



INNO
ECOFOOD



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EDITOR'S NOTE

Dear Readers,

The last six months of 2025 marked an important phase in the progress of the INNOECOFOOD project as partners across Africa and Europe continue to advance innovations for sustainable aquaculture and circular bioeconomy solutions. In this issue, we highlight the steady progress in the construction and operationalization of ECOHUBs in Egypt, Ghana, Kenya, and Tanzania, which are being established as centers for production, research, training, and community engagement powered by renewable energy and supported by AI and IoT technologies. These facilities are expected to play a central role in demonstrating climate-smart aquaculture and innovative food production systems.

This edition also presents key updates from our work packages, showcasing the scientific and technological milestones achieved so far. Significant advances have been made in optimizing spirulina strains for sustainable production, scaling up insect farming for feed and food applications, and testing innovative fish diets that incorporate spirulina and black soldier fly as alternatives to fishmeal. In parallel, partners have made progress in developing value-added products such as biscuits, bhajia and nutrient bars using fish, spirulina, and insect ingredients, demonstrating the practical application of circular bioeconomy principles.

Beyond research and field implementation, INNOECOFOOD continues to strengthen its visibility and partnerships through global and regional platforms. This issue features highlights from key dissemination events including the Jinja Fish Festival 2025 and National Aquaculture Meeting (ENAU25) where project innovations and research findings were shared with scientists, policymakers, and industry stakeholders.

As the project moves further into its third year, the focus will shift toward completing ECOHUB infrastructure, scaling up production trials, and launching training activities aimed at empowering youth, women, and rural communities across participating countries. With strong collaboration among partners INNOECOFOOD remains committed to building resilient, sustainable, and nutrition-sensitive food systems for Africa and beyond.

Happy reading!

Warm regards,

Editors Team

Disclaimer!

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or UKRI. Neither the European Union nor UKRI can be held responsible for them.

Foreward

As the INNOECOFOOD project reaches the 24-month milestone, we are encouraged by the significant progress made across our consortium in advancing sustainable aquaculture and circular bioeconomy innovations. Over the last 6 months of 2025, partners have intensified efforts on the establishment of the ECOHUBs and Living Labs that will serve as centers for research, demonstration, training, and community engagement across project areas in six countries in Africa. These hubs are designed to integrate aquaculture production, spirulina cultivation, and insect farming with clean energy and digital technologies, creating practical solutions for resilient and nutrition-sensitive food systems.

A major achievement has been the steady advancement in the construction and installation of ECOHUB infrastructure. In Kenya, the ECOHUB is nearing completion with Recirculating Aquaculture System (RAS) equipment installed, fish production tanks and nursery areas operational, and spirulina production ponds and insect rearing facilities approaching completion. Egypt has also recorded substantial progress with fish processing structures and spirulina units nearing finalization, while construction in Ghana and Tanzania continues to advance. In parallel, Living Labs and aquaculture cages are being installed across partner sites to enable real-time monitoring of production and water quality through AI and IoT technologies.

Across the technical work packages, the project is generating promising results in sustainable aquaculture production. Feed innovation trials using spirulina and black soldier fly as alternatives to fishmeal have demonstrated strong growth performance and improved resilience of tilapia under environmental stress. Significant progress has also been achieved in spirulina research, with multiple strains identified and characterized from African lakes, and scale-up production underway to support future food and feed applications within the ECOHUB systems.

Advances in insect production and circular bioeconomy practices are equally noteworthy. Optimized feeding substrates derived from agricultural by-products are enabling efficient production of black soldier fly larvae, mealworms, and locusts, while pilot facilities are nearing operational readiness. At the same time, partners are developing value-added products such as biscuits and nutrient bars that combine fish, spirulina, and insect ingredients. These innovations demonstrate the potential of upcycling fish by-products and locally available resources into nutritious food products that contribute to both economic opportunities and environmental sustainability.

Looking ahead, the coming phase of the project will focus on operationalizing ECOHUB facilities, launching training programs, and strengthening dissemination efforts to ensure that innovations reach communities and farmers, especially youth and women across participating countries. With continued collaboration among partners and the support of the European Union and UKRI, we remain confident that INNOECOFOOD will deliver lasting impact by empowering communities, strengthening local food systems, and advancing sustainable aquaculture across Africa.

António Marques
Project Coordinator

Mariana Palma
Project Manager

Notable Events

In the last 6 months of 2025, the 2nd year of INNOECOFOOD Project, the consortium members continued to push the implementation, with eye fixed on the goal of establishing innovative ECOHUBS and living labs to improve local aquaculture using AI and IoT in six African countries; Egypt, Ghana, Kenya, Namibia, Tanzania and Uganda. Tremendous outcomes are being achieved, some, which were presented at a number of national and international conferences amid July and end of December 2025.

This ensured that project innovations, research findings and best practices reach their different stakeholders including farming communities and youths, policymakers, scientists, and international collaborators through participation in regional conferences, and high-level scientific forums. In forging ahead the project mission, our partners continue to foster local innovations co-created with local communities, and amplifying visibility across Africa and Europe. Here are some of the events INNOECOFOOD took part in:

INNOECOFOOD at Jinja Annual Fish Festival 2025, Uganda

On 6th and 7th December 2025, the INNOECOFOOD Project was proudly featured at the Jinja Annual Fish Festival held at Across the Nile Resort in Njeru Municipality, along the scenic banks of the River Nile. Represented by our partners at Makerere University, the project seized this vibrant platform to disseminate its latest innovations and share impactful outcomes with a diverse audience of researchers, farmers, private sector actors, policymakers, and the general public.

The Jinja Annual Fish Festival is renowned for celebrating diverse and innovative fish cuisines while fostering knowledge exchange and raising awareness on developments around Lake Victoria. This year, the Makerere University team showcased innovative baked products including **Fish Bhajia** and **The Fish Bar**, developed using dried fish, spirulina, and insect powders. These nutrient-rich snacks demonstrate the potential of sustainable protein alternatives while promoting value addition across fish, spirulina, and insect value chains.

By highlighting both the nutritional benefits and economic potential of these innovations, the team emphasized opportunities for farmers and entrepreneurs to engage in aquaculture diversification and sustainable agribusiness. We extend our sincere appreciation to Makerere University for their commitment to advancing research-driven solutions that strengthen sustainable food systems and promote the blue economy.



Makerere team showcasing fish bhajia and fish bar products to the festival participants at their booth. Photo: Makerere University.



The Fish Bar containing Spirulina, Cricket powder and Tilapia. Photo: Makerere University



Fish Bhajia containing Spirulina, Cricket powder and Tilapia. Photo: Makerere University

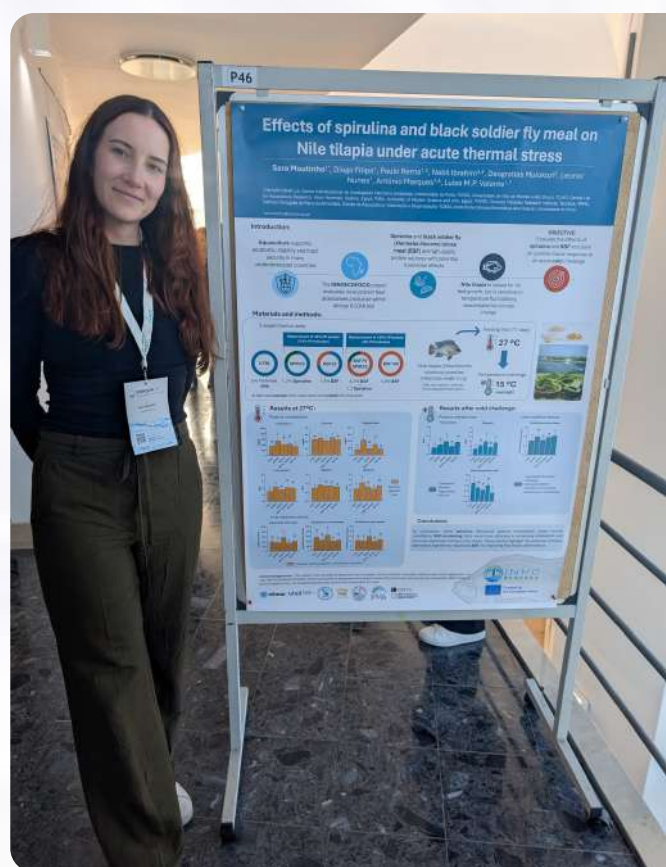
National Aquaculture Meeting (ENAU25): Poster Presentation on Sustainable Feed Solutions for Aquaculture, Portugal

We are pleased to share the successful dissemination of INNOECOFOOD research at the National Aquaculture Meeting (ENAU25), held on 27th–28th November 2025 at the University of Algarve in Faro, Portugal. During the event, our partner Interdisciplinary Centre of Marine and Environmental Research (CIIMAR) – presented a scientific poster titled ***“Effects of Spirulina and Black Soldier Fly Meal on Nile Tilapia under Acute Thermal Stress,”*** highlighting key findings from Work Package 3.

The study explores the use of insect meal and spirulina as innovative and sustainable feed ingredients, demonstrating their potential to enhance the resilience of Nile tilapia juveniles under thermal stress, a growing challenge in aquaculture due to climate change. The research contributes to INNOECOFOOD’s broader mission of strengthening sustainable, climate-resilient, and self-sufficient aquaculture systems, particularly in vulnerable regions.

The presentation attracted a diverse and highly engaged audience, including researchers from national institutions, PhD and Master’s students, representatives from private

aquaculture and feed companies, as well as innovationecosystem stakeholders and SMEs. The session sparked meaningful discussions on the practical applications of novel feed solutions, their relevance to African aquaculture communities, and their role in advancing feed self-sufficiency and climate resilience.

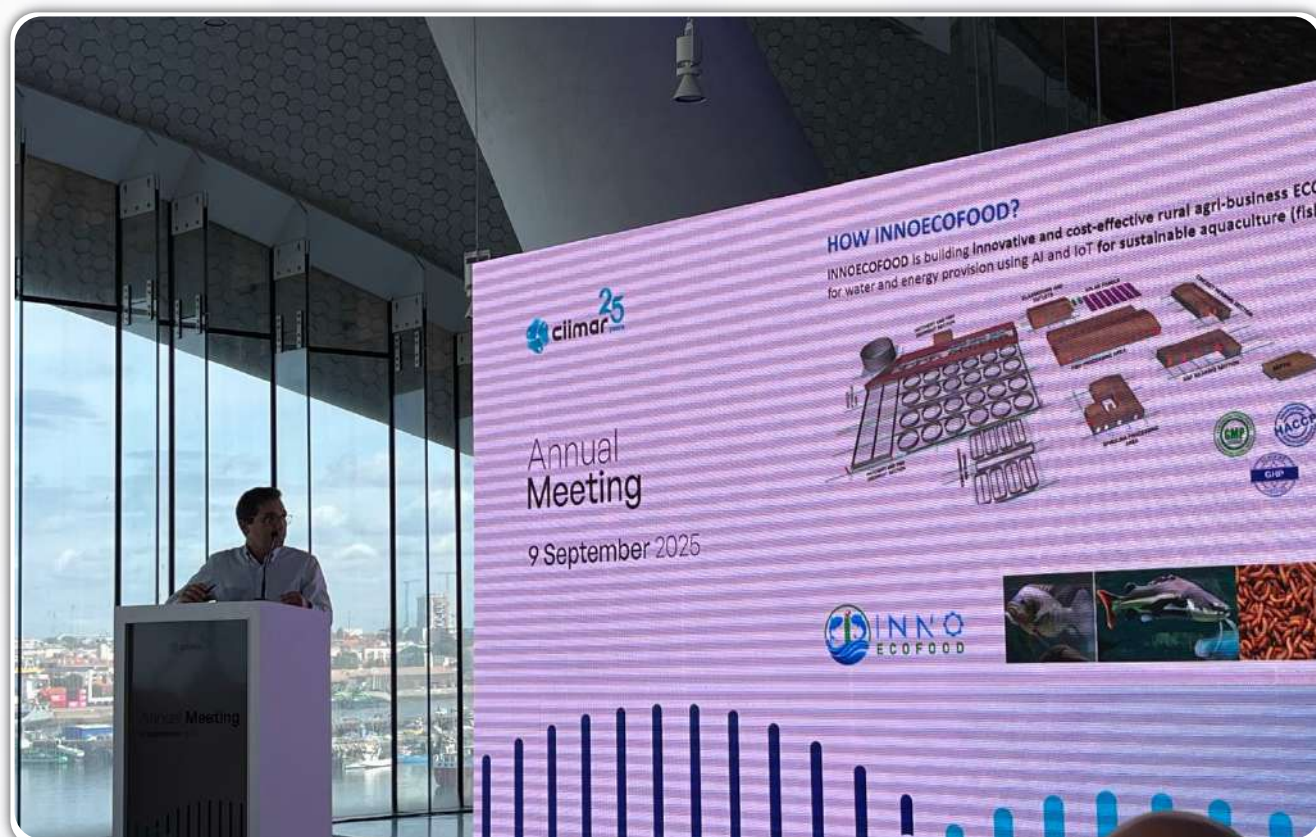


Sara Moutinho at the ENAU25, Faro, Portugal

CIIMAR Annual General Meeting, Portugal

At the CIIMAR Annual General Meeting held on 9th September 2025 in Porto, Portugal, INNOECOFOOD Project Coordinator António Marques presented the significant progress achieved since the project's kick-off toward transforming food systems in Africa. The presentation highlighted the development of four ECOHUBs as innovation centers for sustainable aquaculture, alongside the rollout of AI- and IoT-powered Living Labs designed to drive efficient and environmentally friendly production systems.

Key advancements also include the development of novel feeds and foods from sustainable catfish and tilapia diets to spirulina and insect-based protein innovations, aimed at strengthening feed self-sufficiency and resilience. Beyond technological innovation, the project continues to catalyze community transformation by supporting rural economies, creating employment opportunities, and promoting more sustainable use of water resources.



INNOECOFOOD Project Coordinator António Marques presenting the significant progress achieved at the CIIMAR Annual Genral Meeting 2025 in Porto, Porugal.

Updates from Work Packages

Work package 1: project management

During the second year of the INNOECOFOOD project, the consortium continued to achieve important progress towards the project's goals, strengthening our commitment to the deployment of ECOHUBs as a sustainable and innovative approach for the African's agri-food sector. The construction of ECOHUBs is now in the final stage in two countries - Egypt and Kenya, and progressing in Ghana and Tanzania, being expected in April and July, respectively. These ECOHUBs will soon operate as main demonstration sites for sustainable production and processing practices of fish, insects and spirulina under the circular economy concept in the agri-food sector through collaborative approaches. The Living Labs are also in their final stage of implementation, being expected to start collecting production and water quality data in the coming months.

INNOECOFOOD was promoted, and results presented in several events, including the National Aquaculture Meeting (ENAU25), held by CIMAR-LA in Faro, Portugal. The events offered valuable chances to share our preliminary findings, discuss ideas, receive feedback, and reinforce our network of collaborators and stakeholders.

A relevant event was the 18-month consortium meeting held in July 2025 in Kisumu, Kenya and organized by KMFRI partners. This meeting brought together all project partners, with a notable group of 50 participants attending in person, alongside additional participants joining online. The event included a visit to the local ECOHUB, allowing partners to experience in firsthand the innovative work being carried out. More recently, the project 24-month consortium meeting was hosted by CSIR-FRI in Accra, Ghana, where more than 30 partners were able to visit the ECOHUB and living lab facilities under construction. This enabled INNOECOFOOD partners to share experiences, review progresses, prepare reports, and organize the activities for the last phase of the project. The meeting also included visits to the and Ghanaian partners' research facilities.



INNOECOFOOD Project Coordinator António Marques facilitating discussions during the 18-month Consortium meeting in July 2025 at Kisumu, Kenya

Work package 2: establishing ECOHUBs and living lab cages in African countries

The ECOHUB installations in diverse African countries are at various completion levels. In **Kenya**, the ECOHUB being installed in led by KMFRI is about 95% accomplished, with training/class room, reception & processing areas completed. The RAS equipments installations for fish production has been completed and Spirulina production ponds and green house almost accomplished. Insects' production and processing areas are at 95% to accomplishment. The ECOHUB fencing and landscaping works ongoing and reported to be 90% accomplished.

The **Egypt** ECOHUB installation led by CLAR is about 85% accomplished. Fish Processing Building structure and installation of electrical cables done, and awaiting painting and the installation of doors and windows. However, the IPRS Construction is almost complete (at 85%), while the Spirulina production unit is in place pending renovation works (80%).

The ECOHUB installation in **Ghana** led by CSIR is at 80% accomplished. Fish production and processing areas, and training area buildings accomplished pending plastering and windows/doors fixing (at 85%). The RAS/hatchery equipments for fish production tendered for supply and installation. In Tanzania construction is still in progress.



Kenya Recirculating Aquaculture System (RAS) installed with equipments (Top left “fish production tanks”, top right “nursery area/fingerlings production area: bottom left “RAS operating machines”: bottom right “spirulina production ponds”.

Work package 3: ECOHUBs eco-farmed fish, feed and post-harvest technologies and living lab cages

Construction of the four ECOHUBs advanced substantially, with key milestones reached in Egypt (100% completion of IPRS civil works), Ghana (70% completion of hatchery and grow-out facilities), and Tanzania (pond excavation completed). Living Lab aquaculture cages were installed or nearing completion in Ghana and Uganda, with IoT-enabled aquaponics systems acquired in Namibia and sites secured in Tanzania.

In feed innovation experimental diets replacing fishmeal with black soldier fly (BSF) and spirulina demonstrated promising results: no compromise in growth performance or nutrient digestibility, improved immune response under temperature stress, and enhanced fillet stability.



Fish cages ready for mounting at Lake Volta

Work package 4: optimization of production of selected spirulina species and processing

At Month 24, work package 4 has achieved important scientific and operational milestones in the selection, characterization, and optimization of spirulina strains across ECOHUB countries. Extensive field sampling and laboratory analyses led to the identification of 11 spirulina strains at genus level, with nine strains isolated in Kenya, five in Tanzania, and one in Egypt, while further characterization is ongoing. Advanced phenotypic

Updated economic assessments using localized price data from Kenya and Ghana further strengthened the case for BSF as a viable and sustainable alternative protein source.

Progress was also recorded in post-harvest and processing technologies, including successful test runs of the multipurpose dryer (MPD) systems, integration of AI-powered data platforms, and preparation for installation of green-energy-powered ice machines at ECOHUB sites.

Spirulina inoculum was distributed to partners to accelerate local production, while insect production strategies were refined to address seasonality and scaling challenges. With training strategies, baseline surveys, and dissemination activities advancing in parallel, the project continues to move steadily toward its goal of delivering climate-smart, economically viable and nutrition-sensitive aquaculture solutions for African communities.



Fish cages at Kamos Fish Farm, Lake Victoria

and molecular analyses — including microscopy, PCR sequencing, and BLAST marker identification — have confirmed strain identity, with whole genome sequencing underway for selected samples to differentiate taxa at species level. These efforts lay the foundation for selecting the most suitable spirulina strains for sustainable production within the ECOHUBs.

Significant progress has also been made in scaling up production and processing. Selected strains have been cultivated from laboratory monocultures to 5L and 15L systems, enabling powder production for food toxicity and nutrient quality analysis. Initial batches have been sent for

toxicity testing, while protein, phycocyanin, lipid, and fatty acid analyses are ongoing to assess nutritional value. Despite challenges such as slow growth rates in newly isolated strains and procurement delays, production optimization continues steadily. In parallel, commercial spirulina inoculum has been distributed to

ECOHUB partners to accelerate local production while strain selection is finalized. These milestones strengthen INNOECOFOOD's ambition to integrate high-quality, locally adapted spirulina into sustainable aquaculture feeds and food products, contributing to resilient and nutrition-sensitive food systems in Africa.



Scale-up Production (5L)



Multi-cultivator for Growth Performance Analysis

Work package 5: optimization of selected insect species production and post-harvest

In work package 5, significant progress has been made in optimizing insect production. Mapping of feeding substrates was completed across partner sites, identifying optimal wastes like brewers grain, aquaculture sludge, and chicken droppings. In Kenya, *icipe* and JKUAT achieved enhanced black soldier fly (BSF) larval weight gain (up to 0.45g/larva) and survival rates (95%) using 50% sludge mixes, while mealworm growth accelerated by 17% with 25% chicken droppings amendments, yielding high-protein outputs (48-57%). Desert locust feeds incorporated 70% *Parthenium* for improved nutrition. Facilities reached 90% completion in Siaya County, with Tanzania's UDSM constructing customized BSF units using kitchen leftovers and manures, and Ghana's CSIR-FRI establishing a pilot BSF farm ahead of ECOHUB operations.

Sustainable harvesting and processing milestones include innovative trapping methods for wild insects, with blue and white bulbs proving most effective (up to 77% capture rates) in choice assays, and designs tested for grasshoppers in Uganda. Insect powders from optimized diets showed strong nutritional profiles, such as 44-58% protein in locusts, crickets, and BSF. Packaging trials evaluated aluminum and paper for quality preservation, while ongoing safety assessments and product development aim to support fish feed and human food applications, overcoming construction delays to commence full production soon.



Completed BSF production unit at Kunduchi, UDSM

Work package 6: up-cycling waste nutrients from fish by-products, spirulina and insects

The aim is to use fish co-products from work package 2 to reduce waste and contribute to the circular economy. Recovered fish flesh (Catfish and Tilapia) from frames is being processed to make traditional products like porridge, biscuits, soups and infant foods, in combination with local staple plant products (cassava, sweet potato, millet) and novel products like spirulina (work package 4) and insects (work package 5).

Results: JKUAT has produced extruded cricket powder which has been used to make new products like porridge (JKUAT), and soups (Makerere University) and (CSIR-FRI), biscuits (PECHE, CSIR-FRI), bread rolls (PECHE), bread (*icipe*) and nutrient bars (Makerere University). Nutricalc software was used to design the products. Preliminary quality control analyses indicate acceptable products with higher protein content and that are safe both chemically and microbiologically. Shelf-life studies are underway. A manual of methods used in WP6 entitled **'Manual for Product Development, Characterisation and Functionality of Products'** was compiled earlier and is being used for product development and functional testing.



Nutrient bars containing tilapia fish, cricket powder and sweet potato by Makerere University



Biscuits containing spirulina powder by CSIR-FRI



Bread rolls with cricket powder by PECHE

A selection of products made from staples and fish, cricket or spirulina powders in Africa



Trial products produced on a new twin screw extruder system by UNAM

Progress has been made in sustainable drying technologies that use AI sensors and IoT. A cheap solar powered Sparky drier with AI sensors and IoT has been supplied to CSIR-FRI and a walk-in prototype is being constructed for MAK. Single screw extruders are being used for making food powders containing fish, spirulina and insects by UNAM and JKUAT. A twin-screw extruder has been designed and built by CFAM Int, South Africa. Factory acceptance test have been completed and delivery, installation and commissioning at UNAM, in a refurbished housing unit, will take place in January 2026.

Value-added products like hydrolysates were made from Tilapia and Catfish by-products like skin and frames by CIIMAR, using enzymes. Extraction studies on phytonutrients and oil from spirulina and insects have commenced at BMAEU and ICIPE, for human food or as supplements.

Work package 7: validation of quality, acceptance, LCA and certification of products

The key accomplishments include the revision and consolidation of a comprehensive manual for nutritional value, quality, safety, and shelf life of fish, feeds, insects and spirulina products. Advancement on the assessments of smoked catfish fillets have show strong sensory acceptability and microbial safety. Fish silage and bones from catfish were evaluated for composition and safety, confirming microbial

compliance but noting high oxidation in silage; contaminants like mercury, cadmium, and lead remained below limits. Partners in Ghana, Kenya, Uganda, and Namibia conducted proximate, microbiological, mineral, and shelf-life tests on work package 6 products.

Consumer-focused surveys have been collected on fish farmers, consumers and analysis is in progress. Economic assessments have been finalized for tilapia feed trials at CIIMAR, CLAR, and KMFRI. On the other hand certification program groundwork was initiated with extensions requested for delayed activities to ensure full validation.

Work package 8: training and dissemination

The baseline survey reports, looking at assessing knowledge, attitude and practices (KAPs) on the production, processing, marketing and consumption of fish, spirulina and insects; for the four ECOHUBS and living labs in Egypt, Ghana, Kenya, Namibia, Tanzania and Uganda were completed and plans are underway for dissemination and utilization in the training activities.

Rigorous work has been ongoing on the consolidation and designing of the training modules. The modules are at the final stages of development. They will play a key role in training trainers of Trainer of Trainers (ToT) who will transfer the knowledge to farmers targeting 5,000 youths and women. The training will focus on

production, processing, marketing and consumption of fish, spirulina and selected insects and upcycling of wastes. The training will be offered through practical learning tools at the four ECOHUBs in Egypt, Ghana, Kenya, and Tanzania, supported virtually through the Community Virtual Hub, whose development is completed.

Currently, plans for training are underway and will start at different times attributed to the varried rates of completion of the ECOHUBs' construction.

On communication and dissemination, it is an ongoing exercise and we continue to bring you updates and outcomes as they unfold through our various channels, website and social media as well as through high level events and conferences. More research is work in progress. Expect results and publications to start streaming in, in due course.

24-Month Consortium Meeting in Ghana

The INNOECOFOOD consortium's 24-Month Coordination Meeting, held hybrid in Accra, Ghana from 12-14 January 2026 and hosted by CSIR Ghana, marked significant advancements in eco-innovative agroecological food production across Africa. Partners from Africa and Europe reviewed progress across nine Work Packages, highlighting ECOHUB construction nearing completion in Kenya, Ghana, Tanzania, and Egypt; distribution of spirulina inoculums for early production; optimized insect rearing and sustainable harvesting; flagship product development; rigorous quality validation via Food Technical Sheets; capacity-building through Training of Trainers; and ethics compliance with animal welfare training. A key decision was the near-unanimous vote (16-1) for a project extension to finalize infrastructure, research, and training, ensuring sustainable nutrition and market pathways for spirulina, insects, and aquaculture products.

During the meeting, the team visited the Akosombo ECOHUB and Living Lab near Volta River, witnessing a closed-loop system in action: tilapia and catfish ponds with optimized feeds, emerging insectaries for crickets and Black Soldier Flies converting waste to protein, spirulina raceways blending local resources with science, and solar drying/extrusion processing to minimize waste. Interactions with local Ghanaian technicians underscored co-created innovation, skill development, and community benefits, transforming abstract concepts into tangible circular economies. This site fuels future phases, positioning ECOHUBs as catalysts for resilient food systems and entrepreneurship in Africa.

Read more...



INNOECOFOOD at the ECOHUB in Akosombo, Ghana during the 24-month consortium meeting, 12th January 2026

Upcoming Events

The following are some of the upcoming events where INNOECOFOOD partners have shown interest or submitted abstracts for dissemination of project results and showcasing innovation:



Source: eunosunconference.org



8th International ISEKI-Food Conference

 1st-3rd June 2026

 Faro, Portugal





Transforming Aquaculture for Community Empowerment

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Website: innoecofood.eu

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