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

Deliverable D6.3
Initial NESTLER Dissemination and Communication Activities

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DISCLAIMER

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03	RINIGARD DOO ZA USLUGE	RINI	HR
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05	STICHTING IDH SUSTAINABLE TRADE INITIATIVE	IDH	NL
06	ZANASI ALESSANDRO SRL	Z&P	IT
07	AGRIX TECH SARL	AGRI	CM
08	CONSERVATION THROUGH PUBLIC HEALTH	CTPH	UG
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
12	INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE	IITA	NG
13	MANA BIOSYSTEMS LIMITED	MANA	UK
14	UNIVERSITY COLLEGE LONDON	UCL	UK
15	RINISOFT LTD	RINIS	BG

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Definitions, Acronyms and Abbreviations

ACR	Acronym
CA	Consortium Agreement
CM	Communications Manager
EC-GA	European Commission Grant Agreement
DoA	Description of Action
DPO	Data Protection Officer
IM	Innovation Manager
PM	Project Manager
PMT	Project Management Team
TL	Task Leader
ToC	Table of Content
TM	Technical Manager
WP	Work Package
WPL	Work Package Lead
CMT	Communication Management Team

Executive Summary

The dissemination and communication activities of that NESTLER partners carried out during the first 18 months of the project mainly focused on raising awareness about the project, informing the broader audience about the project's goals and objectives as well as communicate the idea of the EU-Africa One Health sustainability partnership.

The website and social media (Twitter and LinkedIn) have been constantly used as the main digital communication and dissemination channels. Several workshops both virtual or hybrid as well as participation in conference, exhibitions and fairs have set the basis for the first 18 months of the project. Additionally, several publications in conference and journals have documented the progress of the project and communicated its advancements to the research and business sector.

1. Introduction

NESTLER is a joint project between the EU and African member states designed to promote One-Health sustainable partnership. The project aims to bring together interdisciplinary technological advances to effectively monitor the well-being of animals, plants, and humans in a holistic approach. The project platform develops software interfaces for ingesting satellite data sources along with video streams captured from unmanned aerial vehicles and other IoT devices installed for monitoring the environmental and animal well-being. The platform's large volume of data will be subjected to additional processing in order to extract intuitive insights using machine learning algorithms and deep-learning network architectures.

D6.3. is implementing the D6.2 “NESTLER dissemination and communication activities plan”, where all the planned means of communication and activities have been presented at the beginning of the project. The current deliverable presents all the communication and dissemination activities of the project during its first 18 months including participation in conferences and fairs, publication, organisation of workshops and stakeholders meeting and digital presence via the website and social media channels of the project. The structure of the document is as follows:

- Section 1 provides a brief introduction to the deliverable and the document's content.
- Section2 presents the online communication channels of the project.
- Section 3 focuses on the dissemination and communication activities such as the participation in conferences and exhibitions as well as the organisation of workshops and stakeholders’ meetings and the publication of the project.
- Section 4 concludes the deliverable.

2. Dissemination & communication material

2.1. Online communication

The online communication includes the project website and the social media, namely the LinkedIn and the twitter

2.1.1. NESTLER website

The NESTLER website (https://www.nestler-project.eu), which was launched in M2, is the central node for all communication and dissemination activities of the project. The website is constantly being updated with new content including publications, public deliverables and news posts.

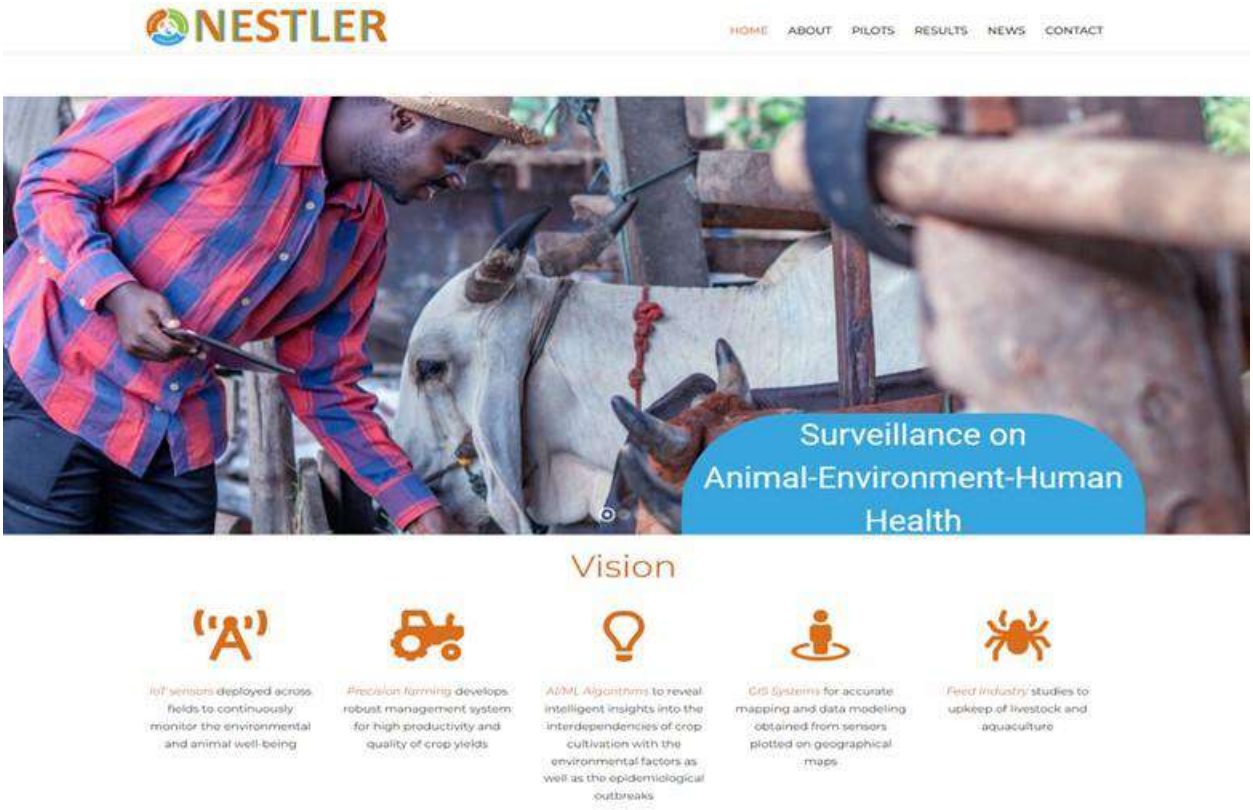


Figure 1: NESTLER Website Homepage

2.1.2. LinkedIn account

The NESTLER LinkedIn page can be found under https://www.linkedin.com/showcase/nestler-project/ and is mainly used to share important findings, news and advancements of the project. It is open to the wider research and agri-business community and with the use of hashtags facilitates the broader communication of the project.

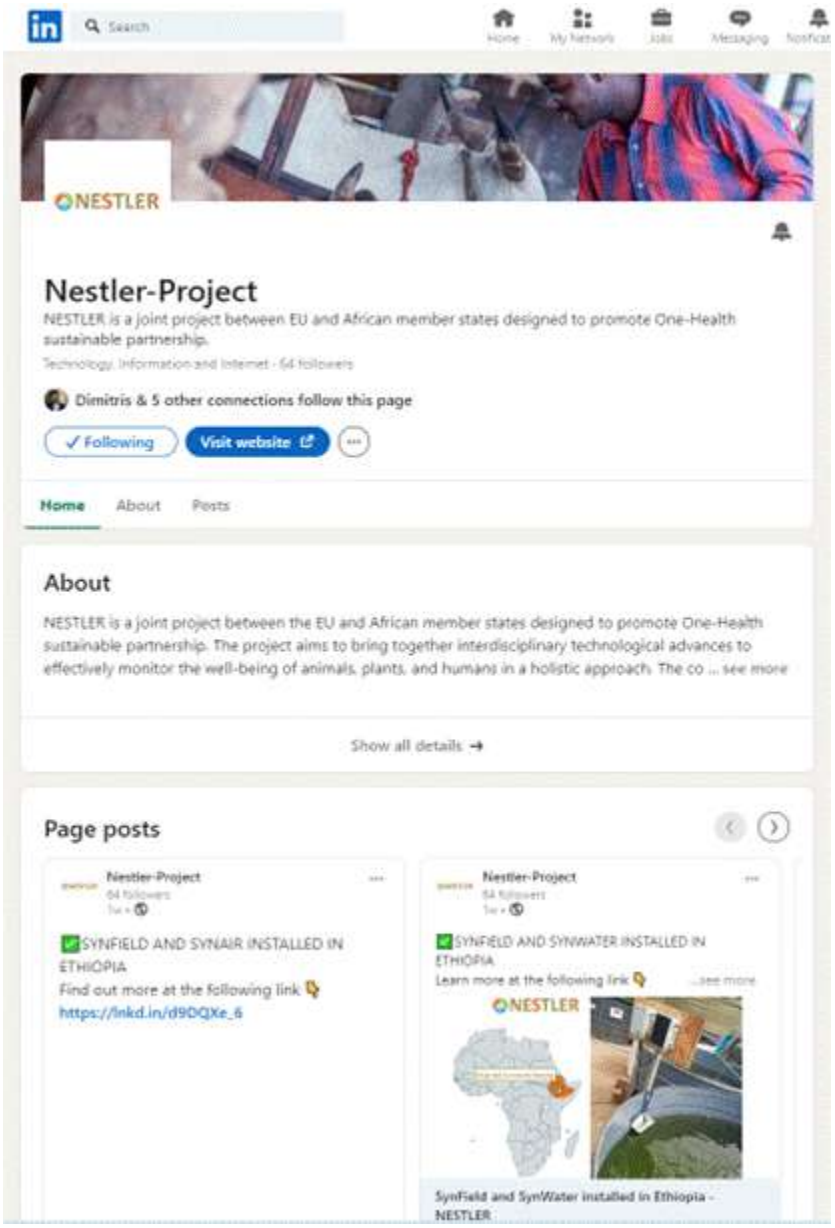


Figure 2: NESTLER LinkedIn page

2.1.3. Twitter account

The NESTLER Twitter profile (https://twitter.com/NestlerProject) was created to communicate in an efficient way the project news and insights related to the technologies and pilots.

Since D6.2, the twitter account has been quite active and now we have 55 followers.

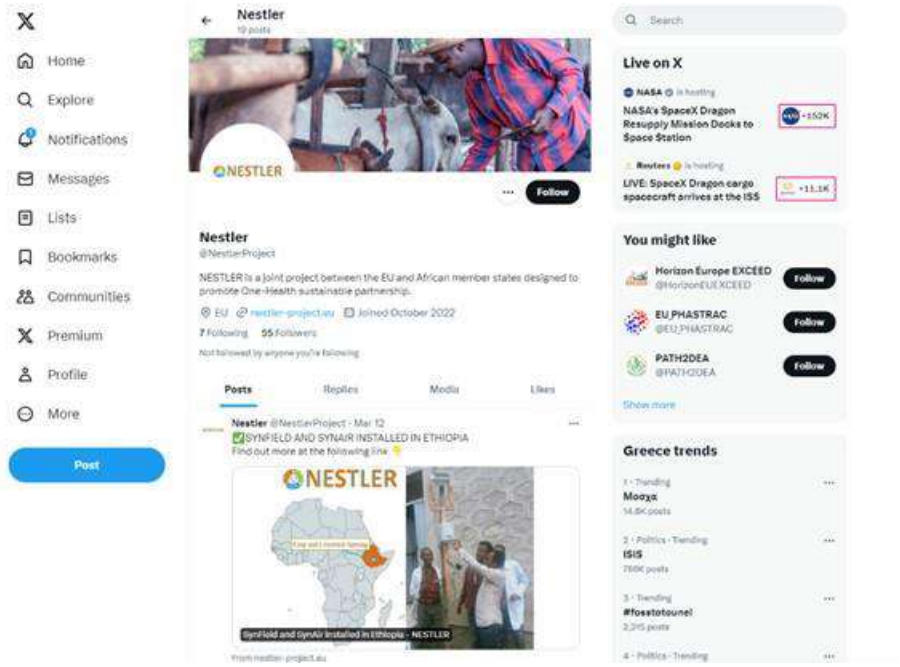


Figure 3: NESTLER Twitter profile

2.1.4. Video/Media material

The media section is instantiated as a NESTLER web page providing video presentations of project pilots and initial demonstrations of the project software tools. All videos have been uploaded at YouTube and available via the page https://nestler-project.eu/index.php/media/

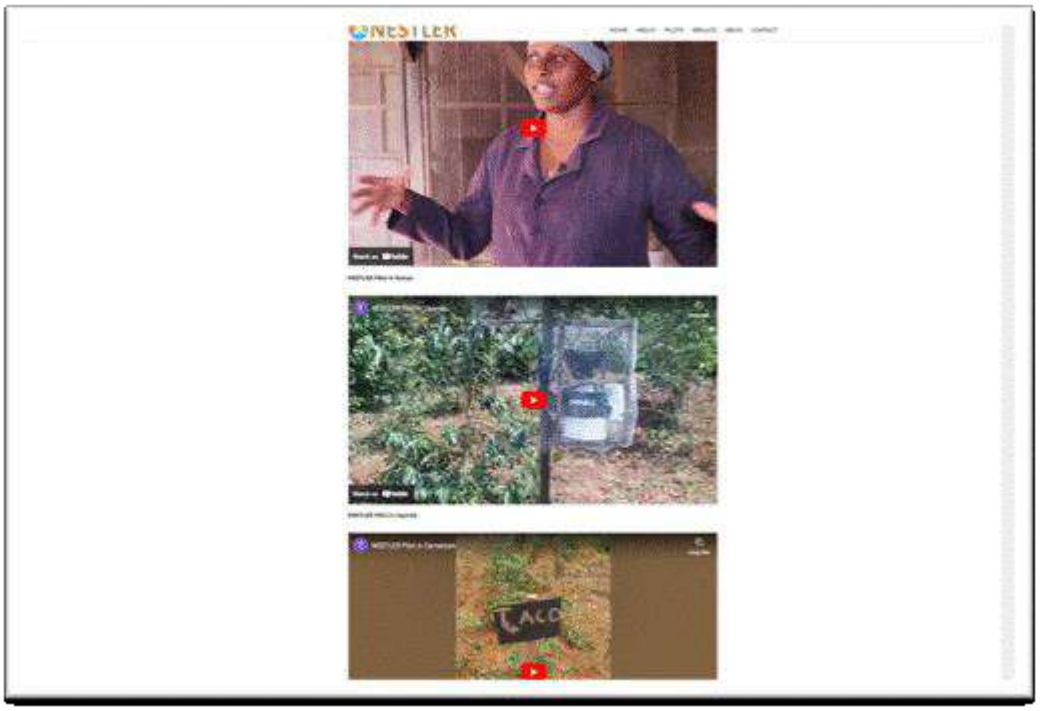


Figure 4 - The "Media" page on the NESTLER website

2.1.5. Website and Social Media Analytics

This section presents the analytics data for the website and associated social media channels of the NESTLER Project. Table 1 presents the visitors and the followers of NESTLER Website, LinkedIn Page and Twitter. Table 2 shows the news that published in NESTLER website and the blog posts on NESTLER LinkedIn Page and Twitter.

Table 1: Visitors and followers of each NESTLER social channel

Channel	Followers/visitors
Website (https://nestler-project.eu/)	>2,100 visitors
LinkedIn Page (https://www.linkedin.com/showcase/nestler-project/)	64 followers
Twitter (https://twitter.com/NestlerProject)	55 followers

Table 2: News and Blog Posts on each NESTLER social channel

Channel	News Posts / Blog Posts
Website (https://nestler-project.eu/)	23
LinkedIn Page (https://www.linkedin.com/showcase/nestler-project/)	27
Twitter (https://twitter.com/NestlerProject)	27

The Figure 5 illustrates the number of visitors to the NESTLER website from October 2022 until March 2024. In total, the website has received 2100 visitors.

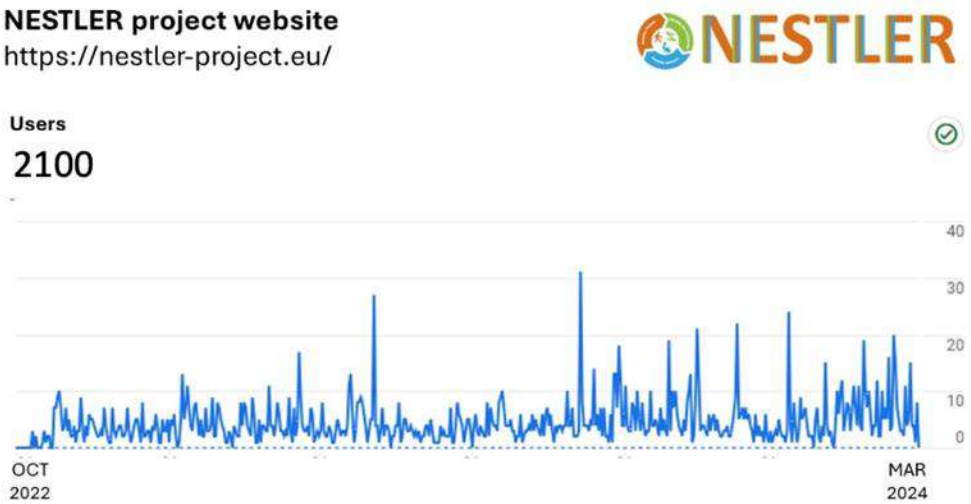


Figure 5: NESTLER website visitors

The image shows a global user distribution map and a table for the NESTLER project website, highlighting the number of users from various countries. The United States leads with 1.2k users, followed by Greece with 202, and other countries like the United Kingdom, Ireland, China, Rwanda, and the Netherlands also contributing to the traffic.

Figure 6: Visitor Distribution by Country for the NESTLER Website

The graph illustrates the impression metrics for the NESTLER LinkedIn page (Mar23 – Mar24). It shows fluctuations over the year, with a peak around September 1st. A total of 3218 impressions were made.

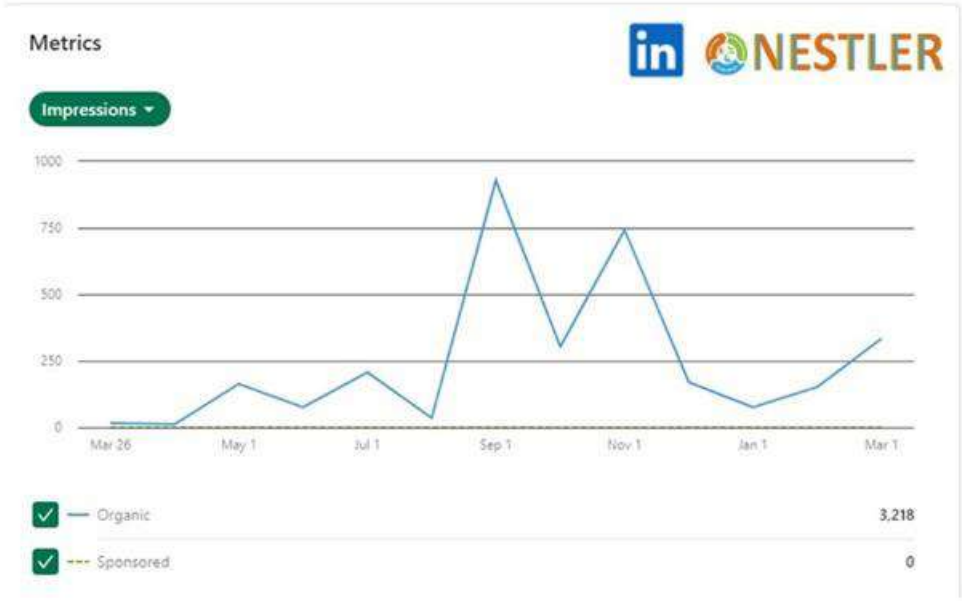


Figure 7: Impressions on the NESTLER LinkedIn page.

2.2. Roll-Up banners – posters

For the dissemination purposes of the NESTLER project, several roll-up banners and posters have been created and utilized throughout the project's communication and dissemination activities. Below you may find examples of such posters.

Figure 8: Roll-up banners created by RAB. (the photo was taken during the visit of the Project Coordinator in NESTLER pilots in Rwanda)

3. Communication Activities

Communication Activities involve promoting the project, the project results and its activities to a broader audience, including the general public. The aim is to raise awareness about the project, its goals, and its potential impact on society. As target audience, we define the general public, the media, educational institutions, non-specialist stakeholders. Tools and Channels for communication are defined a press releases, social media, websites, newsletters, public events, infographics, videos, and other engaging formats[1], [2].

In details, NESTLER consortium has participated at the following events:

3.1. 29th International Fair for Agricultural Machinery, Equipment and Supplies, Greece (AGROTICA 2022)

Agrotica (https://www.agrotica-expo.gr/en/) is a well-established exhibition/fair organized biennially in Thessaloniki, Greece. It is one of the largest events of the agricultural sector focusing on the latest technological and machinery advancements. Apart from the exhibition that showcases a wide range of products and services related to agriculture, it is also a platform for exchanging ideas with the organization of workshops as well as training opportunities, with seminars and presentations by experts in the different fields of interest.

Figure 9: Presentation of the NESTLER project in the 29th International Fair for Agricultural Machinery, Equipment and Supplies Agrotica 2022,

Agrotica is visited by a diverse audience of farmers, agronomist, researchers, business representatives etc. providing great opportunities for companies and research institutions to present their innovations, get feedback and optimize their business to market strategies.

Within the context of the 29th International Fair for Agricultural Machinery, Equipment and Supplies Agrotica 2022 which took place from the 20th to the 23rd of October in the International Exhibition and Conference Centre of Thessaloniki, Greece, SYN presented the NESTLER approach focusing on the Synfield technologies as best practices for smart farming and pest infestation approaches.

[1] European Commission. "Communicating EU research and innovation guidance for project participants." EU Publications.
[2] Horizon 2020 Programme. "Communicating EU research and innovation: a guide for project participants." https://ec.europa.eu/research/participants/data/ref/h2020/other/gm/h2020-guide-comm_en.pdf

Figure 10: Presentation of the SynField technology by Synelixis at the 29th International Fair for Agricultural Machinery, Equipment and Supplies Agrotica 2022,

3.2. 2nd Phytopathology Conference: Protection of cultivated and forest plants, food security and agricultural entrepreneurship, Cameroon

The NESTLER project was also presented in Africa and particularly the **2nd Phytopathology Conference: Protection of cultivated and forest plants, food security and agricultural entrepreneurship** on the 26th and 27th October 2023 in Cameroon, Yaounde. The conference was organized by the University of Yaounde and focuses on the different aspects and challenges of the agricultural sector such as the need for use of biological control methods for pest control, the means and methods for increasing crop quality etc.

AGRI participated in the conference presenting the NESTLER project emphasizing on digital technologies such as AI, satellite data, IOTs, and other digital devices as a solution to addressing several challenges mentioned during the presentations of other participants. Additionally, during the conference the mobile applications for plant disease and pest detection and welfare of chicken was demonstrated to all participants and received positive feedback.

Figure 11: Presentation of the NESTLER project at the 2nd Phytopathology Conference: Protection of cultivated and forest plants, food security and agricultural entrepreneurship, Yaounde, Cameroon

3.3. 30th International Fair for Agricultural Machinery, Equipment and Supplies, Greece (AGROTICA 2024)

The NESTLER project was also presented at the 30th International Fair for Agricultural Machinery, Equipment and Supplies (AGROTICA 2024), which was held from the 1st to the 4th of February 2024 in Thessaloniki. SYN who participated in the project, informed the visitors about the progress of the project and the latest technological advancements of the SynField technologies for collecting sensor data and monitoring field conditions.

Figure 12: Participation of SYN in the 30th International Fair for Agricultural Machinery, Equipment and Supplies Agrotica 2024

3.4. Africa Fertilizer and Soil Health (AFSH) summit

European Union [NESTLER] and Rockefeller Foundation through International Centre of Insect Physiology and Ecology (ICIPE) jointly with the Centre for International Forestry Research and World Agroforestry (CIFOR- ICRAF) organized a side-event during the Africa Fertilizer and Soil Health [AFSH] summit titled "*Agroecological and Regenerative Innovations for Soil Health and Sustainable Production*". This side-event was attended by a total of 114 participants (65 males & 49 females). Ms. Carla Montesi (Director, European Commission's Directorate-General for International Partnerships (DG EU-INTPA) was one of the panellists among others like ICIPE; Regen Organics Limited, Kenya; The Insectary, Kenya; Boston Consulting Group (BCG); CHANZI Ltd, Kenya; InsectiPro Ltd, Kenya; CIFOR- ICRAF and the Rockefeller Foundation. Main recommendations from the side event included:

1) Foster greater collaboration between research and private sector to drive the development and commercialization of organic farm inputs.
2) Advocate for the combined use of organic and inorganic fertilizers for optimal results and conduct proper quality control for –insect frass fertilizers.
3) Drive the co-existence of centralized and decentralized models to achieve a 10% organic fertilizer application within 5 years.
4) Foster the building of a thriving ecosystem focused on collaborations.
5) Incentivize SMEs producing organic fertilizers while promoting environmental sustainability.
6) Policy, financial support and subsidies from governments to propel the organic fertilizer industry.

Figure 13: Photo from Africa Fertilizer & Soil Health Summit, Kenya, including Ms. Carla Montesi (Director, EC Directorate-General for International Partnerships (DG EU-INTPA) (in blue).

Figure 14: Participants at the side-event organized during the Africa Fertilizer & Soil Health Summit, Nairobi, Kenya

The summit brought together some African Heads of State, high-ranking government officials, senior policy makers, private-sector players and civil society organizations. Other participants included representatives of farmer organizations and development agencies, including NGOs, scholars and scientists, and representatives of leading donor organizations.

Also, NESTLER through European Union and ICIPE organized an international exhibition booth on insect frass fertilizer products held at **the Kenyatta International Conference Centre (KICC), Nairobi, Kenya.** Market-driven fertilizer products from over 15 SMEs developed within the projects were displayed and attracted a lot of interest from the public and private sectors.

Figure 15: Exhibition booth of the insect frass fertilizer products displayed by ICIPE & SMEs during the 3-days side-event organized during the Africa Fertilizer & Soil Health Summit, Nairobi, Kenya.

3.5. Ethiopian Food System Resilience Program (EFSRP)

Ethiopia has enacted an ambitious home grown economic reform agenda since 2018 and concurrently revised her agricultural and rural development policy to meet the following key objective:

- Inclusive and accelerated growth in production and productivity (providing benefits to all members of society)
- Increased competitiveness of smallholder and pastoralist agriculture
- Improved use of natural resources by enhancing development, protection and conservation of the natural resource base
- Increasing rural (non-farm) employment opportunities
- Improving resilience to natural and other causes of vulnerability

In-line with the above, the Ethiopian Ministry of Agriculture has designed the Agriculture Sector 10 Years Perspective Plan (2020-2030) with the objective of overall structural transformation in the country's agriculture. In support of implementations of the ten years` perspective plans, the Ministry of Agriculture (MoA) has launched Food System Resilience Program (FSRP) as the national flagship project with the aim to contribute to food-system-transformation, enhanced competitiveness, rural job creation, and improved resilience. The project focuses on three main pillars including rural job creation, improving competitiveness of the agri-food system, and enhancing the overall resilience of the country's agricultural sector towards ensuring food and nutrition security. Overall, the project aims to improve resilience of food systems and increase preparedness against food insecurity in Ethiopia, which is also in-line with the NESTLER project initiatives within EU-Africa.

Three members of the NESTLER team at EIAR have participated in the launching workshop of the project held on 9th March 2023 and 6th April 2023 at MoA and EIAR, respectively and gained useful experiences of practical relevance to the NESTLER project initiatives. Moreover, as the NESTLER team at EIAR is also engaged in the implementation of the research component of FSRP, it is anticipated that some of the results emanating from the ongoing pilot demonstrations under the NESTLER project will be potential inputs for integration into FSRP initiatives and further promotion to end users at reasonable scale.

3.6. Bilateral meetings and dissemination meetings

To strengthen collaboration and closely monitor progress, beyond general project meetings, a number of bilateral NESTLER project meetings took place.

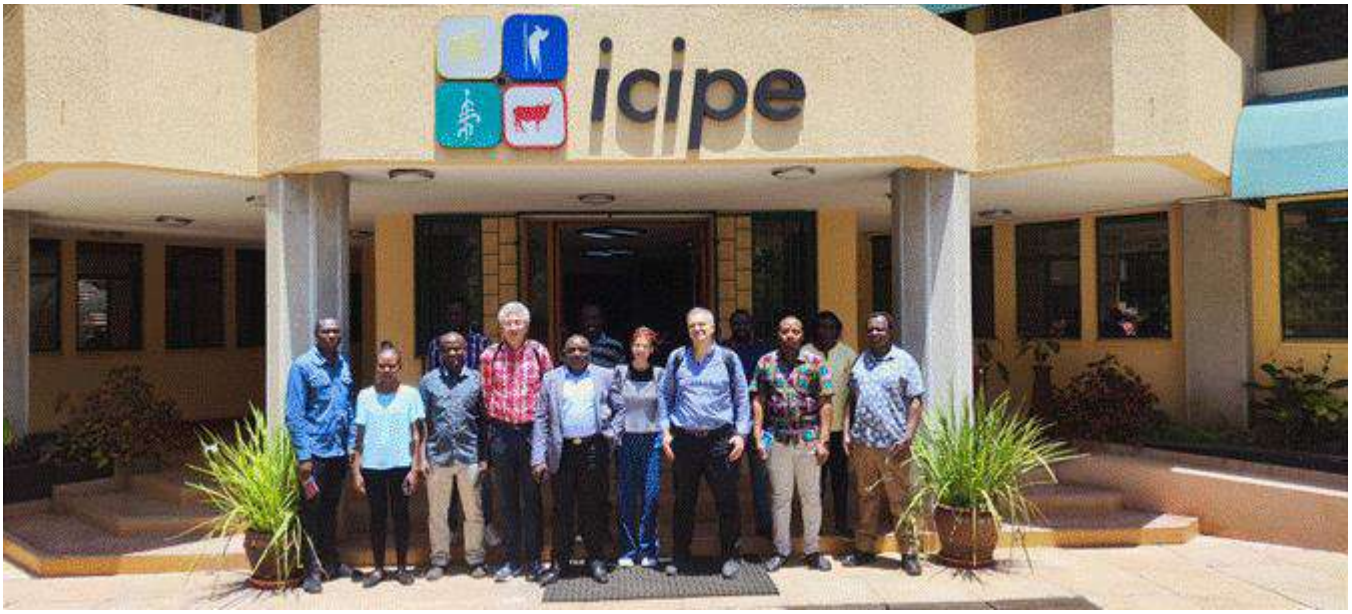


Figure 16: Dr. Th. Zahariadis (SYN, project coordinator), G. Athanasiou (SYN) and Prof. I. Danwajeh (UCL) visiting ICIPE on 22-23 February 2024

Figure 17: NESTLER consortium (SYN, ICIPE) at BSF exhibition in Nairobi, Kenya

Figure 18: Dr. Uwituze (RAB, Deputy Director General/ Animal) and RAB team with NESTLER coordinator Dr. Th. Zahariadis and G. Athanasiou (SYN) in Kigali, Rwanda

Figure 19: NESTLER consortium (RAB and SYN) visiting a chicken and BSF farm in Kigali, Rwanda

3.7. Capacity Building

NESTLER project has built capacity (soft and hard skills) of 1546 youths and women in Kenya (936 males and 610 females) through an Entrepreneurship incubation program established in ICIPE.

Moreover, the project has increased visibility of insect farming and currently the **First Lady of Kenya (Rachel Chebet Ruto)** has endorsed the scale up of insect farming under the "**Mama Doing Good**" initiative. Many other groups have benefited from this training program such as Caritus Muranga Fish Farmers, Korogocho youth group, Kenya Red Cross, Rainforest Alliance, DanChurchAid and others.

Figure 20: Group Photos of young entrepreneurs that have started their business in insect farming or using BSFL feeders based on NESTLER capacity building activities

Figure 21: NESTLER consortium (ICIPE, SYN and UCL) visiting a commercial chicken farm in Nairobi, already exploiting insect feeding for chickens

Figure 22: NESTLER consortium (ICIPE, SYN and UCL) visiting a commercial BSF farm in Nairobi, Kenya (the larval, pre-pupal and pupal BSF section)

4. Dissemination activities

Dissemination focuses on spreading the results of the project to stakeholders who can make use of the knowledge produced. The primary goals are to maximize the impact of the research and to ensure that findings reach the target audience who can benefit from and further apply this knowledge. The dissemination activities include the organisation of project events by the NESTLER partners and the participation of NESTLER in high-impact third-party events related to agriculture.

In details, NESTLER has participated or organized the following scientific or targeted dissemination activities/workshops.

4.1. INSECTA 2023 International Conference Magdeburg, Germany,

ICIPE participated in the INSECTA 2023 International Conference on insects for food, feed and non-food application, which was organized on the 13th and 14th September 2023 in Magdeburg, Germany[3]. The NESTLER project activities were presented with eight (8) abstracts published on several topics[4]. INSECTA has gathered together more than 200 experts, stakeholders from science, business and other sectors from all over the world to present and discuss state-of-the-art insect-based technologies. Within the conference, about 60 orals and 40 poster presentations have addressed topics from research, rearing and processing to safety, ethics and waste valorisation..

Figure 23: NESTLER presentation at the Insecta 2023 International Conference in Magdeburg, Germany.

4.2. CISAR Symposium

CEO participated in the Climate Insurance Solutions for Agricultural Risks (CISAR) Symposium which was organized on the 7th and 8th of May, 2023 in Germany[5]. This event has gathered together stakeholders from the agricultural insurance domain. As such, it was a great opportunity for networking of the project

[3] https://www.royaldutchkusters.com/events/insecta-2023
[4] https://insecta-conference.com/wp-content/uploads/2023/09/INSECTA-2023-BOOK-of-ABSTRACT.pdf
[5] https://www.genillard-co.com/2022/09/21/2023-cisar-symposium-save-the-date/

and further business development of the Answr service developed by CEO. Answr is an API-based platform for climate risk analytics worldwide. It provides answers based on flexible, localized, and highly-available climate and risk data layers for various applications.

4.3. Workshop on "Exploration of Antimicrobial Compounds from Edible Insects and Chicken parts for Applications in Food and Industry"

ICIPE participated in the organization of the Insects for the Green Economy conference (IGEC) held on the 28–29 February 2024 at the African Institute for Capacity Development (AICAD) at Jomo Kenyatta University of Agriculture and Technology (JKUAT), Nairobi, Kenya[6]. The theme of the conference was sustainable food systems and livelihoods in Africa, aiming to explore into the multifaceted roles of insects in driving food security, economic growth, environmental sustainability, and innovation in context of African continent. The conference was a landmark event that brought together researchers, policymakers, and stakeholders both African and international, to explore the potential of insects in shaping a sustainable future. Conference participants included experienced and early-stage researchers, students, policymakers, entrepreneurs, and various stakeholders. Through keynote and research project presentations, in-depth discussions, and stakeholder interactions, the participants explored the latest research and innovations driving the insect sector forward both at the local and global levels. The conference highlighted the pivotal role of technological innovations in unlocking the full potential of insects for the green economy. Presentations on emerging technologies such as automated insect rearing systems, product processing and insect-based non-food products (antimicrobial compounds) offered glimpses into the future of insect-related industries.

The IGEC served as a catalyst for advancing dialogue, collaboration, and action towards harnessing the transformative potential of insects in building a sustainable future. Through vibrant discussions, insightful presentations, and networking opportunities, participants gained a deeper understanding of the multifaceted roles of insects in driving environmental sustainability, food security, and economic prosperity. The momentum generated by the conference is poised to propel forward the integration of insects into the fabric of food security and green economy.

Figure 24: Participants group photo in the Insects for the Green Economy Conference.

[6] http://www.icipe.org/news/announcements/insects-green-economy-conference

4.4. IEEE AFRICON 2023 & NESTLER 3rd Plenary Meeting

In parallel to the IEEE AFRICON 2023 conference, the partners have gathered to address project related issues in a two-day hybrid meeting. The meeting hosted by ICIPE, in Nairobi, Kenya on September 25th and 26th of 2023. As the project enters the second year, the progress is significant, both on the technical and organizational side. A fruitful discussion took place among the partners of the consortium. During the two-day meeting, the consortium reviewed the progress on all work packages and had the chance to address development issues.

Figure 25: NESTLER plenary in parallel to the IEEE AFRICON Conference in Nairobi, Kenya

The partners presented the results achieved so far and the next steps towards the successful delivery of the NESTLER project. During the 3rd plenary meeting of NESTLER in Kenya, the partners of the consortium visited the project pilot in Nairobi, on the 26th of September 2023[7].

4.5. Organization of Technical workshops

The first technical workshop of the project entitled **''Impact of NESTLER technologies and digital tools in One Health Sustainability''**, was organized on the 29th of September 2023 in conjunction with the Plenary Project Meeting which was held in Nairobi, Kenya.

Figure 26: 1st NESTLER Technical Workshop (hybrid)

[7] https://nestler-project.eu/index.php/2023/09/29/nestler-pilot-in-kenya

The aim of the workshop was to inform the wider community about the NESTLER project and its goals and advancements in the context of the ONE-HEALTH program. The workshop was organized in a hybrid way enabling every interested stakeholder to take part. Stakeholders from different domains such as representatives from African member states, technical experts, domain experts and researchers from the agritech domain etc. In total, 36 participants followed the technical workshop, 17 of them with physical presence. A detailed list of participants can be found in Annex 1.

The workshop had a duration of three hours during which the technology partners (SYN, CEO, AGRI, RINI, UCL) of the project presented the different technical solutions that will be combined providing a holistic approach for smart animal and plant management.

NESTLER Workshop Impact of NESTLER technologies and digital tools in One Health Sustainability Agenda 29 September 2023		
Time	**Topic**	**Presenter**
13:40 – 15:45	Project presentation,	Dr. Theodore Zahariadis (Synelixis)
	Redefining parametric crop risk management	Dr. Dimitrios Sykas (CloudEO)
	Environmental Monitoring: SynField Solution	Stavroula Bourou, MSc (Synelixis)
	AI algorithms for external weather impact assessment upon agriculture farming,	Dr. Adamou Kouotou (AgrixTech)
	Electronics for crop quality measurement,	Prof. Izzat Danwajeh and Dr. Temotpe Odedeyi (UCL)
	AI for livestock and aquaculture farming,	Natalia Polushkina (RiniSoft)
	NESTLER Technologies and Pipeline for Pest Infestation Identification	Dr. Theodore Zahariadis (Synelixis)
15:45 – 16:00	Break	
16:00 – 17:00	Open-table discussion: One Health Sustainability	All

Figure 27: Agenda of the NESTLER Workshop

After the presentation, there was a one-hour open table discussion about the project and the One health sustainability approach. The open table discussion was managed by CTPH, IITA, RAB and EIAR. During the discussion important questions were raised and valuable feedback was shared among the participants.

4.6. NESTLER Stakeholders' meetings

As already defined in D6.2 Dissemination and Communication Activities Plan, the key stakeholders of the project include:

- Farmers, feed industry suppliers, precision farming suppliers, healthcare professionals, nutritional analysts, government representatives' policy makers
- Healthcare community, industrial suppliers of agriculture sensors, IoT device manufacturers, venture capitals, angel investors
- General public, industry, local communication organisations
- Business organisations, stakeholder groups

During the first 18 months of the project 2 Stakeholders' meeting events have been organised.

4.6.1. 1st Stakeholders meeting 13.03.2023

The 1st Stakeholders meeting was organised virtually on the 13th of March 2023. The aim of the meeting was to present an overview of the project and the One Health sustainability partnership between EU-Africa to domain experts from the agricultural sector who will play an important role in providing feedback during the implementation of the project.

The 1st stakeholders meeting was followed by 42 participants.

Figure 28: 1st Stakeholders' meeting, 13.03.2023

The Agenda of the meeting can be seen below.

NESTLER

Stakeholders' Meeting Agenda

Connection details

Click here to join the meeting

13th of March 2023

TIME	TOPIC	LEAD
14:30	Welcome. Overview of the NESTLER project	*Prof. Theodore Zahariadis, PhD* NESTLER Coordinator President of the Agriculture Development and Agrofood Dept. of University of Athens, Greece Chief Technology Officer, Synelixis S.A.
14:50	Promotion of One Health sustainability partnership between EU-Africa	*Dr. Fekede Feyissa* Director, Livestock Research Lead Researcher, Animal Feeds and Nutrition Ethiopian Institute of Agricultural Research
15:10	The NESTLER technology platform	*Dr. Dimitrios Sykas* Chief Technology Officer CloudEO A.G.
15:30	Study of insect protein processing technology and contribution to circular economy	*Dr. Chrysantus Mbi Tanga* Senior Scientist Head of Insects for Food, Feed & Other Uses International Centre of Insect Physiology & Ecology
16:00	Q&A and feedback session	ALL

SYNELIXIS cloudeo Zanasi & Partners RiniGARD IITA A

eBOS idh icipe EIAR mana RAB UCL

NESTLER receives funding from the EU Horizon R&I Programme under Grant Agreement No. 101060672

Figure 29: Agenda of the 1st NESTLER Stakeholders' Meeting

4.6.2. 2nd Stakeholders meeting 06.03.2024

The 2nd Stakeholders meeting was organised virtually by AGRI and took place on the 6th of March 2024. The aim of the meeting was to present the different Pilots of the project in the 6 African countries (Nigeria, Uganda, Camerron, Rwanda, Kenya, Ethiopia) to the different stakeholders and field experts identified at the beginning of the project.

The 2nd stakeholders meeting was followed by 38 participants

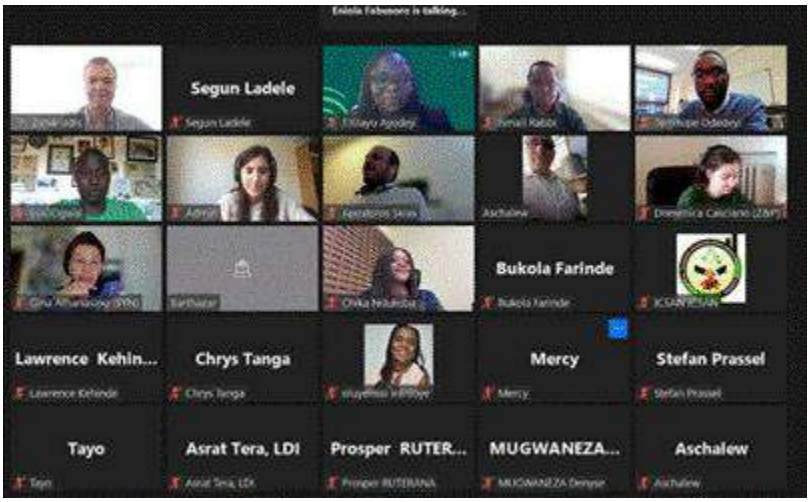


Figure 30: Figure 16: 2nd Stakeholders Meeting, 06.03.2024

The meeting started with an overview presentation of the project and was followed by detailed presentation of the progress and challenges of all Pilots. The meeting was closed with a discussion and Q&A session where valuable feedback was provided.

NESTLER

Stakeholders' Meeting Agenda

Connection details

Click here to join the meeting

6th of March 2024

TIME	TOPIC	LEAD
14:30	Welcome. Overview of the NESTLER project	***Prof. Theodore Zahariadis, PhD*** NESTLER Coordinator President of the Agriculture Development and Agrofood Dept. of University of Athens, Greece Chief Technology Officer, Synelixis S.A.
14:45	Pilot 1: Crop-based farming – Cameroon	***Adamou Nchange Kouotou*** Agritech CEO
15:55	Pilot 2: Biodiversity conservation policies and practices – Uganda	***Ssali Ronald Ogwal*** Coordinator – Community Health & Conservation at CTPH
15:05	Pilot 3: Crop and Livestock farming – Ethiopia	***Dr. Fekede Feyissa*** Director, Livestock Research Lead Researcher, Animal Feeds and Nutrition Ethiopian Institute of Agricultural Research at EIAR
15:15	Pilot 4: Livestock and marine farming – Rwanda	***Dr. Pascal Nyabinwa*** Senior Research Fellow in Runimant Nutrition and Production System at RAB
15:35	Pilot 5: Edible insect farming – Kenya	***Dr. Chrysantus Mbi Tanga*** Senior Scientist Head of Insects for Food, Feed & Other Uses International Centre of Insect Physiology & Ecology at ICIPE
15:45	Pilot 6: Crop quality monitoring solutions and impact on food security – Nigeria	***Ismail Rabbi*** Molecular Geneticist / Breeder at IITA
16:00	Q&A and feedback session	ALL

Figure 31: Agenda of the 2nd NESTLER Stakeholders' meeting

4.7. Publications in Open Access Journals

During the 1st reporting period the following papers have been authored (in many cases co-authored) by NESTLER consortium members. In some cases, we also report papers that during the reporting period had been submitted and now they are already published. All papers have been uploaded at ZENODO repository.

The Annex 2 provides a detailed analysis of the NESTLER publications and the Tasks that are associated with them.

List of Open Access Journals

1. Bulinda C., Gido E.O., Kirscht H., Tanga C.M., *Gendered Awareness of Pig and Poultry Farmers on the Potential of Black Soldier Fly (Hermetia illucens) Farming in Kenya*, MDPI Sustainability, Vol. 15, Issue 4, February 2023, https://doi.org/10.3390/su15043613
2. Kariuki E.G., Kibet C., Paredes J.C., Mboowa G., Mwaura O., Njogu J., Masiga D., Bugg T.H., Tanga C.M., *Metatranscriptomic analysis of the gut microbiome of black soldier fly larvae reared on lignocellulose-rich fiber diets unveils key lignocellulolytic enzymes*, Frontiers in Microbiology, Vol. 14, Issue 26, April 2023, https://doi.org/10.3389/fmicb.2023.1120224
3. Muinde J., Tanga C.M., Olukuru J., Odhiambo C., Tonnang H.E.Z., Senagi K., *Application of Machine Learning Techniques to Discern Optimal Rearing Conditions for Improved Black Soldier Fly Farming*, MDPI Insects, Vol. 14, Issue 5, May 2023 https://doi.org/10.3390/insects14050479
4. Munguti J.M., Obiero K.O., Iteba J.O., Kirimi J.G., Kyule D.N., Orina P.S., Githukia C.M., Outa N., Ogello E.O., Mboya J.B., Ouko K.O., Liti D., Yossa R., Tanga C.M., *Role of multilateral development organizations, public and private investments in aquaculture subsector in Kenya*, Frontiers in Sustainable Food Systems, Vol. 7, August 2023, https://doi.org/10.3389/fsufs.2023.1208918
5. Tanga C.M., Kababu M., *New insights into the emerging edible insect industry in Africa*, Oxford Academic Animal Frontiers, Vol. 13, Issue 4, Pages 26–40, August 2023, https://doi.org/10.1093/af/vfad039
6. Marcasy P. M., Muliro, P.S., Ngoda, P.N., Ghemoh, C.J., Subramanian, S., Xavier, C., Ochieng, B., Ekesi S., Tanga C.M., *Unravelling the nutritional and health benefits of wheat bread enriched with meat powder from laying hen fed diet with insect (Hermetia illucens) meal*, Heliyon, Vol. 9, Issue 10, October 2023, https://doi.org/10.1016/j.heliyon.2023.e20506
7. Ouma, L.O., Muthomi, J.W., Kimenju, J.W., Beesigamukama D., Subramanian S., Khamis F.M., Tanga C.M*., Occurrence and management of two emerging soil-dwelling pests ravaging cabbage and onions in Kenya*, Scientific Reports, Vol. 13, Article number 18975, November 2023, https://doi.org/10.1038/s41598-023-46190-0
8. Gómez-Brandón M., Beesigamukama D., Probst M., Klammsteiner T., Tanga C.M., *Garden fruit chafer (Pachnoda sinuata L.) accelerates recycling and bioremediation of animal waste*, Elsevier Waste Management, Vol. 173, pp.131-140, Jan. 2024, https://doi.org/10.1016/j.wasman.2023.11.019
9. Munguti J., Wekesa F., Osuga I., Kariuki M., Yossa R., Mungai D., Kyule D., Abwao J., Tanga C.M., *Utilization of Black Soldier Fly (Hermetia illucens) Larvae as a Potential Substitute for Fish Meal in the*

Production of Nile Tilapia (Oreochromis niloticus L.), Sustainable Agriculture Research, Vol. 13, Issue 1, January 2024, https://doi.org/10.5539/sar.v13n1p40

10. Tanga, C. M., Ekesi, S., *Dietary and therapeutic benefits of edible insects: A global perspective*, Annual Review of Entomology, Vol. *69*, Pages 303-331, January 2024, https://doi.org/10.1146/annurev-ento-020123-013621
11. Wamai L.K., Munga L.M., Osuga I.M., Munguti J.M., Subramanian S., Kidoido M.K., Ghemoh J.C., Mwendia C.M., Tanga C.M., *Big opportunities for tiny bugs: rush to boost laying hen performance using black soldier fly larvae meal,* Oxford Academic, Journal of Economic Entomology, Vol. 117, Issue 1, February 2024, https://doi.org/10.1093/jee/toad230
12. Achuoth M. P., Mudalungu C. M., Ochieng B. O., Mokaya H. O., Kibet S., Maharaj V. J., Subramanian S., Kelemu S., Tanga C. M., *Unlocking the potential of substrate quality for the enhanced antibacterial activity of black soldier fly against pathogens*, ACS Omega, Vol. 9, Issue 7, February 2024 https://doi.org/10.1021/acsomega.3c09741
13. Anedo E.O., Beesigamukama D., Mochoge B., Korir N.K., Haukeland S., Cheseto X., Subramanian S., Kelemu S., Tanga C.M., *Evolving dynamics of insect frass fertilizer for sustainable nematode management and potato production*, Frontiers in Plant Science, Vol. 15, February 2024 https://doi.org/10.3389/fpls.2024.1343038
14. Kisaakye J., Beesigamukama D., Haukeland S., Subramanian S., Thiongo P.K., Kelemu S., Tanga C.M., *Chitin-enriched insect frass fertilizer as a biorational alternative for root-knot nematode (Meloidogyne incognita) management*, Frontiers in Plant Science, Vol. 15, March 2024, https://doi.org/10.3389/fpls.2024.1361739

Moreover, the following papers have been accepted within the reporting period (already published at the time of delivering this report):

15. Katchali M., Senagi K., Richard E., Beesigamukama D., Tanga C.M., Athanasiou G., Zahariadis T., Casciano D., Lazarou A., *Unveiling Environmental Influences on Sustainable Fertilizer Production through Insect Farming*, MDPI Sustainability, Vol. 16, Issue 9, April 2024, https://doi.org/10.3390/su16093746
16. Kibet S., Kimani N.M., Mwanza S.S., Mudalungu C.M., Santos C.B.R., Tanga C.M., *Unveiling the Potential of Ent-Kaurane Diterpenoids: Multifaceted Natural Products for Drug Discovery*, MDPI Pharmaceuticals, Vol. 17, Issue 4, April 2024, https://doi.org/10.3390/ph17040510
17. Kyalo H., Tonnang H.E.Z., Egonyu J.P., Olukuru J., Tanga C.M., Senagi K., *A convolutional neural network with image and numerical data to improve farming of edible crickets as a source of food—A decision support system*, Frontiers in Artificial Intelligence, Vol. 7, May 2024, https://doi.org/10.3389/frai.2024.1403593
18. Kariuki M.W., Barwani D.K., Mwashi V., Kioko J.K., Munguti J.M., Tanga C.M. , Kiiru P., Gicheha M.G., I.M., *Partial Replacement of Fishmeal with Back Soldier Fly Larvae Meal in Nile Tilapia Diets Improves Performance and Profitability in Earthen Pond*, Scientific African, Vol. 24, June 2024 https://doi.org/10.1016/j.sciaf.2024.e02222

4.8. Conference papers

1. Issa A., Poole C., Darwazeh I., *Cassava starch measurement in the field - evolution of a low-cost test instrument with wireless connectivity*, 2023 IEEE AFRICON, September 2023, 10.1109/AFRICON55910.2023.10293357
2. Odedeyi T., Darwazeh I., *New Insights on Application of Return Loss Measurement for Starch Content Estimation in Cassava,* 2023 IEEE AFRICON, September 2023, 10.1109/AFRICON55910.2023.10293499
3. Anedo E.O., Mochoge B., Korir N.K., Beesigamukama D., Haukeland S., Cheseto X., Nyongesa M., Subramanian S., Tanga C.M., *Exploring the potential of black soldier fly-composted frass fertilizer in the control of nematodes and boosting potato yields in Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023
4. Ouma L.O., Muthomi J.W., Kimenju J.W., Beesigamukam D., Subramanian S., Tanga C.M., *Insecticidal potential of chitin-enhanced black soldier fly frass fertilizer extracts against onion fly (Atherigona orientalis Schiner)*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023
5. Chepkorir A., Gitari H.I., Beesigamukama D., Subramanian S., Ekesi S., Tanga C.M., *Using insect-composted organic fertilizer to increase yield and economic returns of bush beans (Phaseolus vulgaris)*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023
6. Tanga C.M., Kababu M.O., Beesigamukama D., Subramanian S., *Insect Farming Innovations: Lessons from Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023
7. Kassie M., Abro Z., Tanga C.M., Sevgan S., *Socioeconomic and ecological impact of insect farming in sub-Saharan Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023
8. Beesigamukama D., Subramanian S., Tanga C.M., *Efficiency of garden fruit chafers to recycle animal manure: Implications on fertilizer quality, pathogen suppression and crop yield*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023

4.9. Public Deliverables

- D1.1 NESTLER platform requirements
- D2.2 Practice Abstracts - Batch 1
- D3.1 Remote sensing technologies and multi-modal data aggregation protocols
- D4.1 Initial NESTLER backend implementation of AI algorithms
- D6.1 Project website & social networks
- D6.2 NESTLER dissemination and communication activities plan
- D6.3 Initial NESTLER dissemination and communication activities
- D7.2 Data management plan
- D7.3 Data management plan - update

5. Contribution to standards

NESTLER contributed for the standardization realm through 2 contributions. ICIPE and EIAR in partnership with Ethiopian regulatory authorities established the Ethiopian Standards:

- *ES 7015:2023 - Dried insect products in animal feeds-Specifications*
- *ES 7016:2023 - Dried insect products as proteins in animal feeds – Guidelines/code of practice*.

Moreover, a policy paper was developed and presented in an Online summit with the Deputy-Secretary General of the United Nation. In June 2023, an engagement partnership between ICIPE, the African Organisation for Standardisation (ARSO) and the United Nations Economic Commission for Africa (UNECA) was formed with a mandate to establish African standards of interest to intra-African and global trade and to operate a continental conformity assessment system with a view to promoting African products.

Based on the approved standards, insects and insect-based products for either food or feed are currently being certified by Kenya Bureau of Standards (KEBS), Kenya's regulatory industry standard since 2023

6. Conclusion

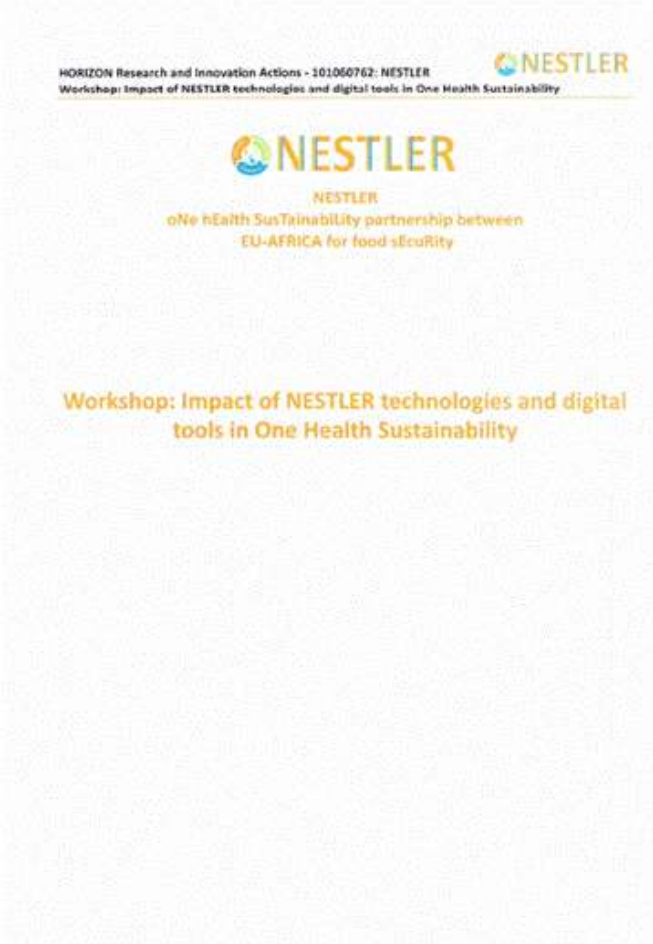
As a follow up of D6.2, the current document presented the communication and dissemination activities of the project during the first 18 months including participation in conferences and exhibitions, digital communication over the website and the social media channels, organization of workshops and evets as well as publications and deliverables.

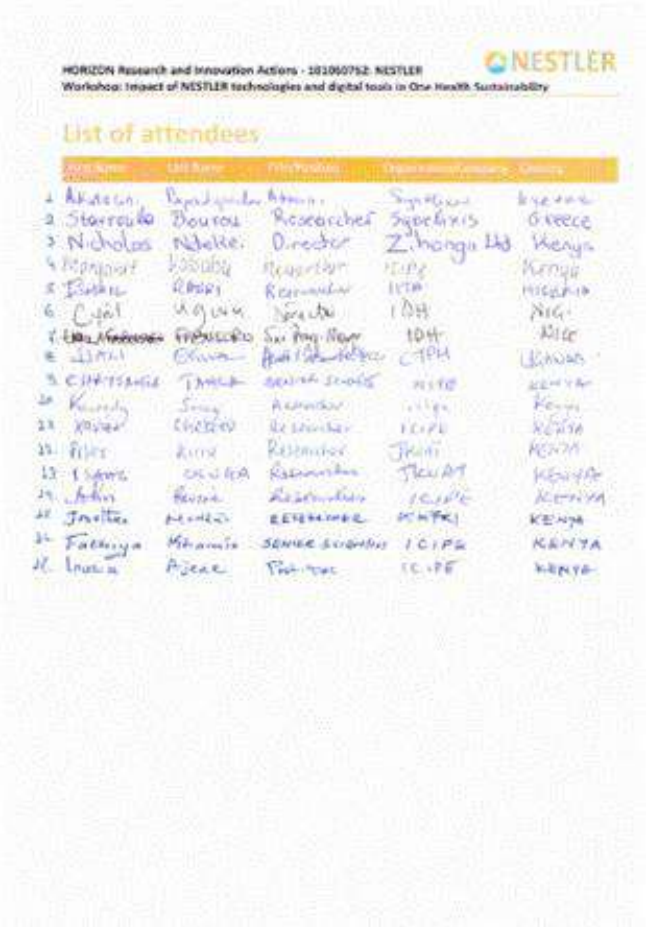
The communication and dissemination activities are constantly being implemented and in parallel with the progress of the project. The complete presentation of the communication and dissemination activities will be presented at the end of the project (M36) within the context of the deliverable D6.4 NESTLER dissemination and communication activities.

7. ANNEX 1: NESTLER Workshop

No.	Participant	Affiliation	Attendance	
				26/09
1	Adamou Nchange Kouotou	AGRI	Virtual	✓
2	Dorothee Mvondo Nganti	AGRI	Virtual	✓
3	Dimitris Sykas	CEO	Virtual	✓
4	Alkyoni Baglatzi	CEO	Virtual	✓
5	Georgia Pantelide	EBOS	Virtual	✓
6	Fekede Feyissa	EIAR	Virtual	✓
7	Etalem Tesafye	EIAR	Virtual	✓
8	Chrysantus Tanga	ICIPE	Physical	✓
9	Ssali Ogwal	CTPH	Physical	✓
10	Eniola Fabusoro	IDH	Physical	✓
11	Cyril Ugwu	IDH	Physical	✓
12	Nyabinwa Pascal	RAB	Virtual	✓
13	Ismail Rabbi	IITA	Physical	✓
14	Denis Kolev	RINI	Virtual	✓
15	Vladislava Vasilyanskaya	RINI	Virtual	✓
16	Natalia Polushkina	RINI	Virtual	✓
17	Apostolos Skias	SYN	Virtual	✓
18	Konstantinos Pramataris	SYN	Virtual	✓
19	Aikaterini Papadopoulou	SYN	Physical	✓
20	Theodoros Zachariadis	SYN	Virtual	✓
21	Stavroula Bourou	SYN	Physical	✓
22	Temitope Odedeyi	UCL	Virtual	✓
23	Izzat Darwazeh	UCL	Virtual	✓
24	Domenica Casciano	Z&P	Virtual	✓

25	Alexandre Lazarou	Z&P	Virtual	✓
26	Alice Barlow	MANA	Virtual	✓
27	Nicholas Ndekei	Zihanga Ltd	Physical	✓
28	Margaret Kababu	ICIPE	Physical	✓
29	Kenedy Deragi	ICIPE	Physical	✓
30	Xavier Lheseto	ICIPE	Physical	✓
31	Peter Kiiru	JKUAT	Physical	✓
32	Isaac Osuga	JKUAT	Physical	✓
33	Jogn Rivise	ICIPE	Physical	✓
34	Jonathan Mungui	XMFRI	Physical	✓
35	Fathiya Khanis	ICIPE	Physical	✓
36	Inusa Ajene	ICIPE	Physical	✓


HORIZON Research and Innovation Actions - 101060762: NESTLER
Workshop: Impact of NESTLER technologies and digital tools in One Health Sustainability
NESTLER
NESTLER
oNe hEalth SusTainability partnership between
EU-AFRICA for food sEcuRity
Workshop: Impact of NESTLER technologies and digital tools in One Health Sustainability


HORIZON Research and Innovation Actions - 101060762: NESTLER
Workshop: Impact of NESTLER technologies and digital tools in One Health Sustainability
NESTLER
List of attendees

8. Annex 2: Analysis of NESTLER publications

In this Annex, we provide a summary of each publication and relation with NESTLER project. All publications have been uploaded to ZENODO repository.

Publication Title	Relevance to NESTLER	Task
Bulinda C., Gido E.O., Kirscht H., Tanga C.M., *Gendered Awareness of Pig and Poultry Farmers on the Potential of Black Soldier Fly (Hermetia illucens) Farming in Kenya*, MDPI Sustainability, Vol. 15, Issue 4, February 2023, https://doi.org/10.3390/su15043613	This study examines the awareness and potential of Black Soldier Fly (BSF) farming among pig and poultry farmers in Kenya, focusing on gender differences. The findings indicate that education, membership in agricultural groups, and the number of livestock owned are significant factors influencing awareness. The publication aligns with NESTLER's objectives to explore insect protein as a sustainable and economically viable feed option. It contributes to the understanding of socio-economic factors affecting the adoption of BSF farming, which is critical for capacity building, policy formulation, and promoting sustainable agricultural practices within the One Health framework of NESTLER.	T2.1 T2.3 T2.4 T2.5
Kariuki E.G., Kibet C., Paredes J.C., Mboowa G., Mwaura O., Njogu J., Masiga D., Bugg T.H., Tanga C.M., *Metatranscriptomic analysis of the gut microbiome of black soldier fly larvae reared on lignocellulose-rich fiber diets unveils key lignocellulolytic enzymes*, Frontiers in Microbiology, Vol. 14, Issue 26, April 2023, https://doi.org/10.3389/fmicb.2023.1120224	This study focuses on the gut microbiome of black soldier fly (BSF) larvae reared on diets rich in lignocellulose, identifying key enzymes involved in lignocellulose degradation. The findings highlight the potential of BSF larvae to convert organic waste into valuable biomass, which is crucial for sustainable feed production. The publication aligns with NESTLER's goals of optimizing insect protein production and developing sustainable feed recipes. This research supports the development of efficient insect farming practices, enhancing the circular economy and sustainability objectives of NESTLER.	T2.2 T2.3
Muinde J., Tanga C.M., Olukuru J., Odhiambo C., Tonnang H.E.Z., Senagi K., *Application of Machine Learning Techniques to Discern Optimal Rearing Conditions for Improved Black Soldier Fly Farming*, MDPI Insects, Vol. 14, Issue 5, May 2023 https://doi.org/10.3390/insects14050479	This study explores the use of ML to optimize rearing conditions for BSF larvae. The research highlights how variables such as feed formulation, bed length, larvae density, and feeding rates affect the yield of BSF larvae. These insights are crucial for enhancing the efficiency and productivity of BSF farming, which can contribute to sustainable feed production. The publication aligns with NESTLER's objectives of utilizing advanced technologies to improve insect protein production. This research supports the development of efficient farming practices and contributes to the circular economy by optimizing resource use and enhancing the sustainability of animal feed production.	T2.2 T2.3
Munguti J.M., Obiero K.O., Iteba J.O., Kirimi J.G., Kyule D.N., Orina P.S., Githukia C.M., Outa N., Ogello E.O., Mboya J.B., Ouko K.O., Liti D., Yossa R., Tanga C.M., *Role of multilateral development organizations, public and private investments in aquaculture subsector in Kenya*, Frontiers in Sustainable Food Systems, Vol. 7, August 2023, https://doi.org/10.3389/fsufs.2023.1208918	This study explores the roles of various stakeholders, including multilateral development organizations, and public and private investments, in advancing the aquaculture sector in Kenya. It assesses the impact of these investments on the growth and sustainability of aquaculture practices. The publication provides valuable insights into the effectiveness of different types of investments in the aquaculture sector, which is directly relevant to NESTLER's objectives of promoting sustainable agricultural practices and enhancing food security. This research supports the project's goals by identifying key factors and stakeholders that influence the success of aquaculture initiatives, contributing to the broader aim of sustainable development and One Health partnerships.	T2.5 T5.1 T5.3 T5.5

Tanga C.M., Kababu M., *New insights into the emerging edible insect industry in Africa*, Oxford Academic Animal Frontiers, Vol. 13, Issue 4, Pages 26–40, August 2023, https://doi.org/10.1093/af/vfad039	This review provides an overview of the rapidly growing edible insect industry in Africa, focusing on the potential of insect farming for food and feed. It discusses how insects can convert organic waste into valuable products like protein, oils, and fertilizers, highlighting the economic and environmental benefits of this emerging industry The study aligns with NESTLER's objectives of promoting sustainable food and feed production through the use of insects. It supports the project's goals of optimizing insect farming practices, ensuring food safety, and fostering economic sustainability, while emphasizes the importance of policy development.	T2.1 T2.2 T2.5
Marcasy P. M., Muliro, P.S., Ngoda, P.N., Ghemoh, C.J., Subramanian, S., Xavier, C., Ochieng, B., Ekesi S., Tanga C.M., *Unravelling the nutritional and health benefits of wheat bread enriched with meat powder from laying hen fed diet with insect (Hermetia illucens) meal*, Heliyon, Vol. 9, Issue 10, October 2023, https://doi.org/10.1016/j.heliyon.2023.e20506	This study evaluates the nutritional benefits of wheat bread enriched with meat powder from hens fed a diet containing insect (Hermetia illucens) meal. The enriched bread showed increased levels of crude protein, essential amino acids, omega-3 fatty acids, and minerals like iron, zinc, and calcium. The publication χ`aligns with NESTLER's goals of optimizing insect protein for food and feed. This research supports the project's efforts in developing sustainable, nutritious, and economically viable food products, contributing to food security and circular economy principles.	T2.1 T2.3 T2.5
Ouma, L.O., Muthomi, J.W., Kimenju, J.W., Beesigamukama D., Subramanian S., Khamis F.M., Tanga C.M., *Occurrence and management of two emerging soil-dwelling pests ravaging cabbage and onions in Kenya*, Scientific Reports, Vol. 13, Article number 18975, November 2023, https://doi.org/10.1038/s41598-023-46190-0	This study investigates the diversity and occurrence of both pest and beneficial insects associated with sorghum crops in Eastern Kenya. The survey identifies the most serious soil-borne pest that warrant management using novel and biorational insect-based frass fertilizer as biopesticide The publication aligns with NESTLER's goals by providing insights into the role of insects in agricultural ecosystems. Understanding the diversity of pest and beneficial insects can help optimize crop production and contribute to the sustainability objectives of NESTLER.	T3.1 T3.3
Gómez-Brandón M., Beesigamukama D., Probst M., Klammsteiner T., Zhou Y.Y., Zhu Y-G., Tanga C.M., *Garden fruit chafer (Pachnoda sinuata L.) accelerates recycling and bioremediation of animal waste*, Elsevier Waste Management, Vol. 173, Pages 131-140, January 2024, https://doi.org/10.1016/j.wasman.2023.11.019	This study examines the use of frass from the garden fruit chafer larvae as an organic fertilizer. The research demonstrates that this frass can significantly enhance the growth of tomato plants and suppress root-knot nematode infections, which are common pests that affect tomato crops. The publication aligns with NESTLER's objectives of promoting sustainable agricultural practices by using insect-derived products. The use of garden fruit chafer larval frass as a fertilizer not only supports crop growth but also provides an environmentally friendly solution to pest management.	T3.2 T3.3
Munguti J., Wekesa F., Osuga I., Kariuki M., …, Liti D., Tanga C.M., *Utilization of Black Soldier Fly (Hermetia illucens) Larvae as a Potential Substitute for Fish Meal in the Production of Nile Tilapia (Oreochromis niloticus L.)*, Sustainable Agriculture Research, Vol. 13, Issue 1, January 2024, https://doi.org/10.5539/sar.v13n1p40	This study explores the use of black soldier fly frass as a biofertilizer and biopesticide, highlighting its benefits for crop growth and pest suppression. It discusses the potential for integrating this organic input into sustainable agricultural practices across Africa. The publication aligns with NESTLER's objectives by promoting the use of insect by-products to enhance agricultural sustainability. It supports the project's goals of developing effective biofertilizers and biopesticides, contributing to the circular economy and improving crop resilience and productivity.	T2.2 T2.4
Tanga, C. M., Ekesi, S., *Dietary and therapeutic benefits of edible insects: A global perspective*, Annual Review of Entomology, Vol. *69*, Pages 303-331, January 2024,	This paper provides a comprehensive overview of the global use of insects as animal feed, highlighting the current state of research and future prospects. The review addresses various aspects, including nutritional benefits, environmental impact, and economic feasibility	T2.1 T2.3

https://doi.org/10.1146/annurev-ento-020123-013621	The publication aligns with NESTLER's objectives of promoting sustainable insect protein production. It supports efforts in understanding the broader implications of using insects as feed, contributing to food security, environmental sustainability, and economic viability in agriculture.	
Wamai L.K., Munga L.M., Osuga I.M., Munguti J.M., Subramanian S., Kidoido M.K., Ghemoh J.C., Mwendia C.M., Tanga C.M., *Big opportunities for tiny bugs: rush to boost laying hen performance using black soldier fly larvae meal,* Oxford Academic, Journal of Economic Entomology, Vol. 117, Issue 1, February 2024, https://doi.org/10.1093/jee/toad230	This study investigates the impact of black soldier fly larvae meal (HILM) as a protein substitute in poultry feed for laying hens. It demonstrates that HILM can improve weight gain, feed conversion ratios, egg production, and economic returns when used as a substitute for conventional protein sources. The publication aligns with NESTLER's objectives by showcasing the benefits of using insect-based proteins in animal feed and supports the project's goals of promoting sustainable and economically viable feed alternatives, enhancing food security, and contributing to the circular economy by reducing reliance on conventional feed ingredients.	T2.3 T2.4
Achuoth M. P., Mudalungu C. M., Ochieng B. O., Mokaya H. O., Kibet S., Maharaj V. J., Subramanian S., Kelemu S., Tanga C. M., *Unlocking the potential of substrate quality for the enhanced antibacterial activity of black soldier fly against pathogens*, ACS Omega, Vol. 9, Issue 7, February 2024 https://doi.org/10.1021/acsomega.3c09741	This study investigates how different substrate qualities can enhance the antibacterial properties of BSFL. The research demonstrates that the type of substrate used in rearing BSFL significantly impacts their ability to produce antibacterial compounds, which can be crucial for sustainable waste management and feed production. The publication aligns with NESTLER's objectives by exploring the optimization of BSFL rearing conditions to maximize their antibacterial properties. The findings contribute to the development of high-quality, safe, and effective insect-based products for agricultural use.	T2.2 T2.3 T2.4
Anedo E.O., Beesigamukama D., Mochoge B., Korir N.K., Haukeland S., Cheseto X., Subramanian S., Kelemu S., Tanga C.M., *Evolving dynamics of insect frass fertilizer for sustainable nematode management and potato production*, Frontiers in Plant Science, Vol. 15, February 2024 https://doi.org/10.3389/fpls.2024.1343038	The paper explores the use of chitin-fortified black soldier fly composted organic fertilizer (BSFCOF) to enhance potato yield and suppress potato cyst nematodes (PCN), demonstrating significant improvements in soil fertility and crop performance. The study aligns with NESTLER's objectives of promoting sustainable agricultural practices and improving crop health using insect-derived products, contributing to the circular economy.	T2.4
Kisaakye J., Beesigamukama D., Haukeland S., Subramanian S., Thiongo P.K., Kelemu S., Tanga C.M., *Chitin-enriched insect frass fertilizer as a biorational alternative for root-knot nematode (Meloidogyne incognita) management*, Frontiers in Plant Science, Vol. 15, March 2024, https://doi.org/10.3389/fpls.2024.1361739	The paper evaluates the efficacy of chitin-enriched insect frass fertilizer as a sustainable and effective alternative for managing root-knot nematode infestations. The study demonstrates that the chitin-fortified BSLF frass significantly reduces nematode egg hatchability, juvenile mortality, and gall formation while improving plant growth and biomass in comparison to conventional chemical nematicides. The paper aligns with NESTLER's objectives to develop and promote sustainable agricultural practices using insect-derived products. The use of chitin-enriched frass supports integrated pest management strategies, enhancing crop health and productivity while minimizing environmental impact.	T2.4
Katchali M., Senagi K., Richard E., Beesigamukama D., Tanga C.M., Athanasiou G., Zahariadis T., Casciano D., Lazarou A., *Unveiling Environmental Influences on Sustainable Fertilizer Production through Insect Farming*, MDPI Sustainability, Vol. 16, Issue 9, April 2024, https://doi.org/ 10.3390/su16093746	The paper examines how environmental factors affect the production of high-quality BSF frass fertilizer. It employs response surface methodology and IoT sensors to monitor and analyze physical-chemical factors such as air temperature, humidity, and moisture content. The study identifies optimal conditions for producing nutrient-rich BSF frass. The paper aligns with NESTLER's goals of enhancing sustainable agricultural practices through innovative insect farming techniques. By optimizing the production of high-quality frass fertilizer, the study contributes to the circular economy and promotes environmentally friendly agricultural inputs.	T2.2 T2.4 T3.1

Kibet S., Kimani N.M., Mwanza S.S., Mudalungu C.M., Santos C.B.R., Tanga C.M., *Unveiling the Potential of Ent-Kaurane Diterpenoids: Multifaceted Natural Products for Drug Discovery*, MDPI Pharmaceuticals, Vol. 17, Issue 4, April 2024, https://doi.org/10.3390/ph17040510	The paper explores the therapeutic potential of ent-kaurane diterpenoids, a class of natural products derived primarily from plants. It includes an in silico analysis of 570 ent-kaurane diterpenoids, evaluating their physicochemical, pharmacokinetic, and toxicological properties. The paper contributes to NESTLER's broader objectives of exploring natural products and their applications. The methodology and insights gained from this paper can support the development of bioactive compounds derived from insect-based sources, aligning with NESTLER's goals.	T2.5
Kyalo H., Tonnang H.E.Z., Egonyu J.P., Olukuru J., Tanga C.M., Senagi K., *A convolutional neural network with image and numerical data to improve farming of edible crickets as a source of food—A decision support system*, Frontiers in Artificial Intelligence, Vol. 7, May 2024, https://doi.org/10.3389/frai.2024.1403593	The paper discusses the development of a decision support system using convolutional neural networks (CNN) and ML algorithms to optimize the farming of edible crickets. By combining image and numerical data, the system monitors and analyzes cricket behaviors and environmental conditions (such as temperature and humidity). This approach aims to improve cricket production by providing farmers with actionable insights on optimal farming practices. The paper supports NESTLER's goals of integrating technological innovations into sustainable farming. The ML system exemplifies how advanced ML can enhance the productivity of insect farming.	T3.1 T3.3
Kariuki M.W., Barwani D.K., Mwashi V., Kioko J.K., Munguti J.M., Tanga C.M. , Kiiru P., Gicheha M.G., I.M., *Partial Replacement of Fishmeal with Back Soldier Fly Larvae Meal in Nile Tilapia Diets Improves Performance and Profitability in Earthen Pond*, Scientific African, Vol. 24, June 2024 https://doi.org/10.1016/j.sciaf.2024.e02222	The paper evaluates the impact of replacing fishmeal (FM) with black soldier fly larvae meal (BSFLM) in the diets of Nile tilapia. The study finds that BSFLM can replace FM up to 100% without adverse effects on growth performance, feed utilization efficiency, or survival rates. Additionally, BSFLM improves the immune response of fish, making it a viable and sustainable alternative to traditional fishmeal. The paper aligns with NESTLER's objectives of promoting sustainable aquaculture practices and reducing dependency on conventional fishmeal. By demonstrating the effectiveness of BSFLM, the study supports the project's goals of integrating insect-based proteins into animal feed.	T2.3 T2.4
Conference papers	**Relevance to NESTLER**	**Task**
Issa A., Poole C., Darwazeh I., *Cassava starch measurement in the field - evolution of a low-cost test instrument with wireless connectivity*, 2023 IEEE AFRICON, September 2023, 10.1109/AFRICON55910.2023.10293357	This conference paper details the development of a low-cost, IoT-enabled test instrument for measuring cassava starch in the field, which directly aligns with NESTLER's objectives of improving agricultural productivity and economic viability for small-scale farmers. The ability to accurately measure cassava starch content on-site addresses a significant barrier for farmers by providing them with real-time quality assessments of their produce, thus enabling them to meet quality standards for high-value markets.	T2.2 T2.3 T3.2
Odedeyi T., Darwazeh I., *New Insights on Application of Return Loss Measurement for Starch Content Estimation in Cassava,* 2023 IEEE AFRICON, September 2023, 10.1109/AFRICON55910.2023.10293499	This conference paper discusses the novel application of return loss measurement for estimating starch content in cassava, which is highly relevant to the NESTLER project's focus on improving agricultural practices through technological innovation. Accurate starch content measurement is crucial for determining the quality and market value of cassava, directly supporting smallholder farmers in meeting market standards and improving their economic outcomes.	T2.2 T3.2
Anedo E.O., Mochoge B., Korir N.K., Beesigamukama D., Haukeland S., Cheseto X., Nyongesa M., Subramanian S., Tanga C.M., *Exploring the potential of black soldier fly-composted frass fertilizer in the control of nematodes and boosting potato yields in Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and	This paper explores the use of black soldier fly-composted frass fertilizer to manage nematodes and improve potato yields, directly supporting NESTLER's focus on sustainable agriculture and food security. By utilizing insect-derived fertilizers, the study aligns with NESTLER's objectives of promoting circular economy practices and enhancing crop resilience and productivity.	T2.4 T5.1

Bioeconomy e.V. (ATB), Book of abstract, Sept.2023		
Ouma L.O., Muthomi J.W., Kimenju J.W., Beesigamukam D., Subramanian S., Tanga C.M., *Insecticidal potential of chitin-enhanced black soldier fly frass fertilizer extracts against onion fly (Atherigona orientalis Schiner)*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023	This paper investigates the insecticidal properties of chitin-enhanced BSF frass fertilizer against onion fly, aligning with NESTLER's goal of developing sustainable agricultural practices through the use of insect-based products. The study contributes to integrated pest management strategies, enhancing crop protection while minimizing environmental impact. This research supports NESTLER's objectives by demonstrating the effectiveness of insect-derived fertilizers in pest management, contributing to the circular economy and improving the sustainability of agricultural practices .	T2.4 T5.1
Chepkorir A., Gitari H.I., Beesigamukama D., Subramanian S., Ekesi S., Tanga C.M., *Using insect-composted organic fertilizer to increase yield and economic returns of bush beans (Phaseolus vulgaris)*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023	This paper investigates the effectiveness of insect-composted organic fertilizer in enhancing the yield and economic returns of bush beans, which directly supports NESTLER's focus on promoting sustainable agricultural practices and improving crop productivity through innovative bio-fertilizers. The use of insect-derived fertilizers is aligned with NESTLER's goals of advancing the circular economy and reducing reliance on synthetic inputs.	T2.4 T5.1
Tanga C.M., Kababu M.O., Beesigamukama D., Subramanian S., *Insect Farming Innovations: Lessons from Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023	This paper provides insights into the innovations in insect farming in Africa, which aligns with NESTLER's objectives of enhancing sustainable agricultural practices and food security. The research emphasizes the economic and environmental benefits of insect farming, supporting the circular economy and sustainable food production strategies advocated by NESTLER.	T2.1 T2.2 T2.5
Kassie M., Abro Z., Tanga C.M., Sevgan S., *Socioeconomic and ecological impact of insect farming in sub-Saharan Africa*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023	This paper investigates the socioeconomic and ecological impacts of insect farming in sub-Saharan Africa, aligning closely with NESTLER's objectives of promoting sustainable agricultural practices and enhancing food security. The study provides insights into how insect farming can contribute to economic development, ecological balance, and food sustainability in the region.	T2.5 T5.1 T5.5
Beesigamukama D., Subramanian S., Tanga C.M., *Efficiency of garden fruit chafers to recycle animal manure: Implications on fertilizer quality, pathogen suppression and crop yield*, INSECTA 2023 International Conference, Leibniz Institute for Agricultural Engineering and Bioeconomy e.V. (ATB), Book of abstract, September 2023	This paper investigates the use of garden fruit chafer larvae in recycling animal manure to produce high-quality fertilizer, which aligns with NESTLER's objectives of promoting sustainable agricultural practices and enhancing food security. The study highlights the benefits of using insect-derived fertilizers for improving crop yields and suppressing pathogens, supporting the circular economy principles championed by NESTLER. The paper supports NESTLER's goals by demonstrating the practical applications and benefits of insect-composted fertilizers in agriculture, contributing to sustainable farming practices.	T2.4 T5.5