WAGENINGEN
UNIVERSITY & RESEARCH

BLACK SOLDIER FLY PRODUCTION AS A CIRCULAR ECONOMY INNOVATION IN KENYA

Mapping impact assessments and the enabling environment through interviews with key stakeholders

Bram De Groote[1] & Somaya Naser El Deen[2]
[1] Wageningen Centre for Development Innovation; [2] Wageningen Livestock Research

Summary Note – December 2023

This note was prepared for the KB34 project *How to assess the performance of CE interventions in agrifood systems in low- and middle-income countries*[1] and has not been peer reviewed.

Preamble

This summary note is a synthesis of interviews conducted with key stakeholders that are active in the field of insect rearing, specifically black soldier fly (BSF) production, in the context of Kenya. This summary note explores key insights on how different stakeholders (academic and research institutions, government and private sector) reflected upon conducting assessments in the landscape and value chain of BSF and its technical, socio-economic and environmental impacts and interactions.

Introduction

This project aims to gain a better understanding of existing experiences in assessing circular economy (CE) innovations in agrifood systems in low and middle-income countries (LMICs), taking into consideration the specific context in which these innovations occur. The project builds on the Butterfly Framework which has been developed by Wageningen University and Research (WUR) to support assessing transitions towards a circular and neutral society.[2] Specifically, we look at two CE innovations: i) black soldier fly (BSF) production for animal feed production and organic fertilisers; and ii) biochar production for soil improvement. In this note we focus on BSF in Kenya.

The Butterfly Framework intends to guide the assessment of CE innovations as a checklist or as a roadmap for assessment. For our specific case we employed the Butterfly Framework to facilitate the formulation of interview questions. The framework urges users to take a comprehensive system perspective and to take into account ecological, technical and socio-economic domains as well as their interrelations. The context in which CE innovations are implemented is captured by means of analysing specific drivers (i.e., barriers and enablers), interventions, goals and system boundaries. Depending on the scale of implementation, these processes may be influenced through interventions while other processes may not (i.e., drivers). With this in mind, the project team used the Butterfly Framework to formulate questions for an interview guide in order to map impact assessments around BSF, the most relevant stakeholders and their enabling environment, within the Kenyan context.

Approach

Prior to the interviews, a short literature scan was conducted to understand what type of assessments have been used in the case of BSF for animal feed production and organic fertilisers in the context of LMICs. Next, an interview guide comprising a wide-ranging (check)list of relevant questions related to the different aspects of the Butterfly Framework was developed.

[1] Please visit the project website for more information.
[2] A description of the Butterfly Framework can be found in Bos et al. (2021) and Bos, de Haas, & Jongschaap, R. E. (2022).

Four semi-structured interviews were held in late 2023 comprising nine different experts in the field of BSF. Interviews were conducted after consent by interviewees to use their insights for further analysis. This note presents the key findings by the stakeholder groups in order to keep individual interviewees anonymous for privacy reasons.

Interview results

Research institutions

The interview with researchers showed that some assessments are being carried out at the moment. The main focus lies on the feasibility of the BSF innovation in terms of i) scalability and competitiveness in the market (price and profitability); ii) the willingness to pay by farmers; and iii) the socio-economic and environmental implications in replacing (completely or partially) conventional poultry feed with insect-based feed.[3] The demand for insect protein in the livestock industry is very high and will likely not be met anytime soon. Even if all waste would be converted through BSF rearing, it would only cover a small percentage of this demand.

One of the main challenges is finding sufficient high-quality waste that have no other uses, to be used as a substrate for BSF larvae. This is in part due to the lack of data on waste availability in Kenya and East Africa. Currently, only 40% of waste in Kenya is being collected. Furthermore, available waste fluctuates in quantity and quality throughout the year, making it hard to have homogenous quality larvae and frass fertiliser outputs when reared on this waste. Another challenge is the increasing competition for waste for different CE usages, affecting the feasibility of certain innovations due to waste becoming more expensive.

Most of BSF production is currently being done by small-scale farmers, closing the circular loop at the farm level or area level. There are few large companies that have a scale large enough to make BSF rearing profitable on a county scale, and possibly country scale, in the future. No records of profitable intermediate companies were found, which can be explained by the high production costs of BSF, needing either locally closed loops or large scalability in order to be cost-efficient. The regulatory challenges are high due to policy hurdles and a lack of consistent policies on waste management to support BSF farming.

Due to the high starting costs of BSF, most of the data and information is being held behind closed doors by the private sector to make sure to return their investment. This has a big impact on the knowledge generation and CE development of the BSF production as a whole.

Researchers are currently doing life-cycle assessments (LCAs) to better understand the environmental effects of BSF rearing. This includes assessments and feasibility studies using less commonly utilised wastes.

To stimulate BSF farming, an enabling environment should include trainings, government subsidies and nudging to promote BSF products (including livestock fed on BSF and frass fertiliser usage).

Academia

The academic researchers that were interviewed focussed on similar topics as the non-academic researchers such as the feasibility of BSF production and its scalability, in addition to topics on slightly different aspects of BSF innovation like genetic selection.

The interviewees were less optimistic about the feasibility of BSF as a cost-efficient replacement of soy- and fishmeal as feed for poultry (broilers) when scaled up. According to them the main reason to use BSF is for recycling and upgrading waste and thus it is only feasible – and only counts as a CE innovation – in small-scale enterprises, by closing the loop at the farm-level.

Research is being done on the use of BSF as an integrated pest management strategy to control nematodes through the use of frass fertiliser. According to the interviewees, studies

[3] Research in Ethiopia indicates the willingness to pay for insect protein as feed of almost 98% of the farmers, when prices are similar to conventional feed.

show that 99% of nematodes are killed when applying frass fertiliser to the soil.

They are also conducting research on the selective breeding of BSF to create varieties that are adaptable to diverse environmental conditions including different substrates and temperatures.

One of the challenges mentioned in the interview related to BSF rearing is to ensure a steady supply of eggs throughout the year. When temperatures drop, females reduce the amounts of eggs that are being laid, which can severely affect BSF production. Another challenge is to guarantee a cost-efficient transport of waste, and the need for regulations related to waste transportation among counties.

According to the researchers, the whole purpose of BSF is to clean the environment through the usage of waste. However, they question if we use BSF as an alternative feed, it would still be feasible or economically viable.

Private sector

The interview with the private sector player shone a totally different light on the feasibility of BSF. Whilst the researchers and academia were sceptical about the feasibility of large-scale BSF rearing due to the costs and substrate availability, the private sector was already doing it, with competitive pricing of their BSF meal (whole dried BSF larvae) compared to conventional feed.

Production has doubled from year to year with the same amount of substrate used, showing the effectiveness of their R&D and approach. They use over 17 different recipes of substrates, depending on the available waste, to make sure they have a homogenous end-product.

The private sector is also having the same challenge of reduced egg laying during the cold season. This needs to be addressed to ensure continuous BSF production year-round.

Other challenges include the seasonality and accessibility of waste. Partnerships are crucial for a continuous supply of waste throughout the year. The private sector player has multi-year contracts for off-taking waste of big industrial fruit producers and processors. These relationships are built on mutual trust and years of building up the partnerships through a franchise approach (make yourself indispensable). The private sector player can have the waste for free but is responsible for the quality/safety of the waste, the pick-up and other logistics around the collected waste. The logistics and transport of waste as substrate for BSF can take up to 60% of the costs of a commercial BSF farm. The location between the farm and the source of waste is thus crucial.

Technical research is being done by several universities on, among others, the bioavailability of fibre-dense waste through fermenting bacteria and degrading fungi. These technologies could unlock waste that is currently not feasible for BSF rearing such as sugarcane, which in theory could supply over 1000 metric tons of waste a day. Besides as protein source and fertiliser, BSF has a myriad of other potential uses such as pesticide, biofuel, chitin production, etc.

Slaughterhouse waste is being researched as substrate; it creates clean larvae with a shorter lifecycle compared to plant waste.

Partnerships and good relationships are equally important with the industrial poultry farmers that use BSF as feed. Poultry protein demand seems to go down when fed with BSF larvae, indicating their high quality of protein.

What became clear during this interview is the strength of the duality in BSF rearing: the combination of both larvae as animal feed and frass (waste residue) as organic fertiliser. Marketing both these products is the way forward to making BSF rearing competitive, with frass being responsible for over 70% of the profit (company data). But the Kenyan market is still sceptical about organic fertiliser due to many issues with low-quality organic fertiliser in the past or farmers using it in the wrong way. Frass fertiliser is a slow-releasing fertiliser with a long-term impact on the soil and is suitable for all crops, from tea and coffee to vegetable production. The private sector player has carried out over 3000 trials, showing the benefits of frass and convincing farmers of its benefits such as improved soil quality, health, structure and water retention as well as increased crop yields by up to 30%.

There are still issues regarding legislation, although the first big producers have paved the way for the rest. One of the main issues is that BSF falls under different government regulatory bodies. The Kenyan Wildlife Service (KWS) sees BSF as wildlife, with its related regulations. The Kenyan Bureau of Standards (KEBS) created production regulations (mainly protein end-product safety). BSF is also seen as livestock, falling under livestock regulations; iv) it also has to deal with regulations for waste and waste disposal for the substrate of the BSF. Finally, the National Environment Management Authority (NEMA) needs an environmental impact assessment before production can start.

Creating a business out of BSF as a small player is hard due to the complexity, the starting costs, the costs of R&D and the risks involved.

An additional technical challenge is the drying of BSF larvae. Drying in the sun is a long process and can lead to uneven drying and can create mould and other issues. Investment in an industrial-grade drier is therefore needed, making the starting costs even higher. Another barrier is the extensive R&D that is needed. Another challenge mentioned is the double tax, as BSFL and frass are taxed according to manufacturing instead of agricultural production, which is twice the amount of tax.

Government

The interview with the governmental sector, specifically with KEBS, defined better the insect production situation and conditions in Kenya. In collaboration with research institutes, the policies specifically for insects as feed were set for several reasons. First, the high competition on fishmeal between the food and the feed industries which elevates the demand for insect products and thus the prices. Second, the long and difficult process that should be followed in order to have policies regarding insects used as food and food ingredients.

The main concerns of using insects in animal feed are the safety and the quality of the product (output), mainly the chemical hazards from heavy metal residues. Other concerns include microbiological hazards when insects and insect products are used as food. The consumers have the right to know the product composition, its processing and packaging.

The insect farms in Kenya are audited by the governmental organisation. Auditors are sent randomly and on appointment to check the farms and the products used throughout the rearing process. Hygiene and safety are the main concerns of the auditor. The substrate categorisation is not mentioned in any policy or legislation so all the types of substrates are allowed to be used to rear BSF larvae as long as no outbreaks (mainly diseases) take place following the golden rule: "Everything is allowed unless proven to be unsafe". Collaborative research and communication between officials and research institutes to check on new developments that expose the research/production to any risk is ongoing.

The safety standards apply also to the insect frass since it is considered a fertiliser. It is objected to the same standards as organic fertilisers such as cow manure.

However, currently, it is not very clear how to classify BSF. Initially, insects were classified as wildlife, but after negotiation with KWS, they are trying to see how insects can be regulated only as livestock. With the current regulatory framework, insect farmers could get confused, resulting in problems and possible fines, which KEBS is currently trying to solve by clarifying the regulations (see previous section). The government is serving the industry and facilitating their businesses, for the sector to develop rapidly without being hindered by ongoing research. When the risk is seen as minimal, the industry can continue with close monitoring from officials. The insect producers receive certificates for their production, but it is not a freeway certificate to produce for one or two years; monitoring and controlling is always ongoing. Additionally, the farmers/industry pay the "feed food safety coordination bill" to cover the regulator costs and to receive the certificate.

More connections and collaborations should be encouraged between the insect sector and the livestock sector. The insect sector still needs a lot of publicity; it is a generative sector and has space to create jobs and a market for youth.

The African Union is working on harmonised standards for the whole of Africa to increase the inter-African trade and the discussions regarding the novel food are ongoing.

Closing remarks and recommendations

BSF production can be seen as a crucial CE innovation in Kenya because of its ability to convert all types of wastes into a high-quality protein source and high-quality organic fertiliser. This role can have a positive and visible impact on social and environmental levels.

The interviews show that BSF as a CE innovation has a promising future in Kenya. Research institutes intend to collaborate with the private sector and government to conduct next-to technical assessments, both socio-economic and environmental impact assessments although they are not holistic in nature yet.

The BSF production sector in LMICs in general, and in Kenya specifically, is still very young where all the stakeholders are striving to learn, apply and optimise this new technology. Due to the high starting costs and high R&D costs, new findings and breakthroughs of BSF farming are often kept secret, with different early adopters competing against each other, to make sure to earn back their initial investment. This prevents new players from starting commercial BSF farms, although with more and more research being done by public research institutes, this knowledge gap will become smaller over time. Only then, with enough data and knowledge about this technology a holistic impact assessment can be done.

Key factors that are needed for BSF as a CE innovation to succeed:

- An enabling environment making it easier to start BSF rearing. A regulatory framework that conduces the different facets of BSF rearing – from waste disposal to feed policies – is essential. This should include subsidies and lower taxes to accelerate innovation and increase the competition between private sector players.
- Research about best production practices should be made publicly available, with a public database of different recipes for substrate mixes based on the local availability, to create an optimal production.
- Sensitisation of farmers on frass fertiliser, and of consumers on insect protein. The latter could accelerate and incentivise more BSF rearing by paying a premium for livestock fed by BSF larvae.