NASENI RESEARCH COMMERCIALISATION GRANTS PROGRAMME (NRCGP) PROPOSAL

Thematic Area: Health and Biotechnology

Project Title: Harnessing Black Soldier Fly Larvae (BSFL) for Sustainable Solutions in Alternative Poultry Feeds

Executive Summary/Abstract

This proposal outlines a project to enhance Nigeria's food security under the Renewed Hope Agenda by utilizing Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) as a sustainable, nutrient-rich alternative protein source for poultry feeds. BSFL meal, rich in protein, lipids, and bioactive compounds, offers a cost-effective substitute for feed ingredients such as nd fishmeal and premixes, while live BSFL are already used as supplementary feed by farmers. The project aims to optimize BSFL meal formulations and standardize its incorporation into poultry feed for reproducible, scalable outcomes, aligning with national goals of food security, youth empowerment, and agribusiness growth.

Within 18 to 24 months, the initiative will establish modular BSFL production units, optimize feed formulations, conduct poultry performance trials, develop demonstration clusters, and create a commercialization roadmap, with key deliverables (substrate optimization, BSFL meal protocols, and poultry performance trials) achieved within the first 12–18 months . Expected outcomes include reduced feed costs, improved poultry productivity, enhanced waste valorisation, job creation, and strengthened local food systems. The project will integrate monitoring, stakeholder engagement, and quality assurance to ensure scalability and alignment with sustainable development targets. Visual representations of BSFL products (e.g., larvae, meal, oil) will be provided to illustrate the project's outputs.

1.0 Introductory Background and Statement of Need

Nigeria's poultry sector remains one of the most critical drivers of food security, rural employment, and agribusiness growth, contributing significantly to the supply of affordable animal protein for millions of households. However, its productivity and profitability are severely constrained by the chronic challenge of high feed costs**,** which account for approximately 60–70% of total production expenses (Chiekezie and Nwankwo, 2022). A major factor is the heavy dependence on imported feed ingredients, particularly fishmeal and premixes (vitamins, minerals, and amino acids**)**, which exposes farmers to global price fluctuations, foreign exchange scarcity, and supply chain disruptions which exposes farmers to global price fluctuations, foreign exchange scarcity, and supply chain disruptions. This situation threatens not only farmer livelihoods but also national food security targets under the Renewed Hope Agenda.

In this context, the Black Soldier Fly Larvae (BSFL; *Hermetia illucens***)** represents a promising and innovative solution. BSFL is capable of bioconverting low-value organic waste into high-value, nutrient-rich biomass**.** Its larval meal contains high-quality protein, essential amino acids, lipids, and functional bioactive compounds such as antimicrobial peptides, lauric acid, and chitin, which have been shown to promote poultry health and improve gut microbiota (Lu et al., 2022; Salahuddin et al., 2024). Importantly, the use of BSFL contributes to **a** circular economy model**,** where agricultural and food processing wastes are diverted from landfills and

transformed into productive inputs. The resulting by-product, frass**,** serves as an organic fertilizer, improving soil fertility and further enhancing environmental and economic benefits (Global BSF Sector Report, 2022).

International and regional studies demonstrate that BSFL meal can partially replace soybean and fishmeal in poultry diets without compromising performance (Attia *et al.*, 2023). Substitution levels of 10–20% have been reported to maintain or even enhance growth rates, feed conversion ratios, and profitability**,** especially when BSFL is produced locally to reduce logistics costs (de Souza Vilela et al., 2021; Dalmoro, 2023). These findings underline the viability of BSFL as a strategic feed alternative for Nigeria's poultry sector. Nigeria's abundant organic waste streams—ranging from municipal food waste to agro-industrial by-products such as brewery grains, fruit residues, and cassava peels—provide a readily available substrate base for localized BSFL production. Harnessing these waste streams not only reduces feed costs but also creates opportunities for rural jobs, youth-led enterprises, and small and medium-sized agribusinesses, in line with national priorities on food security, import substitution, and youth empowerment (OSGF, 2024).

Despite these advantages, key challenges persist. Current BSFL practices in Nigeria are fragmented, small-scale, and largely experimental, lacking standardized rearing protocols, quality control measures, and reliable feed integration systems. Moreover, market acceptance is still nascent, as farmers and policymakers require clear evidence of nutritional safety, cost-effectiveness, and scalability. These gaps highlight the urgent need for systematic research and development efforts to optimize BSFL rearing conditions, standardize processing methods, and demonstrate poultry performance outcomes under controlled trials.

This project is strategically designed to bridge these gaps. By developing modular BSFL production systems, optimizing meal formulations, validating performance in poultry production, and creating commercialization pathways, the initiative will provide a science-backed, scalable, and economically viable alternative feed solution**.** In doing so, it will directly contribute to reducing feed costs, boosting poultry productivity, valorising waste, creating green jobs, and advancing Nigeria's transition toward sustainable food systems.

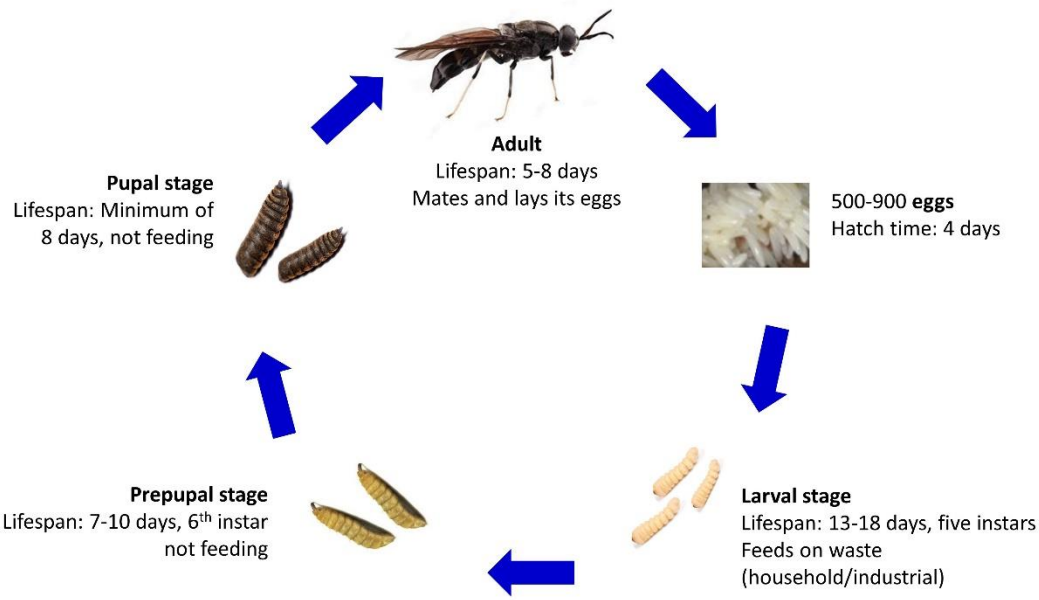


Figure 1: Life cycle of Black Soldier fly (Da Silva *et al.*, 2019)

1.1 Research Idea/Innovation

This project harnesses BSFL as an economically and ecologically viable solution for sustainable poultry feed in Nigeria. It introduces innovations by:

1. Standardizing organic waste use in BSFL production for consistent quality.
2. Developing standardized protocols for optimizing and incorporating BSFL meal into poultry feed, ensuring reliability and predictability of poultry performance outcomes.
3. Optimizing the production process for sustainability and scalability.

These efforts address the current haphazard BSFL production and lack of standardized feed integration.

1.2 Project Justification

Nigeria's poultry industry provides affordable protein and employment but is threatened by costly imported feed ingredients (USDA FAS, 2025). BSFL can convert organic waste into high-quality protein and lipids, reducing environmental waste while offering bioactive compounds like lauric acid to enhance poultry health (Fiorilla *et al.*, 2024). The labour-intensive, low-tech nature of BSFL production suits youth-led SMEs and farmer cooperatives, necessitating optimized and standardized processes for efficiency and profit.

1.3 Project Goal & Objectives

Goal:

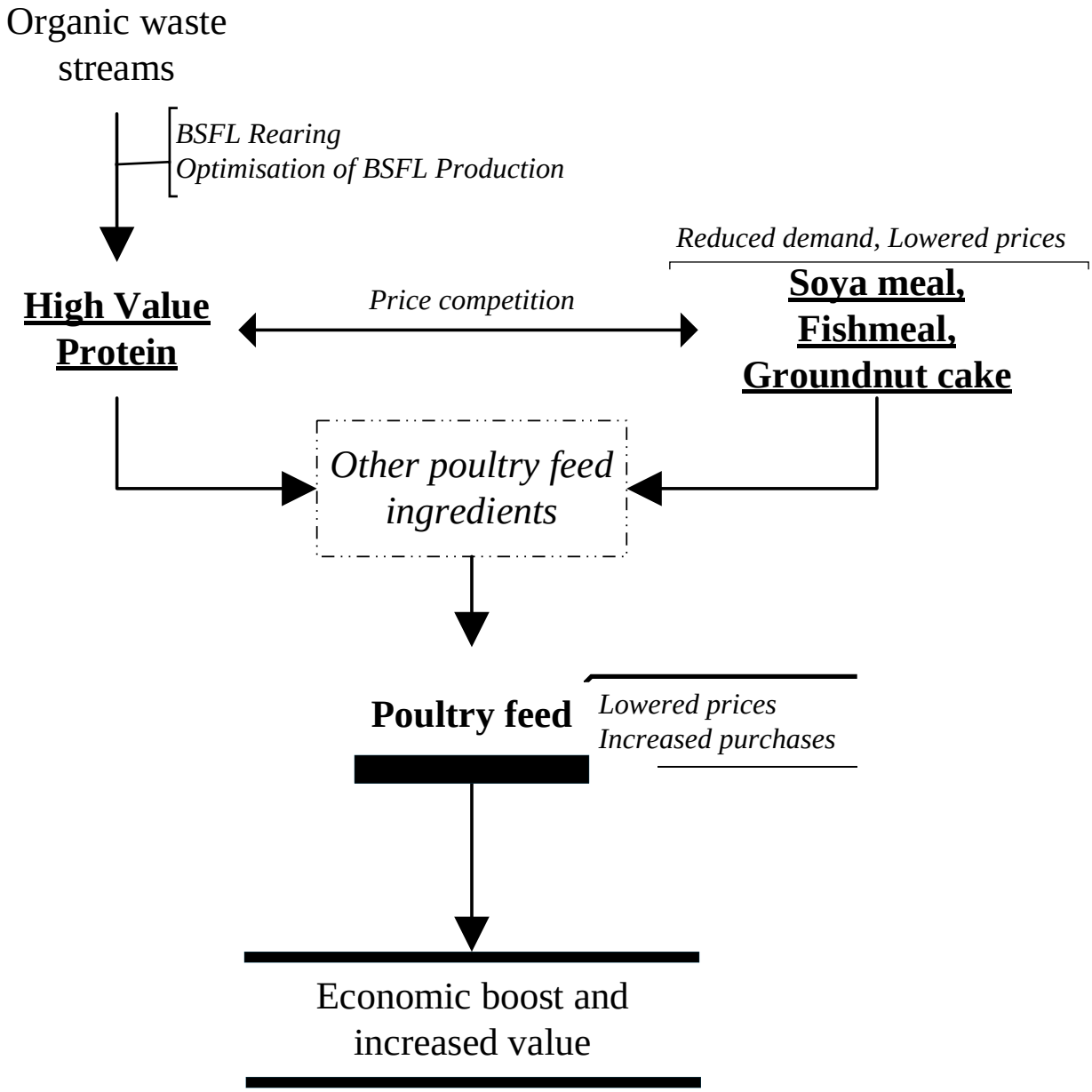
The project seeks to optimize the development of Black Soldier Fly Larvae (BSFL) to enhance yield and nutritional value, standardize production processes for consistent outputs including optimized meal formulations, and establish accessible, low-cost facilities that can be adopted by individuals, SMEs, and industries to drive sustainable poultry feed solutions in Nigeria.

Objectives:

1. To develop and validate standard operating protocols (SOPs) for BSFL meal production by month 12, with documented consistency in proximate composition (≤5% variation in protein and lipid content).
2. To formulate and test nutritionally balanced poultry feed prototypes incorporating optimized BSFL meal, in combination with other locally available agro-waste–derived ingredients, by month 15.
3. To conduct controlled poultry feeding trials over 6–9 months, evaluating growth performance mortality rate and health indices.
4. To design and validate a commercialization and scaling model by month 24, including cost-benefit analysis, market adoption projections, and partnership frameworks for nationwide rollout.

1.4 Conceptual/Theoretical Framework

The project integrates waste valorisation, feed innovation, and eco-friendly practices to deliver a sustainable poultry feed system, targeting an economically and ecologically viable alternative with optimized meal formulations.



It should be noted that the project does not seek a <u>superior</u> product outright. Instead, the target is an <u>economically</u> and <u>ecologically</u> viable alternative.

2.0 Technology Readiness Level (TRL)

BSFL use in poultry feed is at TRL 6, with practical application by farmers but lacking standardized, repeatable methods, risking wastage and profit loss. This project, validated at a laboratory scale is at TRL 4.

3.0 Methodology & Technical Approach

The project will proceed in four phases over 24 months:

Phase 1: Establishment of BSFL Rearing and Waste-Bioconversion Units (Months 1–6)
In this phase, modular Black Soldier Fly Larvae (BSFL) rearing units will be established at NARICT to convert organic waste into high-value larval biomass. The units will include designated breeding, nursery, production, and harvest zones to ensure efficient flow and management. A starter colony will be developed using proven protocols, while substrates will be standardized and optimized for maximum yield. HACCP-based biosecurity measures will be integrated to minimize contamination risks and ensure safe, sustainable operations. This phase lays the foundation for a replicable system that can be scaled.

Phase 2: Optimization of BSFL Meal Processing and Feed Formulation (Months 4–12)
This phase focuses on processing harvested BSFL into meal using low-tech but efficient methods that improve palatability, nutrient retention, and shelf stability. Feed formulations will be optimized by incorporating locally available agro-waste composites such as mango seed kernel (10–20% inclusion) to enhance energy and fibre profiles. Different levels of BSFL meal will be tested to partially or fully replace conventional protein sources such as soybean and fishmeal, while ensuring compliance with national poultry nutrition standards. Activities under this phase will overlap with Phase 1, ensuring continuous improvement and feedback into substrate and rearing practices.

Phase 3: Feeding Trials in Poultry (Months 10–18)

Controlled poultry trials will be conducted with both broilers and layers to evaluate the performance of BSFL-based feeds. Key parameters such as weight gain, feed conversion ratio (FCR), egg production, egg quality, and carcass yield will be assessed. Nutrient digestibility and gut health will be analysed, alongside monitoring of morbidity, mortality, and antimicrobial effects. Statistical analysis will be applied to determine significance and provide evidence for scalability and adoption by poultry producers.

Phase 4: Standardisation, Validation, and Commercialisation (Months 16–24)

This phase will focus on consolidating the research outputs from previous phases into standardised, validated, and market-ready BSFL products. Standard operating procedures (SOPs) for BSFL rearing, processing, and feed formulation will be documented to ensure consistency, quality, and reproducibility across different production batches. Quality assurance and control measures, including proximate composition, microbial safety, and nutrient retention tests, will be implemented to meet regulatory standards. Pilot-scale production runs will be conducted to validate protocols under semi-commercial conditions, providing data for optimization of yield, cost-effectiveness, and operational efficiency. Parallelly, strategies for commercialisation will be developed, including product packaging, market targeting, regulatory compliance, and stakeholder engagement. Dissemination activities such as training workshops, demonstration farms, and policy briefs will facilitate adoption by farmers, feed producers, and relevant industry stakeholders, ensuring sustainable uptake and impact of BSFL technology.

4.0 Expected Outputs and Method of Dissemination

Expected Outputs	Method of Dissemination	Alignment with Renewed Hope Agenda /NARICT/ NASENI Mandate
1.Standardised BSFL-Based Poultry Feed Formula	Distribution to feed millers, poultry cooperatives, and farmer associations through extension services and NARICT/NASENI innovation hubs.	Reduces reliance on imported soybean/fishmeal, lowers feed cost, boosts poultry productivity, and supports food security.
2. Technical Manuals and Feeding Guidelines	Printed manuals, mobile-friendly e-guides, and workshops for farmers and extension workers.	Promotes knowledge transfer, ensures proper adoption, empowers rural farmers with indigenous technology.
3.Peer-Reviewed Publications and Policy Briefs	Publications in scientific journals; policy briefs shared with Ministries (Agriculture, Science & Tech, Trade & Investment); stakeholder roundtables.	Strengthens evidence-based policymaking, drives inclusion of BSFL feed in national livestock feed policy, and advances Nigeria's bioeconomy agenda.
4.Demonstration Farms and Stakeholder Workshops	Pilot farms in collaboration with cooperatives; hands-on training; farmer field schools; media engagement (radio, TV, social media).	Provides practical proof-of-concept, creates jobs, builds youth/women agripreneurship capacity, and supports waste-to-wealth innovation.

5.0 Expected Impact

The project will transform Nigeria's poultry sector by:

Economic Impact

Reduced feed costs: By replacing 10–20% of imported soybean and fishmeal with BSFL meal, poultry farmers can cut feed expenses, which currently account for 60–70% of production costs.

Job creation: Establishment of modular BSFL units will generate employment, particularly for youth and women, across collection, processing, feed production, and distribution chains.

SME development: Localized BSFL production will enable youth-led agribusinesses, stimulating rural economies and contributing to import substitution in line with the Renewed Hope Agenda.

Environmental Impact

Waste reduction: Organic waste will be diverted from landfills and open dumping into productive BSFL biomass conversion, reducing pollution and greenhouse gas emissions.

Sustainable fertilizer supply: BSFL frass will provide farmers with an affordable, organic alternative to synthetic fertilizers, enhancing soil fertility and promoting climate-smart agriculture.

Circular economy: The project will close nutrient loops by recycling waste into feed and fertilizer, demonstrating an eco-friendly model of resource efficiency.

Food Security and Nutrition Impact

Enhanced poultry productivity: Optimized BSFL feed formulations are expected to maintain or improve growth rates, egg production, carcass yield, and overall flock health.

Protein availability: Increased poultry output will make affordable animal protein more accessible to Nigerian households, addressing nutritional gaps in rural and urban populations.

Resilience: Reduced reliance on volatile foreign exchange and imported protein sources will strengthen national food security.

Scientific and Policy Impact

Standardization protocols: The project will produce validated protocols for BSFL rearing, processing, and feed formulation, guiding future research and commercial ventures.

Evidence base: Data from feeding trials will contribute to scientific knowledge on BSFL applications in poultry nutrition, antimicrobial effects, and gut health.

Policy alignment: Outcomes will inform policymakers on practical strategies for waste management, sustainable livestock feed, and youth engagement in agribusiness.

6.0 Project Team Members and Specialization

Engr. Dr. Kabiruu Muazu	Co-investigator	Chemical engineer
Dr. Abe Ayotunde Sunday	Principal Investigator	Environmental Microbiologist
Dr. Saheed Ademola Ibraheem	Co-Investigator	Biotechnologist
Mr. Idowu Olanipekun	Co-Investigator	Biochemist
Mr. Ogabidu Alexander	Co-Investigator	Entomologist
Mrs. Sangodare Rose	Co-Investigator	Phytochemist
Mrs. Judy Adudu	Co-Investigator	Applied Microbiologist

Mr. Abdulwaliyu Ibrahim	Co-Investigator	Nutritional biochemist
Mrs. Odeke Evelyn	Co-Investigator	Parasitologist

6.1 Track Record and Demonstration of expertise

The National Research Institute for Chemical Technology (NARICT) possesses significant research expertise and facilities relevant to the proposed BSFL project. The institute hosts a fully operational BSF rearing facility capable of producing multiple value-added products, including dried BSFL, BSF eggs, BSFL chitin, BSFL-based fertilizer, and BSFL oil. These facilities have been developed and managed from scratch, demonstrating the institute's long-term experience in BSF research and production.

The project team has also contributed to peer-reviewed publications in this field, reiterating their scientific credibility. Notably, one of the project team members is currently pursuing a Master's degree focused on BSFL, ensuring that the project benefits from up-to-date knowledge and specialized expertise.

The project team comprises researchers with extensive experience in BSFL research and related fields. Team members have contributed to multiple peer-reviewed journals, carried out diverse research projects, and have been actively involved in the development and scaling of NARICT's BSFL facilities. This combination of institutional infrastructure, technical expertise, and documented research outputs positions NARICT to effectively execute and deliver on the objectives of the proposed project.

The Principal investigator - **Dr. Abe Ayotunde Sunday** is a PhD-trained Environmental Microbiologist with over 15 years of experience in microbial ecology, waste bioconversion, and feed safety. He has authored more than 10 peer-reviewed journal publications and currently serves as the Head of the BSFL Unit under Biochemical Division at the National Research Institute for Chemical Technology (NARICT), Zaria, where he oversees the BSFL laboratory and provides leadership for sustainable feed production initiatives. His extensive background in microbial processes and laboratory management positions him as the ideal lead for advancing this BSFL-based feed project.

Engr. Dr. Kabiru Muazu – Chemical Engineer and Process Design Specialist

With over 20 years of experience in chemical process engineering, resource recovery, and pilot plant development, Dr. Kabiru Muazu specializes in translating laboratory research into scalable industrial systems. His expertise in process design, equipment fabrication, and waste-to-resource technologies directly supports the BSFL project by optimizing substrate handling, rearing systems, and processing methods for sustainable and cost-effective feed production.

Dr. Saheed Ademola Ibraheem – Biochemist and Biotechnologist

Dr. Saheed Ademola Ibraheem holds a PhD in Biochemistry with research expertise spanning biochemistry, biotechnology, bioinformatics, and biocatalyst applications. His academic work emphasizes biochemical processes and their translation into practical solutions for nutrition and resource utilization. His combination of scientific expertise and applied knowledge in feed systems positions him as a key contributor to the BSFL project, particularly in guiding nutritional evaluation and feed formulation strategies that align with sustainable livestock production.

Mrs. Rose Sangodare – Biochemist and Natural Product Chemist

Mrs. Rose Sangodare is a Biochemist with advanced expertise in biochemical analysis and natural product chemistry. She has published extensively on phytochemicals, antioxidants, therapeutic potentials, heavy metal profiling, and hypolipidemic effects. Her notable 2023 publication in the International Journal of Sciences and Applied Research demonstrated the antibacterial properties of BSFL oil, underscoring its potential as an eco-friendly alternative to synthetic products. Within the BSFL project, she contributes skills in extraction, characterization, and bioassays, enhancing biomedical and nutritional applications through optimized protocols and mechanistic insights.

Mr. Ogabidu Alex – Entomologist

Mr. Ogabidu Alex is an entomologist specializing in the rearing and application of Black Soldier Fly Larvae (BSFL). He has served as lead author on peer-reviewed publications, including studies on biomass yield, morphometric traits, and nutrient composition of BSFL cultivated on different food wastes (Ogabidu *et al.,* 2025a) and the evaluation of BSFL oil as a natural antibacterial agent for potential dermatological applications (Ogabidu *et al.,* 2025b). Currently pursuing his Master's degree, his research focuses on BSFL as an alternative protein source in aquaculture feeds. His expertise in insect physiology, rearing systems, and nutritional profiling provides critical support to the BSFL project, particularly in optimizing larval cultivation and expanding applications in animal nutrition and biomedical uses.

Mr. Olanipekun Oladele Idowu – Nutritional Biochemist

Mr. Olanipekun Oladele Idowu is a Biochemist specializing in nutritional biochemistry and food science, with a research focus on natural products and sustainable nutrient sources. His 2025 co-authored publication in the International Journal of Sciences and Applied Research highlighted the antibacterial activity of BSFL oil against key pathogens, linked to its lauric acid content, reinforcing its potential as an eco-friendly alternative to synthetics. He would contributes expertise in nutritional evaluation and processing optimization, supporting the development of safe, effective, and sustainable feed and biomedical applications.

Dr. Abdulwaliyu Ibrahim – Nutritional Biochemist

Dr. Abdulwaliyu Ibrahim specializes in nutrient metabolism, feed evaluation, and biochemical assessment of alternative protein sources in poultry diets. His expertise is crucial for assessing the nutritional quality, digestibility, and safety of BSFL-derived feed ingredients, ensuring that formulations meet the requirements for efficient poultry production and align with sustainable livestock systems.

Mrs. Atabat Judy Adudu – Applied Microbiologist

Mrs. Atabat Judy Adudu is an Applied Microbiologist with experience in agro-waste utilization, microbial processes, and biochemical analysis of value-added products. She contributes to the BSFL project by optimizing the microbial transformation of organic substrates, improving larval growth conditions, and supporting the development of safe, high-quality feed products through microbial monitoring and process validation.

Mrs. Odeke Evelyn Hope – Parasitologist

Ms. Odeke Evelyn Hope is a Parasitologist with expertise in host–parasite interactions, disease ecology, and parasite control strategies. Her background equips her to address the biosecurity and health safety aspects of Black Soldier Fly Larvae (BSFL) production, ensuring that substrates and larvae are free from parasitic contamination that could compromise feed safety. Within the BSFL project, she contributes to monitoring, risk assessment, and preventive measures against potential parasitic transmission, thereby strengthening the reliability and safety of BSFL-derived feed products for livestock and aquaculture.

PUBLICATIONS

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NARICT BSF Facility

BSF Larvae (prepupa)

BSF Larvae

7.0 Sustainability and Commercialisation Plan

The sustainability and commercialization of the proposed BSFL project are central to ensuring long-term impact and adoption. NARICT's existing BSF rearing facility, which already produces dried BSFL, BSF eggs, BSFL chitin, BSFL oil, and BSFL-based fertiliser, provides a strong foundation for continued production beyond the life of the project.

Sustainability will be achieved through the development of standardized rearing and processing protocols that can be replicated at scale. Optimized feed formulations and efficient substrate utilization will reduce operational costs and enhance the economic viability of BSFL products for small- and medium-scale producers. Capacity-building activities, including training workshops for farmers, extension officers, and researchers, will facilitate technology transfer and adoption, ensuring knowledge continuity.

Commercialisation will be pursued through strategic linkages with local agribusinesses, feed producers, and policy stakeholders. BSFL meal for poultry and aquaculture will be packaged and marketed to meet industry standards. Partnerships with regulatory agencies will ensure compliance with quality and safety requirements, while dissemination activities, including demonstration workshops and policy briefs, will increase market awareness and uptake.

8.0 Timeline (24 Months)

Months / Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Establishment of BSFL Rearing and Waste-Bioconversion Units	■	■	■	■	■	■																		
Optimization of BSFL Meal Processing & Feed Formulation							■	■	■	■	■	■												
Poultry Feeding Trials													■	■	■	■	■	■						
Standardization, Validation, and Commercialization																			■	■	■	■	■	■

9.0 Monitoring and Evaluation

The project will adopt a robust Monitoring and Evaluation (M&E) framework to ensure accountability, track progress against milestones, and measure impact in line with food security, economic, and environmental objectives. Regular monitoring will be conducted quarterly, with mid-term and end-of-project evaluations to inform scale-up and policy engagement.

9.1 Key Performance Indicators (KPIs)

The following measurable indicators will guide performance tracking and impact assessment:

1. BSFL biomass yield per waste unit – Quantifying larval production efficiency per kilogram of organic waste processed, ensuring productivity benchmarks are met.
2. Protein content of optimized BSFL meal – Laboratory analysis of crude protein, amino acid profile, and lipid content to confirm nutritional quality for feed substitution.
3. Poultry performance outcomes – Monitoring weight gain, feed conversion ratio (FCR), egg production, mortality, and morbidity during feeding trials.
4. Waste diversion tonnage – Measuring the volume of organic waste converted into BSFL biomass and frass, supporting environmental sustainability reporting.
5. Feed cost reduction (target: 40%) – Comparing feed costs before and after BSFL substitution to confirm economic viability for farmers, adoption rate of improved BSFL rearing practices among stakeholders.
6. Number of laboratory analyses successfully completed (proximate, microbial, and chemical), standardization of protocols for BSFL rearing and meal production, peer-reviewed reports, technical manuals, or SOPs developed.
7. Timely completion of project phases according to the proposed timeline, adherence to safety, biosecurity, and quality standards (QA/QC), effective utilization of project resources within budget.

9.2 Risk Management Plan

A proactive risk management strategy will be implemented to anticipate and mitigate potential threats to project success:

1. Biological Risks

Risk: Disease outbreak among BSFL colonies or trial animals.

Mitigation: Strict biosecurity protocols will be implemented, larvae and trial animals will be regularly monitored, infected batches will be isolated, and proper hygiene will be maintained in all rearing and experimental areas.

2. Substrate and Feed Supply Risks

Risk: Inconsistent availability or quality of organic substrates for BSFL rearing.

Mitigation: Multiple reliable substrate sources will be identified, substrates will be properly stored, and collection and preparation schedules will be maintained to prevent shortages.

3. Equipment and Facility Risks

Risk: Equipment breakdown or inadequate facility conditions affecting BSFL rearing or processing.

Mitigation: Preventive maintenance will be conducted on all critical equipment, backup systems will be provided, and facility upgrades will be completed prior to trials.

4. Data Quality and Research Integrity Risks

Risk: Inaccurate data collection or analysis leading to unreliable results.

Mitigation: Standardized protocols will be used, personnel will be trained on data recording, duplicate measurements will be performed, and regular audits of experimental and analytical data will be conducted.

5. Human Resource and Operational Risks

Risk: Delays due to limited trained personnel or coordination issues.

Mitigation: Activities will be scheduled in advance, staff and collaborators will receive targeted training, and clear roles and responsibilities will be established.

6. Environmental and Safety Risks

Risk: Accidental release of BSFL or contamination during trials.

Mitigation: Containment protocols will be followed, waste will be properly disposed, and adherence to environmental and occupational safety standards will be ensured.

7. Financial Risks

Risk: Budget overruns or unanticipated costs.

Mitigation: Contingency funds will be allocated, expenditures will be regularly reviewed, and procurement plans will be adjusted as needed.

8. External and Policy Risks

Risk: Regulatory or policy changes affecting BSFL rearing, feed approval, or dissemination activities.

Mitigation: Close communication with regulatory agencies will be maintained, compliance with NAFDAC and other relevant authorities will be ensured, and project activities will be adapted if regulations change.

10.0 Project Budget and Justification

Category	Description	Estimated Cost (₦)
Infrastructure Upgrade	Renovation of NARICT building (ventilation, drainage, electrical, biosecurity measures)	**₦10,000,000**
Equipment and Facilities	Rearing units, substrate processors, dryers, grinders, pelletisers, lab instruments (proximate analysis, microbiology, moisture analyser)	**₦60,000,000**
Research and Field Trials	Substrate optimisation, feed formulation, feeding trials (fish/poultry), lab analysis, performance monitoring	**₦40,000,000**
Capacity Building	Training and skill enhancement for project team members (BSFL rearing, feed formulation, Quality assurance and quality control, lab analysis), including workshops, exposure visits, and development of technical manuals.	**₦12,000,000**
Utilities and Consumables	Power, water, substrates, feed production consumables, lab reagents	**₦15,000,000**
Monitoring, Evaluation QA/QC	Protocol validation, feed safety certification, external evaluation	**₦10,000,000**
Dissemination and Outreach	Farmer demo days, stakeholder workshops, conferences, policy briefs, knowledge products	**₦30,000,000**
Logistics and Transport	Local travel, sample collection, field visits, light vehicle for BSFL/logistics	**₦8,000,000**
Contingency (3%)	Inflation buffer and unforeseen needs	**₦5,500,000**
Total		**₦190,500,000**

10.1 Budget justification

Infrastructure Upgrade

Although NARICT provides an existing building, modest renovation is required to make it suitable for BSFL rearing. Improvements in ventilation, drainage, electrical fittings, and biosecurity are critical to ensure hygienic and efficient operations.

Equipment and Facilities

Specialized equipment is central to the project's success. Rearing units, substrate processors, dryers, grinders, pelletizer, and laboratory instruments are needed to rear larvae at scale, process them into meal, and analyze nutritional and microbial quality.

Research and Field Trials

Substrate optimization and animal feeding trials are essential to validate BSFL as a sustainable protein source. Costs cover experimental feed production, laboratory analysis, and monitoring performance in fish and poultry.

Capacity Building

This is important to enhance the team's technical expertise in BSFL rearing, feed formulation, and quality assurance through workshops, exposure visits, and development of SOPs, ensuring effective project delivery and future scalability.

Utilities and Consumables

Continuous supply of electricity, water, substrates, feedstock, reagents, and consumables is required to sustain rearing, processing, and analytical experiments throughout the project.

Monitoring, Evaluation and QA/QC

Rigorous monitoring ensures delivery of project outputs. QA/QC activities such as feed safety certification and independent evaluation provide credibility and compliance with regulatory standards.

Dissemination and Outreach

Results will be communicated through farmer demonstration days, stakeholder workshops, conferences, and policy briefs to promote uptake and inform policy directions.

Logistics and Transport

Local travel, field visits, sample collection, and a light project vehicle are necessary for efficient movement of substrates, larvae, and personnel during implementation.

Contingency (3%)

A modest buffer to accommodate inflation and unforeseen costs ensures smooth project execution without budgetary disruption**.**

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