# Report of the Agroecology Summit organized by: Consortium partners of the Potentials of Agroecological practices in East Africa with a focus on Circular Water-Energy-Nutrient systems (PrAEctiCe) Project
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## 1. Executive Summary

On October 17, 2024, the PrAEctiCe project hosted an online agroecology event aimed at advancing sustainable agroecological practices by bringing together diverse stakeholders including indigenous farming communities, African and EU researchers, academics, government officials, experts and policy drivers to dialogue, explore and share how adoption of these can help feed Africa.

The summit's – ***"Facilitating Agroecological Transition among Smallholder Farmers through Technology and Innovation"*** – overall objective was to enhance agroecological practices across Africa with a focus on agroecological aquaculture systems. The summit served as a platform for dialogue, exploring current and emerging innovations as well as challenges and opportunities in smallholder farming aimed at creating sustainable agroecological food systems that align with the United Nations' Sustainable Development Goals. It also aimed at discussing existing and developing frameworks of agroecological practices that would promote increased association between stakeholders and smallholder aquaculture producers in Africa.

In order to join the summit, participants were required to formally register online in order to access the discussions. At this phase, 776 persons registered with 561 (72%) being male and 215 (28%) being female, representing various sectors, including 184 farmers (24%), 125 from academia (16%), 109 from government agencies (14%), 96 from research institutions (12%), 32 from scientific community (4%), 18 Living Lab practitioners (2%), and 212 from other institutions (27%). During the actual summit, 134 registrants participated representing 17.3% of the total registered persons.

Subsequently, key discussions revolved around implementing frameworks for adopting agroecological practices, fostering stakeholders' collaboration and empowering smallholder aquaculture producers. The event underscored the importance of collective action in driving sustainable agricultural transformation, highlighting how technologies and applications such as remote sensing, digital data and GIS, could improve the efficiency, selection and monitoring of sustainable smallholder operations, support traditional practices, enhance resilience and improve food security across the African continent.

The summit noted that indeed, agroecology is the heart of sustainable agriculture in Eastern Africa as smallholder farmers contribute significantly to agricultural production accounting for 75% of the regions' total agricultural output. There was general agreement of the need to explore further agroecological principles that will create food systems that are economically viable and supportive to the effects of climate change. The summit therefore provided a great opportunity for sharing agroecological ideas between African and European partners and further collaborative areas among stakeholder including indigenous farming communities, researchers, governments, academia and agroecology experts, that will determine the best aquaculture agroecology practices and effectively support smallholder farmers in their agroecological transition. It was also noted that while agroecological practices have been found to be useful in food systems, even the best technologies make no big sense if they are not adopted by local communities. There is a need therefore to overcome bottlenecks that hinder this transition, including data collection that demonstrates the benefits and change of perception by some smallholder farmers that agroecological practices are not economically viable, that they lack supportive financial mechanisms and that there is limited government support in terms of policy frameworks.

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## ACRONYMS

| | |
|---|---|
| AD | Academic Data |
| AE | Agroecology |
| AFSA | Alliance for Food Sovereignty in Africa |
| AI | Artificial Intelligence |
| CIRAWA | Agroecological Solutions for Resilient Farming in West Africa |
| CSO | Civil Society Organization |
| DST | Decision Supporting Tool |
| EU | European Union |
| IAA | Integrated Aqua-agriculture |
| IKS | Indigenous Knowledge System |
| IOT | Internet of Things |
| IPES | International Panel of Experts on Sustainable Food Systems |
| NARO | National Agricultural Research Organization |
| NATAE | Fostering Agroecology Transition in North Africa |
| PELUM | Participatory Ecological Land Use Management |
| PrAEctiCe | Potentials of Agroecological Practices in East Africa with a focus on circular water-energy-nutrient system |
| R & D | Research and Development |
| RUFORUM | Regional Universities Forum for Capacity Building in Agriculture |
| SUA | Sokoine University of Agriculture |

## 2. Introduction

Hochschule Karlsruhe University of Applied Sciences, Germany together with 15 other organisations from Africa and Europe received support from the European Commission Horizon Europe Programme to implement a four (4) year project entitled **“Potentials of Agroecological Practices in East Africa with a Focus on Circular Water-Energy-Nutrient Systems (PrAEctiCe)”**. The overall objective of PrAEctiCe is to provide a novel agroecology indicator set for East Africa to facilitate smallholder farmers in their agroecological (AE) transition. The specific objectives of PrAEctiCe are; i) Mapping and profiling of best existing agroecological practices in different climatic zones in East Africa; ii) Identification of existing barriers and drivers on farm, national, and regional levels to define transition pathways and strategies to further develop existing AE practices; iii) Creating an agroecological indicator framework that covers integrated aqua-agriculture – PrAEctiCE Indicator Framework; iv) Developing a decision support tool for identifying best agroecological practices; v) To validate the decision support tool on integrated aqua-agriculture systems through three living labs in different climate zones in East Africa based on a water-energy-nutrient nexus circular approach; vi) Awareness raising, capacity building, and knowledge transfer on agroecology in East Africa, -strengthening transdisciplinary research and integrated scientific support for relevant AU and EU policies and priorities, and vii) Increasing opportunities for women and youth due to tailored training opportunities and business models.

To create an essential collaboration between Europe and Africa, the project brought together 16 partners from 9 countries across both continents. African partners include Ministry of Fisheries and Livestock in Kenya’s Department of Agriculture, Livestock and Fisheries (DALF) at Kisumu County Government, Maseno University (MSU), Alliance for Food Sovereignty in Africa (AFSA), the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), Sustainable Agriculture Tanzania (SAT), Africa Agribusiness Academy (AAA), National Agricultural Research Organization (NARO) Uganda, Uganda Martyrs University (UMU), Makerere University (MAK), Uganda and Apodissi Ltd (APO), Nigeria.

European partners are Karlsruhe University of Applied Sciences (HKA), University of Maribor (UM), University of Gothenberg (UGOT), Aqua-Biotech Ltd (ABT), Steinbeis 2i Gmbh(S2i) and Aquagri IIM (AQG).

The project goes beyond the existing indicator framework and strives to put “Concept into Action” with a Decision-making Support Tool for agroecological advisors supporting the most suited combination of agroecological practices in the local content. The focus is on water-energy-nutrient systems of integrated aqua-culture, a practice with higher potential for efficient farming practices with minimal climate impacts, which has not been explored sufficiently in previous indicator work. Through a multi-stakeholder’ approach, the project aims at gathering new insights on agroecological practices in East Africa gathered to inform on existing successful practices as well as barriers and drivers of smallholder farmers.

## 3. Background to the Summit

The PrAEctiCe project is developing new knowledge and technologies to support smallholder farmers’ transition to agroecology in East Africa. These include; i) a compendium of agroecological practices with a deeper focus on integrated agriculture-aquaculture practices, that are suitable for the East African context; ii) an indicator framework for assessing transition to agroecology in the East African context; iii) circular water-energy-nutrient systems of integrated aqua-agriculture that is adapted to smallholder context; iv) a Decision Support Tool for smallholder farmers and the agroecology advisors to accelerate their transition to agroecology. To ensure that the new knowledge and technologies are relevant to the end-users and synergy with existing initiatives, the PrAEctiCe project was designed to engage the relevant stakeholders at different levels. Stakeholder engagement was achieved through different approaches including interviews with farmers and agroecology advisors, field or open days, and national consultation workshops with relevant stakeholders. The purpose of the stakeholder engagement is to ensure that end-users of the compendium of agroecology practices, indicator framework, the Decision Support Tool, and the circular water-energy-nutrient systems of integrated aqua-agriculture are part of the design, development, testing, and rollout of this knowledge and technologies, hence providing feedback for their relevance to the East African and other contexts. Information gathered from the consultation workshops, field days, and stakeholder interviews are to be validated at an Agroecology Summit involving stakeholders from within the PrAEctiCe region of interest and beyond and other projects that are generating similar knowledge.

The purpose of the virtual Agroecology Summit organized by the PrAEctiCe project was to engage agroecology stakeholders within and beyond East Africa to review the new knowledge and technologies being generated by the project and provide feedback on how they can be deployed for accelerated transition to agroecology in East Africa. The current, emerging, and future advantages of agroecology aquaculture systems in Africa's food system were highlighted in the process. The focus was on exploring the frameworks for adopting agroecology practices, aimed at fostering collaboration among stakeholders and smallholder aquaculture producers in Africa. To accomplish this, the organizers invited carefully selected stakeholders that included indigenous farming communities, researchers, governments, experts, academia and policy makers to engage in discussions to pave the way for climate-smart global and continental agri-food systems.

The event aimed at exploring ways of how and what should be done to accelerate smallholder farmers' transition to agroecology by demonstrating how advanced technologies such as remote sensing, digital data and GIS can be leveraged to improve sustainable smallholder aquaculture operations' efficiency, selection and monitoring, while emphasizing the integration of indigenous and scientific knowledge, digitization and innovation in agroecological practices.

The key thematic areas of the summit were:

i. Soil and Water Management from an Agroecological Perspective
ii. Digital Decision Support Tools for accelerated transition to agroecology by smallholder farmers
iii. Downscaling technologies to suit the socio-economic context of Africa's smallholder farmers
iv. Renewable energy solutions in agroecological systems for Africa
v. Integrating scientific innovation and indigenous knowledge for accelerated transitions to agroecology by smallholders
vi. Assessing smallholder farmers' transition to agroecology in a way that builds on indigenous knowledge
vii. Indicator framework for measuring agroecology transition in smallholder farming context
viii. Agroecological Innovations for Soil Health and Smallholder Empowerment

## 4. Summit sessions

**Annex 1: Summit Programme**

### 4.1: Plenary/General session

This general session entailed gathering all participants to receive key information, providing introduction of key organizers, participants, essential context, goals and key themes of the summit. It was attended by 124 participants and moderated by Prof. Majaliwa Mwanjalolo, Manager of Research and Innovation for Development at the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)

### 4.1.1 The role of agroecology in sustainably enhancing productivity, food security and profitability of global food systems

#### i. Opening remarks by Prof. Jan Hoinkis
Director of the Institute for Applied Research at Karlsruhe University of Applied Sciences in Germany

In his opening remarks, Prof. Jan Hoinkis noted that the overall theme of the summit of facilitating agroecological transition among smallholder farmers through technology and innovation resonated very well with what the PrAEctiCe project is looking into, exploring how technology and innovation can support smallholder farmers in their ecological transition. He noted that indeed, agroecology is the heart of sustainable agriculture as smallholders are the backbone of food systems in Eastern Africa. The summit also offered an opportunity for exploring the integration of traditional knowhow with agroecology principles as well as how stakeholders can create food systems that are economically viable and resilient to the effects of climate change.

Some of these technologies include digital tools, satellite observations, variety of sensors for precision farming, renewable energy and water treatment methods. However, smallholder farmers face various challenges in adopting these technologies. Even best technologies make no sense if they are not accepted by local communities.

The summit therefore offers a great opportunity for sharing ideas between African and European partners on what the project can do in determining best aquaculture agroecological practices and further collaborative areas in supporting smallholders' transition to agroecology. It should explore how to overcome bottlenecks that hinder smallholder farmers transition to agroecology including the perception that is not affordable, lacks a robust financing mechanism, it is not economically viable and therefore less acceptable.

#### ii. Key note address by Million Belay Ali
General Coordinator Alliance for Food Sovereignty in Africa (AFSA)

Million mentioned that he had just completed a 3-day agricultural summit with over 1000 youth attending both online and in-person. What was really exciting is that Agroecology formed a big part of the discussion in which the conversation looked at ways of incorporating agroecology into new Africa agricultural policy initiatives. The outcome of this was the "Kampala Declaration" but currently dubbed "Post-Malawi Process" in which the youth committed themselves to integrate the agroecology agenda in policy framework for sustainable food systems in their countries.

As a partner in the PrAEctiCe project, he is pleased that agroecology is rapidly gaining traction in the research process and indeed, during the discussion with various Ugandan and other regional universities, they have agreed to initiate a university network on agroecology. He was confident that the outcomes from the PrAEctiCe project in Eastern Africa will be helpful to other parts of Africa so that agroecology can particularly be incorporated into the countries' agricultural policy campaigns. He noted that some of the existing findings are already being integrated into climate policy in countries like Ethiopia and Kenya. Indeed, the summit could not have come at a better time as agroecology will certainly play a critical role in the current and future Africa's food systems.

### 4.1.2 Deploying the circular economy in integrated agri-aquaculture systems in Africa
Prof. Jan Hoinkins

Prof. Jan Hoinkins highlighted the role of the PrAEctiCe project in bringing about agroecological evolution by converting concepts into action and provide a novel agroecology indicator set for East Africa's agroecology advisors focusing on circular water-energy-nutrient systems of integrated aqua-agriculture.

The AE indicator framework will guide smallholder farmers on their way from conventional agriculture to AE practices. This will involve a combination of AE practices such as turning waste into valuable aquaculture health and innovation, use of solar power that is abundant in Africa and waste water treatment for agricultural production. The project will also ride on emerging innovations such as IOT-based sensors and AI to accelerate transition and monitor progress remotely.

How will PrAEctiCE meet these objectives?


i. **Co-creation of activities:** This will involve convening stakeholders to provide input for research activities. They will have an opportunity to validate developed conclusion and results. This will be done through site visits and surveys by collaboration between various partners.
ii. **Decision Support Tool:** A dedicated tool will put PrAEctiCe's vision and objectives into concrete action, establishing agroecological guidelines for farmers through data collection and practical approaches to different challenging situations.


iii. **Living Labs:** Three living labs will be operated with the aim to unify community knowledge with scientific expertise. These demonstration pilots are action-based projects that produce data and validation for the Decision Support Tool.
iv. **Training:** Supporting the farmers and building knowledge through "train the trainers" courses and practical training on integrated aqua-agriculture. Facilitation of knowledge exchange across continents and between disciplines.

### 4.1.3 User perspectives on agroecological transition
Panel discussion by end-users of agroecological technologies and innovations

The main questions were:

a. How do they integrate agroecology in their farming activities?
b. Has agroecology improved productivity and soil health?
c. What can be done to accelerate adoption of agroecological practices among smallholders?
d. How do their organizations work with smallholder farmers?
e. How do their organizations balance between economic viability and agroecology practices?

### i. Farmer A: Robin Ndungu – Farmer Practitioner, Kenya

Founder & CEO Kisumeo Organics Limited, Kenya, a passionate angler, farmer and innovator, focused on social impact in aquaculture and mariculture fisheries industry.

Robin avers that the challenge faced by smallholder aquaculture farmers is lack of skills and technologies that could provide a crucial head-start to upcoming entrepreneurs. However, research institutions and universities in Kenya, notably Jomo Kenyatta University of Agriculture and Technology, has started collaborating with smallholders and other stakeholders in designing and carrying out research in various aspects of agroecology. His company is currently working with smallholders, providing training and contracting them to produce crustaceans that are responsive to market demand and safety, hygiene and regulatory standards.

The main challenge he faces is the low acceptance by the community, lack of government support and lack of financing mechanism to support agroecology practitioners, both as smallholders and promoters. He thinks that skills development and promotion of healthy living by consuming agroecologically-produced food will accelerate smallholders' adoption of these practices. With this, smallholders' aquaculture farmers will be able to reduce production costs by recycling waste and using this to produce other crops by utilizing livestock waste as a source of organic fertilizer and clean energy. This will also improve soil health and fertility in their farms.

In his aquaculture enterprise, water and feed waste is used to grow and fertilize farms for indigenous vegetable production. This integration of inputs and waste has reduced the cost of vegetable production by 30%.

### ii. Farmer B: Samuel Kabuye

A smallholder farmer in Uganda practicing and promoting agroecological practices within his locality.

Samuel, an AFSA-trained farmer, cascades the skills learned by visiting and training other smallholders on how to actively engage in agroecological practices. Since he started this, almost 80% of smallholders within his location are applying some level of agroecological principles in their agricultural production. The main practices include polyculture, where they grow crops, trees, and livestock on their farms.

The main challenge he faces is the low acceptance by the community, lack of government support and lack of financing mechanism to support agroecology practitioners, both as smallholders and promoters. He is of the opinion that skills development and promotion of healthy living by consuming agroecologically-produced food will accelerate smallholders' adoption of these practices. With this, smallholders will be able to reduce production cost by recycling waste and using this to produce other crops and utilize livestock waste to produce clean energy and improve the soil fertility in their farms.

### iii. Civil Society Organization supporting farmers in adopting agroecological practices

PELUM Association is a network of 357 Civil Society Organizations (CSOs) working across 14 countries in Eastern and Central Africa. The main theme is "Promoting agroecology food systems transformation and livelihoods through agroecology".

Represented by Bihunira Medius - Head of Programmes

The main question was: What strategies is PELUM implementing to support sustainable agroecological practices?

The main strategy for agroecological adoption is the use of their own ground-level networks including their 12 million farmers to promote these practices in each country chapter. These farmers provide answers to the question on whether agroecology can really feed the world. They have established “Agroecology Centers of Excellence” where they train and demonstrate practical application and benefits of adopting agroecological practices.

PELUM also holds annual Food and Seed festivals promoted at community, national, and regional levels that are focused on Indigenous food and seed systems. This platform provides an opportunity for farmers to show-case the results of agroecology principles and also engage in policy dialogue processes with the governments through evidence adduced from their practices. It also provides good insights into areas requiring further research and technical support, as well as policy interventions as are necessary for accelerated adoption of agroecological practices by smallholder farmers.

## 4.2 Breakout/Parallel sessions

### 4.2.1 Digitization and innovation in agroecological practices

Prof. Domen Mongus, Head of GeMMA Lab, University of Maribor

This breakout session was attended by 20 participants and was moderated by Thanasis Chantzaropoulos an aquaculture consultant in Aquaculture from the University of Stirling’s Institute of Aquaculture and currently working for Aqua-biotech as the technical coordinator.

The key challenges and opportunities that were identified in relation to agroecological transition in smallholder agricultural production included:

i. Data collection from many different sources.
ii. Lack of user friendly applications and opportunity to design the same.
iii. Opportunity of gathering necessary agroecological information into digital handbook
iv. Limited access to necessary technology such as smart phones and stable internet connection.
v. Digital illiteracy.
vi. Difficulties to change the smallholder farmers’ mindsets.

Key technologies, innovations and agroecological practices shared/identified by the presenters and participants to address the challenges of soil degradation, climate change and dependency on subsistence farming and seize opportunities to accelerate agroecology transition in smallholder farmers were identified and this entailed designing of a decision support system and tools as well as utilization of comprehensive data analytics tools.

It was noted that similar systems are utilized within precision farming across Europe and USA

The Key take away messages from this session were:

i. There should be a precision monitoring system of the agroecological practices.
ii. There is a need to design automatic alerts if monitored values go out of optimal ranges and in which the DST would provide possible solutions to the farmer in case of the alert.

The key action points that were identified for different stakeholders in the Agrifood systems for accelerated transition to agroecology in regard to digitization and innovation for smallholder agricultural production were:

i. How to address farmers without smart phones. Should advisors stand-in for multiple farmers, observe what is happening on their fields based on intelligent systems and deliver appropriate feedback to them?
ii. How do AI tools help with decision support? It should be complementing and speeding up the necessary work to save time. However, the content must still be curated by a human.
iii. What is the commercial possibility of the presented tools? If tools save time by providing the relevant information, then it would make sense to continue developing commercially.
iv. DST will primarily help advisors and extension services so that they can provide good advice and share good practices to their group of smallholder farmers.
v. How is data collected and stored? Is it stored centrally and separated between workspaces or is it collected from the parent platforms that collect data directly from provided sensory networks or from satellite providers?

Screen shot for the session

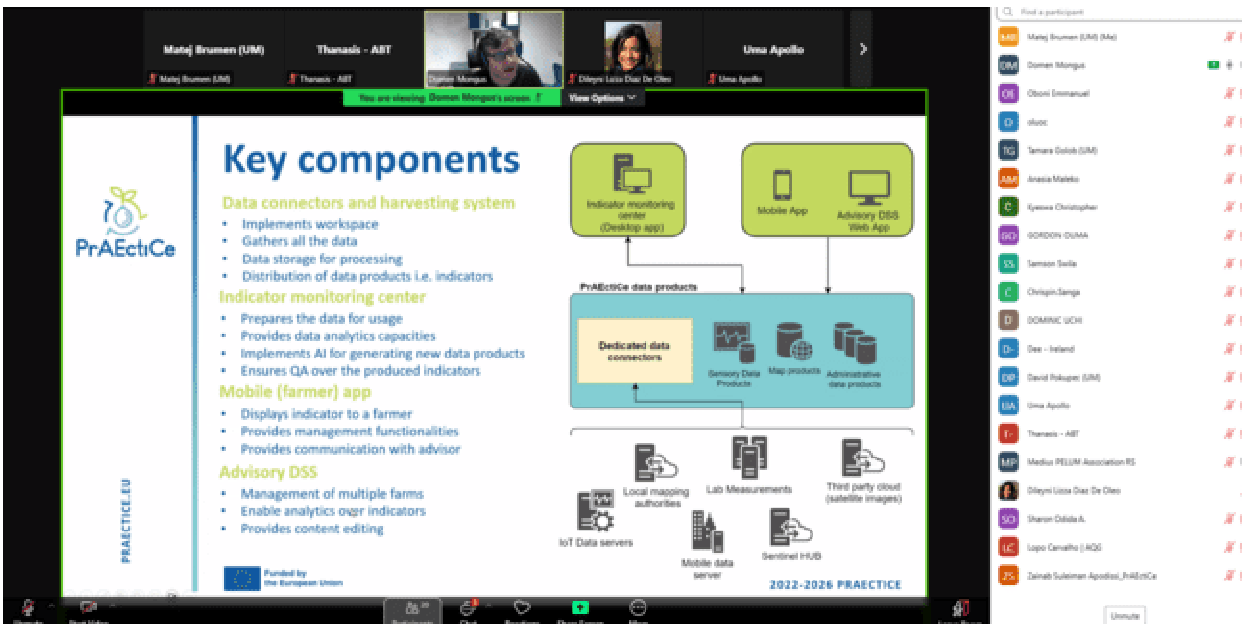


*Figure 2: Key PrAEctiCe components for digitalization of AE practices*

## 4.2.2 Integrating scientific innovation and indigenous knowledge for accelerated transitions to agroecology by smallholder farmers

This breakout session was attended by 20 participants spanning from academia, industry, NGOs and other researchers and was moderated by Charles Lwanga Tumuhe from the Alliance for Food Sovereignty in Africa (AFSA).

The session had two presentations:

## Presentation i: How can scientific research, information and innovation be integrated with indigenous knowledge to accelerate smallholders' transition to agroecology and enhance food production in Africa?

Prof. Harun Okello Ogindo, Professor of agrometeorology at Maseno University

In his presentation, Prof. Ogindo explained that Indigenous Knowledge Systems (IKS) refer to the cumulative, dynamic body of knowledge, practices, and beliefs developed and passed down through generations within a specific community. This knowledge system is deeply rooted in the cultural traditions, values, and experiences of Indigenous people and is used to sustain and improve their way of life, particularly in areas such as agriculture, healthcare, and natural resource management. He gave examples, including Community Seed Systems, emphasizing its importance in agroecology. He explained that these seed systems allow farmers and communities to improve their seeds and other food production resources over the years.

He also explained agroecological indicators as measurable variables used to assess specific aspects of a production system to measure sustainability. In agroecology, indicators may be used to evaluate factors such as soil health, biodiversity, water usage, or socio- economic impacts, providing insights into the sustainability and performance of agricultural practices.


Some of the challenges associated with the attempts to integrate indigenous knowledge with scientific innovations were also highlighted; the main one being the missing link between researchers and the community members that renders continuous sharing of information sharing difficult.

PrAEctiCe

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## Example of Indicators

| Indicator Category | Indicator | Means of Measurement | Means of Monitoring | Thresholds and Critical Values | Mitigation Measures |
|---|---|---|---|---|---|
| Water Quality Indicators | Dissolved Oxygen (F) | DO concentration (mg/L) | Continuous or periodic water quality monitoring | >5 mg/L for fish survival | Aeration, water flow management |
| | Ammonia (F) | Ammonia concentration (mg/L) | Regular testing of water samples | <0.02 mg/L for chronic exposure | Increase water exchange, biological filters |
| | Nitrite (F) | Nitrite concentration (mg/L) | Water quality monitoring | <0.1 mg/L for sensitive species | Biofiltration, reduce feeding |
| | Nitrate (F) | Nitrate concentration (mg/L) | Regular water testing | <50 mg/L for freshwater systems | Water changes, improved filtration |
| | Total Suspended Solids (F) | Concentration of solids (mg/L) | Turbidity meters or sampling | System-specific, e.g., <25 mg/L | Sedimentation, mechanicalfiltration |
| | Biochemical Oxygen Demand (F) | BOD (mg/L) | Testing over 5 days | <5 mg/L for healthy systems | Improve organic waste management |
| | Chemical Oxygen Demand (F) | COD (mg/L) | Laboratory analysis | <50 mg/L in treated effluent | Improve waste management, filtration systems |
| | Total Phosphorus (F) | Phosphorus concentration (mg/L) | Regular testing of water samples | <0.1 mg/L for prevention of eutrophication | Use of phosphorus-free feed, water exchange |
| | Total Nitrogen (F) | Nitrogen concentration (mg/L) | Regular water quality testing | <1 mg/L for good water quality | Improve nutrient management, use of biofilters |

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Prof. Ogindo highlighted some of the challenges smallholder farmers face in their agroecological transition. These include a lack of adoptive tools and approaches for engaging knowledge-holders, divergent worldviews, identities, practices, ethics, and asymmetries of power and rights, as well as the total absence of educational, research, and extension programs that integrate and build on Indigenous values, beliefs, and traditions. He further highlighted a lack of institutional support and policy recognition, diverse cultural differences and perceptions, deficient intellectual property and knowledge ownership, language and communication barriers, limited research on compatibility and validation, risk of knowledge erosion and loss of traditional practices. Economic pressures and incentives for modernization, climate change and environmental degradation were also stated as part of these challenges.

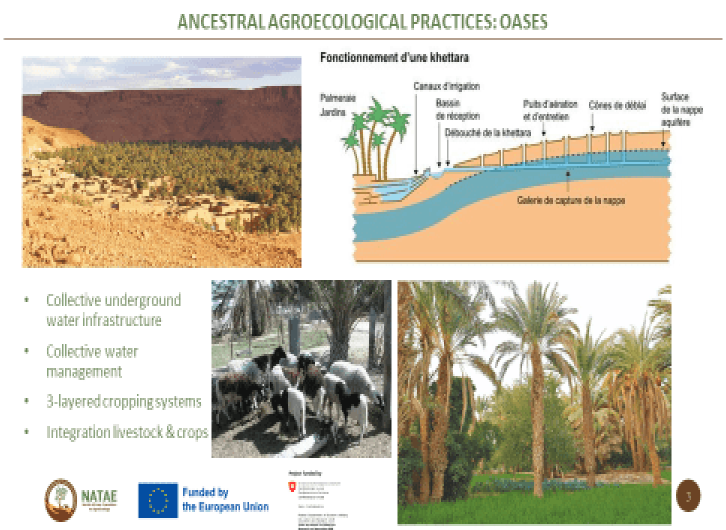
Some of the approaches that were identified to support the integration of scientific knowledge and indigenous knowhow were:

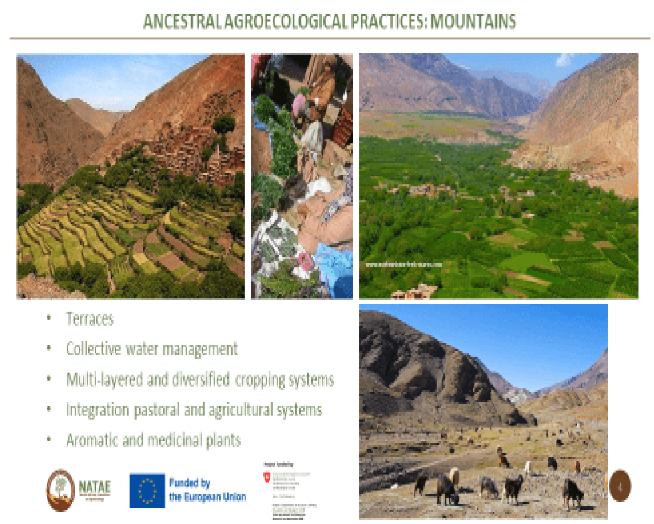
i. Participatory Research: Engage Indigenous communities in co-designing research and projects, allowing them to contribute their knowledge and insights. Participatory methods foster mutual learning and can bridge epistemological differences.
ii. Cultural Sensitivity and Training: Train researchers, policymakers, and extension workers on the importance of cultural respect and IK. This can improve understanding and communication between stakeholders.
iii. Policy Advocacy: Advocate for policies recognizing and protecting indigenous knowledge and promoting its integration with scientific information in sustainable farming programs.
iv. Knowledge Documentation and Preservation: Support initiatives that document indigenous knowledge and make it accessible to younger generations while ensuring cultural protocols and intellectual property rights are respected.
v. Localized Indicators: Develop context-specific agroecological indicators that can be used to evaluate IK practices alongside scientific measures, allowing for a more nuanced assessment of sustainability.

## Presentation ii: How can agroecological practices and technologies be effectively deployed by smallholder farmers to accelerate this transition?

### Elen Lemaitre-Curri – From NATAE - Fostering Agroecology Transition in North Africa

In her presentation, she explained the multi-sectoral approach adopted by the NATAE project particularly in Northern Africa. There are different methods of resource conservation that have been adopted by communities in the water scare parts of North Africa where water is mostly obtained from oases. This includes drip irrigation, integration of nature, food systems, and agroforestry. She explained that there are a lot of traditional practices that have been adopted by communities in these areas that are helping in their agroecology transition.




Some of the threats to agroecological transition in these areas include urbanization, climate change and overreliance on imports.

The NATAE project identifies most promising technologies and validates them with the communities in Living Labs. This is similar to the approach adopted by the PrAEctiCe project. Elen Lemaitre-Curr gave an overview of how indigenous knowledge has been integrated with scientific innovations for accelerated agroecological transition in Northern Africa under the project NATAE by sharing some traditional agroecological practices in this region, threat to this transformation, scientific practices that have been introduced and hybridized over time and how NATAE has co-designed and co-evaluated multi approaches in this transformation.

In the oases, some of the ancestral practices that have been integrated with scientific knowledge include; designing and developing underground infrastructure, adopting 3-layered cropping system that integrates crops, agroforestry and livestock. In the mountains, some of the integrated practices include terracing, collective water management systems, integration of pastoral and agricultural systems as well as production of aromatic and medicinal plants. In the Cereal Plains, these farmers have adopted rotations between cereals and legumes, under cropping e.g. under olive and almond trees, mixed farming such as fodder crops, legumes and cereals, and use of improved local crop varieties such as wheat.

In conclusion, scientific research and innovation largely focus on improving efficiency and, to some extent, substituting indigenous knowledge, which over time becomes more complex. This leads to testing a combination of practices, combining field, farm and value chain territorial levels for hybridization with indigenous practices. This is particularly prevalent in arid and vulnerable agro-systems, which are at risk of disappearing due to incomplete or poorly adapted combinations. Furthermore, agroecological innovations are largely driven by urban population and civil societies, and receive limited political attention, except in marginal areas.

To accelerate adoption of AE practices among smallholders, there is a need to:

i. Provide comprehensive understanding of agroecological combinations and perceptions.
ii. Assess multi-dimensional benefits, identify conditions, means, tools and support to AE transition.
iii. Broaden consumers and value chain base for smallholders.
iv. Set up a multi-actors AE network.
v. Empower policy, research and education initiatives in AE.
vi. Assess and quantify multi-scaler impact and adoption conditions.

Arising from the presentations, the participants sought to get further insights on specific aspects:

i. How does NATAE project engage stakeholders in co-creating activities?

The project works closely with farmers in identifying the most promising technologies and innovations and share knowledge with them based on data collected from the Living Labs. The co-creation involves farmers, public institutions and private sector.

ii. Are there challenges with institutionalization, research capacity and compatibility at the Living Labs in the PrAEctiCe project? – This was directed to Maseno University and NARO.

The Living Lab in Kisumu is indeed under the County Government of Kisumu, hence domiciling and institutionalizing it under the local government administration. It also makes it easy for local farmers to access and learn the different technologies and innovations from there. In Uganda, the Living Labs are under NARO which again, is a government owned institutions.

iii. Agroecology in North Africa has been driven by urban populations. How can smallholder farmers in East Africa be involved in the innovation?

Urban populations create demand for AE products hence driving the need for adoption of these agroecological practices. Some projects are driven by government and research institutions.

iv. How are the youth and women integrated into these research projects?

In North Africa, for example, most of the students in agricultural institutions are women (NATAE project). This makes it easy to transfer the knowledge on agroecology to the youth and women. Digitization of AE especially in aquaculture and other agricultural systems has also enhanced the involvement of the youth.

At the end of this breakout session, the participants emerged with the following opinions:

i. Improved seeds are not sustainable to the local farmers and they should be encouraged and supported to develop and manage community seed systems.
ii. The starting point should be the indigenous knowledge, then move to find out how science can be used to improve it. This way, science will respond to the real needs of local farmers.
iii. Transition should also focus on policy advocacy which has been the missing link in most agroecology projects.

iv. Traditional or local does not mean low quality as has been assumed by policy makers which has led to over emphasis on modern systems. There is a need for sensitization of policy makers on the importance of indigenous knowledge in agroecology and food systems. This way, policies can be formulated to recognize indigenous knowledge.
v. Women are the main providers of agricultural labor in Africa and there is a need to convince them that agroecology is the way to go.
vi. There is a need to empower smallholder farmers to develop simple indicators like soil color or texture which are easy for them to monitor and describe. These can then be used as proxi-indicators and can be improved through science.
vii. There is a need for scientific data to move from the fields and labs to smallholders' policy and decision-making spaces.

### 4.2.3: Soil Health and Water Quality Management in Circular Integrated Agriculture and Aquaculture Systems

This breakout session had two presentations and was attended by 22 participants. It was moderated by Prof. Majaliwa Mwanjalolo.

#### Presentation i: Soil and Water Management from agroecological perspective

Dr. Nyambilila Abdallah Amuri, Senior Lecturer and Researcher in Soil Science specializing in soil chemistry/soil fertility management at Sokoine University of Agriculture (SUA), Tanzania

Some key technologies and innovations have been used to address the challenges of soil and water management to accelerate agroecological transition among smallholder farmers. These include:

i. Development of mobile Apps for farmers and a desktop application for advisors and backend for specialists
ii. Valorization of agro-waste and acceleration of production of bio-based fertilizer
iii. Production of high quality seeds
iv. Reclamation of saline soil through Phytoremediation
v. Adoption of soil fertility, water and crop management practices
vi. Integration of scientific and indigenous knowledge in water and soil management practices
vii. Carrying out soil fertility and water management studies to support a combination of agroecological practices

Agroecological practices in regard to soil and water management require time and commitment. Operation principals for adoption of effective soil and water management practices include:
i. Mitigating soil health threats
ii. Waste management
iii. Clean up of the environment
iv. Identification of what works best and in what conditions
v. Use of integrated soil fertility management
vi. Native tree conservation
vii. Package available best management practices to limit or mitigate agri-systems challenges
viii. Composting and vermi-composting technologies
ix. Use of organic fertilizer and soil amendment

The key action points identified by different stakeholders for accelerated smallholders' transition to agroecology, more specifically related to soil and water management in smallholder agricultural production were acknowledged. These included collective efforts to promote production and consumption of healthy food through healthy soils, sharing data, knowledge and best practices through an inclusive platform, training of youth and women in agroecological principles, adopting recycling of water and biomass at the farm level as well as carrying out and analyzing periodical economic, social and environmental assessments.

### Session ii: Sustainable soil and water management technologies and innovations in smallholder agriculture

Silvia Gómez Valle from CARTIF Technological Centre in Agrifood and Sustainable Processes Division

The main agricultural challenges to soil and water management technologies that slow down smallholders' transition to agroecology are related to:

i. Soil degradation
   a. Soil erosion and loss of fertility
   b. Contamination by agrochemicals
   c. Deforestation and loss of biodiversity
ii. Climate Change
   a. Prolonged droughts and erratic rains
   b. Changing rainy season patterns
   c. Increase in average temperature
iii. Dependence on Subsistence Agriculture
   a. Vulnerability of small farmers
   b. Persistent food insecurity
   c. Vulnerable groups: women and youth

**CIRAWA** is developing new agroecological-based practices that builds on existing local and scientific knowledge to help create more resilient food supply chains.


CIRAWA aims to demonstrate how working with nature can enhance ecosystem health and biodiversity, while improving local livelihoods and climate resilience using four key agroecological approaches:

1. Valorisation of agro-wastes and bio-based fertilizer production
2. Production of high quality seeds
3. Saline soil reclamation through phytoremediation
4. Soil fertility, water and crop management practices

How will effective implementation be ensured?

i. Clear definition of the farmers and communities ‘requirements and needs through consultation process by way of farmer interviews, key informant interviews and focus groups.
ii. Selection of 100 plots (25 per country) where selected agroecological strategies and techniques will be implemented following a Living Lab approach and engagement of 2000 farmers.
iii. Strong collaboration between farmers so as to combine scientific and indigenous knowledge.
iv. Soil fertility studies: soil analysis to identify nutrient deficiencies, soil problems and fertility recommendations.
v. Combination of different agroecological practices, adapted to each case and evaluation of synergies.
vi. Most suitable agroecological practices adapted to specific local conditions.

What are the soil health agroecological solutions?

i. **Saline soil reclamation**
   This will involve phytoremediation with *Acacia ampliceps* combined with soil amendments as well as characterization of microbial communities in saline soils.
ii. **Agro-residue valorisation**
   This is evaluating the potential use as bio-products such as vermicompost and fertilizer, fuel for energy production and construction material.
iii. **Quality seeds production**
   This will involve research on new seed coating techniques with fertilizers to improve soil fertility and breeding of saline-adapted rice varieties.
iv. **Decision Support System**
   That should be easy-to-follow, customized advisory services on fertilization, irrigation and recommended agroecological practices.

What are the key ideas in supporting smallholder farmers in their agroecological transition?

There is a need to establish an integration platform for agroecological best practices that facilitates data analysis and knowledge sharing among stakeholders, providing guidance on different agroecological practices. This platform should be easy to access and use for farmers and technical staff. The trainings should also focus on youth and women for sustainable agroecology practices, while circular economic models should be developed mainly on management of waste and seed inventory. Finally, there should be assessment results on socio-economic and environmental impact arising from agroecological strategies in order to demonstrate and optimize the benefits of agroecology in smallholder farming communities.

**Key take-away points**

The participants from this breakout session recognized the need to precisely define soil parameters that will be improved by adoption of agroecological practices. Other key approaches for accelerated adoption are training, awareness-raising among stakeholders, supporting this transition at all levels, identifying case studies and interpreting data from Living labs to support DSTs and utilizing these for autonomous decision making. Consequently, the session recognized the importance of collaboration between farmers, researchers and local communities to ensure long-term adoption of these sustainable practices.

For smallholder farmers, they expect that adoption of agroecological practices should lead to increase in yields, increase in soil organic matter, improved livelihoods, and reduction in cost of production.

### 4.2.4 Renewable energy solutions in agroecological systems for Africa

#### Fabian Dold – Equator Solar Group

This breakout session was attended by 17 participants and was moderated by Prof. Nicholas Kiggundu, an Associate Professor at Makerere University (MAK), department of Agricultural and Biosystems Engineering.

Equator Solar Group in East Africa was founded in 2011 in Kampala Uganda and is owned and managed by Group members operating in East Africa. They are renewable energy experts and project developers. They also design, implement and commission solar projects, and are active in energy efficient consulting and engineering.
The main challenges identified in relation to adoption of renewable energy solutions for smallholder farmers in Africa are high investment costs and high dependency on natural environmental conditions.

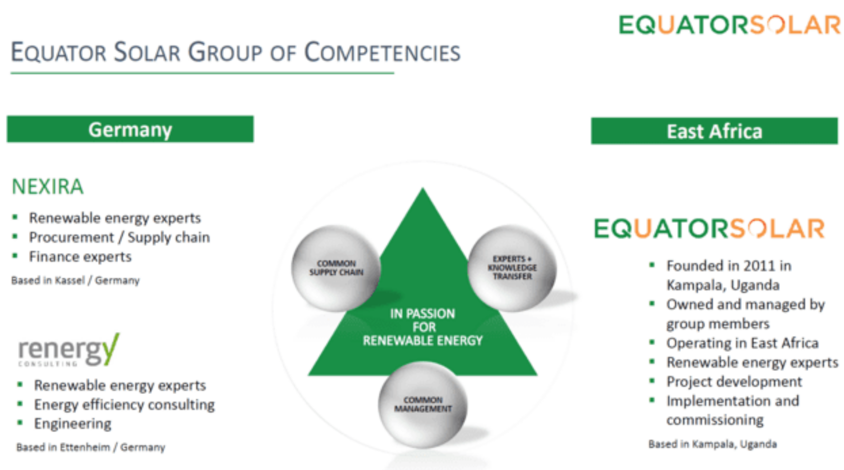
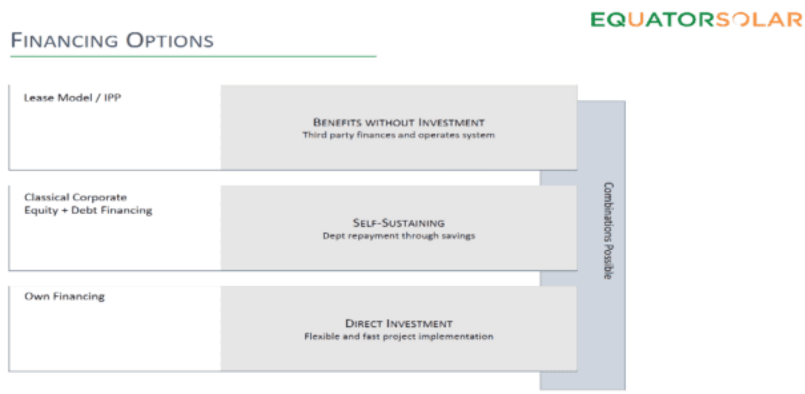



*Figure 9: Equator Solar Group key competencies*

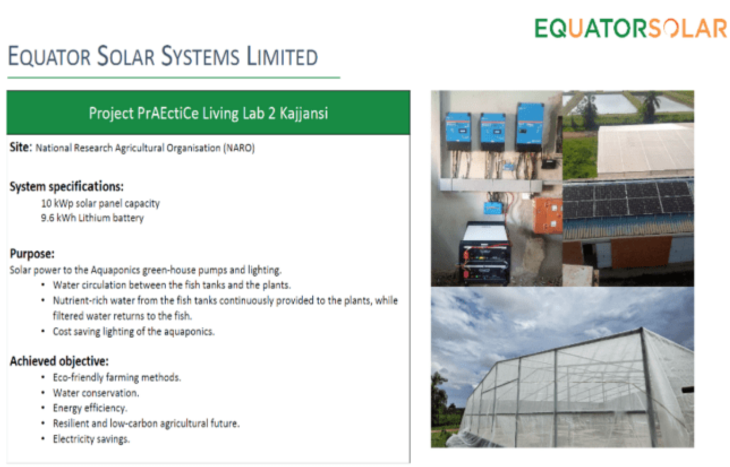
In order to address these challenges, some opportunities mainly in terms of key technologies and innovations have been identified to support smallholders in their agroecological transition. These include:

i. Minimizing operating costs (OPEX) and maintenance costs of solar equipment through adoption of modern technology such as remote access, digitalization and use of sensors.

ii. Adopting flexible financing options such as leasing, building cooperation, financing by third parties and building partnerships. This will overcome the high initial costs for smallholder farmers.




iii. Scalability: Many different system solutions are available and scalable (modularity). Surveys and consultations are necessary in order to select the solar system that best suits the farmers' needs in terms of financing, technical requirements, and operational costs. In Uganda, for instance, different regions face varying levels of water/sunshine availability, while different stakeholders require solar for a range of needs, including food cooling, irrigation or/and lighting. Consulting facilitates selection of suitable solutions to address these needs.




Different systems call for different needs and environmental conditions. For instance, in Kajjansi Living Lab 2, NARO has adopted a solar system that has saved their costs by 57%, while in Kisumu, Living Lab 1, the County government has saved their cost by 78%.

Besides saving costs, solar energy solutions ensure continuous availability of energy during shortages.

During the plenary discussions, a number of issues were addressed:

i. How Equator Solar research addresses the varying energy needs for different agroecological zones across the continent?

Equator Solar carries out research in different zones to determine the most suitable solar solutions depending on industries / communities distribution / purpose vis-à-vis availability of water / sunshine. Energy need is easily scaled (up/ down) when different systems are needed.

ii. How can existing renewable energy technologies be downscaled or simplified to make them more accessible to smallholder farmers in remote areas?

The most appropriate solution is to consider various financing options and partners available and select the one that suits their situation. Equator Solar helps farmers to connect to financiers.

iii. What role do you see for private-sector involvement or public-private partnerships in scaling renewable energy solutions for smallholder farmers?

The smallholders are better off if they form cooperatives that they can use to collectively acquire solar solution technologies due to technology transfer and cost effectiveness.

iv. What strategies have been effective in facilitating knowledge transfer and training for farmers to adopt renewable energy technologies?

a. Communicate the energy problem
b. Demonstrate using practical examples of existing solar systems used by farmers
c. Offer technical support to farmers
d. Select the most reliable system for the farmers

v. How do you envision the role of digital technologies (e.g., mobile applications, remote monitoring) in supporting renewable energy integration in agroecological farming systems?

Remote monitoring ensures real-time responses and saves time and costs translating into improved benefits.

### 4.2.5 Agroecological practices in smallholder aquaculture production: Socio-economically viable models for the African context

This breakout session had two presentations and was attended by 28 participants. It was moderated by Alyssa Joyce, an Associate Professor in the Department of Marine Sciences at the University of Gothenburg in Sweden.

#### Session i: Technology-based systems for aquaculture production

Nasser Kasozi Ugandan scientist working with the National Agricultural Research Organization (NARO) based at Buginyanya Zonal Agricultural Research and Development Institute.

Key statistics

Introduction: Aquaculture production and consumption patterns in Eastern Africa

i. 75% of East Africans regularly consume fish, 30% of whom consume it as their main source of protein.
ii. Per capita consumption in East Africa is relatively low by global standards (averaging 7.5kg).
iii. Rwanda's per capita fish consumption = 2.3 kg.
iv. Kenya =4.7 kg per person per year.
v. Tanzania = 8 kg per person per year.
vi. Uganda = 10 kg per person per year.

**Aquaculture production and value in East Africa**

| Country | Aquaculture production (2021) MT | Estimated farm value @US$2.7 per Kg |
|---|---|---|
| Uganda | 138 558 | 374,481,081.1 |
| United Republic of Tanzania | 106 482 | 287,789,189.2 |
| Kenya | 63 355 | 171,229,729.7 |
| Rwanda | 10 313 | 27,872,973.0 |

***Source:*** *FAO Fishery and Aquaculture Statistics. Global aquaculture production 1950-2021 (FishStatJ)*

**What are the technology-based systems for Aquaculture?**

These range from very extensive through semi-intensive and highly intensive to hyper-intensive. The progressive staging reflects the increasing level of the use of technology in aquaculture, from non-supplementary feeding in extensive systems to highly intensive automated systems with intensive feed supplementation. Aquaculture-based technologies focus on use of improved technologies/innovations to increase production and productivity such as automated feeding systems, advanced monitoring and control systems, use of renewable energy sources such as solar and wind power and use of recycled nutrients.

**Various Aquaculture systems**

i. Land-based systems (rain-fed ponds, irrigated or flow-through systems, tank-sand raceways)
ii. Recycling systems (high control enclosed systems, more open pond-based recirculation).
iii. Water-based systems (cages and pens, inshore/offshore).
iv. Integrated farming systems (e.g. livestock-fish, agriculture and fish dual use aquaculture and irrigation ponds)
v. The level of technology being commensurate with the level of operation

Ponds

Aquaculture: Farming of aquatic organisms with some form of intervention in the rearing process to enhance production plus ownership

Tanks

Indoor systems

Cages

**Integrated fish/crop/animal farming Strategies**

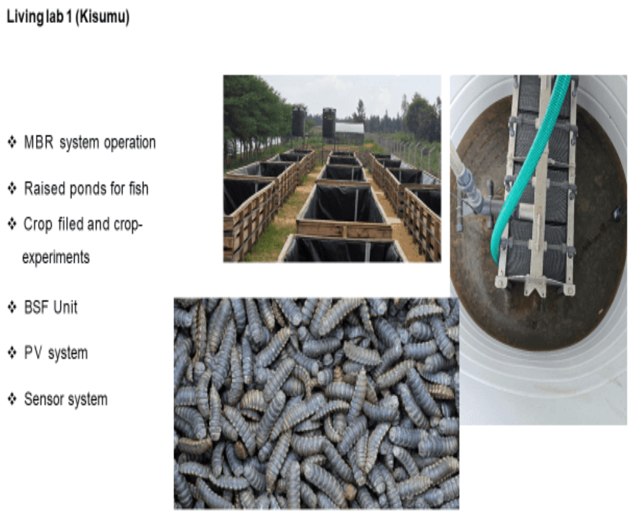
*Figure : Various types of AE aquaculture systems*

contributing to increased food and fish production. Integrated fish farming generally consists of two types:

i. Agri-based farming – Paddy-cum-fish culture; Horticulture-cum-fish farming
ii. Livestock-fish farming (Poultry-cum-fish farming, Duck-cum-fish culture; Pig-cum-fish culture; Rabbit-fish integration)

**Aquaculture-vegetable farming using effluent water from ponds**

In this approach, fish pond water is utilized to water vegetables such as onions, tomatoes, and cabbage, hence reducing the farmer's need to buy chemical fertilizers.




**PrAEctiCe contribution to development of technology-based systems for aquaculture (IAA- Integrated aqua-agriculture living labs)**

**Living lab 1 - Kisumu, Kenya:** Organic-based fish feed production unit using Black Soldier Fly as bio-waste converters
**Living lab 2 Kajjansi, Uganda:** Circular water and nutrient management for integrated aquaponic systems
**Living lab 3, Morogoro, Tanzania:** Integrated aquaculture-poultry system

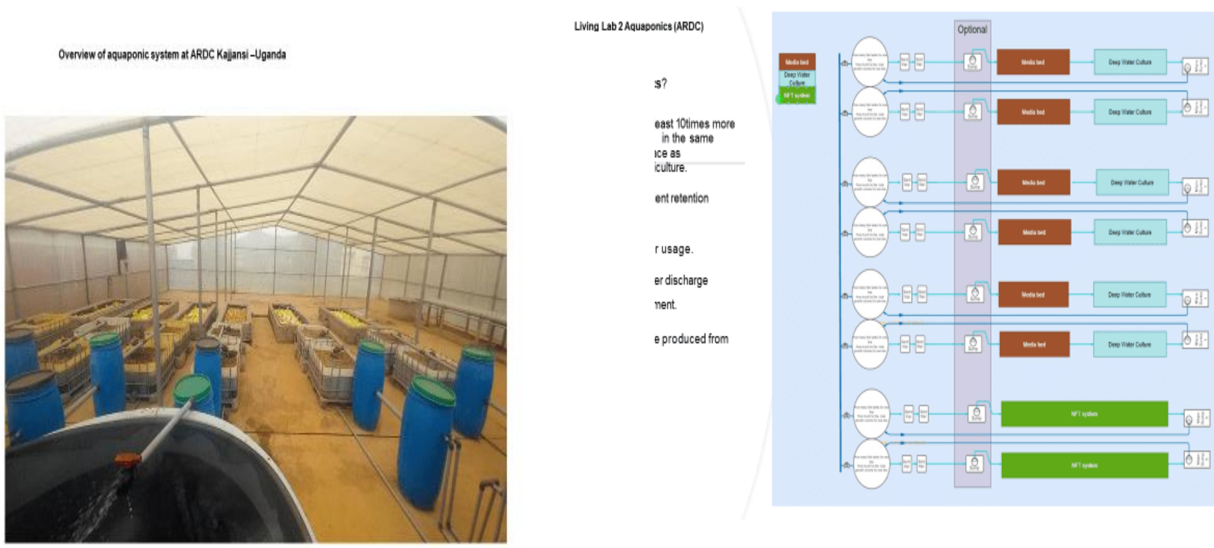



*Figure 17. Components of Living Lab 2 in Kajjansi, Uganda*


Presentation ii: ... llholder farmers

*Figure 18. Integrated aquaculture - Poultry system at SAT, Tanzania*

Florence Birungi Kyazze, Senior lecturer in the Department of Extension and Innovation Studies, Makerere University

Downscaling to fit the smallholders involves:

**Adoption of affordable technologies**: Develop cost-effective solutions tailored to the financial capabilities of smallholders. This includes low-cost crop, livestock enterprises, and small-scale water quality testing kits.

**Training and capacity building**: Provide training programs that focus on best practices in aquaculture. These should cover fish management, biosecurity, fish health, and environmental sustainability.

**Community support networks**: Strengthen farmer cooperatives or support groups that share knowledge, resources, and best practices in aquaculture. This can help in collective, marketing purchasing of inputs and technology.

**Research and Development**: Engage in research focused on smallholder needs, adapting existing technologies to be more suitable for low-input systems and less intensive management.

*Figure 22: Some examples of research and development project focused on aquaculture for smallholder farmers*

## 5.Key highlights of the summit and way forward

i. Training of Trainers to create a wide scope of AE Advisors should be undertaken to accelerate smallholders' transition to agroecology
ii. Extension workers to carry out AE campaigns at the farm level should be supported
iii. It is evident that AE is gaining traction and governments are already laying emphasis on adoption of agroecological practices among farming communities
iv. AE adoption by smallholder farmers face various challenges among them:
    - They lack learning exposure and centers of AE excellence where they can learn from
    - Are not sure of AE economic viability
    - AE technologies seem to be complicated
v. There is need for creation of synergies among stakeholders such as formation of a multi-sectoral research network to spearhead research in AE
vi. Alternative feeding systems within the agricultural value chains should be explored to supplement fish protein
vii. Breeding programmes are essential for seed quality especially for Nile Tilapia
viii. Use of locally available resources should be the way to go since there are available in their unique localities
ix. Capacity building: How can PrAEctiCe support this at different levels and scale?
x. There is need to generate relevant data to support a robust DST for smallholder farmers
xi. Need to develop proxi-indicators to be used by farmers in integrated food systems
xii. Need to integrate indigenous and scientific knowledge in co-creation activities
xiii. Need to influence AE policies at country and regional levels through development of policy briefs and advocacy drives
xiv. Integration of energy technologies in IAA for sustainability and reduce Carbon footprints, cost of production and maintenance cost for aquaculture systems
xv. Public-private partnership should be supported to scale-up AE uptake and transition
xvi. There is need to look at niche market for agroecologically-produced food in order to support sustainable food production system and offer incentives for adoption

The project's partners: Hochschule Karlsruhe University of Applied Sciences, Steinbeis Europa Zentrum, AquaBiotech, Prototipi, University of Gothenburg, Makerere University, Uganda Martyrs University, University of Maribor, Ministry of Agriculture and Livestock Development (moALD), RUFORUM, National Agriculture Research Organisation, Maseno University, Sustainable Agriculture Tanzania (SAT), Aquagri, AFSA Africa and Africa Agribusiness Academy

*Partners*

For more information, view the **PrAEctiCe Concept** and the **PrAEctiCe Co-Creation Activities.**
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