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NESTLER
oNe hEalth SusTainabiLity partnership between EU-AFRICA for food sEcuRity

Deliverable D5.4
Practice Abstract Batch 2

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Abstract	This deliverable contains the practice abstracts that will be published in the EU CAP Network for broad dissemination to practitioners. Specifically, there are three practice abstracts: 1. Assessment of controlled livestock breeding 2. Assessment of controlled fishery breeding 3. Assessment of frass fertilizer for crop immunity and harvesting

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09	THE INTERNATIONAL CENTRE OF INSECT PHYSIOLOGY AND ECOLOGY LBG	ICIPE	KE
10	ETHIOPIAN INSTITUTE OF AGRICULTURAL RESEARCH	EIAR	ET
11	RWANDA AGRICULTURE AND ANIMAL RESOURCES DEVELOPMENT BOARD	RAB	RW
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Definitions, Acronyms and Abbreviations

GDPR	EU General Data Protection Regulation no. 2016/679
AI	Artificial Intelligence
BSF	Black Soldier Fly
BSFL	Black Soldier Fly Larvae
BSFLM	Black Soldier Fly Larvae Meal
EU	European Union
IoT	Internet of Things
KPI	Key Performance Indicator
NESTLER	oNe hEalth SusTainabiLity partnership between EU-AFRICA for food sEcuRity
One Health	Integrated approach to human, animal, and environmental health
PM	Project Manager
PMT	Project Management Team
TL	Task Leader
TM	Technical Manager
WP	Work Package
WPL	Work Package Lead

Executive Summary

Deliverable D5.4 gathers the second batch of practice abstracts from the Horizon Europe NESTLER project, translating pilot results into plain, actionable guidance for farmers, advisors, and One Health practitioners across Uganda, Ethiopia, Cameroon, Kenya, Rwanda, and Nigeria. Prepared for publication in the EIP-AGRI format[1], it distills what worked, where, and why, so that peers can replicate methods with confidence.

Three innovation lines anchor the document building on **D2.2**:

1. An updated assessment of **controlled livestock Feeding**. Controlled livestock feeding replaces costly soy and fishmeal with locally produced Black Soldier Fly (BSF) larvae while using IoT tools to observe housing conditions and animal behaviour in real time.
2. An updated assessment of **controlled fishery Feeding**. Controlled fishery/aquaculture production uses BSF larvae meal in tilapia diets and monitors water quality with networked sensors.
3. An updated assessment of **frass fertilizer for crop immunity and harvesting**. FRASS (the organic residue of insect rearing) is applied as a fertiliser to improve crop immunity and yield while closing nutrient loops. Together these demonstrations show how circular bio-innovations and digital monitoring can reduce inputs, manage risk, and raise productivity under diverse agro-ecological conditions

These practice abstracts translate WP5's piloted activities into **practical, concise knowledge products** for farmers, extension agents, and One Health practitioners, supporting replication and broad adoption across African agro-ecological contexts.

[1] https://ec.europa.eu/eip/agriculture/en/content/eip-agri-common-format

1 Introduction

Deliverable D5.4 compiles the second batch of practice abstracts produced within the Horizon Europe NESTLER project. Prepared for publication through the EU CAP Network, practice abstracts distill pilot activities into practitioner-oriented guidance. The focus remains practical: *show what worked, where, and why, so farmers, advisors, and policymakers can act with confidence*.

The document concentrates on three applied innovation lines:

a) controlled livestock feeding

b) controlled fishery/aquaculture production, and

c) use of frass-based fertilisers to strengthen crop immunity and improve harvest performance.

Together, they translate Work Package 5 results into accessible knowledge while aligning with the Commission's EIP-AGRI common format for broad dissemination.

It should be underline that across six African pilot contexts (Uganda, Ethiopia, Cameroon, Kenya, Rwanda, and Nigeria) the project couples circular bio-innovations with digital monitoring. Black Soldier Fly (BSF) larvae are valorised as local, high-protein feed for poultry and fish, while frass is recycled as an organic soil amendment. IoT systems (e.g., SynField, SynAir, SynWater) support continuous sensing of housing conditions and water quality, enabling evidence-based management with lower input intensity and better biosecurity.

In **controlled livestock feeding pilots**, Ethiopia and Rwanda demonstrate that substituting soy and fishmeal with insect protein can reduce feed costs and environmental pressure while maintaining or improving performance. Digital tools for real-time observation of housing conditions and animal behaviour allow earlier detection of stress and disease, supporting reductions in antibiotic use. Socio-economically, the approach can enhance household income—often under women's control in poultry systems—while catalysing youth employment in insect rearing and tech support.

Aquaculture pilots in Ethiopia show similar promise. BSF larvae meal has successfully replaced conventional fishmeal in Nile tilapia diets, with peer-reviewed results already published and a second phase targeting soybean meal replacement underway. The team established reliable BSF mass production, recording 30–50 kilograms of larvae every 15 days, and used IoT devices to track critical environmental parameters for both rearing rooms and fish tanks. These steps strengthen resilience, reduce dependence on imported feeds, and cut the embodied environmental footprint of fish production.

On the crop side, **Cameroon trials compared organic fertilisers (poultry and cattle manure) with mineral fertilisers under a rigorous experimental design**. Poultry manure, particularly when guided by prior soil analysis, delivered the strongest vegetative growth, highest yields, and the best returns on investment, at times exceeding a three-to-one payback. Beyond profitability, organic amendments improved soil structure, water retention, and microbial activity while lowering the risks of nitrate leaching and long-term acidification associated with poorly dosed mineral fertilisers.

The work candidly documents operational challenges and how teams resolved them. Connectivity gaps in poultry houses, climate-sensitive BSF life cycles, limited early-stage BSF production capacity, pest pressures, and community perceptions were addressed through fibre-based internet upgrades, standard operating procedures for BSF farming, housing modifications for temperature and humidity control, mesh protection of rearing infrastructure, rotational water-quality monitoring, and hands-on training with partners such as ICIPE. These measures enabled steady data capture and reliable biological outputs despite variable field conditions.

Cumulatively, the pilots illustrate a coherent One Health pathway: converting local organic wastes into insect protein and frass; using sensing and analytics to manage risk; and building inclusive value chains that create jobs for youth and women. The updated practice abstracts are designed to accelerate replication via the EU CAP Network and open repositories, ensuring that methods, standard procedures, and lessons learned are discoverable and actionable beyond the initial pilot geographies.

Looking ahead, the document points to targeted next steps: expand BSF supply chains and farmer training, formalise exchange and technical assistance with specialised centres, deploy user-friendly digital platforms for BSF practitioners, and embed routine soil testing and support for organic inputs within policy and extension services. These actions would consolidate early gains, reduce dependency on volatile imported feeds and fertilisers, and anchor climate-smart intensification within local circular economies.

2 Overview of NESTLER Innovations

WP5 pilots address key innovations under NESTLER, including controlled livestock Feeding using digital monitoring tools to enhance productivity and animal health, controlled fishery Feeding supported by IoT devices for monitoring water quality and fish health, and the use of frass fertiliser to improve crop immunity, yields, and disease resistance while supporting circular economy practices.

Demonstrations have been conducted in Uganda, Ethiopia, Kenya, Rwanda, Cameroon, and Nigeria, showcasing how NESTLER innovations can address local challenges while strengthening One Health sustainability pathways across diverse agro-ecological contexts.

2.1 Controlled Livestock Feeding (EIAR)

The table that follows includes details with respect to the effect on the ecosystem, the social and economic impact and the mitigation/prevention actions of the controlled livestock feeding.

Table 1. Controlled Livestock Feeding

Controlled Livestock Feeding (RAB, EIAR)	
Year of Pilot:	2024
Regions/Country	Ethiopia
Lead Partners:	CTPH
Contributing Partners	EIAR, RAB, ICIPE
Description	The EIAR pilot under the task “Livestock Farming Outcomes” aims to adopt and develop the required skills on Black Soldier Fly (BSF) larvae rearing and processing techniques, which is a new innovation introduced to the EIAR research system *via* the NESTLER project. Along with this, the pilot aims to evaluate and demonstrate the potential biological and economic benefits of BSF based feed recipes as an alternative source of protein for chicken (both layers and broilers) under controlled feeding experiments in a research station. The best BSF based feed recipe identified from the on-station testing will also be further demonstrated as a scavenging feed supplement to dual-purpose chicken maintained by small-holder farmers under semi-intensive management. This will be integrated as part of our formal research agenda after the project tenure to ensure sustainability and wider adoption in Ethiopia`s poultry industry. The pilot trials have been supported by IoT devices installed for monitoring and recording the chicken production environments such as light intensity and air quality in the chicken houses.
Effect on Ecosystem:	Using insect-based feed in poultry farming reduces pressure on the conventional protein feed ingredients like soybean and fishmeal, promoting sustainable resource use and biodiversity conservation. Insects also have a high feed conversion rate, require less water and land, less capital investment, and low ecological footprints than conventional livestock and crop production. The use of BSF for converting organic waste into protein

	and frass fertilizer is gaining momentum globally as it offers circular economy opportunities and thus enhances environmental cleanup services by recycling biowaste and greenhouse gas emissions. Given that safe waste disposal remains a challenge in many low-income countries like Ethiopia, insect farming not only reduces waste disposal costs but also contributes to better health. The organic fertilizers produced from the insect farms may further enhance environmental sustainability and food security.
Social and Economic Impact:	Inadequate supply and high feed cost are the major impediments to livestock development in general and poultry production in particular in Ethiopia. The fact that poultry also competes with humans for some feed ingredients such as soybean further exacerbates the problem, with the combined effects resulting in limited availability and highly inflated costs of animal/chicken source foods. In view of this, the adoption and use of insect-based feed as alternative sources of protein offers a more feasible opportunity to reduce production costs and also eases competitions for commercial feed ingredients including soybean. Upon promotion and utilization at scale, the BSF based feed innovation can improve productivity and further enhance the estimated 20 to 25% contribution of the poultry sector to household income, about 80% of which is controlled by women (Ayele and Rich, 2010). This in turn will help to enhance the overall contribution of poultry production to poverty alleviation and the supply of high-quality protein in the human diet. Moreover, there is a huge scope for commercialization of BSF larvae based feed as a new agri-business venture in which unemployed youth and women can engage, generate income and support their livelihoods. BSF farming can also contribute to improved food/nutrition security and income by supplying a cheaper source of poultry feed and organic fertilizer, reducing food-feed competition and diversifying income generating opportunities of farmers and other actors engaged in the business. In addition, BSF rearing is highly cost-effective as it uses organic waste as the sole input (no extra cost for waste disposal), ensuring efficient use of resources and contributing to the circular economy.
Mitigation/Prevention Actions:	As the use of BSFL for animal feed is a new concept in Ethiopia, various efforts have been made to raise awareness among stakeholders. These include organizing seminars, presenting findings at national research review forums, conducting site visits, publishing review papers, and disseminating research results. The limited experience in BSFL rearing and adoption posed significant challenges; however, continuous experiences sharing and accessing educational content through different self-teaching mechanisms such as YouTube have proven helpful in building local capacity.
More Info:	● The result from the first pilot experiment involving layer chicken "Effect of Dietary Inclusion of Full-Fat Black Solder Fly Larvae (*Hermetia illucens* L.) on Egg Production and Quality in Laying Hens" has been published and uploaded in AJOL – African Journals Online

	under the current issue of the Ethiopian Journal of Agricultural Sciences (**https://www.ajol.info/index.php/ejas/issue/view/18855)**. ● The second result generated from the first pilot experiment on layer chicken "Performance Evaluation of Laying Hens Fed Diets Containing Partially Defatted Black Soldier Fly Larvae (*Hermetia illucens* L.) Meal is also being drafted for submission to an appropriate journal for publication. ● The other pilot experiment involving broiler chicken will begin upon securing an adequate amount of processed BSF diet required for the experiment. The experiment will be supported by SynField[2] and SynAir[3] IoT devices installed at the pilot site for data collection and monitoring the production environments.

[2] https://www.synfield.gr/about/
[3] https://www.synfield.gr/about-synair/

2.2 Controlled Livestock Feeding (RAB)

The table that follows includes details with respect to the effect on the ecosystem, the social and economic impact and the mitigation/prevention actions of the controlled livestock feeding.

Table 2. Controlled Livestock Feeding

Controlled Livestock Feeding (RAB, EIAR)	
Year of Pilot:	2024
Regions/Country	Muhanga/Rwanda
Lead Partners:	RAB
Contributing Partners	EIAR, ICIPE
Description	The task demonstrates the project's outcomes related to the use of insects in animal feed production. It also showcases the digital tools developed such as IoT and video/sound analysis for monitoring animal behaviour and identifying new land areas for animal feed production. Additionally, the task addresses animal health and illustrates how NESTLER supports farmers in implementing regulated deficit strategies. Demonstrations are being conducted in Rwanda, Ethiopia, and Kenya.
Effect on Ecosystem:	Using insect-based feed in poultry farming (layers, broilers, and dual-purpose chickens) reduces pressure on traditional feed resources like soy and fishmeal, promoting sustainable resource use and biodiversity conservation. Digital tools such as IoT and video/sound analysis enhance poultry health monitoring, enabling early disease detection and reducing antibiotic use. Additionally, NESTLER's regulated deficit strategies improve water and feed efficiency, lowering environmental pollution. Overall, these innovations contribute to a more circular, resource-efficient poultry sector with reduced ecological impact, though careful management is needed to avoid potential risks such as invasive species or e-waste.
Social and Economic Impact:	The project enhances livelihoods by lowering poultry production costs through affordable insect-based feed and improved animal health, leading to higher productivity and income for farmers. Digital tools empower farmers with better decision-making, while NESTLER's strategies promote resource efficiency and resilience. It also creates new job opportunities in insect farming, technology support, data collection and recording, and local feed production, particularly benefiting youth and women. Overall, the initiative strengthens food security, supports rural economies, and fosters inclusive, sustainable agricultural growth.
Mitigation/Prevention Actions:	• Awareness and preference for quality of meat from fish and chicken fed with insect-based feed will be conducted. • Beneficiaries will be trained on the use of digital devices and mobile apps • RAB will collaborate with ICIPE to train BSF farmers on the use of mobile app

	● The Standards Operating procedures for BSF farming were developed and disseminated to farmers.
More Info:	● Livestock: Poultry (Layers, Broilers, and Dual-purpose) ● Equipment installed on the experimental site: SynField X3 and Cameras ● GPS coordinates of the experimental site: 2°4’12’’S & 29°43’25’’E https://zenodo.org/records/15063494 https://nestler-project.eu/index.php/trial-4/

2.3 Controlled Fishery Production (EIAR)

The table that follows includes details with respect to the effect on the ecosystem, the social and economic impact and the mitigation/prevention actions of the controlled fishery production.

Table 3. Controlled Fishery Production

Controlled Fishery Feeding (EIAR)	
Year of Pilot:	2024
Regions/Country	Ethiopia
Lead Partners:	EIAR
Contributing Partners	RAB
Description	The pilot site is used to demonstrate the use of insects namely black solder fly to replace conventional protein sources such as fishmeal and Soybean meal. Additionally, IoT devices are used to monitor the water quality in fish growing tanks and ponds. Black solder fly larvae rearing in different rearing facilities were established at the pilot site to ensure continuous supply of larvae, provide training for agricultural experts and demonstrate the project outputs to the small-scale farmers, technicians and policy makers.
Effect on Ecosystem:	The production of black solder fly larvae in the project pilot site has a multifunctional ecosystem role. BSF larvae are a high-protein, locally produced and environmentally friendly fish feed alternative, reducing reliance on conventional fishmeal and soya bean meal sources. Additionally, BSFL reduces large quantities of organic waste including, food waste, fruit and vegetable wastes, animal manure and others through decomposition process, thus lowering accumulation and greenhouse gas emissions that in turn contribute to a healthy ecosystem. Moreover, the valorization of organic waste results in the production of nutrient-rich organic fertilizer (frass), contributing to improved soil health and support crop production at the pilot site and beyond. Additionally, BSFL plays a significant role in minimizing unpleasant odors associated with rotting waste in the pilot site, contributing to improved sanitation and environmental conditions. Important environmental parameters for optimal BSF production are frequently monitored with IoT devices (SynAir) for temperature, lighting, substrate moisture and humidity requirements to ensure sustainable production without adversely affecting the environment.
Social and Economic Impact:	The cost of feed constitutes about 60% of the fish production. The projects introduced high quality insect-based feed with black soldier fly larvae meal (BSFLM) as a major protein source, fully replacing the expensive and less available conventional fishmeal base feeds. Additionally, BSFL farming requires low investment costs, making it an accessible and sustainable income-generating activity, especially for jobless youth and women. BSF farming utilizes diverse organic wastes including fruit and vegetable wastes, agricultural residues and food scraps which are readily available and often free. Moreover, BSFL can be farmed locally with minimal infrastructure,

	further reducing operational costs. The project introduced IoT devices for measuring environmental parameters in the BSF farming pilot (SynAir) which allows optimizing suitable conditions to upscale BSFL production in different locations of Ethiopia and beyond.
Mitigation/Prevention Actions:	Several challenges encountered in establishing and maintaining BSF production at the pilot site were fully resolved through experience sharing and on-hands training.
More Info:	● A research activity conducted at the pilot site to replace fishmeal with BSFL in the diet of Nile tilapia has been completed and published (https://www.ajol.info/index.php/ejas/article/view/284290). ● The second phase activity is going well to replace Soybean meal with BSFL in Nile tilapia production (the experiment will be completed in August, 2025) ● SynWater and SynAir IoT devices are working properly to measure environmental parameters in fish tanks and BSF rearing room, respectively.

2.4 Frass Fertiliser for Crop Immunity (AGRI)

The following table mentions the effect on the ecosystem, the social and economic impact and the mitigation/prevention actions with respect to the frass fertiliser for crop immunity.

Table 4. Frass Fertiliser for Crop Immunity

Frass Fertiliser for Crop Immunity	
Year of Pilot:	2024
Regions/Country	Cameroon
Lead Partners:	AGRI
Contributing Partners	SYN
Description	Pilot Project PCMR.1 of the Nestler Project conducted by Agrix Tech in Cameroon aimed to assess tomato cultivation quality using organic fertilizers, IoT devices for meteorological parameter recording, and soil nutrient analysis. More specifically, the objective was to evaluate the impact of organic fertilizers and IoT technologies on sustainable tomato production. We implemented a trial consisting of a completely randomized experimental design with 7 treatments replicated 3 times. This allowed us to [1] Compare the efficacy of various soil amendments (cow dung, layer chicken manure, and NPK) at different application rates through agronomic analyses; and [2] Evaluate the financial profitability of the different production systems established. Key Findings from Pilot 1: Among the three fertilizers tested (layer chicken manure, cow dung, and NPK), chicken manure proved most effective for both vegetative growth and yield production, followed by cow dung. The economic analysis revealed that one hectare of Rio Grande tomato production was profitable across all fertilizer types, particularly in plots that had undergone prior soil analysis. Treatment T3 (application of chicken manure following soil analysis) delivered the highest financial returns, while Treatment T5 (NPK application without soil analysis) recorded the lowest yields and profitability rates. Conclusions and Recommendations: Based on these results, organic fertilizer derived from chicken manure presents a viable alternative to conventional chemical fertilizers (NPK + urea). This approach, leveraging locally available natural resources at lower cost while maintaining ecological sustainability, could: Reduce grower expenses; preserve the environment; promote sustainable soil fertility management and ensure harvest quality Therefore, we recommend the following actions for key stakeholders: 1. Prioritize organic fertilizers (particularly poultry manure) for their profitability and sustainability

	2. Combine with soil testing to optimize nutrient application and reduce costs 3. Implement farmer education programs on best practices (composting, dosage) 4. Advocate for public policies to subsidize soil testing and improve access to organic fertilizers.
Effect on Ecosystem:	The use of organic fertilizers such as poultry manure and/or cow dung has positive effects on ecosystems. These fertilizers enhance soil health by improving water retention and soil structure through their organic matter content. Unlike chemical fertilizers, organic amendments reduce soil degradation (erosion, compaction) while enriching microbial biodiversity by stimulating beneficial microorganisms. In contrast, prolonged use of NPK fertilizers may lead to soil acidification. Organic fertilizers also minimize environmental pollution by eliminating risks of excessive nitrate leaching, a common issue with improperly dosed chemical fertilizers; thereby protecting groundwater quality. Furthermore, they prevent the accumulation of chemical residues in soils. Poultry and cattle manure can effectively replace synthetic fertilizers. Their application provides essential nutrients while improving soil structure, water-holding capacity, porosity, bulk density, and moisture retention. These organic amendments also increase microbial populations and help maintain crop quality, offering a comprehensive solution for sustainable soil management and agricultural productivity.
Social and Economic Impact:	However, many agricultural lands do not require such intensive fertilization, as optimal application rates vary according to crop varieties and local climatic conditions. Soil nutrient analysis provides crucial data about existing soil composition, enabling precise determination of fertilizer requirements for optimal plant development. From an economic perspective, the application of organic fertilizers following soil testing leads to yield optimization through targeted nutrient supplementation while minimizing wasteful over-application. This approach demonstrates superior profitability (achieving up to 306% return on investment) while reducing expenditures on chemical inputs, thereby decreasing dependence on imported agricultural commodities. The social benefits include enhanced self-sufficiency for smallholder farmers through utilization of locally available poultry manure and bovine excrement, diminishing reliance on external suppliers. Furthermore, this methodology ensures long-term agricultural sustainability by maintaining soil fertility for future generations, in contrast to the progressive soil degradation associated with prolonged NPK fertilizer use.
Mitigation/Prevention Actions:	● Nitrate pollution: Replace NPK with organic fertilizers + soil analysis for precise dosage. ● GHG emissions: Aerated composting and rapid soil incorporation.

	● Nutrient imbalances: Mandatory soil testing prior to fertilization. ● Low profitability: Prioritize poultry manure (306% ROI) and avoid unanalyzed NPK use. ● Input dependency: Promote local fertilizers (poultry/cattle manure) for sustainable self-sufficiency.
More Info:	● Comparative Agronomic Evaluation of Organic and Mineral Fertilizers Applied to Tomato (Lycopersicon Esculentum Mill.) Plots with or without Prior Soil Analysis

3 Practice Abstracts

Considering the **EIP-AGRI structure**[4], the next sections mention updates over the assessment of the controlled livestock feeding and controlled fishery/aquaculture production.

3.1 Updated Assessment of Controlled Livestock Feeding

<table>
<tr><th colspan="2">Updated Assessment of Controlled Livestock Feeding</th></tr>
<tr><td>Problem Addressed:</td><td>Lack of internet connectivity in the chicken experimental houses to support Network cameras.

Rarely disease occurrence due to climate variability.

Lack of technology for disease detection in aquaculture.

Climate change such as flooding and heavy rain.

A social challenge due to insect-based poultry feed.

Difficulties in implementing technology on the field.

Lack of an online mobile interactive platform for BSF farmers and feed processors/retailers.

BSF larvae adoption and adaptation due to cold weather and other environmental conditions.

Lack of farmers' guide (Standards Operating procedures) on BSF production available at the Farmer-level
Climate variability (during cold season) verse BSF life cycle management (P.ETH.1)
The small-scale pilot production capacity and the lack of commercial BSFL producers make it challenging to produce enough dried BSFL meal within the required timeframe, influenced to start the feeding trial timely. (P.ETH.1)</td></tr>
<tr><td>Solution Provided:</td><td>The chicken experimental houses were connected with fiber internet to support network cameras.

Consult regularly the meteorology situation in the demonstration sites.

Awareness of the quality of eggs/meat from poultry fed with insects-based feed.</td></tr>
</table>

[4] http://ec.europa.eu/eip/agriculture/en/content/eip-agri-common-format

	Developing and disseminating the Standards Operating procedures for BSF farming. Try to modify the house to keep heat and relative humidity.
Main Results /Recommendations:	Real-time monitoring of poultry behavior allows early detection of disease and stress, reducing the need for antibiotics and minimizing environmental contamination from over-medication or mortality disposal. High performance of chicken under experiment. Recommendations: Organize an exchange visit with ICIPE aiming to explore the use of digital feed formulation tools to optimize insect-based protein utilization for sustainable and cost-effective livestock feeding. It will also focus on applying smart and traditional trap networks to detect blood-feeding insect vectors of zoonotic diseases and deploying advanced tools for vector monitoring, surveillance, and early pathogen detection to enhance disease prevention and response systems.
Contributing Partners	EIAR, ICIPE
Further Links/Contact	https://nestler-project.eu/index.php/trial-4/ https://zenodo.org/records/15063494

3.2 Updated Assessment of Controlled Fishery/Aquaculture Production

Problem Addressed:	Limited experience to establish and produce BSFL in the pilot site (P.ETH.2) at the beginning of the project phase. Climate variability to ensure continuous production of BSFL sufficient to project pilots in Ethiopia. Presence of only one SynWater[5] device to measure real time water quality parameters from 10 experimental fish tanks. Pests mainly rats poses a threat to BSFL production and damage the infrastructure like "love cage".
Solution Provided:	Build BSF production skills through hands-on training, experience sharing, communication with project partners (ICIPE) and through Youtube channel. BSF mass production facility was modified to overcome extreme temperatures and regular adjustment were made based on the data obtained from SynAir[6] device. Measuring the water quality parameters using SynWater[7] device on a rotational basis and applying a multiline probe to measure the remaining 9 fish tanks three times a day. Protect the BSF rearing and larvae production infrastructures using wire-mesh.
Main Results /Recommendations:	BSFL production is successful at the pilot site (P.ETH.2) and produces 30-50 kg every 15 days. Data on waste mixing and preparation for maximum larvae production, quantitative measurements of larvae and frass and environmental parameters inside the production room has been recorded and analysis is underway BSFL production manual preparation addressing the local favourable conditions
Contributing Partners	RAB
Further Links/Contact	https://nestler-project.eu/index.php/trial-3/

[5] https://www.synfield.gr/synwater/
[6] https://www.synfield.gr/about-synair/
[7] https://www.synfield.gr/synwater/

4 Conclusions

Deliverable D5.4 under the NESTLER Horizon Europe Project highlights a key stage of the One Health Sustainability Partnership between EU and African institutions. It showcases how controlled livestock Feeding, regulated fishery production, and frass fertilizer applications are being practically tested and shared across different agro-ecological settings. The lessons learned from these innovations, especially the use of insect-based protein feed, IoT-enabled monitoring, and circular bio-waste management, show strong potential for replication and scaling up.

These pilots have generated practical insights into resource-efficient, climate-smart, and economically inclusive agricultural systems, with a special focus on empowering youth and women through job creation in sustainable agritech sectors. Additionally, the outcomes align well with One Health principles by improving animal welfare, reducing antibiotic use, and fostering ecological sustainability through waste-to-value strategies.

The updated practice abstracts in this deliverable will promote widespread knowledge sharing through the EU CAP Network and beyond, ensuring that innovative practices are not only tested but also accessible, practical, and transformative for farmers, practitioners, and policymakers dedicated to enhancing food system resilience.

5 References

[1] European Commission. (n.d.). *EIP-AGRI common format for practice abstracts*. European Commission. https://ec.europa.eu/eip/agriculture/en/content/eip-agri-common-format

[2] Ethiopian Institute of Agricultural Research. (2025). *Black Soldier Fly larvae feeding trials in poultry and fish production: Ethiopia pilot results*. *Ethiopian Journal of Agricultural Sciences*. https://www.ajol.info/index.php/ejas/article/view/284290

[3] NESTLER Consortium. (2025, January). *Deliverable D3.1: Remote sensing technologies and multimodal data aggregation protocols*. Horizon Europe Project. https://nestler-project.eu/wp-content/uploads/2025/01/D3.1-Remote-sensing-technologies-and-multimodal-data-aggregation-protocols.pdf

[4] NESTLER Consortium. (2025). *Trial 3: Controlled fishery Feeding pilot in Ethiopia*. NESTLER Project. https://nestler-project.eu/index.php/trial-3/

[5] NESTLER Consortium. (2025). *Trial 4: Controlled livestock Feeding pilot in Rwanda*. NESTLER Project. https://nestler-project.eu/index.php/trial-4/

[6] Zenodo. (2025). *NESTLER Project—Practice abstract repository*. https://zenodo.org/records/15063494

[7] Ayele, G. & Rich, K.M. 2010. *Poultry value chains and HPAI in Ethiopia*. HPAI pro-poor HPAI risk reduction. Africa/Indonesia Team Working Paper 25.

6 Annexes Photos

6.1 Photos of Pilots

Figure 1: Poultry farming in Rwanda (P.RWA.1)

Figure 2: Aquaculture farming in hapas in Rwanda (P.RWA.2)

The following figures are images captured at the Aquaculture farming pilot site Ethiopia (P.ETH 2).

Figure 3: BSFL production in protected container in Ethiopia (P.ETH 2)

Figure 4: BSF farming products (Larvae and frass) in Ethiopia (P.ETH 2)

Figure 5: Formulated BSFL based fish feed in Ethiopia (P.ETH 2)

Figure 6: Hands on training for experts and researchers in Ethiopia pilot (P.ETH.2)

6.2 Photos from Workshops

Figure 7: Group photo of farmers trained on Black Soldier Fly larvae farming using SOPs developed by the NESTLER project in Rwanda

Figure 8: Group photo taken during the visit to the BSFL farming site

Participants to the training on Black Soldier Fly (BSF) larvae farming

S/N	Name of invitee	Affiliated Cooperative	Role in Cooperative	Province	District	Sector	Tel
1	NSHIMIYIMANA ERIC	UPR/RULINDO	Fish feeding	North	Rulindo	Buyoga	0788510593
2	UWAMARIYA VESTINE	HUGUKA MWOROZI	Fish feeding		Rulindo	Bushoki	0790638081
3	TUYAMBAZE JOSELINE	INKINGI Y'URUGO	Fish feeding		Gakenke	Rushashi	0793061741
4	NIYIBIZI SAMUEL	ISUGI	Fish feeding		Burera	Kinoni	0788556853
5	RUCAMUMIHIGO JEAN BAPTISTE	IFI YA GIKERI	Fish feeding	South	Muhanga	Mushishiro	0798352665
6	KABATESI ODILE	KORA UTERIMBERE	Fish feeding		Muhanga	Shyogwe	0790561402
7	MUNYESHAKA THADEE	URUMULI RWACU	Fish feeding		Huye	Huye	0722564935
8	MUNYENTWARI AIMABLE	TUBEHO TUMBA	Fish feeding		Huye	Tumba	0784495356
9	NTIBIHANGANA JOSEPH	ABATANDUZANYA	Fish feeding		Huye	Mbazi	0783850069
10	IYAMUREMYE INNOCENT	BUZANA FRM CHAICE Ltd	Fish feeding		Huye	Mukura	0792094063
11	TWAGIRUMUKIZA DOMINIQUE	TWITEZIMBERE	Fish feeding		Ruhango	Kinazi	0783711667
12	NSENGIYUMVA François	KOABAKI	Fish feeding		Nyaruguru	Kivu	0789553546
13	NDAYISENGA MATHIEU	MUSAMBIRA CROPS COLLECTING CENTER LTD	Fish feeding		Kamonyi	Musambira	0780853220
14	MUTAGANIRA ANTOINE	DUFATANYE NYANZA	Fish feeding		Nyanza	Busamana	0788594354
15	RUTERANA Prosper	RARICO	RARICO President				
16	MUKATABARUKA BONIFRIDE	DUTERANINKUNGA NYAMAREBE	Fish feeding	East	Kayonza	Rukara	0787247783
17	NIRINGIYIMANA CLAUDE	CLEMANTIS FARM Ltd	Fish feeding		Bugesera	Kamabuye	0785264044
18	TUYISENGE CHANTAL	AFTCO	Fish feeding		Gatsibo	Muhura	0785412141
19	MANIRAGABA EMMANUEL	COPEPOGI	Fish feeding		Gatsibo	Gitoki	0786122713
20	RWAGASORE JOSEPH	KOUAKI	Fish feeding		Kirehe	Kigarama	0783246426
21	BIZIYAREMYE BONIFACE	KOABMK	Fish feeding		Ngoma	Karembo	0789871380
22	KAREKEZI CELESTIN	ISANGANO Y'ABOROZI RUSIZI	Fish feeding	West	Rusizi	Mururu	0723717488
23	SIBOMANA PROJECTE	COOPIAG	Fish feeding		Rusizi	Gashonga	0781620310
24	BISERUKA VALENS	TERIMBERE KAZABE	Fish feeding		Ngororero	Ngororero	0786310645
25	NSENGUMUREMYI PIERRE	KOBUFI	Fish feeding		Nyamasheke	Bushekeri	0725151069
26	NYIRANGENDAHIMANA VALENTINE	KAABI	Fish feeding		Nyamasheke	Bushekeri	0784870285

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Figure 9: Participants list on the training on BSFL farming