Evaluation of the “Flying Food” Project in Kenya: Can a Cricket Value Chain Fly?

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Evaluation of the "Flying Food" Project in Kenya: Can a Cricket Value Chain Fly?

Project Evaluation 1 under the Impact Evaluation of the Facility for Sustainable Entrepreneurship and Food Security (FDOV)

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Executive Summary

This report evaluates the project 'Flying Food' that was supported by the Facility for Sustainable Entrepreneurship and Food Security (FDOV). FDOV is a Dutch government-funded grant programme, implemented by the Netherlands Enterprise Agency (RVO.nl). It supports public-private partnerships aimed at improving food security and private sector development in developing countries. This evaluation is the first out of five FDOV project evaluations that are being conducted by PwC, AIGHD and SEO. This project evaluation was carried out by SEO.

The main objective of Flying Food is to develop a sustainable cricket value chain in Kenya and Uganda. started in 2013 and ended in June 2018. This evaluation focuses only on Kenya. Project activities focused on three 'impact pathways' with the following objectives:

1. **Supply side:** establishing at least 300 small-scale cricket farms in Kenya by training farmers and supplying them with cricket rearing equipment and other inputs.
2. **Demand side**: development of cricket recipes, design of food products, consumer testing and marketing campaigns.
3. **Private sector development side**: developing a sustainable value chain for crickets and cricket products, including the production of inputs and equipment, processing, packaging, distribution, and retail.

This report summarises our findings about the relevance, additionality, effectiveness, and sustainability of the Flying Food project. We conclude that, despite many positive achievements, the project did not meet its key objective of establishing a sustainable cricket value chain in Kenya.. In addition to political turmoil and flooding, the project suffered from an unexpected disease outbreak that was still not under control by the end of the project.. Nevertheless, there are a number of useful lessons that can be learned from this project.

The relevance of Flying Food for local development was clear 'ex ante', but limited 'ex post'. On the one hand, its focus on income generation and food security (in light of protein deficits) was clearly relevant for Base of the Pyramid (BoP) producers and consumers, in particular smallholder farmers, women and youth. Moreover, it was well aligned with the economic and social priorities of the Kenyan government. On the other hand, the focus on BoP producers may have partly been responsible for the relatively low effectiveness of the project. For example, yields were far lower than expected, not only because of the bacterial infection but also because of the limited ability of BoP farmers to implement strict hygienic methods and cleaning protocols to prevent re-infection. Moreover, there are substantial economies of scale that make production by a larger central producer and processor more economic. Given the novelty of the project, it would, with hindsight, have been preferable for the project design to focus initially on the 'Middle of the Pyramid' (MoP) producers and then roll out lessons learnt to the BoP. Similarly, a well-functioning market for cricket products could have first been created among 'MoP' consumers in cities before trying to establish such markets in villages.

The additionality of the project was high 'ex ante', but lower 'ex post'. On the one hand, input additionality was high because Flying Food project activities would almost certainly not have materialised without public support. Also, development additionality was high because the 'development focus' on BoP producers and consumers (and special emphasis on women) would almost certainly not have occurred without public funding. On the other hand, the development outcomes that were targeted in this way were not achieved ex post, and some farmers may in fact have been left worse off.

The effectiveness of the project was reasonable in terms of outputs, but low in terms of outcomes. While many outputs were achieved, outcome targets were only partially met. Many activities were conducted, but little was achieved in terms of actual production, income generation, sales, or consumption. This was due to various factors, including most importantly an unexpected disease outbreak. In addition, the project suffered from periods of political turmoil and flooding due to which the training and monitoring activities were hampered.

- **On the supply side, many output targets were met but outcomes were drastically below target**. In terms of outputs, methods were developed, a group of trainers was formed, and more than 300 farmers were trained, but not all of these were fully equipped. In terms of outcomes, however, the production of crickets and resulting income were much lower than targeted. This was due to various factors, including most importantly an unexpected disease outbreak. In addition, the project suffered from periods of political turmoil and flooding.
- **On the demand side, many outputs were achieved, but outcome targets were only partially met.** Various activities took place: awareness was raised, consumer research was conducted and innovative cricket products were developed. However, outcome targets were only partially met: only a few active local markets for crickets were identified and they did not offer the targeted 5,000 affordable servings of cricket products per months.
- **On the private sector development side, most outputs were reached and outcomes were partially met.** Many value chain actors were identified and developed, and the project made great progress with building a full cricket value chain. Outcomes were mixed thus far, mostly because of the setbacks experienced on the supply side.

The sustainability of the project is potentially high, but fragile. While the project was not yet sustainable when it formally ended, project partners made remarkable progress with improving the prospects for a financially sustainable cricket value chain in Kenya. In particular, they deserve credit for having attracted an MFI as a key value chain player, which was not originally part of the project plan. By the time this report was concluded, the project was still in search of additional financing.

We suggest several lessons learned that RvO.nl or other donors could usefully take into account when supporting similar projects in the future:

1. For high-risk projects, RVO.nl should conduct or require a more thorough analysis of the risks involved, including their probability and potential impact.
2. When deciding whether or not to fund an innovative but high-risk project like Flying Food, RVO.nl should consider requiring a piloting or pre-testing phase.
3. When judging the relevance of a project, more attention should be paid to financial sustainability, which in some cases could mean that the initial emphasis should be on the 'MoP' (Middle of the Pyramid) in order to develop a viable business case that then later could be rolled out to the BoP.

4. RVO.nl should ensure that the proposed M&E indicators are SMART (Specific, Measurable, Assignable, Realistic, and Time-bound).
5. In innovative, high-risk projects, careful consideration should be made as to who should bear the risk.
6. When a project goes off-track for exogenous reasons, output targets do not necessarily need to be adjusted, as it could be more insightful to show that targets were missed and explain why.
7. Too much pressure on meeting output targets could lead to 'output-driven' activities without regard to outcomes.
8. As part of an innovative project, sufficient time should be allowed to pre-test innovative production processes.

1 Introduction

This report contains the evaluation of the project 'Flying Food' that was implemented with support from the Facility for Sustainable Entrepreneurship and Food Security (FDOV). FDOV is a Dutch government-funded grant programme initiated in 2012 that supports public-private partnerships aimed at improving food security and private sector development in developing countries. FDOV is implemented by the Netherlands Enterprise Agency (RVO.nl) and issued calls for proposals in 2012 and 2014 (and another one in 2018 under the successor facility SDGP). This evaluation is the first out of five FDOV project evaluations that are being conducted by PwC, AIGHD and SEO. This project evaluation was carried out by SEO.

The main objective of the Flying Food project is to develop a sustainable cricket value chain in both Kenya and Uganda. This project was proposed by a public-private consortium led by TNO and involving private partners, knowledge institutes and NGOs from Kenya, Uganda, and the Netherlands. It was selected by FDOV during its first Call for Proposals in 2012, and formally started in 2013. The end date was initially set to September 2017, but was extended to June 2018. Project activities focused on three 'impact pathways' (described in more detail in the next chapter):

- **On the supply side,** the project aimed to establish at least 600[1] small-scale cricket farms in Kenya and Uganda by training farmers and supplying them with equipment and other inputs. These cricket farms would produce raw crickets that could either be eaten directly (roasted) or could be processed into flour and used as an ingredient for cricket-based food products. Particular attention was paid to the involvement of women and youth in cricket farming.
- **On the demand side**, the project's activities included the development of recipes, design of food products, consumer testing and marketing campaigns.
- **On the private sector development side**, the project aimed to develop a sustainable value chain for crickets and cricket products, creating and supporting private businesses involved in the production of inputs and equipment, processing, packaging, distribution, and retail.

This evaluation assesses the relevance, effectiveness, additionality and sustainability of the Flying Food program in Kenya. The full list of research questions is given in Table 1-1. The concepts are broadly defined as follows:

- **Relevance** is the extent to which the project design is relevant to the local context in that (a) it addresses the needs of local beneficiaries; and (b) it is consistent with local government priorities of host countries.
- **Additionality** can be broken down into 'input additionality' and development additionality, in line with DCED (2014).[2]
    a. **Input additionality** is the extent to which the public input resources are additional to what might have been invested or undertaken by the applicant/partner company and other parties, as well as the timing of it.

[1] Initially, the project aimed at training 4,000 farmers. The reasons for this downscaling will be discussed in Chapters 6.

[2] DCED (2014), "Demonstrating Additionality in Private Sector Development Initiatives", Donor Committee For Enterprise Development.

b. **Development additionality** is the extent to which public resources contribute to changes in development-relevant results that would not have materialised without them.

- **Effectiveness** is the extent to which the project has reached its outcome and impact objectives, and the extent to which the observed effects can be attributed to the project.
- **Sustainability** is the extent to which (the design of the project is such that) the outcomes and impact of the project are likely to continue after FDOV funding ceases to exist. In this specific case, it refers to the financial sustainability or viability of the cricket value chain in the long run.

Our key findings are the following:

1. The relevance of the project design was high ex ante, but more limited ex post.
2. Both input additionality and development additionality were high 'ex ante', but lower 'ex post'.
3. Effectiveness was reasonable in terms of outputs, but low in terms of outcomes.
4. Potential sustainability is high, although more remains to be done to make the project sustainable.
5. The project did not have any negative CSR effects.

When drawing conclusions from this evaluation, it is important to keep in mind the following limitations:

- As agreed with the Steering Group, this report only evaluates the project's activities in Kenya. Since it was decided that depth is preferred to breadth, we have not evaluated the project's activities in Uganda. This was advised to us during the inception phase by the project partners, given that the Kenyan value chain was slightly more developed.
- The methods used for assessing effectiveness and determining attribution were mostly qualitative in nature. While we used quantitative data collected from farmers where possible, no rigorous comparison between a 'treatment group' and 'control group' could be made, as a control group had never been set up. While ICCO initially conduct a baseline survey among a broader set of farmers, an endline survey was never conducted. We therefore do not know what the situation of farmers would have been in the absence of the project.
- Given that the supply side (raw cricket production) turned out to be the key bottleneck for value chain development in the short run, the evaluation team ended up devoting more attention than expected to the supply-side impact pathway than to the demand-side impact pathway. In the end, we were not able to say much about the effectiveness of demand-side activities, given that hardly any sales or consumption took place. Nevertheless, we were able to draw conclusions about the effectiveness and sustainability of the private sector development pathway.
- When interpreting the conclusions, we encourage the reader to focus less on the question of *whether* the envisaged targets were met (which is a rather narrow definition of 'effectiveness'), and focus more on the question of *why* they were not met, and what this implies for the long-term sustainability of a project such as this one. Even if the results are currently not sustainable, we have aimed to draw conclusions about the *potential* of creating a sustainable cricket value chain in Kenya. (See Chapter 7 and Appendix A).

Table 1-1. List of Research Questions (RQs)

	RELEVANCE
RQ1	**Is the intervention locally relevant?**
1.1	To which degree did projects research and design their intervention according to needs of end beneficiaries?
1.2	To which degree are projects relevant for local and governmental policies of host countries?
	ADDITIONALITY
RQ2	**To what extent were the projects additional according to the DCED definition?**
2.1	To what extent was the ex-ante additionality assessment in line with evidence?
2.2	Was public funding necessary for the implementation of the project?
2.3	How can ex-ante additionality assessment be improved?
2.4	What difference has the public contribution made to the achievement of public goals?
	EFFECTIVENESS
RQ3	**To what extent are the projects effective in reaching their outcome and impact objectives?**
3.1	What changes related to outcomes and impact can be observed in comparison to the project baseline?
3.2	What was the contribution or attribution (net effect) of the intervention (design of the project, project duration, the partners, the cooperation within the partnership, etc.) to the observed effects?
3.3	Is the engagement of civil society effective in keeping the focus on public objectives?
3.4	Did the projects reach the desired end-beneficiaries (women, youth, vulnerable groups, farmers, policy makers, etc.) and how are they benefitting?
RQ4	What are the key determinants (both internal and external to the project) for inducing or hampering the intended and unintended effects?
	SUSTAINABILITY
RQ5	To what extent do the benefits of the project (outcome & impact level) continue after FDOV-funding ceased and how was this influenced by the business case and/or revenue model?
RQ6	Did the project/ intervention lead to systemic change and/or was the intervention scalable? If yes, in what way?
	CSR
RQ7	**What is the CSR performance of the selected FDOV projects?**
7.1	How relevant were the designed CSR plans?
7.2	What effects can be observed of CSR plans of private partners in consortia?
7.3	To what extent did the projects have a major positive or negative influence on their direct natural environment or contributed to (combatting) global climate change?

2 Theory of Change and Methods

This chapter describes the reconstructed Theory of Change (ToC) that we have used as a tool to guide our evaluation (Figure 1). Based on the overall ToC we developed for FDOV, this ToC consists of three impact pathways: (1) the supply side, (2) private sector development (PSD) and (3) the demand side. Not all elements of the ToC were originally part of the project; some were added later.

2.1 Supply-side pathway

The project aims to establish the production of crickets by (1) training farmers on rearing; (2) establishing a learning alliance on rearing and processing; and by (3) introducing new conservation processes, equipment and product design. This is expected to lead to improved farmers' knowledge on rearing and their uptake of new conservation processes, equipment and product design, which will lead to an increase in the production of cricket products. This in turn is expected to increase both the farmers' income and own consumption of cricket products, both which are expected to contribute to increased food security for farmer households (particularly those at risk of protein deficiency). In addition, this could increase awareness about the business potential among smallholder farmers and the population at large, thereby serving as a 'demonstration effect' that could encourage additional farmers to increase cricket production.

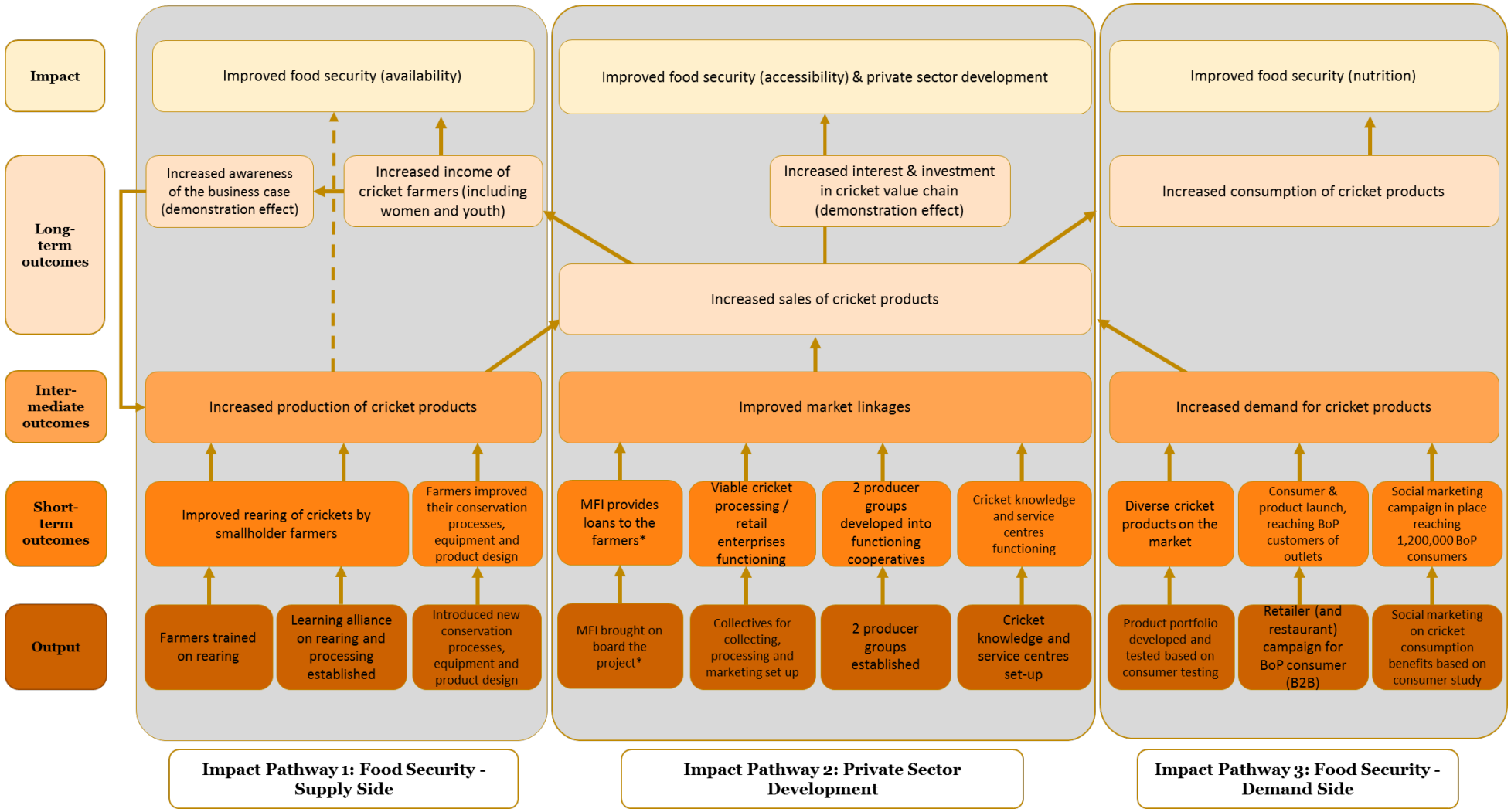
2.2 Private Sector Development pathway

The project aims to develop the private sector by building a sustainable cricket value chain. This involves: (1) providing access to microfinance for the cricket farmers by involving an MFI in the project ; (2) setting up collectives for collecting, processing and marketing; (3) establishing producer groups; and (4) setting up cricket knowledge and service centres. This is expected to lead to increased access to finance for farmers, viable and functioning cricket processing/retail enterprises, functioning cooperatives, and two branded cricket products introduced in local markets. This could improve market linkages and thereby increase the sales of cricket products. As a result, the interest and investment in the cricket value chain could increase, further developing the private sector.

2.3 Demand-side pathway

The project aims to increase the demand for cricket products by (1) developing a product portfolio based on consumer testing; (2) organising a campaign for BoP consumers; and (3) organizing a social marketing campaign. This is expected to lead to a successful consumer & product launch reaching BoP customers of outlets, and a social marketing campaign aimed at BoP consumers, which in turn could lead to increased demand for cricket products. As a result, it is expected that sales will increase, leading to an increased consumption of cricket products and thereby improved nutritional outcomes.

Figure 1: Reconstructed Theory of Change for Flying Food.



2.4 Methods

Our assessment draws on a variety of mixed, triangulated, quantitative and qualitative data sources. The evidence presented is based on the project documentation, the project's M&E system (including 'means of verification') and our own primary data collected during the field visit through semi-structured and in-depth interviews with project partners and beneficiaries.

The evaluation team visited the Kisumu area in Kenya in June 2018 and conducted a series of interviews with all relevant (local) project partners. At the request of RVO, we also interviewed several project partners that had dropped out of the project, including ADS and JOOST (see chapter 3 for a discussion of all project partners). The interviews included:

- Multiple in-depth interviews with the representative from TNO;
- Semi-structured interview with the representative from Mixa;
- One in-depth and multiple semi-structured interviews with the representative from Lamiro;
- Semi-structured interviews with 6 data collectors (DCs);
- In-depth interview with four representatives from ADS;
- Semi-structured interview with a representative from Rafode (MFI);
- Semi-structured interview with a representative from JOOUST; and
- In-depth interviews with 9 smallholder farmers.

We took considerable effort to make sure that the sample of interviewed farmers was reasonably representative. Therefore, in discussion with the representative from TNO, we selected the farmers based on the following criteria:

a. **Regions/counties**
   The project was active in two counties: Kisumu county and Homa Bay county. Within these two counties, there were several regions in which the farmers were located. We visited a mix of these regions, spread across both counties. We also visited several farmers in Kisumu town.
b. **Gender**
   We visited both male and female farmers. Some of the interviews were held with both the husband and wife.
c. **Age**
   The farmers we visited varied in age. We interviewed multiple farmers that were still in the beginning years of their career as farmers, while others were more experienced and towards retirement age.
d. **Involvement within the project**
   Some of the farmers interviewed were involved since the start of the program, whilst other farmers just joined recently.
e. **Cricket production**
   It was important for the representativeness of the answers to ensure that we did not only interview 'success stories'. Therefore, we interviewed farmers that produced a relatively large amount, farmers that had previously produced but who had to stop production, and farmers that had not (yet) started producing.

Priority was given to breadth. Due to the large distances between the farmers and the limited amount of time available during the field trip, we decided to prioritise in-depth interviews with a smaller number of farmers (9) rather than shorter interviews with a larger number of farmers. However, we are confident that we were able to obtain a representative sample of farmers who provided us with a wide range of useful insights.

The main methods used for this evaluation are desk research and structured interviews. Desk research was conducted prior and after the field visit. Prior to the field visit, the purpose of the desk research was to inform our field visits and to prepare the structured interviews. After the field visit, extensive desk research was done in order to analyse all available M&E data from the project, including the quantitative data from the Akvo Flow system on cricket production. The structured interviews were held during our field visit and in private settings. Almost all interviewees spoke English. Only a few farmers were more comfortable speaking the local language – for these few the DCs functioned as translators.

3 Project Partners

This Chapter provides an overview of the original list of partners, their respective responsibilities, and changes that were made to the list partners during the course of the project.

The Flying Food project was implemented by a large consortium of 12 partners. The list of partners operating in Kenya is given in Table 2-1 and includes knowledge institutes, NGOs, private sector partners, and a foundation. In addition, the project had two local partners in Uganda: ICCO ROCEA and BADDA. Table 2-2 shows the distribution of work packages across partners as originally envisaged in the project plan.

Table 2-1. The project originally included 10 project partners active in Kenya

Name	Type of organisation	Based in	Description
TNO	Knowledge Institute	NL	Independent applied research institute
ICCO	NGO	NL & KE	Interchurch organisation for development cooperation
Jagran B.V	Private Sector	KE	
VENIK	Private Sector	NL	Netherlands insect farmers association, which includes members such as Kreca, NGN-Pro Active, Nostimos, RUIG, and Wagening University & Research.
BoP Innovation Centre (BoPInc)	Foundation	NL	Alliance that develops, learns about and accelerates market-led BoP inclusive innovation.
HAS Den Bosch	Knowledge Institute	NL	Independent college that offers courses in the theme of agriculture, nature, nutrition and the environment.
Bondo University College (BUC), now JOOUST	Knowledge Institute	KE	Constituent College of Maseno University in Kenya.
Mixa Food & Beverages Ltd	Private Sector	KE	A registered business that deals in fabrication of food processing equipment, their usage, producing food stuffs and promotion and selling of food products.
Kenya Biologics Ltd	Private Sector	KE	Kenyan SME that rears insects for the development, manufacturing and selling of biological pesticides.
Angelican Development Services (ADS)	NGO	KE	Kenyan Development Organisation on value chain development at food and agro.

During the course of the project, several partners changed their involvement in the project:

- Jagran BV (private sector) left the project because of bankruptcy.
- Lamiro was added as a new commercial partner in Kenya (headed by Mrs. Phoebe Owuor) and took over some responsibilities from ADS (including the provision of trainers).
- Rafode was added as MFI to provide credit to the farmers.

Table 2-2. Distribution of work packages among the project partners

Work package	Responsible	Partners
1. Rearing	Jagran	Venik, BUC, ADS, KBL
2. Conservation and food product development	TNO	HAS, Venik, BUC, MIXA
3. Market identification & implementation	BoPInc	HAS, ICCO, TNO, Jagran, Venik
4. Value chain development	ICCO	ADS, BUC, Venik, BoPInc, HAS, TNO
5. Monitoring and evaluation	ICCO	ADS
6. Project management	TNO	Venik

Source: Flying Food Project Plan

In total, the project spent 25% more than its initial budget – both financially and in-kind (over €500,000). The largest share of the expenditures (and thus contribution) were made by TNO, i.e. more than 40 percent. They exceeded their total initial budget (own contribution and subsidy combined) with around €600,000. This was mostly the result of the unexpected need to change the cricket production process (transition from bucket system to crate system, including import of expensive Dutch crates) and the outbreak of the cricket disease (described in Box 1). Most other project partners spent slightly more or about the same as originally budgeted. The partners that spent significantly less than initially planned are BADDA (a partner active in Uganda), JOUUST, and RUIG, who, due to various reasons played smaller roles in the project than envisaged.

Table 2-3. In total, project partners contributed around 25 percent more than originally planned.

		Original budget			
Country	Partner	Own contribution (in €)	Subsidy (in €)	Type	Final expenditure (in €)
NL	TNO	153,000	290,000	Cash	1,046,595
NL	ICCO	20,000	100,000	Cash	139,214
Uganda	ICCO ROCEA	80,000	140,000	Cash	289,039
NL	RUIG	40,000	2,000	n/a	23,205
NL	KRECA	40,000	6,000	In kind	83,939
NL	NOSTIMOS	20,000	3,000	In kind	37,854
NL	NGN	60,000	90,000	In kind	251,348
NL	BOP INC	5,000	120,000	Cash	123,118
NL	HAS	50,000	20,000	In kind	63,627
NL	JAGRAN	60,000	30,000	In kind	85,398
Uganda	BADDA	412,000	3,000	In kind	8,400
Kenya	ADS	20,000	143,000	Cash	207,732
Kenya	JOOUST	20,000	50,000	In kind	20,787
Kenya	MIXA	15,000	2,000	In kind	99,014
Kenya	KBL	5,000	1,000	In kind	1,200
Uganda	FXSsalongo	0	0	n/a	0
Uganda	EntoAfrica	0	0	n/a	70.996
Total		***1,000,000***	***1,000,000***		***2,551,466***

4 Relevance

This chapter assesses the research question (RQ1) of whether the intervention is 'locally relevant'. It finds that the project design of Flying Food was highly relevant (ex ante) in addressing the needs of base-of-the-pyramid (BoP) producers and consumers. The design was also well aligned with the economic and social priorities of the Kenyan government related to food security and poverty reduction, particularly for vulnerable groups, women, and youth (RQ2).

Local relevance of the Flying Food project is assessed in two ways:

- RQ 1.1: To what extent did the project research and design its intervention according to needs of end beneficiaries?
- RQ 1.2: To what extent are projects relevant for local and governmental policies of host countries? (in this case, Kenya)

Research question 1.1 is discussed in Section 4.1. Research question 1.2 is discussed in Section 4.2.

4.1 Relevance with respect to end-beneficiary needs

According to the project plan, the project was designed to meet the specific needs of 'Base of the Pyramid' (BoP) producers and consumers in less developed regions of Kenya and Uganda. In particular, the project aimed "to promote economic development and strengthen local food systems in Kisumu and Masaka."[3] Moreover, within these regions they aimed specifically at improving the situation of BoP producers (smallholder farmers) and BoP consumers (typically the same smallholder farmers). Within these groups, there was also a special focus on women.

The main 'end-beneficiary needs' the project aimed to address were related to food security needs. Specifically, the two "biggest challenges" were identified by project partners as:

- "Assuring **availability of sufficient nutritious food** for all, through a value chain approach including: sustainable production, storage, conservation/processing, distribution and marketing mechanisms;
- Assuring **access to sufficient nutritious food** for all, including Base of the Pyramid consumers/producers, through well targeted development programs, focusing on production of **affordable quality food** alongside **income generating activities** and **social safety nets**".[4]

4.1.1 Ex ante relevance for BoP consumers

With respect to improving food security, the project design appears to have been highly relevant 'ex ante' in addressing the protein needs of the BoP consumer. In the project plan, partners stated that there is a problem of hunger and micronutrient malnourishment in the two rural regions targeted by the project.[5] This malnourishment results from the fact that the food supply is carbohydrate-based (e.g. maize, rice, sweet potatoes) and lacks protein-rich food (such as meat and fish), which is typically more expensive. The hope was that crickets would improve food security by offering farmers a cheaper source of protein.

3 Project Plan Flying Food FDOV, p.17.
4 Project Plan Flying Food FDOV, pp. 14-15.
5 Project Plan Flying Food FDOV, pp. 14-15.

In our interviews, local research experts confirmed that there was a protein deficit among smallholder farmers in these regions. In this context, crickets seemed a highly relevant food product to introduce, as they contain a relatively high amount of protein (see Table 4-1), similar to or higher than the amount of protein in beef. In addition, crickets can contain more iron and zinc than the dried silver fish ('omena') that is commonly consumed in this region, but omena is also an important source of protein.

Crickets also seemed relevant to the taste of consumers. As reported in project documents, a market exploration in Kenya's Nyanza region confirmed that there was a history of insect consumption in the region: more than 80% of the population were found to consume insects whenever they were in season. However, thus far the consumption of crickets was seasonal, and the production and consumption of processed insects remained undeveloped.

However, when the price of crickets and alternatively protein sources is taken into account, the relevance of crickets diminishes somewhat. On the one hand, multiple interviewed farmers confirmed that locally available protein-rich food (mostly omena fish or chicken) was scarce and (as a consequence) hardly affordable. As Table 4-1 shows, however, these other sources are sometimes cheaper than the price offered for crickets, depending on the type of cricket and the time of year.[6] If they are cheaper, then it is more lucrative for farmers to sell their crickets and buy other sources of protein instead. As discussed below, this is also sometimes what happened.

Table 4-1: Crickets are highly nutritious

Nutrients*	100g fresh whole crickets **	100g dried silver fish ('omena')	100g eggs (boiled)	100g beef (grilled)	100g chicken (grilled)***
Protein (in g)	23-69	59.5	12.7	25.9	18.15
Fat (in g)	0.05	10.6	8.1	28	3.12
Iron (in mg)	4-18	6.9	1.6	0.95	2.06
Zinc (in mg)	13-22	16	1.07	1.00	1.28
Price (in Ksh)	70 Ksh	58-120 Ksh	22 Ksh	40-70 Ksh	56 Ksh

Sources: price information taken from project partners and various internet sources.
* Unless otherwise noted, nutritional information was taken from FAO and Government of Kenya (2018), "Kenya Food Composition Tables 2018": http://www.fao.org/3/I9120EN/i9120en.pd
** Nutritional information for crickets taken from: Mwangi, Martin & Oonincx, Dennis & Stouten, Tim & Veenenbos, Margot & Melse, Alida & Dicke, Marcel & van Loon, Joop. (2018). Insects as sources of iron and zinc in human nutrition. *Nutrition Research Reviews*. 31, pp. 248-251.
*** Nutritional information for indigenous chicken taken from M. Chepkemoi et al. 2015, "Nutritional diversity of meat and eggs of five poultry species in Kenya", Jomo Kenyatta University of Agriculture and Technology, Kenya.

4.1.2 Ex ante relevance for BoP producers

With respect to the goal of promoting economic development, the project design was also relevant (ex ante) in addressing the income generation needs of BoP producers (smallholder farmers). The project design was relevant to smallholder farmers, as it aimed to generate income for them by simultaneously developing the supply-side (by providing information, training and equipment) and the demand-side of the cricket market (by promoting consumer awareness of their nutritional value and developing cricket products to adapt to consumer tastes). If the supply-side had been targeted without attention to the demand side, farmers would have

6 According to one newspaper article from 2017, 400 grammes of omena in a Nairobi supermarket cost 233 shilling, so 100g would have cost around 58 Ksh. According to the same article, beef at that time cost Sh200 for half a kilo, i.e., Ksh40 per 100 gram. These prices are used as lower bounds in Table 4-1. See: https://www.standardmedia.co.ke/evewoman/article/2001231754/chapati-edges-ugali-out-of-table-in-kenya-as-the-rich-salivate-over-poor-man-s-diet

been able to consume their own crickets (thus contributing to food security) but may not have been able to sell them, hence the market would not have developed beyond the farmers themselves.

The project design was also highly relevant in that it targeted groups with limited alternative income generation capacities. Given that crickets require only a small amount of land, capital and physical activity, the project was assumed to be especially well suited for smallholder farmers (BoP producers). Moreover, within this group, it seemed particularly suited for women and youth who, in these regions, tend to be most constrained in terms of access to land and capital. While the project originally targeted 33% female farmers, it turned out (ex post) that more than half of the farmers trained by the project were female. Based on our interviews, we learned that many of these women would not have had many (or any) alternative income generation activities. They therefore eagerly welcomed this additional (potential) source of income and considered cricket rearing a meaningful and productive way to spend "idle" time. An unintended side effect (i.e. not part of the project's ToC or design) was that it also improved their status in the community, in part due to the weekly visits by trainers and 'data collectors'.

The project's scale was small, but its novelty implied a potentially large impact on *indirect* beneficiaries via demonstration effects. On the one hand, the project aimed to reach only 300 smallholder farmers in Kenya directly,[7] which is a very small fraction of smallholder farmers in the country. The potential direct impact on food security and income generation was therefore small by design. On the other hand, the project targeted the development of a totally new value chain that aimed to introduce novel food products using novel methods. This element of 'novelty' means that the project had significant potential demonstration effects, i.e., the potential to be copied by other smallholder farmers and processing companies in other communities or regions. By design, the potential indirect effects of the project were therefore much larger than its direct effects (although the small number of Flying Food farmers was an obvious limiting factor).

4.1.3 Ex post relevance

Despite the high 'ex ante' relevance of the project, 'ex post' relevance was more limited in that little income was generated and limited consumption of crickets actually took place. Note that 'relevance' is, in fact, an 'ex ante' concept related to the design of the project, so the concept of 'ex post relevance' is somewhat unusual and is in fact more closely related to effectiveness. With hindsight, the results in terms of both income generation and consumption were disappointing. This was mostly due to the project's low effectiveness with regard to the supply side (low yields), reflecting the many setbacks that are described in more detail in Chapter 6.

The disappointing results with respect to consumption of crickets by BoP consumers were not only related to supply-side setbacks, but also to the demand side. In particular, cricket prices were high relative to other protein sources, so that many farmers preferred to sell their crickets directly to the processor (Mixa) rather than consuming them or selling them to surrounding communities. While a few farmers reported having consumed crickets themselves, or having added them to their children's porridge, many of the farmers that did earn some income by selling crickets appeared to use the proceeds to buy other, cheaper sources of protein instead, such as chicken or omena. One local project partner confirmed that "the farmers would like to sell their cricket and buy omena and other protein sources as food." In this way, the project still contributed to food security, but not in the way it was originally foreseen.

[7] Originally, the project aimed to reach a total of 4,000 smallholder farmers in Kenya and Uganda. However, halfway through the project the project partners and RVO.nl agreed to reduce this target to 300 farmers in Kenya (and another 300 in Uganda). Chapter 6 and the annual progress reports provide further details.

The limited income generation for BoP producers reflects in part a misleadingly positive 'business case' that promised to yield a positive net income for new cricket farmers several years after recovering the start-up costs. The business case developed by project partners is presented and analysed in Appendix A. It shows that small-scale farmers are able to generate positive net income from cricket farming only under certain assumptions that are somewhat unrealistic (e.g., the cost of labour and various other costs are considered negligible and not included as costs). This is discussed in more detail in Section 7.1.1 ('Sustainability of cricket production') and Appendix A.

4.2 Relevance with respect to local government policies

When compared to the priorities and objectives of the Kenyan government, the design of the Flying Food project appeared highly relevant. This can be seen when comparing project goals with the priorities of the Kenyan government as expressed in its 'Vision 2030' for Kenya. This vision document was originally launched in mid-2008 with the objective to help transform Kenya into a "newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment."[8] The Vision 2030 is based on three pillars (economic, social and political), and the Flying Food project aligns well with the priorities of economic and social pillars.

One way in which the project is relevant to the Kenyan government's agenda is that agricultural sector development and food security are their explicit priorities. Within the economic pillar of Vision 2030, the Kenyan government focuses on reforms and developments in ten sectors, among which the agricultural sector (and in particular, "increasing value in agriculture"). In addition, the new administration of Uhuru Muigai Kenyatta picked four key economic deliverables in 2018, which are referred to as "the Big Four" within the framework of Vision 2030. Food security is one of these "Big Four". The other three are (1) universal healthcare, (2) affordable housing, and (3) manufacturing (for the regional market).

A second way in which the project is relevant to the Kenyan government agenda is that its targeted social impact on specific groups is in line with local governmental policies. The social pillar of Vision 2030 focuses on developments in eight sectors. Among these are 'gender, youth and vulnerable groups', which are precisely the Flying Food project's target groups. . Another sector in the social pillar is 'equity and poverty elimination', which is another goal that the Flying Food project contributed to via income generation. Given the relevance of this project to smallholder farmers, women and youth (described in the previous section), the Flying Food project appears to be very well aligned with local government priorities.

8 "Vision 2030 - Vision". Government of Kenya. Retrieved 18 March 2013.

5 Additionality

This chapter assesses the input additionality and development additionality of Flying Food. It concludes that both types of additionality were high.

The research questions addressed in this chapter are:

RQ2 To what extent were the projects additional according to the DCED definition?

2.1 To what extent was the ex-ante additionality assessment in line with evidence?

2.2 Was public funding necessary for the implementation of the project? (output, outcome, impact?)

2.3 How can ex-ante additionality assessment be improved?

2.4 What difference has the public contribution made to the achievement of public goals?

In line with DCED (2014),[9] it is important to differentiate between input additionality and development additionality. Input additionality occurs when "the public input resources are additional to what might anyway be invested or done by the applicant/partner company and other parties, as well as the timing of it". Development additionality is the extent to which public resources contribute to changes in development-relevant results that would not have materialised without them. In the case of FDOV, the development additionality of the Dutch government can also be indirect, through the influence it may have on the inclusion of NGOS or knowledge institutes into the PPP, which in turn may have development additionality.

5.1 Input additionality

Since input additionality generally needs to be assessed *ex ante*, it is somewhat challenging to validate the input additionality assessment *ex post* for a project that started in 2013. Nevertheless, we aimed to reconstruct an assessment of the availability of alternative resources ex post through desk review and in-depth interviews with relevant stakeholders.

The ex-ante additionality assessment reveals that FDOV had strong input additionality. While the evaluation team was not able to identify a full 'ex-ante additionality assessment', the FDOV assessment of this project concluded that "Based on the figures of the Cash Flow provided and taking into account a small correction (deleting the investment costs outside the project period) it can be concluded that the project does fulfil the requirements set by FDOV: the project showed to be not commercially viable while being financially sustainable."[10] With hindsight (ex post), the latter statement turned out to be incorrect, as discussed in Chapter 7.

While little evidence is available, it seems fair to conclude that Flying Food project activities would not have materialised without public support. According to both Dutch and local project partners, the project was clearly "too innovative" to qualify for funding from

[9] DCED (2014), "Demonstrating Additionality in Private Sector Development Initiatives", Donor Committee For Enterprise Development.

[10] FDOV B&R12KE09: Assessment form complete qualification proposal FDOV (stage 2).

commercial financial institutions or investors. At the start of the project, many factors were still uncertain (e.g. the best method for rearing crickets adapted to local circumstances, the local availability of equipment and feed) and a subsidy element was clearly needed to finance training and monitoring activities, transport, research on cricket rearing, and the import of Dutch equipment. Farmers lacked access to finance and local financial institutions would not have been willing to provide them or other value chain actors with seed capital or bridge finance. Providing such finance only became interesting toward the end of the project, when local private companies had been identified to provide training and equipment on a commercial basis. The ex-ante additionality assessment therefore appears to have been correct in that the project would not have been commercially viable at the start.

In the absence of FDOV, it may have been possible to attract non-commercial funding from another donor or subsidy program. For example, the project could have applied for funding from 2SCALE—another Dutch subsidy program aimed at private sector development and food security. However, the funding in this case would still have come from the same donor (Dutch Ministry of Foreign Affairs), which still would have been additional to commercial sources of funding. A more interesting example is that Mixa was able to attract a loan of 14 million Kenyan shillings (around €120.000) from the Achmea Foundation, which was used to provide credit to newly trained farmers to purchase equipment, cricket feed, and 'parent stock' for crickets. This, however, was a highly concessional, zero-interest loan, to be repaid within 5 years. Moreover, it is unlikely that Mixa would have been able to obtain this loan without FDOV funding. The fact that a project partner attracted this funding could therefore be considered as a spinoff or 'catalytic effect' of the Dutch FDOV subsidy.

5.2 Development additionality

In addition to input additionality, a programme can have development additionality if it can be demonstrated that it contributed to changes in development-relevant results. According to DCED (2014), this can be related to e.g. scale, scope, quality, target group, or location of activities.

One way in which FDOV is likely to have had development additionality (sometimes called 'outcome additionality') is by its focus on "Based of the Pyramid" (BoP) producers and consumers. If FDOV had not had this requirement, it is possible that the project (or any other investor that would have been interested in cricket rearing) would have focused on large-scale cricket rearing at a central location, which may have made more commercial sense given the significant economies of scale. In interviews, one project partner stated that they would have been willing to work with BoP producers anyway, while two other project partner stated that it may have been more efficient and effective to work with the "Middle of the Pyramid" or "MoP" producers (and sell crickets to MoP consumers), but they did not because of "the social impact that the project had in mind." However, project partners indicated that the project's focus was in fact switching from BoP producers and consumers to MoP producers and consumers (see the chapter 'Effectiveness' for a further discussion).

Another example of development additionality (sometimes referred to as 'behavioural additionality') is FDOV's contribution to the development of new business models. Without public funding, less resources would have been available for research and development, and cricket rearing in Kenya may have continued with the inferior 'bucket system' rather than the 'crate system'.

Besides the direct contribution of public resources, it is also possible that FDOV had an indirect contribution. This 'indirect development additionality' could occur if FDOV induced lead partners to work with non-private partners (NGOs, knowledge institutions) which in turn also had development additionality. However, based on interviews with lead project partners, it does not appear to have been the case that additional partners were added because of FDOV requirements. According to the local lead partner who was involved in the project from the beginning, "all partners were added at will." According to the Dutch lead partner, working with these partners "was a requirement for the project to succeed […]. The best way for innovation to succeed is to have all actors on board from the beginning, actors which you might think you will need during the actual success."

6 Effectiveness

This chapter assesses the effectiveness of the project. It finds that, while many output targets were met, many outcome targets were not met.

The key research questions discussed in this chapter are the following:

- RQ3: To what extent has the project been effective in reaching its outcome and impact objectives?
    - 3.1 What changes related to outcome and impact can be observed in comparison to the project baseline?
    - 3.2 What was the contribution or attribution (net effect) of the intervention (design of the project, project duration, partnerships, cooperation within the partnership, etc.) to the observed effects?
    - 3.3 Is the engagement of civil society effective in keeping the focus on public objectives?
    - 3.4 Did the projects reach the desired end-beneficiaries (women, youth, vulnerable groups, farmers, policy makers, etc.) and how are they benefitting?
- RQ4: What are the key determinants (both internal and external to the project) for inducing or hampering the intended and unintended effects?

Rather than discussing these questions one by one, we present the answers to these questions per impact pathway. For each impact pathway, we first provide a short description of the impact pathway before discussing results. As noted in the introduction, we cover all three impact pathways even though the original plan had been to focus mostly on private sector development and the demand-side. This is because the supply-side pathway appears to have been an important bottleneck in the short-run.

To remind the reader of the project's key outputs and outcomes, the three impact pathways are presented as excerpts of our own reconstructed Theory of Change for the project. Within these three pathways, we discuss the 'results' and 'sub-results' as defined by the project. Note that these results and sub-results do not always perfectly correspond to the boxes in the ToC diagram, as the ToC is an analytical tool that helps organise and conceptualise the theory behind the results chain, while the results and sub-results are key performance indicators that were previously defined and agreed upon between the project partners and RVO.nl.

6.1 Supply side

On the supply side, the project aimed to establish profitable small-scale cricket farms. The objective was for these cricket farms to produce crickets that could be eaten either directly or sold to a processor. In both cases it was expected that local food security would improve, either via consumption or via income channels. Particular attention was paid to the involvement of women in cricket farming.

6.1.1 Supply-side outputs

The key supply-side outputs were largely met. These outputs concern project activities related to training, equipment, feed, and other inputs/support provided to farmers.

Result	Sub-result		Accomplished	Realisation as of June 2018
2	1	Validated methods and manual for rearing insects developed and competent group of trainers formed.	Yes	Methods and manual were developed and competent group of trainers was formed.
	2	300 small farmers in Kenya (at least 33% women) are well trained and supported for rearing crickets	Yes/Partly	412 farmers (of which 237 women) were trained, but it is not clear to what extent they were "well trained".
	3	300 small farmers in Kenya are well equipped for rearing crickets, having access to affordable starter kits and good and affordable feed for crickets	Partly	Only 80 farmers were equipped by the end of the project.

Result 2.1: Validated methods and competent trainers

The project was partially successful in (a) developing validated methods and a manual for rearing insects, and (b) forming a group of competent trainers. Training methods were developed with the help of Dutch project partners from VENIK, and were elaborated in training modules and a training manual. Starter kits were defined and costs of individual components were listed. By the end of the project, both Kenya and Uganda appeared to have a competent training team (including many women) that trained farmers following the methodology laid out in the manual. Training teams could offer their services for initial training and farmer support according to specified prices.

The project eventually developed validated methods for rearing insects, albeit with a considerable delay. This is because the project started off training farmers to rear crickets in buckets, which they had assumed was an established system that worked well. In interviews, Dutch project partners explained that they realised only well after the project had already started that the bucket system was subject to various problems and was not the most productive system for rearing crickets. TNO therefore proposed to switch to a crate system developed by Kreca. Developing this alternative system and finding a local crate manufacturer for the crate system took time. As a consequence, the project initially needed to import Dutch crates, which led to delays and large transportation costs.

The project was successful in forming a competent group of trainers, but this also took time. Initially, ADS (the local implementing partner) provided the trainers for the projects. These trainers in turn were trained by Dutch project partners [VENIK/KRECA]. In late 2015, when the number of farmer started increasing, more trainers came on board. They were also hired by ADS and were being referred to as 'Data Collectors' (DCs). In addition to providing the training, they oversaw the backstopping of the whole process. Their activities included harvesting, monitoring, providing feed, and transporting the harvest to Mixa. Activities added later include mopping up crickets that were ready and taking care of the distribution of 'parent stock' from one farmer to the other. Following some management issues between TNO and ADS (described later), the original trainers largely were replaced by other trainers who ended up being managed by Lamiro, a local consultancy run by Ms. Phoebe Owuor (a key stakeholder of the project). Based on our field visit, these trainers or 'DCs' seemed competent but most of them were trained in business rather than in agriculture.

Result 2.2: 300 farmers trained and supported

The (adjusted) target of "training and supporting" at least 300 farmers in Kenya was achieved. In total, the project provided training to 412 farmers in Kenya, of which 237 were women.

The fact that very few of the 412 trained farmers actually started producing and selling crickets may suggest gaps in the quality of training and ongoing support. Some of the trained farmers that did start rearing crickets later quit rearing because of disappointing yields. Based on interviews, this appeared to have been caused mainly by the relatively low yields of crickets compared to what was 'promised' during the training. Instead of the promised 1 kilogram per crate, many farmers indicated they did not even reach a third of that amount per crate, even though they put a lot of effort into it.[11] This lower-than-expected productivity (confirmed by the data) was due to a variety of factors, some of which undoubtedly related to the cricket disease (see Box 1) and the need to find good cricket food,[12] coupled with political unrest and floods, which redcued the frequency of training and monitoring. It appears that these were the main reasons for the lower-than-expected yields, but we cannot exclude the possibility that the disappointing output results were in part the result of insufficient or ineffective training and support (monitoring).

In summary, we cannot conclude with certainty whether the target of 300 farmers being "well trained and supported" was truly met. For example, many farmers appeared to have remained very dependent on the weekly visits of the trainers, and could not operate independently. For future purposes, we would recommend to more clearly define what is meant by such terms, and to monitor these more actively.

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11 Moreover, some farmers noted that rearing crickets took more time than the initially promised 30 minutes per day. A more common estimate was 1 to 2 hours per day, including the preparation of cricket feed. The business case presented in Appendix A therefore assumes 1.5 hours per day spent on cricket farming.

12 According to project partners, finding the optimal mix of ingredients for good cricket food was another challenge that was responsible for low yields. By the time the right mix had been identified, the cricket disease had hit.

Box 6. 1: The cricket disease that plagued the Flying Food project

In September 2017 the first signs of unexpected cricket deaths were reported at the project site in Uganda. Photos of these crickets were sent to the Dutch project partners, who concluded that these crickets were ill. These photos were forwarded to Copenhagen University whom Kreca (a member of Venik) had been in contact with in the past.

At the end of October 2017, crickets were transported for further examination in the Netherlands by Wageningen University & Research. They concluded that the crickets were not infected by a virus but, rather, contained a large amount of bacteria. The advantage of this diagnosis was that a virus would have wiped out the whole population within a few days. However, the disadvantage was that bacteria—unlike viruses—are not specific to species, and that therefore it is not possible to simply switch to new cricket species, as these could still be infected with the same bacteria.

By November 2017, the infection had spread across many farms. A PhD student from Copenhagen University, who was doing research on cricket diseases, took samples from crickets in the wild and from farms in both Kenya and Uganda. These were analysed both locally and by Wageningen University & Research. It was concluded that all farms in both Uganda and Kenya were infected, suggesting that contamination had taken place.

Taking hygienic measures did not have a sufficient effect. Given the small size and novelty of the insect-rearing industry worldwide, little was known about possible cures for 'infected' crickets. At first, the project introduced a number of hygienic measures for both the farmers and the DCs. In January 2018, the crickets were again evaluated, and it was concluded that the hygienic measures had not had the desired effect.

The project then opted to treat all crickets (in Kenya) with antibiotics. Killing the entire population of crickets and starting with a healthy new population was also an option, but the local processor (Mixa) advised against it as farmers would get discouraged and drop out of the project. However, there were several risks of using antibiotics:

- It was unknown which antibiotics would be suitable for crickets and which dosage to use.
- As the origin of the infection was unknown and crickets from the wild were also infected, reinfection could occur.
- Supply of antibiotics might lead to antibiotic-resistant bacteria.
- The relatively young and small insect industry still had the image of being antibiotics free, unlike other forms of animal husbandry worldwide.

The antibiotics treatment initially appeared to be successful. Initially, only the crickets reared on a large scale by Mixa were treated with antibiotics. The results were positive. Some farmers were taught how to administer the antibiotics, but unfortunately the method proved too difficult for the farmers. Therefore, Mixa started supplying the 'clean' pinheads to farmers as new parent stock. By July 2018, all crickets were thought to be 'clean'.

During their latest visit in November 2018, project experts from the Netherlands observed that the disease was still active (antibiotics were not effective or not applied correctly) and had affected all crickets in both Kenya and Uganda. This obviously has led to significant disappointment among farmers**.** The experts ran additional tests in the Netherlands, which demonstrated that the disease is not transmissible from mother to egg. This means that, when the eggs are disinfected on the outside, it is possible to start with a new bacteria-free generation. Project partners are currently selecting and drafting cleaning protocols, which will be implemented by Mixa. From now on, Mixa will be responsible for the reproduction of crickets and distribution of clean eggs.

Result 2.3: 300 farmers equipped for rearing crickets

Even though more than 300 farmers were trained and supported, only slightly less than 90 farmers were well equipped to rear crickets. In contrast with 'disillusioned farmers', there were also farmers that were trained and eager to rear crickets, but (still) could not do so due to a lack of equipment or inputs. Not all farmers trained were provided with 'starter kits' and some farmers

complained that they lacked pieces of equipment. According to project partners, all farmers did have access to equipment (via the MFI), but delivering the equipment was postponed because of the bacterial infection (Box 6. 1).The infection not only killed many crickets, but the limited number of healthy crickets also prevented the project from using existing 'parent stock' to produce eggs. Reproduction at that point dropped to nearly zero. This was a major challenge for project partners, as they were no longer able to provide new farmers with eggs. As a consequence, cricket production virtually fell to zero at the end of 2017.

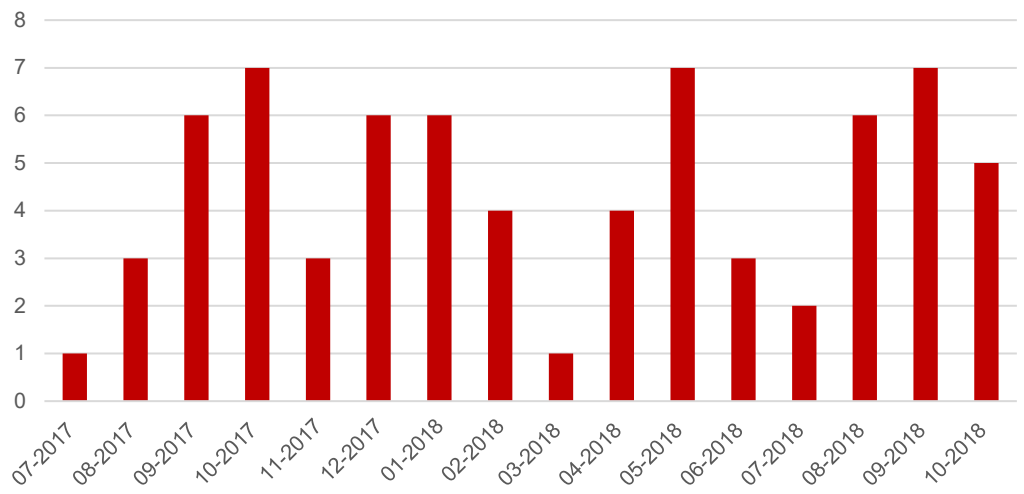
6.1.2 Supply-side outcomes

Result 2.4: 300 farmers produce 1500kg good quality crickets per month

Result	Sub-result		Accomplished	Realisation
2	4	300 small farmers produce 1500 kg good quality crickets/month	No	The maximum total amount produced in one month was 14 kg/per small farmer.
	8	300 small farmers increase their income with at least €200 / year	No	Very few farmers have realised a considerable increase in their income so far.

The target of 300 producing farmers was far from being met. As discussed below, only a fraction of the farmers who were trained ended up actively rearing crickets. In October 2018, which is the latest month for which production data is available, only 5 farmers were selling crickets for processing (Figure 6-1).

Figure 6-1: Only a very small number of farmers were selling crickets each month.

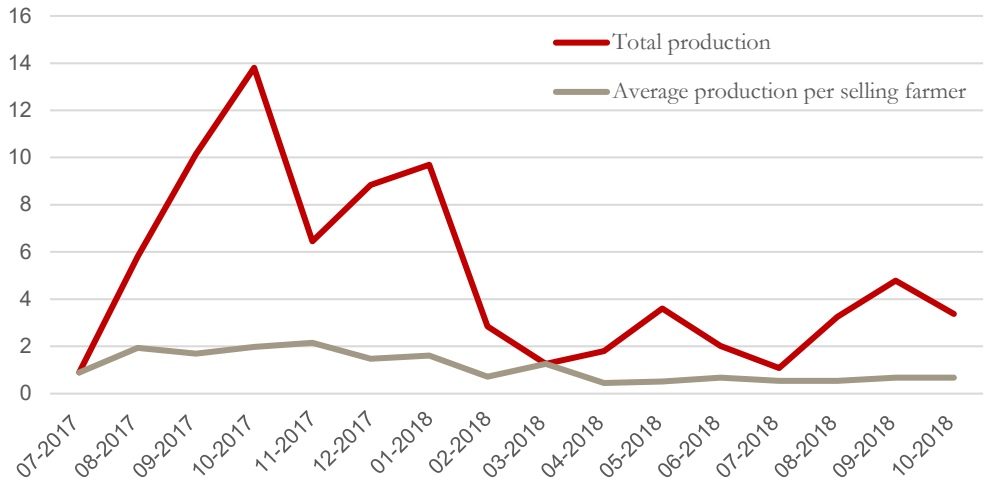


Source: Raw data from ICCO; slightly modified to account for incorrect or inconsistent entries.

The maximum number of farmers selling crickets before the disease equaled seven. This number reached its lowest point (equal to 1) in March 2018, a few months after the disease hit in November 2017. Based on the latest monitoring data available, production increased again in August-October 2018, despite the fact that the project formally ended in June 2018. However, the target of 300 producing farmers was still very far from being met.

Total production per farmer was much lower than targeted. Total production of crickets sold for processing[13] peaked in October 2017 at around 14 kg per month, produced by 7 farmers, i.e. a production of nearly 2kg per producing farmer. This was only 40% of the targeted 5 kg per farmer (1500 kg produced by 300 farmers) per month. This maximum production of October 2017 was reported when the disease had just been diagnosed.[14] In written communication, project partners stated that "if the results of farmers that were out of the start-up phase before the disease hit are extrapolated, these amounts of cricket production should be possible with the current farmers group, once all farmers have started rearing again." Reaching 1500 kg per month, however, would have required that all 412 farmers started rearing with an average production level of nearly 4 kg per month.[15] This is unlikely, given that farmers would then have had to double their production levels from the pre-disease recorded average of nearly 2kg per farmer. While it is possible that the October 2017 peak would have been higher than 2kg per farmer had the disease not already started,[16] there are no clear indications that 4kg per farmer would have been feasible in this counterfactual no-disease scenario.

Figure 6-2: The total pre-disease volume of crickets sold for processing peaked at 14 kg per month in October 2017



Source: Raw datasheet from ICCO, which has been slightly modified to account for incorrect entries.

There are several reasons for the lower-than-expected (pre-disease) production levels:[17]

13 No separate monitoring data were collected for raw crickets produced and raw crickets sold. The total amount of crickets produced may have been slightly higher than the amount sold, to the extent that farmers may have consumed some crickets themselves (or may have sold them to outside buyers). However, the monitoring data suggest that consumption of crickets was very low (almost negligible), while interviews suggest that side-selling was not a major issue and was unlikely to have taken place at a large scale.

14 While no data was received for the period before July 2017, it is unlikely that total production was higher before that time, since many farmers only got trained in 2017.

15 According to project partner TNO, total production per month should also include large-scale production by Mixa. However, the wat the original target was stated was that "300 *small farmers* produce 1500 kg". Moreover, Mixa itself was eventually also infected by the disease.

16 According to project partner Kreca, it is likely that the disease was already present in the cricket population, in a less visible form, before it was discovered in October 2017. In this case, the disease may have also been an important reasons for the lower-than-expected yields in the beginning of the project.

17 Based on interviews with stakeholders and project documentation, e.g. MOV for Result 2.7.

1. *Transition from bucket to crate system.* As described above, the original bucket system was not working and had to be replaced with a crate system that was newly developed for small-scale farmers. While a large-scale crate system had already been used by Kreca for several decades in the Netherlands, implementing this system on a smaller scale among smallholder farmers in Africa was a novel idea, which had not yet been tested in the field.
2. *Climatic conditions.* Experiments with the crate system in a controlled environment in the Netherlands suggested potential yields that were much higher than what was actually achievable in Kenya. One reason was that rearing facilities at the smallholder farm level did not have a climate regulation system in place, like in the controlled cricket farms in the Netherlands. Smallholder Kenyan farmers were therefore more strongly influenced by the weather than anticipated.
3. *Feed.* Optimal cricket feed could not yet be provided in Kenya, since the aim was to use locally produced feed for sustainability reasons. In practice, the feed was produced by Mixa (and supplemented by farmers with e.g. locally grown leaves), but the search for optimal feed was still ongoing at the end of the project, and further improvements in feed are expected to have a considerable effect on yields.
4. *Reproduction of crickets.* Suboptimal feed also affects reproduction. Female crickets that are fed with high quality feed produce more and better eggs. In addition, hatching of eggs was less than optimal because many farmers still had to learn the right composition of egg-laying substrate and sometimes had difficulties maintaining the right moisture content.
5. *Training and support.* Training and support to farmers was less than optimal due to ineffective cooperation between partners. There were a number of management issues related to contracts and payments between partners. In some instances, there appeared to be tensions between local partners because the respective responsibilities were not clearly defined. This caused delays in training and the provision of other support services that may have affected yields.
6. *Political instability and floods.* During the project period, Kenya experienced significant political instability, as well as flooding. For both reasons, there were periods when trainers/data collectors could not visit farmers as frequently as planned. These unanticipated disruptions are likely to have contributed to lower yields.
7. *Risks underestimated:* Flying Food was the first project of its kind, aiming to start a cricket value chain from scratch in a developing country, so a lot had to be discovered and researched as the project proceeded. With hindsight, the associated risks were underestimated.

Result 2.8: 300 farmers increase their incomes by at least €200 per year.

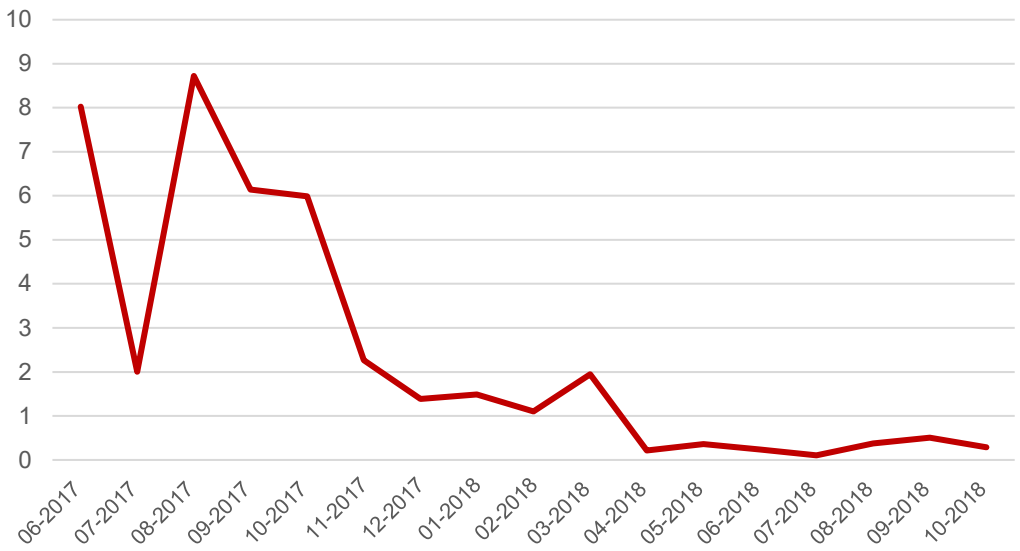
As the production target was not met, it is not surprising that the income target was not met either. In fact, very few farmers had earned any considerable cricket revenues by the end of the project. Before the disease outbreak, the best-performing farmer had monthly cricket sales of nearly €80 in the best performing month.[18] However, the average value of cricket revenues reached a maximum of €9 per month (see Figure 6-3). Since the disease, this amount dropped below €2 and has yet to recover.

There are no strong indications that the target of at least €200 per year would have been achieved in the counterfactual scenario where no disease had occurred. Meeting this target

[18] Source: AKVO-FLOW data from ICCO

would only have been met if the pre-disease levels had almost doubled (to €17 per month). We consider this unlikely, for the same reason that we consider it unlikely that result 2.7 would have been achieved without the disease. This does not mean that a target of €200 per year is not feasible in principle – it was just not achieved during the course of the project.

Figure 6-3: Average monthly cricket revenue per farmer dropped considerably since the disease hit (in Euros).



Source: Raw data from ICCO; slightly modified to account for incorrect entries.
Note: Revenues are expressed in euros. The exchange rate used is 0.0086 Euro per Kenyan Shilling (on 17th Jan, 2019 from www.xe.com).
This figure only shows average monthly revenues for which data was collected during the specific month. For income, the costs (which include wages of farm assistants, costs of feed, etc.) should be deducted, but data on this was incomplete. In total, there were 117 different farmers for which data was collected. Of these, only a small amount of were being visited per month.

The reported increases in income (revenue) do seem to be largely 'additional' to other sources of income. In theory, the amount of ' additional' income due to cricket rearing would be even lower if one takes into account that farmers may also give up certain other income generating activities in order to make time for rearing crickets. In practice, however, almost all farmers we interviewed noted that they had spare time for cricket rearing and did not have to give up other income generating activities. For example, they could still combine cricket rearing with raising chickens or growing potatoes.[19]

6.2 Demand side pathway

On the demand side, the project aims to increase the consumption of crickets. For this to occur, the increase in the (produced) supply of crickets must be met with an equivalent demand for crickets and cricket products among consumers.

[19] However, some farmers mentioned that they would consider giving up chicken farming for the sake of crickets, as the latter appeared to be more lucrative and less risky at that time.

6.2.1 Demand-side outputs

Result	Sub-result		Completed	Realisation
4	1	Awareness and consideration of benefits of cricket consumption among BoP consumers, authorities, farmer groups and change agents	Partly	A marketing strategy was drafted but not (fully) implemented yet.
	3.	One branded cricket (derived) product successfully launched among BoP consumers in Kenya [same as result 5.3]	Partly	Branded product launched but not successfully launched
	4.	Market research report on edible insects	Yes	Report is available

Result 4.1: Creating awareness on benefits of cricket consumptions

The project was partly successful in raising awareness of the benefits of cricket consumption.[20] To this end, project partners developed a marketing strategy report that contained a stakeholder engagement plan. A different approach was proposed for each of the following stakeholders:

- The church
- Schools
- Chief/village elders
- Community health workers
- Specialists on nutrition

The marketing strategy report included a specific communication strategy for BoP consumers. First, the report outlined the key benefits and barriers of crickets (see Table 6-1). Based on this, a strategic plan was set out that determined what information should be shared in the varying communication channels (which included flyers, stakeholder activities, posters, radio and TV).

[20] Note that awareness campaigns themselves are outputs of the project, but actual success at raising awareness is technically an outcome, as it is not fully under the control of the project. For simplicity, however, we have listed the discussion on awareness under 'outputs', as they were mostly project-driven activities.

Table 6-1: The key benefits of and barriers to the consumption of crickets

Benefits	Barriers
The taste is sweet	It does not look like food
It is a cheap replacer of meat and fish	It is still an unknown dish and people prefer dishes which they know
It is nutritious (high in protein, fat, fiber and minerals)	It is not always accepted to eat crickets in the community
It is a natural product	Parts of some communities believe crickets make the sound of the devil
The preparation is easy and quick	Some people believe that crickets are toxic
It can be eaten with locally known dishes	
People believe that crickets clear the throat	
It is less harmful to the environment than normal protein sources.	

Source: Marketing Strategy Report Flying Food, MoV 16022016

The marketing strategy plan was not (yet) fully implemented. This is mostly a consequence of the very limited volume of crickets produced so far. Without a continuous and reliable supply of crickets on the market, a widespread campaign would not reach its desired effect. In interviews, the Director of Mixa told us that he on purpose limited marketing activities at the moment because he wanted to avoid a situation where demand would exceed supply, which could lead to disappointed potential consumers. However, many of the BoP farmers that already produced crickets (mostly before the disease) indicated that their family had already developed a taste for cricket products. In particular, several women indicated that they prepared a cricket-based breakfast for their children, e.g. by mixing crickets with cereals, which children were happy to eat and which the family believed was good for their health.

Result 4.3: Branded cricket product launched for BoP consumers

In Kenya, a branded cricket product line Bora (" better" in Kiswahili) was launched in 2018. However, due to the low production levels, the brand did not yet appear to be widely known by the local population. Nonetheless, the project partners indicated that the local population reacted very positively the first time they sold the products on a local market.

Result 4.4. Market research report on edible insects

A market research report on edible insects was drafted. The key consumer findings and recommendations were the following:

- The look of crickets initially put off many consumers, but more than 50% of people were willing to taste for the first time. These people were also willing to try them again and recommend them to others.
- Children were the most willing to taste cricket products and recommend them to their friends.
- For crickets to be accepted as food in East Africa, they must be incorporated in local traditional foods, such as chapatti and sukuma wiki. Only after initial awareness and acceptability, should they be packaged as branded products.

- As trust is derived from the community, it is critical to use local influencers (elders, health workers, the church) as stakeholders to enable acceptability of the product.

These insights translated into various marketing challenges. However, there were also various signs of consumer acceptance of crickets. Apart from the positive feedback on the taste of the products, consumers were more generally already consuming insects in the targeted regions. In addition, the 'distractors' identified above could be overcome by education, marketing and specific recipes. Based on the above, a marketing strategy was formulated.

6.2.2 Demand-side outcomes

Result	Sub-result		Completed	Realisation
4	2.	5 local markets/outlets for crickets and cricket derived products	Partly	Mixa claimed to have several outlets (sales points), and the Akado Cooperative was mentioned as an additional local sales point. However, at the time of our field visit, only 1 outlet was selling cricket products.
	5.	5 local markets/outlets, targeting BoP consumers, offering 5,000 affordable servings[21] of cricket (derived) products/month	Partly	BoP consumers were among the target groups, but very few servings were offered in practice due to the limited production

Result 4.2: 5 local markets for cricket products

The target of identifying or creating 5 active local markets for cricket-based products was not met. This is mainly a consequence of the low production levels of crickets, which hampered the retailers from having a continuous stock of cricket products in store. In addition, the main market where cricket products were being sold in Kenya was Mixa's farm, which was not ideally situated given its long distance to the most nearby town center. Upon our visit in Kenya, we were only informed of three markets, of which only 1 (Mixa's own farm) appeared to be actively selling cricket products. We could not verify the existence of the other local markets or outlets.

Result 4.5: 5,000 affordable cricket servings per month

Perhaps as a consequence of not having reached 5 local markets (Result 4.2), the goal of 5,000 affordable servings of cricket products per month (Result 4.5) was also not achieved. However, project partners indicated in the M&E data that this target could have been met with the pre-disease production levels. As before, we are not convinced that this would have been the case in the absence of the disease, but we do not consider the target of 5,000 cricket servings per month unfeasible.

[21] A serving equals 25 grams of crickets.

6.3 Private sector development (PSD) pathway

On the PSD side, the project aims to develop the private sector by building a sustainable cricket value chain. This involved: (1) bringing on board a microfinance institution (MFI); (2) setting up collectives for collecting, processing and marketing; (3) establishing producer groups; and (4) developing a product portfolio based on consumer testing. This was expected to lead to increased access to finance for farmers, viable and functioning cricket processing/retail enterprises, functioning cooperatives, and the introduction of at least one branded cricket product into the local market. This would improve market linkages and thereby increase the sales of cricket products. As a result of demonstration effects, further private sector investments in the cricket value chain were expected to increase via replication.

6.3.1 PSD Outputs

Result	Sub-result		Completed	Realisation
3	1.	Methods and instruments designed and validated for proper preservation, processing, packaging and transport of crickets (derived products)	Yes	Methods and instruments have been designed.
	2.	Cost-effective drying, processing and packaging equipment available.	Yes	Cost-effective equipment is available.
	3.	Cricket based product portfolio developed and introduced	Yes	A cricket based portfolio has been developed.
	4.	Tailor made business development services in place for cricket processing/retail enterprises	Yes [?]	MoV not available [?]
	5.	Business plan for cricket processing/retail enterprise	Yes	A business plan has been drafted.
5	2.	Proposition for sustainable cricket knowledge and services center	Yes	A proposal for a sustainable knowledge and services center has been elaborated.
	4.	Facilities and staff in place to run knowledge center.	Partly	Unclear who is in charge of the cricket knowledge center and how it operates
	5.	National quality and food safety control of cricket (derived) products established and functioning	No	A national quality and food safety control of cricket products has not been established.

Results 3.1 and 3.2: Methods and instruments designed for preservation, drying, processing, packaging and transport of cricket products

The project was successful in developing methods and instruments for proper preservation, processing, packaging and transport of crickets. The system that was developed worked as follows:

- Once the crickets are fully grown, they are collected by the DCs.
- The crickets are then transported to Mixa, who is the key player in the Kenyan value chain.
- At Mixa, the drying, processing and packaging occurs, which is kept as simple as possible.

By the end of the project, Mixa was the only player capable of proper processing, preserving and packaging the crickets. The initial plan had been to train farmers in some of these techniques.. Instructions for primary processing for direct consumption (frying) had been given to the farmers during training workshops, and some processing equipment was installed at the houses of ' lead farmers'. While readily available household equipment was considered to be sufficient for primary processing, this equipment was not used by farmers by the end of the project. Instead, Mixa was the only player involved in processing, in part as a result of economies of scale and their previous experience with using professional processing equipment, and in part because of the need to ensure quality control.[22]

Result 3.3 Cricket-based product portfolio developed and introduced.

A cricket-based portfolio was developed. In particular, the project focused on fried whole crickets, cricket flour and a cricket muesli bar. Additionally, a Dutch (syrup) waffle machine was transported to Kenya so that cricket-based waffles could be produced.

Result 3.4 Tailor made business development services are in place for cricket processing/retail enterprises.

Business development services were drafted for the players in the value chain, including a business plan for the cricket processing/retail enterprise. In 2017, partners that were working on processing were offered guidance to select products and start introducing them to the market.

Result 5.2 & 5.4: Proposal for a sustainable cricket knowledge and services center

A proposal for a sustainable knowledge and services center was elaborated. The role of knowledge and service center has been combined with the SME responsible for processing and marketing crickets (Mixa). Charles (the owner of Mixa) and his assistants have been taught the best techniques and are able to help out local farmers. In addition, Mixa is in contact with the DCs and the project partners on how to improve the rearing of crickets. Via the DCs, Mixa could also provide support to farmers located in other more distant villages.

However, it is not entirely clear how the cricket knowledge center operates and who is responsible for which tasks. In the M&E system the project partners also stated that Lamiro functions as the knowledge center, since it is the company that coordinates the efforts of the trainers team. In addition, during the field visit we were made aware of around 25-30 lead farmers who were being referred to as CKCs (cricket knowledge centers). One key stakeholder stated that the idea was to create lead farmers who were rearing to be reference points in the respective clusters, at the village level. However, this idea hasn't taken off yet due to the improvements that

[22] According to project partners, ensuring quality control was the most important reason. The original plan had been for groups of farmers to be engaged in 'primary processing' (blanching and drying of crickets). Mixa was concerned about the lack of quality control in case of local processing, which was a risk for Mixa as it would lend its name to the product. This is why Mixa eventually decided to buy fresh crickets from farmers (transported on ice) and carry out the processing in one central location (Kisumu town), rather than let farmers locally conduct the processing.

can still be made to rearing techniques. In conclusion, it seems that, with regard to the cricket knowledge centers, coordination could be improved.

Result 5.5: National quality and food safety control of crickets (derived) products established and functioning

A national quality and food safety control of cricket products has not been established (yet). The legislative body is being updated on the progress of the cricket rearing business. The project partners stated that because of the limited scope of production, there is no need yet for regulation[23]. The first analysis for certification is currently being done by the Kenyan Bureau of Standards.

6.3.2 PSD Outcomes

Result	Sub-result		Completed	
2	6.	5 Cricket collection and basic processing enterprises in place with capacity to dry, process and pack 1500 kg crickets/ month	No	Only 1 cricket collection and processing center is in place.
	7.	Production, processing and distribution cost are low enough to serve local BoP market	No	The project changed its approach to focus on MoP consumers to enable development of the new value chain.
3	6.	Investments (credit) available for establishing of a cricket processing/retail enterprises	Yes	Credit was made available to Mixa by the Achmea Foundation.
5	6.	Context specific and quality services provided towards farmers, distributers, processors and retailers of cricket (derived) products	Yes	The project partners have been in close contact with the farmers and Mixa to provide context specific and quality services.
	7.	Learning and innovation in the area of commercial rearing of insects for consumption taking place	Partly	Although some learning and innovation is taking place, synergies between the knowledge institutes and the other project partners could have been improved.

Result 2.6: Establish 5 cricket collection and basic processing enterprises

The project did not reach its target of establishing 5 cricket collection and processing enterprises. At the time of our visit, we were informed of only 1 active collection and processing enterprise (Mixa).[24] In interviews, project partners mentioned that they opted for 1 bigger central collection and processing enterprise because of hygienic and quality standard reasons. In addition, it is our impression that there are economies of scale present in the collection and processing of crickets.

23 Source: Flying Food – Tabel met indicatoren

24 In the M&E reports the project partners indicated that there were two active collection and processing enterprises. However, we were only made aware of Mixa. It seems implausible that there is a second one were not made aware of.

Although the capacity is currently still not there, the central collection and processing enterprise (Mixa) will probably be able to dry, process and pack a sufficient amount for the value chain to expand. Mixa has the physical and human capital available to expand its crickets processing unit. In addition, Mixa's owner (Charles Odira) seemed to be a highly motivated individual who wanted to make the cricket value chain a successful one.

Result 2.7: Lower production, processing and distribution costs

The project changed its approach to focus on MoP consumers. In the project's M&E reports, the partners stated that "having the whole value chain (production, processing, consumption) in the hands of BoP would not lead to conditions to actually create this whole new agro-food chain for insects". Although the farmers would still be BoP, the processor and the consumers are now in hands of MoP. A larger processor was needed to accelerate production, create sufficient volumes and do some process development. Additionally, during interviews the project partners mentioned that cricket products should be targeted to MoP consumers, as it would otherwise be branded as a 'poor man's food', which the project deemed to be undesirable. Nonetheless, in the projects M&E reports it is stated that once production and processing are optimised, the costs from well performing farmers combined with the costs of the processor should still be sufficiently low to serve BoP consumers.

Result 3.6: Make investments (credit) available for cricket processing/retail enterprises in Kenya

Credit was made available for Mixa by the Achmea Foundation. Mixa received a loan of 14 million Kenyan shillings (around €120.000) with no interest, to be repaid within 5 years. The loan was mostly used by Mixa to function as credit for the newly trained farmers that still need the equipment, the feed and the crickets themselves. However, Mixa did not want to fulfill this financial role. Therefore, the project partners found an MFI (Rafode) willing to join the project and take up Mixa's role as credit provider towards the farmers. By the end of the project, Rafode had taken over the 40 loans initially made by Mixa. Further loans, however, were put on hold due to the disease.

Result 5.6: Provide context-specific and quality services towards farmers, distributors, processors and retailers within the cricket value chain.

The project partners have been in close contact with the farmers and Mixa (which functions as the processor, distributor and retailer) to provide context-specific and quality services. During the interviews, the farmers indicated that they appreciated the continuous aid from the DCs and that in general they were content with the project. However, various farmers did indicate that some (minor) improvements could have been made to improve the project. In two instances interviewed farmers mentioned that the monthly meetings/training did not occur as frequently as it was meant to be. Nonetheless, all farmers seemed excited about the project and indicated that they wish the project will not end.

Result 5.7: Learning and innovation

Some learning and innovation took place in the area of commercial rearing of insects for consumption in Kenya. Firstly, continuous learning by doing is being done by the trainers (DCs)

and Mixa. Secondly, a representative from JOOUST (formerly called Bondo University) stated that research has been done by the university on the rearing crickets. However, both representatives of the project partners and JOOUST indicated that the collaboration between the two sides was not optimal. As a result, the Flying Food project is currently not included in a large World Bank project executed by JOOUST.

7 Sustainability

This chapter discusses the sustainability of the Flying Food project. It finds that, while the project was not yet fully sustainable at the end, the potential for constituting a financially sustainable cricket value chain in Kenya is high.

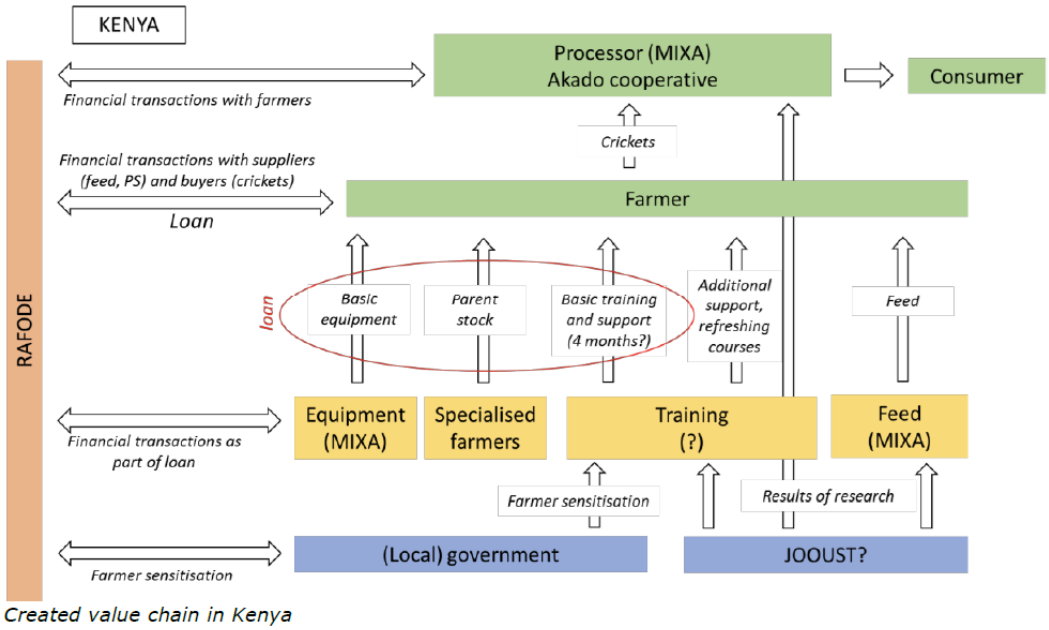
Given that many of the project's target outcomes are not (yet) achieved, this chapter discusses the project's sustainability, mostly from the perspective of potential sustainability of the cricket value chain as a whole. We do this by assessing the sustainability of each segment of the Kenyan value chain (see Figure 7-1 below), with a focus on financial sustainability.[25]

The two research questions discussed in this chapter are the following:

- RQ5: To what extent do the benefits of the project (outcome & impact level) continue after FDOV-funding ceased and how was this influenced by the business case and/or revenue model?
- RQ6: Did the project/ intervention lead to systemic change and/or was the intervention scalable?

RQ5 is discussed in Section 7.1 while RQ6 is discussed in Section 7.2.

Figure 7-1: Kenyan cricket value chain as modelled by the project partners



Source: Project M&E reports
Note: The loan package was later modified to also include the cost of (additional) training and cricket feed.

[25] Note that we do not discuss consumers separately, as they are already discussed under the demand-side pathway.

7.1 Financial sustainability of value chain segments

7.1.1 Sustainability of cricket production

During the first years of the project, cricket rearing was not financially sustainable for farmers. This is mostly a consequence of the very limited capital of farmers, in combination with a lack of access to finance. As a result, the farmers were unable to make the necessary initial investment into equipment, feed and parent stock. In addition to supporting farmers with this initial investment, the project had to continually 'subsidise' farmers throughout the project given their lower-than-expected productivity in terms of cricket production.[26]

The bacterial infection caused a significant delay in improving the project's financial sustainability. Suddenly, the entire production of crickets came to a halt. This had various potential consequences for the farmers. First, it caused some demotivation among both the rearing farmers and the farmers that had been trained but had not yet started rearing, as they might consider the risks of cricket rearing to high. Second, all farmers needed a healthy new population of crickets, which increased the costs. Third, the farmers that had already received a loan were temporarily unable to repay this and had to come to an agreement on how to restructure loan payments.

Despite these limitations, the majority of our sample of smallholder farmers stated they were still very motivated to continue rearing crickets. During interviews in June 2018, farmers indicated that they understood they were going to encounter difficulties along the way, given the novel and different nature of the cricket value chain. They were still optimistic, however, that project partners would ensure a successful continuation of the value chain.

Several project measures significantly increased the likelihood that cricket production could be sustainable in the future. First, the project brought on board an MFI, Rafode, together with which they designed a loan package for farmers that would be sufficient to provide them not only with crickets, but also with access to equipment, feed, and a 'starter kit' for cricket rearing, including support provided in the form of the training workshop and the follow-up visits by DCs (see 7.1.5). Second, the project tried to make sure that there was a valid business case for farmers even in case of lower productivity.[27] This business case is described in more detail in Appendix A.

However, there were some concerns regarding the sustainability of cricket production. First, the business case (described in Appendix A) assumed that follow-up support would be provided to farmers for only twelve months. However, the farmers we interviewed included farmers who indicated that regular visits by DCs continued to be needed after one year, if only to remain up to date with the latest techniques. Moreover, we observed that numerous farmers were either unable or unwilling to keep good records, and were reliant on DCs for regular record keeping and monitoring. The cost of follow-up support by DCs after 12 months was, however, not included in the loan package. Second, as described in Appendix A, some costs were not included in the business case even though they will need to be covered by future potential cricket farmers: the

[26] Instead of producing around 1kg of crickets per crate, most farmers were producing less tshan 0.5kg per crate. See Chapter 6 on Effectiveness, Section 6.1.

[27] See 'Flying Food D2-7-2 – Attachment 1 Business case small holder farmer 201806' from the project M&E reports.

labour put in by farmers; the costs of cricket housing; costs related to pieces of equipment; and costs related to energy, water, and waste. Including these costs makes the business case less sustainable,.

7.1.2 Training, monitoring and transportation

At first sight, the training and monitoring activities did not seem sustainable. Initially, trainers and data collectors (DCs) were fully paid by the project without farmers having to pay for these activities. Following tensions between TNO and ADS, the management and financing of DCs was taken over by Lamiro, a local consultancy that in turn was financed by the project. Given this financial reliance of the trainers on financial support from the project, their duties would seize the moment this funding were to stop, thereby making their activities financially unsustainable.

However, the project has taken remarkable measures in order to ensure the future financial sustainability of the training, monitoring and transportation. During our field visit, they indicated that the costs associated with these three support activities performed by the DCs will become part of the loan package provided to the farmers by the microfinance institution (MFI), Rafode. This significantly improved the sustainability of the support activities, as donor support would (eventually) no longer be needed, provided the farmers can repay the loans out of their cricket income. The role of the MFI is described in more detail below. Appendix B provides an example of a loan that includes payment for the training and monitoring of the farmers.

7.1.3 Processing

The existence of a commercially viable cricket processor, Mixa, has considerably improved the project's sustainability. Its dedicated owner, Mr. Charles Odira, was involved with the project from its early stages and has allegedly been the most important cricket value chain actor in Kenya. While his initial role had been limited to the provision of equipment, he subsequently developed the human, physical and financial capacity to process large amounts of crickets and sell them on the market. Moreover, inspired by a study tour to Thailand financed by the project, Mr. Odira developed Mixa's capacity to produce crickets on a large scale, using a 'pen' rather than crates. As a consequence, Mixa was able to share its own cricket rearing expertise with smallholder farmers and to ensure a relatively reliable (albeit still small) supply of crickets on the market.

Even though the business case for the processor hasn't proven profitable yet, the nature of the company ensured Mixa could maintain its role as a processor. During our visit to Mixa, Charles mentioned that the processing of crickets is not his core business. His business includes various crops that are more profitable than cricket rearing. This is also a consequence of the low and variant production levels of smallholder farmers. However, if prices don't change and if cricket production by smallholder farmers will increase, then there is a profit to be made by the processor.

To ensure sufficient capacity in the future, more processors will be required. Given the possible dramatic increase in cricket production levels and the distribution of smallholder farmers over a large region, it would be useful to have at least one more large processor active in another region.[28]

[28] Mr. Charles Odira (Mixa's owner) even proposed this himself.

7.1.4 Equipment & feed

While the provision of equipment was initially not financially sustainable, project partners put considerable effort into making sure that all equipment could be supplied locally and at affordable prices for farmers. For instance, upon switching from the bucket to the crate-system, the project searched extensively for locally available crates that satisfied the specific technical requirements deemed crucial for cricket production and storage. At first, the search was unsuccessful, forcing project partners to import crates from the Netherlands in order to keep the project running. This was of course very expensive and not financially sustainable.

After 1.5 years, Mixa was able to create an innovative and sustainable solution for local crate production. Local crates that were initially deemed unsuitable for cricket rearing were bought from a Kenyan producer in Nairobi and then modified by Mixa, using a self-constructed machine, so as to make them suitable. These local, modified crates were in use at the time of our visit, and were provided to all farmers in need of crates. Interestingly, while Mixa could have easily sold the locally produced crates to Flying Food's sister project in Uganda, they decided instead to sell the Ugandan partners a machine with which they themselves can modify the locally produced crates.

A similar solution for cricket feed was found when Mixa started selling cricket feed to farmers. According to Mixa, the original intention had been to find or develop a company that would offer ready-made cricket feed (as exists, for example, in Thailand). While Mixa was originally only meant to supply equipment, they also started developing and producing cricket feed. As part of the project activities, research was conducted on feed composition and on the local sources that can make cricket feed both high-quality and affordable. Although most of the feed was eventually produced and distributed by Mixa, farmers also used feed sources from their own farm.

Involving a microfinance institution improved the sustainability of equipment and feed provision, described further below. Going forward, the cost of equipment and feed needed for rearing crickets are now included in the loan package to farmers, thereby improving the financial sustainability of the value chain.

7.1.5 Microfinance institution (MFI)

By bringing on board an MFI (Rafode), the project took a major step towards guaranteeing the financial sustainability of the cricket value chain in Kenya. During the project's first years, the training, equipment and feed were all provided for free to the farmers (or in fact, in exchange for the obligation to record and share data).[29] Naturally, project partners realised that this was an unsustainable solution. Therefore, in collaboration with other partners, Mixa started providing credit to farmers in the form of equipment and feed. However, given the already central role of Mixa in the value chain, and its limited knowledge and interest in financial services, the project

[29] According to project partners, equipment was not given for free, but was initially 'lent' to farmers. The first farmers had been told that the equipment would become their property only in exchange for a 'payment' in the form of data provision. During a period of three years after receiving the equipement, these farmers needed to record data about temperature, feed, sales, price, etc. In practice, data were often recorded by Data Collectors (DCs), as some farmers were illiterate (which we confirmed during interviews). In some cases, the project re-confiscated crates from farmers who did not keep this obligation (or did not properly take care of crickets). This was possible because the crates were not (yet) the property of these farmers.

partners started searching for an external MFI to join the project during the first months of 2017. In May 2017 the project partners reached an agreement with Rafode, a local MFI specialised in providing credit to BoP farmers. Rafode then took over the 40 loans from Mixa and aimed to start offering its own loans in subsequent months. However, the latter was put on hold as a result of the cricket disease.

The loan is a comprehensive package with favourable terms for farmers:

- It includes all the equipment, feed, and 'starter kit' for cricket rearing, including support provided in the form of the training workshop and the follow-up visits by DCs (see Appendix B for an example of a loan form).
- The principal of the loan is around 70,000 Kenyan Shillings, which is considered sufficient to cover the "starting package".
- The repayment schedule is subject to actual sales, with a maximum duration of 2 to 3 years, depending on how productive the farmers are.
- The interest on the loan equals 10%. Since the commercial rate of Rafode is 20%, this can be considered as a subsidy. In our interview, they confirmed that this the first time they offered such low interest rates. However, they planned to increase the interest rate to 20% as soon as the income flow of the farmers would allow this.
- Farmers are or will be trained in financial literacy, so that they understand the conditions of the loan.
- Farmers are required to become members of a cooperative, which will ensure that members guarantee each other's loans.
- At the time of our visit in June 2018, Rafode was negotiating with a micro-insurance company to insure the loans.

7.1.6 Knowledge institutions

Not all knowledge on cricket rearing appears to have been sustainably transferred to the local partners. If the Dutch partners (TNO/Venik) were to stop their involvement, a considerable amount of knowledge would likely be lost.

The original plan to make JOOUST the key local knowledge institution for the Flying Food project failed. From the beginning, JOOUST and other project partners appeared to have had conflicting views about cricket rearing issues, which was likely related in part to personalities. JOOUST initially supported the bucket system, but other project partners found this system problematic and proposed a novel crate system. Subsequently, JOOUST appeared to be willing to work with the crate system, but also wanted the right to purchase crickets from participating farmers for further research, which other project partners were unhappy about.[30]

During our visit to JOOUST, the evaluation team was made aware of a major new World Bank project won by JOOUST that Flying Food did not participate in. This World Bank project will focus on the sustainable use of insects for food and feeds and JOOUST will work

[30] According to project partners, the purchase of crickets by JOOUST was not the main problem. In their view, the main problem was that JOOUST visited project farmers without the presence of trainers. In their (project partners') experience, JOOUST had incorrect knowledge of insect rearing; they were not open to advice; would provide incorrect information to farmers and confuse them. This is what they wanted to avoid.

together with different local knowledge institutions to conduct research, develop valuable research curricula for students, and train farmers. This sounds promising for the further development of the cricket value chain in Kenya, and particularly for the role of JOOUST in developing itself as a sustainable local knowledge institution on insect rearing in Kenya.[31]

The fact that Flying Food partners did not participate in this World Bank project can be seen as a missed opportunity. According to project partners, JOOUST did not meet the contractual obligation among partners to inform each other about other initiatives in the area of insect rearing (e.g., processing). By accident, project partners were informed about this World Bank project via other participants in this project. This was just before the final proposal submission, at which stage not much else could be added despite attempts by Flying Food to do so. Following the selection of JOOUST and other partners (including African Centre of Excellence) for the World Bank project, JOOUST proposed to let ADS train farmers, but Flying Food partners rejected this proposal given the status of ADS in the project at that moment. From the point of view of value chain development, it would have been most logical to let Mixa participate in the World Bank project, but this was rejected by JOOUST, possibly because of the deteriorated personal relations by that stage.

7.1.7 Commitment of partners

Most partners in Kenya who were involved until project-end appeared willing to continue project implementation in case additional financing could be attracted. The list of these partners is provided in Table 7-1. As a sign of their commitment, it is interesting to note that several of them submitted renewed project proposals, both to the Dutch government and to another Dutch financiers. Most partners stated that they would not be able to continue operating this project without additional financing. Naturally, their commitment also depends on the speed and extent to which the cricket disease can be brought under control.

[31] Project partners noted, however, that the majority of the World Bank project budget is meant for investments in the facilities of JOOUST and the creation of other academic initiatives for MSc and PhD students. Apparently, only a small share is reserved for implementation and realisation of cricket rearing, processing and sales.

Table 7-1: By the time the project ended, at least 7 partners continued to be interested in the project

Name	Type of organisation	Based in	Description
TNO	Knowledge Institute	NL	Independent applied research institute
ICCO	NGO	NL & KE	Interchurch organisation for development cooperation
BoP Innovation Centre – BoPInc	Foundation	NL	Alliance that develops, learns about and accelerates market-led BoP inclusive innovation.
HAS Den Bosch	Knowledge Institute	NL	Independent college that offers courses in the theme of agriculture, nature, nutrition and the environment.
Mixa Food & Beverages Ltd	Private Sector	KE	A registered business that deals in fabrication of food processing equipment, their usage, producing food stuffs and promotion and selling of food products.
Lamiro	Private Sector	KE	A consultancy that employs the trainers (DCs).
Rafode	Private Sector	KE	Local MFI providing the loans to the farmers.

7.2 Systemic change and scalability

Given various setbacks, the Flying Food project has not (yet) lead to systemic change. Due to the many challenges and resulting low yields of the few actively rearing farmers, the cricket value chain so carefully built up during this project would likely seize to exist if the key project partners were to stop their activities. A positive indication is that, half a year following project end, most project partners and farmers still continued their activities. During interviews, the key project partners all indicated that they were eager to continue with this project until the value chain becomes self-sustaining. For that to happen, continued financial support is still needed for some time. However, promising measures had been taken that are likely to considerably improve the financial sustainability of the project (e.g., by including the costs of training and monitoring in the loan package from the MFI).

The project's novelty and relevance have attracted considerable attention that may well lead to 'demonstration effects'. Despite its small scale and setbacks, the project already attracted a lot of attention from the media and from other organisations.[32] For instance, the project was included in a Dutch public broadcasting audio report, in a major Dutch newspaper ('De Volkskrant') and in a Youtube video made in Uganda by two journalists cycling across Africa making short documentaries about sustainability and innovation. In addition, two popular scientific articles were published, one in the 'Journal of Insects as Food and Feed' and another in the Dutch magazine 'Voedingsindustrie'. Lastly, Flying Food was included in an exhibition on the United Nations Millennium Development Goals in the 'Museon' in the Hague.

[32] See the MoV 'Flying Food D5-1-1 and D5-1-2 amd D5-2-1 and D5-2-2 - Learning Alliance and cricket knowledge centres'.

The new World Bank project in which JOOUST participates suggests that the project has great potential for systemic change and upscaling within Kenya. As mentioned above, local partner JOOUST was awarded a large World Bank project related to cricket rearing. Since there had been tensions between JOOUST and other Flying Food partners, Flying Food itself did not participate in the World Bank project, which seems to have been a missed opportunity. Nevertheless, JOOUST representatives noted that they would not have won this World Bank project without their participation in Flying Food. Given the size of the World Bank project and the expected positive effect on the regional insect industry, the future of insect rearing in Kenya seems bright.

The potential project replication by other countries via demonstration effects is also promising. In fact, one of the project's explicit goals is the development of a model for up-scaling and replication of inclusive value chain development for cricket (derived) products.[33] A presentation was prepared and a website was created (www.flyingfoodproject.com) in order to inform interested parties. These and other PR activities were successful in that many commercial parties, both from within and outside of Kenya, approached project partners to express interest in setting up (part of) a cricket value chain. However, during interviews in mid-2018, project partners mentioned that further upscaling of the cricket value chain in other countries had been put on hold due to the ongoing challenges in the Kenyan and Ugandan value chains.

[33] This was part of Result 5.1.

8 Corporate Social Responsibility Performance

This chapter discusses the CSR performance of the Flying Food project. It finds that CSR plans were relevant and effective, and CSR risks were minimal.

The questions addressed in this chapter are:
RQ7: What is the CSR performance of the selected FDOV projects?

- How relevant were the designed CSR plans?
- What effects can be observed of CSR plans of private partners in consortia?
- To what extent did the projects have a major positive or negative influence on their direct natural environment or contributed to (combatting) global climate change?

8.1 Relevance of designed CSR plans

The project proposed mitigation measures in five CSR domains that all seemed relevant:[34]

1. **Human rights and suppression**. The project identified the risk of supporting governments that pose threats to human rights. As a mitigating measure, project partners stated that they would only work with local partners, local suppliers and local markets, thereby minimising this risk.
2. **Corruption and bribes.** The project identified Kenya to be a high-risk country with respect to corruption and bribes. As mitigating measures, project partners stated that they would: (1) try to keep the interaction with the government minimal and through local partners, and (2) keep the value chain short and local, with NGO and farmer organisations involved.
3. **Freedom of association.** By setting up farmer collaborations, the project aimed to increase the power of farmers to speak up for themselves.
4. **Discrimination.** To ensure that the work of female farmers would be appreciated (equally), the project took extra care to recruit female farmers and include women into the training workshops on rearing.
5. **Safety and health.** To ensure a safe and healthy environment for farmers, the project monitored participants and handed out certificates to well-performing participants. The project had not foreseen the need for antibiotics, and had not researched the impact of such antibiotics on consumer health. However, research carried out on behalf of the project indicated, according to project partners, that the consumption of crickets treated with antibiotics was not dangerous to humans.

In addition, the following relevant CSR domains were discussed in the project's 'Updated ICSR Risk analysis':

6. Impact on local population
7. Property

[34] See 'Flying Food D5-9-1 - Attachment 1 – Annex 3f : ICSR Risk Analysis table'.

8. Biodiversity[35]
9. Animal welfare

8.2 Effects of private partner CSR plans

According to project documents, most of the larger partners involved already had (I)CSR policies in place, while the smaller companies were planning to do so. The evaluation team was not able to obtain information about any separate CSR policies of private partners not already mentioned above. However, all project partners committed that they would "under no circumstances make use of child labour, compulsory labour, nor any form of labour that would violate human rights. The same accounts for the suppliers or any other stakeholder the partners would work with. In case the project partners would be informed about or observe child labour and/or compulsory labour along the value chain, measures will be taken immediately to eliminate this and/or business relations will be terminated."

During their visit to Kenya in June 2018, the evaluation team did not encounter CSR-related issues with project partners or smallholder farmers. This could either mean that the designed CSR plans were effective in preventing CSR risks, or that CSR risks were simply minimal to start with. In our assessment, both were likely the case. While the political turmoil during the 2017 election did have a significant temporary impact on the effectiveness of the project (as most farmers could not be visited for an extended period), the turmoil did not appear to cause any significant CSR-related risks.

8.3 Impact on direct natural environment and global climate change

The impact of the project on global climate change was minimal. First, this is a consequence of the limited impact the project had on farmer activities due to the low productivity levels of the farmers so far. Second, in the project plan it is stated that "recent research has shown that insects produce much less greenhouse gas than usual livestock".[36] In theory, the project could even have had a positive impact on climate change (albeit very small) if it had been the case that smallholder farmers who started rearing crickets would have reduced other farming activities (e.g. involving livestock) that were more harmful. In practice, however, we found that farmers did not significantly reduce any of their other activities as a result of their cricket rearing.

35 Rearing crickets avoids abundant capture of crickets from the wild, with the risks of extinction.
36 Project Plan Flying Food, p.16.

9 Conclusions and lessons learned

This chapter summarises our findings about the relevance, additionality, effectiveness, and sustainability of the Flying Food project. It concludes that, despite many positive achievements, the project did not meet its key objective of establishing a sustainable cricket value chain in Kenya. Nevertheless, there are a number of useful lessons learned.

9.1 Summary of findings

Relevance: high 'ex ante' but lower 'ex post'

The design of this FDOV project initially appeared highly relevant for Base of the Pyramid (BoP) producers and consumers, in particular smallholder farmers, women and youth. While we did not yet complete other FDOV project evaluations, an earlier mid-term review of FDOV had suggested that a lack of attention to gender and subsistence farmers was an issue in earlier FDOV projects.[37] Among other findings, this review found that a lack of gender analysis resulted from the focus of FDOV on "high potential" small-scale commercial farmers, which could also have implied a bias towards male farmers (who often formally own the resources). In contrast, this Flying Food project focused on BoP farmers with a clear focus on women and youth.

The design was also well aligned with the economic and social priorities of the Kenyan government, as expressed in their Vision 2030 for Kenya. Key priorities in this Vision relate to food security and poverty reduction, particularly for vulnerable groups, women, and youth. The Flying Food project therefore appeared to be very well aligned with these goals.

Despite this high relevance 'ex ante', the relevance 'ex post' is questionable. As discussed in the chapter on Effectiveness, the focus on BoP producers may have partly been responsible for the project's relatively low effectiveness. Given the novelty of the project, it may—with hindsight—have been preferable for the design of the project to focus initially on the 'Middle of the Pyramid' (MoP) producers in order to make optimal use of economies of scale and allow time to test various cricket rearing techniques before rolling these out to small-scale farmers. Rolling this out prematurely, without proper testing under local Kenyan conditions, may have unnecessarily burdened farmers with excessive risk. This was particularly the case after the MFI loan was introduced and farmers invested their own time, while signing a loan contract that they did not fully understand. The fact that all farmers ended up being infected by a bacteria is a case in point. Another example is that, due to the relatively high price paid for crickets, many small-scale farmers appeared to prefer selling crickets rather than eating them, implying that the crickets were more likely to be consumed by MoP consumers in Kisumu town, rather than the BoP consumers in the farmer communities originally targeted. This reduced the food security relevance of the project.

[37] The mid-term review of FDOV was conducted in 2016 by the Dutch Royal Tropical Institute (KIT).

Additionality: high 'ex ante' but lower 'ex post'

Both the project's input additionality and output additionality were high. Input additionality was high because Flying Food project activities would almost certainly not have materialised without public support. Development additionality was high because the setup of FDOV encouraged project partners to focus more on the BoP than they otherwise may have done. Even in the unlikely case that funding could have been obtained from a commercial financier, such financiers would almost certainly not have involved small-scale famers, as it would have been far more efficient to produce crickets on a larger scale. RVO.nl can therefore be considered highly additional.

Despite the high 'ex ante' development additionality derived from the project's BoP focus, the project's 'ex post' additionality was low. On the one hand, the 'development focus' on BoP producers and consumers (and special emphasis on women) would almost certainly not have occurred without public funding. On the other hand, the development outcomes that were targeted in this way were not achieved ex post, and some farmers may have been left worse off. While the project had very admirable social intentions, its low effectiveness implies that it did not, in fact, deliver on its development objectives.

Effectiveness: low

The effectiveness of the project was reasonable in terms of outputs, but low in terms of outcomes. This was mostly the result of setbacks on the supply side.

- **On the supply side, many output targets were met but outcomes were drastically below target**. In terms of outputs, methods were developed, a group of trainers was formed, and over 300 farmers were trained, but not all of these were fully equipped. In terms of outcomes, however, the production of crickets and resulting income earned from selling crickets was much lower than targeted. This was due to various factors, including most importantly an unexpected disease outbreak. In addition, the project suffered from periods of political turmoil and flooding which in turn hampered training and monitoring activities.
- **On the demand side many outputs were achieved, but outcome targets were only partially met.** Various activities took place: awareness was raised, consumer research was conducted and innovative cricket products were developed. However, outcome targets were only partially met: only a few active local markets for crickets were identified and they did not offer the targeted 5,000 affordable servings of cricket products per month.
- **On the private sector development side, most outputs were reached and outcomes were partially met.** Many value chain actors were identified and developed, and the project made great progress with building a full cricket value chain. Outcomes were mixed thus far, mostly because of the setbacks experienced on the supply side.

Without taking into account the potential long-run impact of the project, the outcomes achieved were disappointing relative to project costs. The measurable outcomes were substantially lower than originally planned, while the project costs were 25% higher than budgeted (around EUR 2.5 million rather than the planned EUR 2 million). This represents a very high cost per farmer reached. While the project potentially could have had many indirect beneficiaries via positive demonstration effects (to other farmers, processors and consumers), this did not materialise, largely because of the cricket disease.

Sustainability: potentially high, but fragile

While the project was not yet sustainable at the end, project partners made remarkable progress with improving the prospects for a financially sustainable cricket value chain in Kenya. In particular, they deserve credit for having attracted an MFI (Rafode) as a key value chain player, which was not part of the original project plan. Sustainability was also strengthened by the outsourcing of training and monitoring to a private company that could potentially work on a commercial basis in the future, as most of their fees are already included in the loan package.

Nevertheless, prospects are fragile given the renewed outbreak of the bacterial infection. In November 2018—more than four months after the formal end of the project—it appeared that many farms had again been infected. Upon further research, it turned out that this had spread to all project farmers in both Kenya and Uganda. While research is currently ongoing to identify the most hygienic reproduction methods that will prevent re-infection, the key risk is now that farmers will turn away from cricket farming, given the risks that they experienced. This, in turn, may discourage other project partners from participating in the future. Nonetheless several key project partners remain optimistic and are likely to continue with the Flying Food project in the event that the disease is brought under control and additional financing can be attracted.

Lessons learned

Based on this evaluation, we suggest a number of useful lessons learned for RvO.nl that could be taken into account when supporting similar highly innovative projects in the future.

Lessons for project selection

1. **For high-risk projects, RVO.nl should conduct or require a more thorough analysis of the risks involved, including their probability and potential impact**. Before its implementation, the Flying Food project paid insufficient attention to assessing risks such as disease, political unrest, and natural disasters (floods), and the impact these risks could have on cricket rearing, training and monitoring**.** While it is notoriously difficult to assign probabilities to such risks, what could have been predicted in advance is that if these risks do materialise, they could have a significant impact on cricket yields (particularly since cricket farmers in the early stages were known to depend heavily on regular visits by data collectors). Such risks can be made more visible in advance by including a risk matrix in the proposal that lists the expected probability and also the expected impact of the risk on project outputs and outcomes. For risks with low or unknown probability but high potential impact, RVO.nl could consider requiring project partners to decide in advance on risk mitigation measures.

2. **When deciding whether or not to fund an innovative but high-risk project like Flying Food, RVO.nl should consider requiring a piloting or pre-testing phase.** The Flying Food project was highly innovative in that it aimed to develop an entirely new value chain that never existed before in Africa. This clearly implied a higher risk than a project aimed at deepening an already existing value chain. In such high-risk cases, more thorough testing would seem warranted. For example, RVO.nl could have required a pilot period, during which

the proposed cricket rearing methods would be pre-tested among a few pilot smallholder farmers. Rolling out the project to more farmers could have remained on hold until the new agricultural techniques had proven successful during the pilot.

3. **When judging the relevance of a project, more attention should be paid to financial sustainability.** In case of Flying Food, the project seemed highly relevant ex ante, as the target group was BoP consumers and BoP producers. However, if a thorough analysis of the financial sustainability of the business case had been conducted, one could potentially have predicted in advance that the most relevant business case was not feasible, while a less relevant business case may have been more feasible. For example, it now seems apparent that the project would have had a much higher chance of being financially sustainable (as well as more effective) if it had focused on the 'MoP' first (e.g., with Mixa as producer and middle income consumers). Once this business model had proven both technically feasible and commercially viable, it could then potentially have been expanded to include the BoP (smallholder farmers as producers and consumers) at a later stage. Similarly, careful analysis of the proposed business case may have revealed that cricket prices were set above the prices of several other sources of protein, such as omena or chicken, so that farmers would prefer to sell the crickets and consume other sources of protein (or potentially even non-protein foods).

Lessons for project design

4. **RVO.nl should ensure that the proposed M&E indicators are SMART (Specific, Measurable, Assignable, Realistic, and Time-bound).** For example, the target of reaching 4,000 farmers in two countries was clearly unrealistic from the start. Similarly, the target that "300 small farmers in Kenya (at least 33% women) are well trained and supported for rearing crickets" is not clearly measurable, because it consists of 4 targets at once (300 farmers should be trained, 300 farmers should be supported, the training should be done "well", and at least 33% should be women). If one of these 4 sub-indicators is missed, the entire target is missed.. Measuring and monitoring each of the 4 indicators separately would reveal at an earlier stage whether, e.g., there are issues with the quality of training or with the number of women reached.

5. **Careful consideration should be made as to who should bear the risk in innovative and high-risk projects**. In the case of Flying Food, one could question whether all risks should have been transferred to farmers via loan agreements, including the risks of disease and natural disaster. While transferring the credit risk from Mixa to an MFI was a very good measure in terms of financial sustainability, letting farmers bear all operational risks in such an innovative project could potentially be questioned on ethical grounds.

Lessons for project implementation

6. **When a project goes off-track for exogenous reasons, output targets do not necessarily need to be adjusted.** In fact, it is far more transparent to report the realised values relative to the original output target, and explain why the original target could not be met. By adjusting

the output target, information on the original output target may get lost and an important part of the story may remain untold.

7. **Too much pressure on meeting output targets could lead to 'output-driven' activities without regard to outcomes**. For example, it appears that, in the last year of Flying Food, many project resources were devoted to meeting the (revised) output targets (in particular, the target to train 300 farmers) even though meeting some of these targets was not the most commercially sensible thing to do. In particular, it appears that large numbers of farmers were trained in a relatively short amount of time despite not having all equipment available to them. Similarly, the Organisational Development (OD) training may have taken place too early. It was originally supposed to take place only after training all farmers, and after farmers had elected the leaders of the cooperative, who then would receive OD training. However, while ADS complained that OD took place too early, other project partners said it was needed because cooperatives were needed to get guarantors for loans.

8. **As part of an innovative project, sufficient time should be allowed to pre-test innovative production processes.** In this case, as the project aimed to develop an entirely new value chain, sufficient time should have been allocated to the process of identifying and developing key value chain agents, and to carefully sequence activities. For example, farmers should not be trained before new agricultural techniques have been fully tested in the field.

Appendix A Business Case Flying Food

Financial Appraisal

Based on the 'business case' developed by project partners, the costs required to establish a small-scale cricket farm in Kenya are assumed to be around €665. As Table A-1 shows, these costs consist of the capital expenditures related to the required equipment, training and facilities. The main components of capital expenses are the cricket crates and 'hiding places' (a divider that is put inside the cricket crates), and the costs related to the basic training and support.[38] In the last column, the depreciation period is shown, which is the expected number of years after which equipment will be worn out and will need to be replaced. These depreciations costs are subsequently considered in the calculation of 'operating income'.

Table A-1 Capital expenditures for setting up cricket rearing are assumed to amount to € 665.

Category	Type	Price	Depreciation period (years)
Basic rearing equipment	Cricket Crate	€ 402.00	25
	Lid	€ 20.65	25
	Transport	€ 10.00	25
	Hiding places	€ 72.50	5
	Drinking Facility	€ 0.00	1
	Feeding Bowl	€ 0.00	1
	Egg laying container	€ 0.64	1
Primary Processing equipment	Cooking pot (blanching)	€ 0.00	5
	Sieve (blanching)	€ 3.00	5
	Lid to put on sieve (blanching)	€ 2.00	5
	Solar dryer*	€ 0.00	10
Training	Basic training + support	€ 154.00	5
Facilities		€ 0.00	-
Total		**€ 664.79**	**-**

Source: SEO reconstruction of data provided by TNO.
*Note: Project partners assumed that roasting crickets could be done using ordinary kitchen appliances.

In the baseline scenario, the business case assumptions suggest that the capital expenditures of a cricket farmer can be recovered within approximately three years. The starting situation is displayed as scenario 1 in Table A-2. In this first scenario, 'earnings before interest and taxes' (EBIT) equal 195 euros, implying that the required capital expenditures for becoming a cricket farmer can be recovered in 2.6 years. If interest expenses and taxes need to be deducted, the 'net result' equals 141 euros, which means that the payback time of capital expenditures becomes 3.2 years.

[38] After the training, follow-up support was provided for twelve months. After this period, cricket farmers were supposed to be self-supportive.

Table A-2 Operating income and expenditures

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Yield per crate (in grams)[39]	**500**	**700**	**500**	**500**	**1,000**
Price	**€5.85**	**€5.85**	**€4.00**	**€8.00**	**€5.85**
Yearly turnover	€284	€397	€194	€388	€777
Costs of feed	€26	€34	€24	€24	€49
Costs of labour, housing, energy, water and waste	€0	€0	€0	€0	€0
EBITDA	€259	€363	€170	€364	€728
Depreciation costs	€64	€64	€64	€64	€64
EBIT	€195	€299	€105	€300	€663
Interest costs on capital expenditures and working capital	€8	€12	€4	€12	€27
EBT	€187	€287	€101	€288	€637
Corporate tax	€47	€72	€25	€72	€159
Net Result	**€141**	**€215**	**€76**	**€216**	**€478**
ROI (EBIT)*	**2.6**	**1.8**	**3.9**	**1.8**	**0.9**
EBIT in terms of the monthly minimum wage	4.0	6.1	2.2	6.2	13.6
ROI (Net result)**	**3.2**	**2.4**	**4.7**	**2.4**	**1.2**
Net result in terms of the monthly minimum wage	2.9	4.4	1.6	4.4	9.8

Source: SEO reconstruction on the basis of information provided by TNO.
Note: All numbers are on an annual basis and mostly rounded to integer numbers.
* Calculated as the number of years required to recover the costs of capital based on the EBIT.
** Calculated as the number of years required to recover the costs of capital based on the Net Result.

To put these numbers in perspective, annual cricket earnings are compared to the earnings one could make in a job that earns the Kenyan minimum monthly wage. In the first scenario, EBIT equals four times the minimum monthly wage. This means that being a cricket farmer for one year yield as much income as working for the minimum wage for 3 to 4 months. In the second through fourth scenarios, where assumptions about yield and price have been slightly altered, this varies between 2.2 and 6.2 months for EBIT and between 1.6 and 4.4 months for the net result..

The business case developed by project partners appears to be a bit too optimistic. This is because it depends on a few assumptions that seem unrealistic:

- **First, labour costs were set to zero.** This was done for two reasons: (1) all work was assumed to be done by cricket farmers themselves and therefore no labourers are assumed to be hired and no wages to be paid; (2) the 'opportunity costs' of farmers' time were assumed to be negligible, i.e., they were assumed not to have been able to earn any other income with the time spent on cricket farming. While the first assumption seemed realistic, the second assumption

[39] The yield per crate is assumed to lie between 0.5kg and 1kg per crate. The lower bound is 0.5kg per crate for a small scale farm in its infancy, and the upper bound is 1kg per crate for a well-developed, large-scale farm (as in the Netherlands).

was likely not realistic in all cases. Indeed, many interviewed farmers indicated that cricket farming was a side activity and that all their work was done within their spare or 'idle' time for which they had no (productive) alternative use. However, some farmers did indicate that an alternative activity would have been (more) chicken farming or production of clothing.

- **Second, the costs of cricket housing were not included in the overall costs.** The reason given was that only a few square meters were needed for small-scale cricket farming, which were assumed to be readily available at small farms and would only become relevant for cricket farms that operate on a larger scale. Before being considered eligible to join the project, farmers in fact had to prove that they already had the required land at their disposal and were able to build the required cricket structure. For existing farmers who had already joined the project, the cost of housing therefore did not need to be included in the loan package from the MFI.[40] However, for future potential cricket farmers this assumption is not realistic, as there can still be a substantial cost associated with making land available and building a suitable cricket structure. This cost should therefore be included in the business case.
- **Third, the costs related to some pieces of equipment was considered negligible.** For example, no expenses related to drinking facilities, feeding bowls, cooking pots and solar driers were taken into account, because this equipment was either already available at the household level or could be made out of readily available materials.
- **Finally, costs related to energy, water and waste were not included** either. This is because they were only assumed to be relevant once cricket farming is operated at a larger scale.

If cricket production were to be become more efficient, e.g. due to larger-scale farming, there would be a more convincing business case. This is shown in the fifth scenario in Table A-2, where the yield per crate is at its optimum of 1 kilo per crate, which according to project partners can easily be achieved by a large-scale cricket farm in the Netherlands. In this case, capital expenditures can be recurred in roughly one year, as they are slightly smaller than the EBIT, which exceeds the yearly minimum wage (13.6 months). After interest and taxes, the net result is still almost ten times the monthly minimum wage. It is not very likely that this optimum could be reached in the near future in Kenya. However, it illustrates that larger-scale farming under better conditions improves the financial sustainability of cricket farming.

Sensitivity and Risk Analysis

Revenue is defined as the realised output times the actual market price, two variables that are able to fluctuate over time. Currently, the realised output is well below the optimal level and is expected to increase over time.[41] In other words, the effect of possible fluctuations in the first determinant of revenue is expected to be positive. The expectations of the market price are more ambiguous. At the moment, the price of one kilogram of fresh whole crickets is set at €5.85, a price at which producers are willing to sell crickets and consumers are willing to buy crickets. Assuming that the cricket disease will be eventually controlled and new financing is found for the project, the

[40] By the time farmers could apply for a starter kit to become a cricket farmer (the costs of which are covered by the MFI loan, which in fact is provided in kind), they were assumed to already have built the necessary facilities. While some farmers may in fact have faced construction costs for building such facilities, these 'sunk cost' were not taken into account in the business case.

[41] The production in Kenya is lower than in the Netherlands, because of a longer cricket cycle and a lower yield per crate. The former is a result of differences in climate and is expected to stay constant. The latter, however, is expected to increase as farmers move along the 'learning curve' and as the scale of cricket farming increases.

supply of crickets would be expected to increase, both in terms of the number of cricket farmers and possibly the size of each cricket farm.

While price developments are difficult to forecast, we can explore several scenarios for price changes. Assuming that market mechanisms operate at least to some extent, an increase in supply that exceeds demand growth would be expected to be accompanied by a decrease in the market price, and vice versa.[42] Table B-2 shows what happens as a result of these price changes. For example, in case the price of crickets were to be reduced to the price of cheaper beef (€4.00 per kilo), capital expenditures are expected to be recovered within four years. In this case, the yearly EBIT would be more than double the minimum monthly wage in Kenya.

Farmers were originally not only expected to generate income from selling fresh crickets for consumption, but also by selling 'parent' crickets to farmers that are planning to start cricket farming. This 'parent stock' is the basis for new cricket farms, as these lay the eggs resulting in a new stock of crickets. However, due to the disease and other setbacks, very few cricket farmers had reached the stage in which they were able to sell parent stock. If the project will continue, it is now highly unlikely that farmers will still sell parent stock to other farmers, due to the risk of infection. It is possible however that they will sell their parent stock to Mixa. Should this start to happen, farmers would thereby further increase the return on cricket farming in Kenya.

During the programme, DCs visited cricket farmers on a regular basis to combine the provision of support with the collection of fresh crickets. This combination of tasks was the result of limited supply and was not part of the initial plan. It is questionable whether cricket farmers could continue to sell their output at low or no costs after the initial support ends, if only because of the cost of transportation related to cricket collection. However, project partners believed that, once more farmers start to operate at a 'considerable scale', preferably geographically clustered, Mixa could collect the crickets by scooter more easily and at very low costs.[43] An additional effect of the geographical clustering is that is also likely to result in networking- and learning effects.

The project has shown that cricket farming in Kenya is not free of risk, as virtually the whole population of crickets was eventually infected by bacteria. This infection is the main reason that cricket farmers have been operating well below the expected level. At the moment of writing, a team of experts is examining possible solutions, but it cannot yet be excluded that bacterial infections will continue to hamper structural growth in the (near) future.

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42 The programme was initially designed to stimulate not only supply, but also demand, including via marketing campaigns. The latter did not take place to the extent originally envisaged due to the problems on the supply side, but marketing activities were expected to pick up again as soon as supply increased. According to almost all project partners, there was still a lot of potential for demand to grow.

43 A considerable scale is defined as at least 300 farmers rearing 500 grams of crickets or more a day.

Appendix B Loan package

	Equipment needed	Cost per unit	Total cost
1	30 plastic cricket rearing crates (1 set), including ventilation holes and stainless steel mesh	1950	58,500
2	7 plastic lids	NIL	NIL
3	30 plastic hiding places	30	900
4	20 petri dishes for feed	35	700
5	20 water supply systems	35	700
6	10 plastic egg laying containers	12	120
7	20 litres of egg laying substrate	N/A	N/A
8	1 cricket ruler	70	70
9	1 thermometer	250	250
10	1 spraying bottle	150	150
11	1 role of masking tape	200	200
12	1 permanent marker	100	100
13	1 farmer handbook on cricket rearing and primary processing	500	500
14	1 starter set of crickets (amount) of various ages and supplied in two stages (1st week and 5th week)	700	1,400
15	1 training workshop of 5 days	250	1,500
16	Follow up/ support by trainers for a period of 9 months including weekly/monthly visits	400	3,600
17	1 sieve + lid (for blanching)	3,500	3,500
18	5 polythene bags	80	400
19	1 farm diary	350	350
20	4 kgs of feed	65	260
21	15 pieces of blanket	4	60
	Total cost		**73,260**

Source: Flying Food Project Partners.

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