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A Report for

COVID-19 RAPID RESPONSE

Addressing Covid-19-related food insecurity through household farming in southeast Madagascar: Summary of household insect farming intervention

May 2021

Introduction

Since the outbreak of Covid-19 in Madagascar, national transport restrictions reduced food and market access, causing increased prices and lack of food diversity. In the south of the country, an ongoing drought during the usual 'wet' season has exacerbated the problem, leading to widespread famine and increasing levels of poverty (European Commission, 2021). The diet in Madagascar is severely deficient in many macro and micro-nutrients including calories, fat, B12, and zinc (Golden et al., 2019; Smith, 2016). Consequently, many households rely on Madagascar's biodiversity for nutrition, with 40% of the meat consumed in the diets of children under five and pregnant women derived from wildlife (Golden et al., 2019; Borgerson et al., 2019).

The village of Sainte Luce, in the Anosy region of southeast Madagascar, is predominantly a fishing community where up to 83% of households rely on lobster fishing as their main source of income (Savage, 2020a). With the start of the National Closed Season in January preventing fishers from catching lobsters for three months and the selling value of lobster decreasing since the start of the pandemic (Savage, 2020b), the community is increasingly vulnerable to food insecurity. Key foods such as red kidney beans, white kidney beans, rice, and cassava also increased in price by at least 36.4% (Savage, 2020b).

Compared to traditional livestock agriculture, insect farming has been shown to be a more sustainable option in providing macro and micro-nutrients in the human diet (Halloran et al., 2017). In addition to requiring less land and fewer resources to produce the equivalent amount of meat (Oonincx et al., 2011; Klunder et al., 2012), insect rearing releases fewer greenhouse gas emissions than conventional livestock farming. Insects can also provide a comparable protein source to livestock (Yi et al., 2013) and can provide a higher level of protein than plant-based sources (Belluco et al., 2013).

The *Zanna* genus of insects are tropical planthoppers found in sub-Saharan Africa. In Madagascar, they are locally known as *sakondry* and feed on the phloem of common nitrogen fixing bean plants. Already eaten opportunistically, particularly by children, the bugs are easily grown at artificially-increased densities. Borgerson et al. (in press) have measured the success of *Z. tenebrosa* farming through a pilot community rearing program, indicating that *Z. tenebrosa* are a high forest-derived source of calories, fats, and micro-nutrients in regions of low food security and high biodiversity. The *Zanna* bugs and one edible native bean host plant, locally called *antaky,* are known to occur in Sainte Luce. Insects arrive on their own to host plants and quickly establish manageable populations.

To address the immediate food security risk presented by Covid-19 and utilise the low-input, high-impact opportunity presented by edible insect farming, SEED developed a rapid response project in partnership with Dr. Borgerson, funded by the Darwin Initiative. This project aims to increase dietary diversity and decrease food insecurity in the area, supporting recovery from the economic impact of Covid-19 through improved food security, nutrition, and availability of supplementary livelihoods. Through targeting the immediate food security risk presented by Covid-19, this project may also decrease reliance on limited forest and marine resources.

Methods

45 households in Sainte Luce were selected for participation in the insect farming component of the Darwin Rapid Response project. Household selection was based on a series of criteria, focused on maximising support to those most vulnerable. Households already involved with a SEED project or associated committee were therefore not considered for participation. Households considered to have a high level of food insecurity were prioritised, as well as those showing the most motivation towards project participation.

One representative from each household was invited to attend trainings. SEED aimed for at least 50% of household representatives to be women and for there to be an equal number of participants across the three hamlets of Saint Luce. Household participants were ultimately chosen by the community, with SEED's criteria taken into careful consideration. It was agreed that if any participants were to break a *dina* (local law) associated with any other SEED initiative, they would immediately be removed from the project.

Baseline Survey

The baseline survey was conducted to assess which protein sources *sakondry* may replace or supplement in the community. Every participatory household was surveyed prior to material distribution and training. Demographic data on each household was collected, and basic information was recorded on household consumption and spending on different food groups. Participants were also asked about prior experience of growing beans and harvesting *sakondry*.

Two indicators were chosen to provide a rapid analysis of food insecurity amongst the households: The Minimum Dietary Diversity Scale for Women (MDD-W) and the Coping Strategies Index (CSI). The MDD-W measures dietary diversity by calculating the number of necessary food groups in an individual's diet over the past 24 hours (FAO, 2010). The food groups as listed by the Food and Agriculture Organization of the United Nations (FAO) are included below, along with the specific food inquired about on the baseline survey in Sainte Luce (Table 1).

Table 1: List of food groups asked about in the MDD-W baseline

Which of the following have you eaten in the past 24 hours?	
MDD-W Group	**Site-specific items**
1 - Grains, white roots and tubers, and plantains	Potatoes
2 - Pulses (beans, peas, and lentils)	Pulses
3 - Nuts and seeds	A type of nut
4 - Dairy	Milk (fresh, powdered, or canned)
5 - Meat, poultry, and fish	Meat/fish
6 - Eggs	Eggs
7 - Dark green leafy vegetables	Dark leafy greens
8 - Other Vitamin A-rich fruits and vegetables	Papaya (cooked), carrots, or lemon/oranges
9 - Other vegetables	Chayote or other vegetables
10 - Other fruits	Papaya (raw) or other fruit

The CSI is used to determine common strategies in periods of food insecurity by measuring coping strategies, or changes in feelings, perceptions, and behaviours, in response to insufficient access to food (Maxwell & Caldwell, 2008). The CSI contains 15 different coping strategies often used in situations of high food insecurity (Table 2). The *Chef Fokontany* (Village Head) assigned each of the strategies a severity ranking from one (least severe) to four (most severe). The most severe rankings would be given to a coping strategy that is not common and only employed during periods of extreme food insecurity in the community. The least severe rankings would be allocated to a coping strategy that is the first to be used during the onset of food insecurity. Household participants were then asked how many days over the last week they had implemented each of the strategies. The index is calculated by summing the products of the *Chef Fokontany's* severity ratings for an average frequency of each coping strategy.

Table 2: List of coping strategies used for the Coping Strategy Index

How many times in the past seven days did your household…	
CSI1	…not eat throughout the day?
CSI2	…not have sufficient food for three meals?
CSI3	…decrease the quantity of food for non-workers, but the quantity of food for workers remained the same?
CSI4	…decrease the quantity of food for children, but the quantity of food for adults stayed the same?
CSI5	…decrease the quantity of food for adults, but the quantity of food for children stayed the same?
CSI6	…decrease the quantity of food for everyone?
CSI7	…invite individuals into your home to eat because they had insufficient food?
CSI8	…send individuals out of your home to eat somewhere else because you had insufficient food?
CSI9	…eat harvest that was assigned to be for seedling?
CSI10	…collect harvest before its season or before it was mature?
CSI11	…hunt, trap, collect food without success?
CSI12	…collect food from the forest without success?
CSI13	…buy food using credit?

CSI14	…borrow food or depend on support from a friend for food?
CSI15	…depend on food that you don't like because it was cheaper than what you prefer?

Training

Training in insect farming followed the structure created by project partner Dr. Cortni Borgerson. Households received initial training on the nutritional value of *sakondry*; how to grow the host plants, *antaky;* how to protect host plants from pests; and how to harvest and cook *sakondry* safely. Visual learning aids (VLAs) were utilised within the community to reinforce and supplement learning. As *antaky* is an edible bean species, follow-up training was also delivered to show participants how to harvest beans for food and seed stock, ensuring that the crop itself can be maintained as a food source in the future.

Ongoing Monitoring

Following material distribution, initial training, and the planting of *antaky*, periodic monitoring was conducted to assess *antaky* growth and *sakondry* colony establishment. Monitoring included determining plant height, presence or absence of *sakondry*, the life stage of any *sakondry* present and, if applicable, questions related to the harvest and consumption of *sakondry* or *antaky*. Any key problems in growing antaky (e.g., pests) were also identified and mitigation measures based on local knowledge suggested.

Endline Monitoring

An endline survey was conducted in month three of the project. Questions about household diet and food insecurity, including MDD-W and CSI, were repeated from the baseline to assess the situation at project end. Despite this, any changes in MDD-W or CSI cannot be attributed to the insect farming intervention, as neither *sakondry* nor *antaky* were ready to consume or sell by endline.

Results

Baseline Results

All 45 participatory households were surveyed in Sainte Luce on the 19th and 20th January 2021, with 15 households surveyed in each of the three hamlets. 28 of the 45 household representatives were women. Household sizes ranged from two to 15 people, with an average of 5.7 people per household. The total number of people across all participating households was 255, including 109 women, of whom seven were pregnant or breastfeeding.

Each household included one to six houses, with an average of 2.4 houses per household. 17.8% of households owned a metal roof. Household spending on food per day ranged from 1,000 MGA to 20,000 MGA, with an average spend of 8,947 MGA. For other expenditures, the range was from zero to 35,000 MGA with an average of 3,267 MGA. Based on household numbers, this equated to an average of 1,685 MGA per person for food and 364 MGA per person for other expenses. Full details on demographics and spending are available in Annex 1.

Nine households had already grown beans during the last year, including two who were growing *antaky,* the *sakondry* host plant. All households expressed an interest in growing beans, and recorded eating an average of 6.6 cups of beans within the last month. Four households had also sold beans in the last month.

All survey participants were aware of *sakondry* and had previously eaten the insects. On average, households had consumed 9.8 cups of *sakondry* in the past year, all collected from the wild. In the week prior to the survey, participants had eaten, on average, one cup of *sakondry*. All participants expressed interest in having greater access to *sakondry*, although no one had sold or bought *sakondry* during the previous year in Sainte Luce. The given reasons for wanting increased access to *sakondry* could be categorised as 'an additional food source' (80%), 'because *sakondry* tastes good' (11%), and 'for nutritional benefits' (9%).

In the 24 hours prior to the baseline survey, households consumed an average of 7.2 cups of rice, all of which were purchased by households at a cost of 700 MGA per cup. Fish was the most commonly consumed meat, with households eating an average of 11.7 kg in the week prior to the survey. Just under half of the fish consumed was

bought (5.1 kg on average), for an average cost of 2,096 MGA per kilogram, although this ranged from as little as 600 MGA to 3,000 MGA per kilogram (kg). None of the participant households consumed or bought pork or poultry in the week prior to the survey, and only one household purchased one kg of beef, at a price of 8,000 MGA per kg. One household reported consuming half a kg of wild meat—a wild-caught tenrec.

MDD-W

The MDD-W was considered for all households with female members (n=44). Participants were asked if they had consumed any of the ten different food groups 24 hours prior to the survey. The three most common food groups in Sainte Luce were Group 5 (meat, poultry and fish), Group 10 (other fruits), and Group 7 (dark green leafy vegetables). Group 3 (nuts and seeds) and Group 6 (eggs) were not consumed by any of the participants (Figure 1).

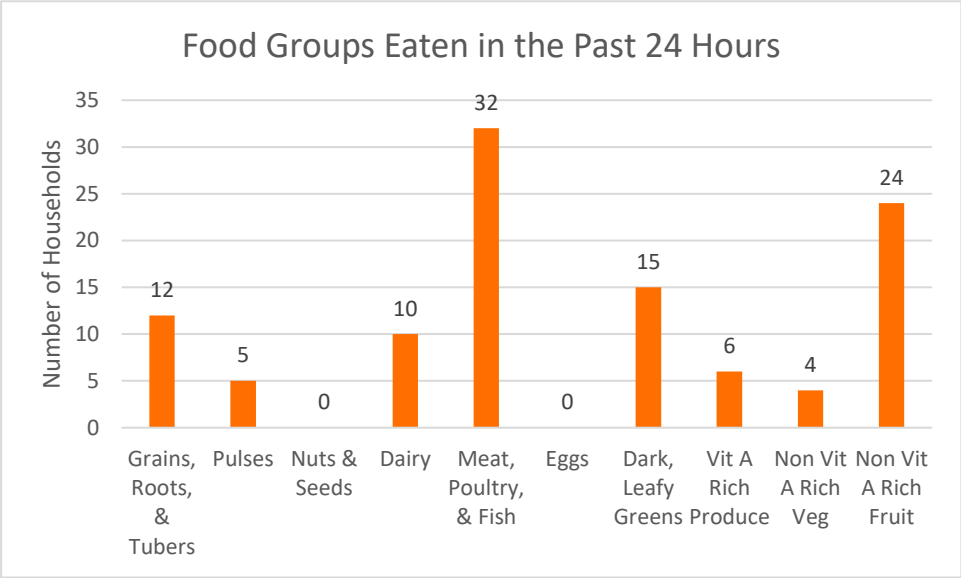

Figure 1: Number of households that reported consuming each food group in the 24 hours before the survey.

To be considered as achieving the minimum of adequate diet diversity, five of the food groups should be consumed (FAO, 2010). The average number of food groups consumed in Sainte Luce the day prior to the survey was 2.6. Only three households met the required minimum of five food groups (Figure 2).

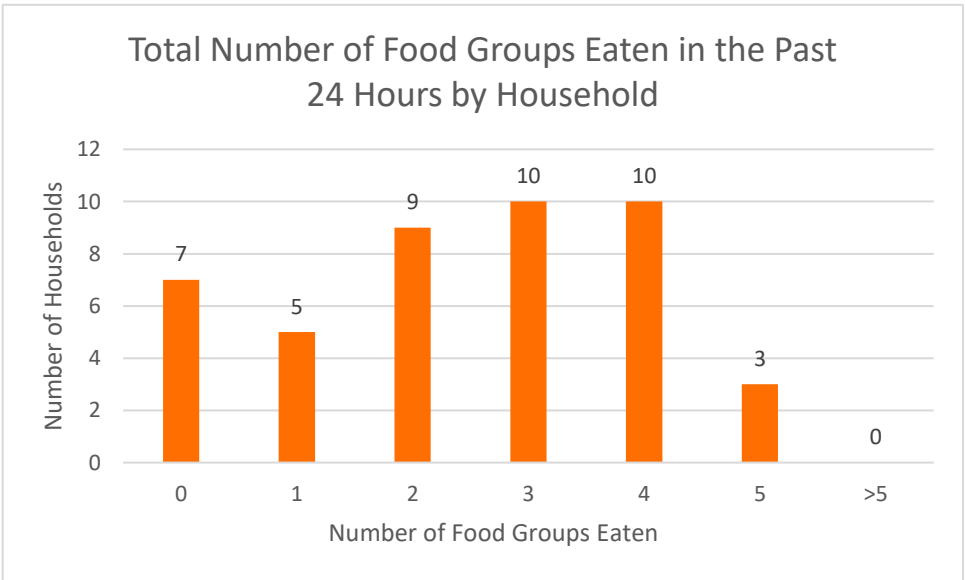

Figure 2: Total number of food groups consumed by each household 24 hours prior to the survey.

CSI

On a scale that ranges from 0 (most secure) to 420 (least secure), Coping Strategies Index score was 76.0 in Sainte Luce. Scores above 40 have been cited in multiple studies in comparable contexts as *highly* to *severely* food insecure (Borgerson et al., 2019; D. Maxwell et al., 2014). The most commonly used strategies were *decreasing the amount of food for everyone* (average of 4.1 days out of 7) *and buying food using credit* (average of 3.4 days out of 7). All strategies were implemented at least once (Figure 3).

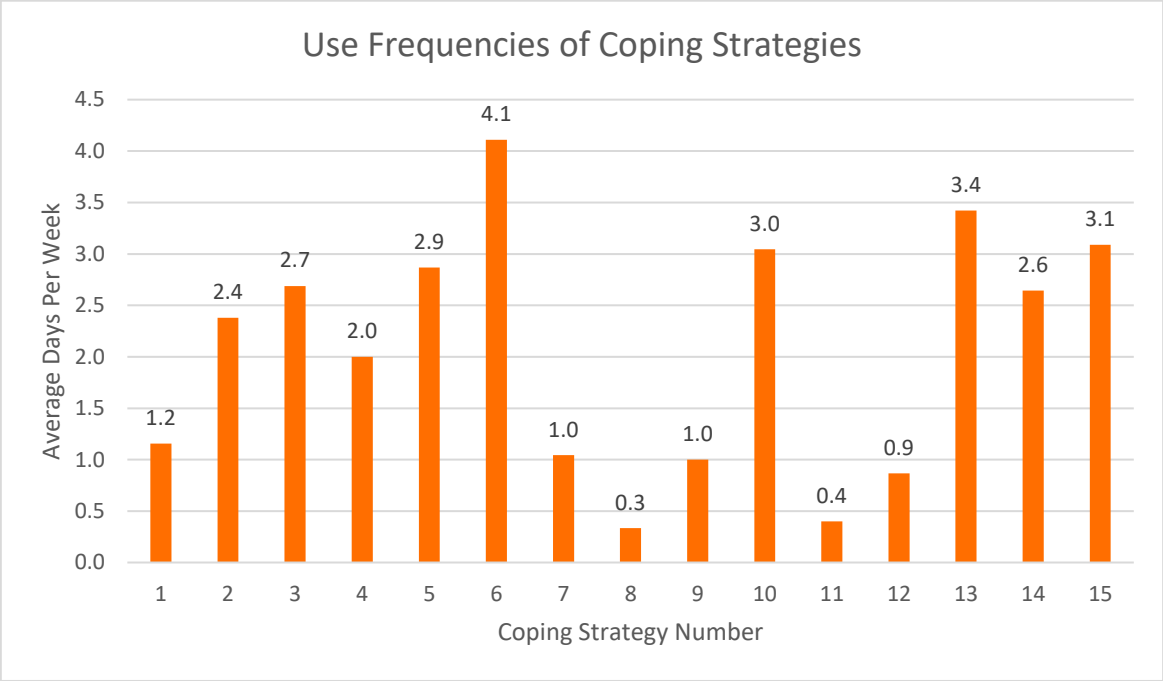

Figure 3: Frequencies of each coping strategy

Farming Monitoring Results

Monitoring was conducted twice after planting, from February 17th to 18th and from March 16th to 18th 2021. In February, 1,643 host plants were recorded and monitored (Table 3). Nine plants from four households had *sakondry* present, and 180 *sakondry* insects were recorded in total. These plants hosted between 25 and 65 individual insects, with an average of 20 *sakondry* per plant. In March, 2,769 host plants were recorded and monitored. 75 plants from 13 households had 268 *sakondry* present. Each of these plants hosted five to 50 individual insects, with an average of 3.5 *sakondry* per plant.

Table 3: February and March *antaky* and *sakondry* monitoring results

	February	March
Total *antaky* plants	1,643	2,769
Plants <50cm	1,481 (90.1%)	433 (15.6%)
Plants 50cm - 1.0m	141 (8.6%)	1,094 (39.5%)
Plants 1m - 2m	12 (0.7%)	1,053 (38.0%)
Plants > 2m	9 (0.5%)	189 (6.8%)
Plants with *sakondry*	9	75
Mean *sakondry* per plant	20 (range 25 - 60)	3.5 (range 5 - 50)
Groups of *sakondry* eggs	21	32
Total *sakondry*	180	268

Common challenges were also identified during monitoring, as described in Discussion.

Endline Results

The endline survey was completed for 38 of the 45 participatory households on the 20th to the 25th of March 2021. Seven participating households were unavailable during this time and could not provide endline data.

Household spending on food per day ranged from 2,500 MGA to 10,000 MGA, with an average spend of 5,221 MGA. For other expenditures, the range was from zero to 10,000 MGA, with an average of 1,518 MGA. Based on household numbers, this equated to an average of 1,226 MGA per person for food and 348 MGA per person for other expenses. Full details on spending are available in Annex 2.

All households had grown *antaky* during the last month, with an average of 36 bean plants per household. All participants expressed interest in having access to more *sakondry,* the given reasons being for nutritional benefits (55%), as an additional food source (40%), and as a source of income (5%). All survey participants were aware of *sakondry* and had previously eaten the insects, however, zero beneficiaries had eaten *sakondry* in the week prior to the survey.

In the 24 hours prior to the endline survey, households consumed an average of 6 cups of rice, all of which were purchased by households at a cost of 700 MGA per cup. Fish was the most commonly consumed meat, with households eating an average of 5.3 kg in the week prior to the survey. Just under half of the fish consumed was bought (2.2 kg on average) at 2,500 MGA per kilogram. None of the participant households consumed or bought pork, beef, or poultry in the week prior to the survey. No households reported consuming wild meat.

MDD-W and CSI

Participants (n=38) were asked if in the 24 hours prior they had consumed any of 10 different food groups. The most commonly consumed food groups were Group 5 (meat, poultry, and fish) (n=38), Group 7 (dark green leafy vegetables) (n=24), and Group 10 (other fruits) (n=21). The average number of food groups consumed in the day prior to the survey was 2.2. None of the households met the required minimum of five food groups, with many below. Nine households only consumed one food group and 13 households only consumed two groups over the past 24 hours. Group 1 (grains, white roots and tubers, and plantains), Group 3 (nuts and seeds), Group 6 (eggs), Group 8 (other Vitamin A-rich fruits and vegetables), and Group 9 (other vegetables) were not consumed by any of the respondents during the previous 24-hour period. The endline CSI was 75.0.

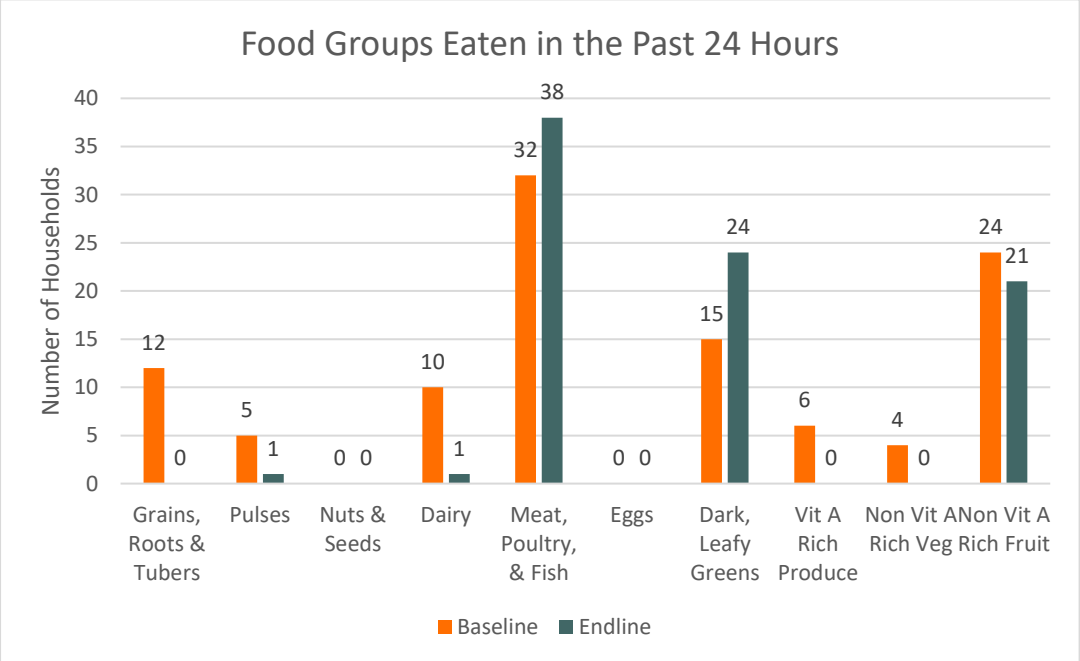

Figure 4: Number of households that reported consuming each food group in the 24 hours prior to the survey, for both baseline and endline

There was a decrease in both spending and MDD-W from baseline to endline, likely due to the ongoing drought and the fishing community nearing the end of the 3-month-long national closed season for lobster fishing. As discussed below, insect farming is anticipated to improve these metrics, though at present any changes in MDD-W or CSI cannot be attributed to the insect farming intervention, as neither *sakondry* nor *antaky* were ready to consume or sell by endline.

Discussion

Challenges Faced

Whilst an advantage of *antaky* is its ability to grow in restricted space, limited planting locations in Sainte Luce meant that some plants were sown in suboptimal locations, lost to intense sun or wind. However, transplanting and replanting remedied most of these issues. Additionally, four households reported issues with pests (ants). This was again due to the location of the host plants, and was addressed by replanting to a more suitable location. Unanticipated high rates of germination also resulted in some *antaky* being planted too close together. In response, select bean plants were replanted to increase spacing. Future developments and expansion will incorporate these learnings on optimal growing locations and conditions, paying particular attention to sowing location to facilitate greater *antaky* survival.

Overall contributions

Notably, beneficiaries showed an increased understanding of the nutritional value of *sakondry*. Whilst the majority of beneficiaries were initially interested in farming *sakondry* as an additional food source, by the end of the pilot the majority of the beneficiaries intended to farm sakondry based on its nutritional value. Further research and an expansion of the pilot should focus on assessing whether community members take this newfound knowledge into account during selection of preferred protein sources.

Insect farming is anticipated to have positive impacts on both MDD-W and CSI metrics. The *sakondry* will provide an alternative source of 'meat' protein, whilst the *antaky* beans will improve dietary diversity as a source of pulses. The high focus on training throughout the project worked to promote insect and crop farming as an indefinite food source for long term recovery from Covid-19. The inclusivity of training sessions equipped women in particular with the skills to farm sakondry and the opportunity to generate household income selling sakondry as a food source once populations are large enough.

As the pilot project was limited to three months in duration, the endline survey took place just two months after the initial planting of the *antaky* seeds. With households hosting a large number of bean plants, germination success appeared relatively high, however, it was still too early to see the true colonisation success of *sakondry* on the bean plants and to harvest any beans themselves. Whilst initial signs show that the project is likely to have a positive impact on food security within the community, it is not yet possible to quantify these impacts. However, with colonisation occurring, on average, two months post-germination, it is expected that colonisation rates and colony size will increase beyond project end. Additionally, the increase in plants with *sakondry* present from February to April suggests that this colonisation is underway and increasing. Based on the work of Borgerson et al. (in press) in the northeast of Madagascar, it is expected that this increased availability in sakondry will contribute to a reduced reliance on potentially unsustainable practices and extractive livelihoods such as fishing.

Future directions

Independent of project funding, monthly monitoring will continue to build knowledge around the introduction of sakondry agriculture in Anosy. Opportunities for expansion are being pursued, including the potential introduction of insect farming in non-coastal, food-insecure communities. It would also be beneficial to trial a greater number of host plants, including non-edible but perennial plants, to host *sakondry* colonies outside of the bean season and in areas where *antaky* is not established. These learnings will be critical to inform an expansion of the pilot, bringing necessary skills and techniques to other malnourished communities in the region.

Conclusion

The work by Borgerson et al. (in press) showed that sakondry could successfully be farmed in the northeast of Madagascar as a nutritional food source for communities in regions with low food security and high biodiversity. This pilot has shown that this is indeed possible within coastal communities in Anosy, contributing to both dietary diversity and the availability of nutritious food in Sainte Luce. Evaluation revealed that this project was feasible, scalable, and well-received, with appetite for continuation and expansion from the community. With interest in

sakondry as a food source growing within the community, there is likely to be market interest in the future. Beneficiaries may be able to sell surplus seed stock to other community members leading to a natural expansion of the techniques across Sainte Luce. Learnings from this project will inform future development and expansion of insect farming, with SEED currently pursuing funding opportunities in partnership with Dr. Borgerson to begin *sakondry* farming in additional communities.

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Annex I

Baseline demographic and spending data			
	Minimum	Maximum	Average
Household size	2	15	5.7
Number of females	0	6	2.4
Number of males	1	9	3.1
Number of houses per household	1	6	2.0
Rice eaten yesterday (cups)	3	16	7.2
Rice purchased yesterday (cups)	3	16	7.2
Rice cost (MGA/cup)	700	700	700
Yesterday's expenses on food (MGA)	1,000	20,000	8,947
Yesterday's expenses on non-food items (MGA)	0	35,000	3,267
Fish eaten in the last week (kg)	1	28	11.7
Fish purchased in the last week (kg)	0	25	5.1
Cost of fish (MGA/kg)	600	3,000	2,096
Poultry eaten in the last week (kg)	0	0	0.0
Poultry purchased in the last week (kg)	0	0	0.0
Cost of poultry (MGA/kg)	-	-	-
Pork eaten in the last week (kg)	0	0	0.0
Pork purchased in the last week (kg)	0	0	0.0
Cost of pork (MGA/kg)	-	-	-
Beef eaten in the last week (kg)	0	1	0.0
Beef purchased in the last week (kg)	0	1	0.0
Cost of beef (MGA/kg)	0	8,000	-
Sakondry eaten in the last week (cup)	0	5	1.0

Annex II

Endline demographic and spending data			
	Minimum	Maximum	Average
Rice eaten yesterday (cups)	4	12	6
Rice purchased yesterday (cups)	0	12	6
Rice cost (MGA/cup)	700	700	700
Yesterday's expenses on food (MGA)	2,500	10,000	5,221
Yesterday's expenses on non-food items (MGA)	0	10,000	1,518
Fish eaten in the last week (kg)	0	10	5.3
Fish purchased in the last week (kg)	0	10	2.2
Cost of fish (MGA/kg)	2500	3500	2,500
Poultry eaten in the last week (kg)	-	-	-
Poultry purchased in the last week (kg)	-	-	-
Cost of poultry (MGA/kg)	-	-	-
Pork eaten in the last week (kg)	-	-	-
Pork purchased in the last week (kg)	-	-	-
Cost of pork (MGA/kg)	-	-	-
Beef eaten in the last week (kg)	-	-	-
Beef purchased in the last week (kg)	-	-	-
Cost of beef (MGA/kg)	-	-	-
Sakondry eaten in the last week (cup)	0	0	0