity conservation (SDG 15). However, no specific section is provided in the 2022 annual report template on the contribution to the Global Goals for Sustainable Development.

10. Other comments on progress not covered elsewhere

In year 3 of the project, the project team strengthened communications and dissemination through workshops, conferences and participation with agricultural fairs. A project closing workshop will be organized on 28 April 2022 to present project achievements to the stakeholders to further raise awareness of benefits of TAVs for the people and of the impacts of school gardens.

11. Sustainability and legacy

Twenty-five extension workers and 200 women farmers have been trained and have become experts in TAV production and seed multiplication. The farmers are selling the seeds of TAVs and some extension workers are also growing the vegetables. In year 2 and 3 the project organized exhibitions at the project sites during agricultural fairs and engaged with national media to showcase the project activities and results. TAV seed and biodiversity fairs were organized again in year 3 (Figures 15 and 16). The project continued to strengthen the partnerships with local governments and NGOs to support the scaling of project products, e.g. visibility for TAV seeds and school garden programs. The NGO Agrisud has requested a collaboration to supply seed kits to 8,000 rural households in the framework of their EU-funded project to strengthen food and nutrition security in Vakinankaratra region. In total 11 MSc students have been involved with project activities by the end of year 3, and 7 of them were trained on the four-cell methodology to assess ABD, two were trained on socioeconomic research, one on vegetable germplasm characterization and one on school garden interventions (Appendices 3 and 4). The project achievements were also publicized to enhance visibility (Table 3 of Annex 3, section VI of Annex 9 for further details on the publications and visibility).

The planned exit strategy remains unchanged.





Figure 15: Exhibition of TAVs in project sites in Madagascar

12. Darwin identity

As in previous years the project used the Darwin Initiative logo on all training and communication materials developed by the project (e.g. the training leaflets, project posters and banners, T-shirts, etc.). Promotion of project activities continued through web articles, blogs and tweets with hashtag to the Darwin Initiative. The project continued to organize the seed and biodiversity fairs at project sites to increase visibility. Two regional workshops and one national conference were organized in year 3 on school gardens and the potentials of TAVs for nutrition and poverty reduction. The partnerships with local governments and NGOs were strengthened. The project team participated in various radio and TV programs to promote the project. Darwin’s financial support was acknowledged at all dissemination events. Find [here](#) a tweet on project activities; see also section 3.4 of Appendix 8.

13. Impact of COVID-19 on project delivery

The outbreak of the COVID-19 in Madagascar coincided with the start of project year 2. Antananarivo was put on lockdown, followed by the restrictions on international travels. This caused a postponement of the activities requiring mass group gatherings (training of large groups of farmers, and school children). But the team was able to catch up as soon as the measures were softened by the government. One important element allowing to mitigate delays due to the pandemic was the closeness of FOFIFA staff to the project sites. The project team also made use of information and communication technologies, by organizing online trainings and by using mobile-based data collection tools. The project team members and participants were always reminded to follow the safety measures as directed by the national authorities. Based on the implementation strategy put in place to cope with the pandemic, it was expected that COVID-19 has only a limited impact on the project. However, with the second wave of COVID-19, further restrictions have been put in place by the Malagasy government, including the closure of airports. If these restrictive measures on international travel to Madagascar will last longer, the project team may consider a request to redirect the budget allocation for international travels to support other components of the project.

14. Safeguarding

Please tick this box if any safeguarding or human rights violations have occurred during this financial year.

If you have ticked the box, please ensure these are reported to ODA.safeguarding@defra.gov.uk as indicated in the T&Cs.

The World Vegetable Center has a Safeguarding Policy in place to protect vulnerable people. This policy guided project implementation at the institute and includes review of all research and development projects involving human participants by the Institutional Biosafety and Research Ethics Committee (IBREC). Only projects approved by IBREC can be implemented.

15. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2021 – 31 March 2022)

The figures in the table are indicative, as all receipts have not been received by the time of reporting.

Project spend (indicative) since last Annual Report	2021/22 Grant (£)	2021/22 Total Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)	██████	██████	-6	
Consultancy costs	█	█	-	
Overhead Costs	██████	██████	0	
Travel and subsistence	██████	██████	0	
Operating Costs	██████	██████	9.9	
Capital items (see below)	█	█	0	
Monitoring & Evaluation (M&E)	█	█	0	
Others (see below)	██████	██████	-0.5	
TOTAL	104,101	104,101		

16. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for the Darwin Initiative Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here).

Through the Darwin project 26-015 in Madagascar, 501 accessions of vegetable landraces were collected and protected in ex-situ at FOFIFA genebank in Antananarivo with a duplicate stored at the World Vegetable Center genebank in Tanzania. One population of the endangered *Vigna keraudrenii*, an endemic wild relative of cowpea, was found back at one site and is being monitored for *in-situ* conservation and also for seed collection for *ex-situ* conservation in genebank.

The project has empowered 200 women and created interests on traditional vegetables in Madagascar. The women are now generating tangible income from the sales of these vegetables, and thereby bring traditional vegetables back to the Malagasy plates, something which they are very proud of.

Under the project, the first national school gardens workshop was organized by FOFIFA and the World Vegetable Center in November 2021. There were 72 participants in total (65% women), from the ministries of agriculture, education, environment, health population and women's welfare, research institutes, NGOs operating in the agriculture and nutrition sectors in Madagascar, JICA, GIZ, UN agencies (FAO, WFP, UNICEF), private sector (seed companies, SUN, etc.), directors of the beneficiary schools and representatives of the beneficiary women farmers. A panel discussion was organized to discuss the levers for broader integration of traditional African vegetables into school gardens and canteens in Madagascar. The panellists were representatives of the National Nutrition Office, HINA a civil society organization, FOFIFA, FAO, and WorldVeg. The major conclusion is that the high success of the project indicates that integration of traditional African vegetables into biodiversity-rich school gardens should be expanded and generalized in Madagascar by encouraging public procurement to improve nutrition and awareness of the benefits of TAVs.

The national conference on school gardens was highly successful and was endorsed by key stakeholders in Madagascar including FAO and WFP. Six NGOs and two local governments are now partnering with FOFIFA and the trained women farmers to promote these forgotten food crops for their inclusion into development projects and programs aimed at strengthening nutritional security and poverty reduction in Madagascar.