Scaling regenerative black soldier fly farming innovations with vegetable push-pull cropping systems for One Health in Rural Kenya, Rwanda and Uganda 2023 MSc Projects

Project Number	MSc Project Title	Project Summary	Location of project	Qualifications and experience required
1	Availability and suitability of organic waste streams for BSF farming in East Africa	The use of black soldier fly (BSF) to recycle organic waste into high-quality animal feed ingredients and organic fertilizer for improved agricultural productivity and income generation has gained global attention to address the challenges of costly animal feeds climate change and waste accumulation. Recent studies have shown that the BSF bioconversion efficiency is largely influenced by the availability, type and quality of organic wastes used for rearing. It has been demonstrated that sourcing and preparing the waste substrate for rearing the BSF larvae accounts for 81-90% of the total overhead production costs, indicating that the rearing substrate is a key determinant for optimal BSF production. Most of the organic wastes used for BSF production vary in time, space and quality due to seasonality of crop production, differences in agricultural enterprises, and distance from urban areas/points of generation. Thus, the quantities of organic wastes required for mass production of BSF may not be readily available on the farm. This implies that insect farmers would need to source for organic wastes. The MSc. project will use survey and laboratory data to map and characterise the organic wastes produced in different areas to provide vital information for BSF production in East Africa. Information on the generators/sources of different organic wastes, volume of production, and availability throughout the year, cost of waste sourcing and proximity to BSF farmers will be collected. Furthermore, the nutritional quality and contaminants of the organic wastes will be determined and maps developed based on data on socioeconomic studies and nutritional quality.	Rwanda	- Candidates should have completed a BSc in Agriculture, Entomology, Environmental Sciences, Biochemistry or related area, and scored at least second-class degree (upper division). - Skills in GIS and remote sensing and capacity to collect and analyse both qualitative and quantitative data are key. - Experience in organic waste management is an added advantage.
2	Develop and validate post-harvest processing and shelf-life of BSF products	Currently, black soldier flies (BSF) are being marketed as a low-cost, environmentally friendly, and sustainable source of high-quality biomass for animal feed. It has an excellent protein content ranging from 42-60% with well balance essential amino such as lysine, methionine, and tryptophan. Black soldier fly larvae are a great source of nourishment for animals since they also contain high concentrations of important fatty acids like linoleic and linolenic acid. Additionally, the larvae are a good source of nutrients like calcium, potassium, and zinc. On the negative side, previous studies have revealed that processing and storage of the dried BSF larvae products is subjected to huge spoilage, leading to significant quantitative and qualitative losses. Therefore, the proposed work will seek to explore the effect of various processing techniques on the shelf life of insect-based stored products to ensure good marketable quality of the products. The proposed MSc project will collect data on: a) The effects of four common methods of BSF post-harvest processing i.e., sun drying, freeze drying, oven drying and microwave-assisted drying on whole BSF larvae, grounded defatted and un-defatted BSF meal samples. The focus will be in color change, rancidification, nutritional and aflatoxin content development for a period of six months. b) Identify active volatile compounds that are indicative of spoilage during storage under different packaging conditions for a period of six months The study's findings will give information required for processing of safe high-value BSF larvae products for the market and integration into animal feed.	*icipe*, Nairobi, Kenya	- Candidates should have completed a BSc in Food Chemistry, Food Science, Analytical Chemistry, Biochemistry or related area, and scored at least second-class degree (upper division). - Skills in Nutritional and microbial analysis are key. Experience in organic BSF rearing is an added advantage
3	Participatory selection of target sites and	African smallholder farming systems are both socially different and spatially heterogeneous. Farmer participatory research is therefore a necessary and key component for technology development, adoption, and subsequent diffusion. For successful adoption, the recently intensified	*icipe*, Mbita Point, Kenya	- Should be a national of an African country

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	crops/cultivars in different agroecologies	push-pull requires extensive locally specific knowledge of farmer preferred crops/cultivars against the background context of biophysical constraints and climate conditions, and smallholder farm typologies typical of the relevant agroecological regions. Together with target farmers, the current project will identify key sites and crops that are necessary to build a cropping system that is nutrition-sensitive, climate resilient, generates income and is compatible with Black soldier fly (BSF) based interventions. The candidate will use innovative participatory research tools including focus group discussions and key informant interviews to gather the required knowledge in potential sites within Kenya, Rwanda and Uganda.		- Completed a bachelor's degree in agronomy/entomology/agricultural economics. - Registered for MSc in a recognized University (or eligible for a full masters by research dissertation as prescribed by the registering University) - Completed course work/year one of study awaiting research - Basic knowledge in analytical software (STATISTICA, and/or R) - Proficiency in scientific writing
4	Crop response to frass fertilizer across agroecolgical zones.	Soil degradation is a major challenge to food and nutrition security in sub-Saharan Africa (SSA). Yet, mineral fertilizers are unaffordable due to the high-cost, limited access and geopolitical conflicts that have disrupted global fertilizer supply chains. In East Africa, the fertilizer prices have increased by 63-113% due to the ongoing Russia-Ukraine war. On the other hand, organic fertilizers have poor-quality and long production time, and organic matter has competitive uses. The use of insects such as black soldier fly (BSF) to efficiently recycle organic waste into high-quality organic fertilizer for improved soil health and crop production has gained global attention. The black soldier fly frass fertilizer (BSFFF) could an innovative local solution to enhance and sustain the productivity of local food systems in SSA in the wake of the fertilizer crisis due to the covid-19 pandemic, geopolitical conflicts such as Russia-Ukraine conflict and climate change. Pilot studies undertaken by the International Centre of Insect Physiology and Ecology (icipe) and its partners have demonstrated the high potential of BSFFF to boost soil health, yield and nutritional quality of various food crops while increasing profit margins. Given that BSFFF is an emerging and promising innovation, its application as a multipurpose, cost-effective, and environmentally-friendly intervention for improved soil health and crop productivity has not been fully exploited in SSA. Integrating BSFFF with functional cropping systems such as vegetable integrated push-pull could enhance crop and soil health improving crop productivity. The proposed MSc. project will determine optimal BSFFF application rates for enhanced soil health, crop productivity and profit margins in vegetable integrated push-pull cropping systems in various agroecological zones. The studies will assess the growth, pest infestation, plant-soil feedbacks, yield and nutrient use efficiency of crops grown in various agroecolgical zones amended with different application rates of BSFFF. Furthermore, the rates of nutrient release and their synchrony for uptake by crops grown in various soil types, and changes in physical and chemical properties of soils amended with BSFFF will be determined. Findings from the study will provide information necessary for integration of BSFFF in current farming practices.	*icipe*, Nairobi, Kenya	- BSc. Agriculture, Soil Science, Agronomy, Environmental Sciences, or related area. - Experience in field experimentation and fertilizer trials is an added advantage