Deliverable N.: D2.2.1(a)

Title: Report on the 1st Module of the Training and Capacity Building Course (Contribution to D2.2.1 – Two (2) reports on performed training and capacity building sessions)

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WATDEV CONSORTIUM

The project consortium is comprised of:

EGYPT	Heliopolis University (HU)
ETHIOPIA	Water and Land Resources Institute (WLRI)
FINLAND	Finnish Environment Institute (SIKE)
ITALY	Centro Internazionale di Alti Studi Agronomici Mediterranei di Bari (CIHEAM-Bari)
ITALY	Italian Research Council (CNR)
KENYA	Kenya Agricultural & Livestock Research Organization (KALRO)
SUDAN	Water Research Centre (WRC)
THE NETHERLANDS	International Soil Reference Center (ISRIC)
UGANDA	Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)

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Abstract **(for dissemination)**	From 11th to 16th December 2023, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM Bari), as technical and scientific lead partner of WATDEV project, organized and conducted the 1st Module of the Course "Water, Soil, and Crop Management in a Climate-Smart Agriculture" on its Campus in Bari, Italy. Fifteen representatives from universities and local authorities from Kenya, Ethiopia, and Egypt together with other five online participants from Sudan attended the 1st Module, after being selected by project Local Partners. The objective of this 1st Module was to empower local actors living in the study areas on the effective implementation or introduction of the best management practices (BMPs) and Innovations selected for these areas. The Course's lecturers were experienced soil scientists, geneticists, agronomists, engineers, and officials of organizations such as FAO. The 1st Module provided insights on theoretical approaches and technical solutions on Manuring, Agroforestry, Intercropping, Water Users' Association, Crop rotation, and Improved Seeds. Moreover, the environmental and socioeconomic sustainability of the selected agricultural practices were examined, through practical exercises on their feasibility in the four study areas. On 15th December, participants embarked on a field visit to the Irrigation Scheme District 10 (San Ferdinando di Puglia, Foggia) managed by the Consorzio di Bonifica di Capitanata. The visit continued in Consorzio di Bonifica Montana del Gargano, where participants witnessed bio-engineering interventions in Rignano Garganico. According to the participants' training evaluation, the participants' expectations were fulfilled plenty. Conceived as a training for trainers, this first training Module allowed participants to organize between March and April 2024, specific Follow-up training events in the study areas, to transfer the newly acquired knowledge to local stakeholders. The 2nd Module of the Course, will focus on innovative technologies in agriculture and will take place in Autumn 2024.
Keywords	Best Management Practices (BMPs), Training, Capacity building, Dissemination

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Acronyms and Abbreviations

AICS	Italian Agency for Development Cooperation
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa, Uganda
AU-EU	Africa-Europe
CIHEAM	Centre International de Hautes Etudes Agronomiques Méditerranéennes, Italy
CNR-	Consiglio Nazionale delle Ricerche, Italy
DG DEVCO	The Commission's Directorate-General for International Cooperation and Development
EARI	Ethiopian Institute of Agricultural Research, Ethiopia
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
HRC	Hydraulics Research Center- Ministry of Water and Irrigation- Gezira, Sudan.
HU	Heliopolis University, Egypt
ISRIC	International Soil Reference Center, The Netherland
IWUA	Irrigation Water Users Association
KALRO	Kenya Agricultural & Livestock Research Organization, Kenya
KU	Khartoum University, Sudan
NRC	National Research Council, Sudan
R&I	Research and Innovation
WRC	Water Research Centre, Sudan
SACCO	Savings Credit and Cooperative Organizations
STI	Science, Technology, and Innovation
SYKE	Finnish Environment Institute, Finland
WATDEV	Climate Smart WATer Management and Sustainable DEVelopment for Food and Agriculture in North and East Africa
WLRC	Water and Land Resources Center, Ethiopia

Executive Summary

The Climate Smart **WAT**er Management and Sustainable **DEV**elopment for Food and Agriculture in East Africa (WATDEV) aims to enhance sustainability of agricultural water management and resilience of agro-ecosystems to climate change in Easter Africa and Egypt. AICS (Agenzia Italiana per la Cooperazione e lo Sviluppo) is the executive agency, CIHEAM-BARI is leading scientific institution working with ASARECA (Strengthening Agricultural Research in Eastern and Central Africa), KALRO (Kenya Agricultural and Livestock Research Organization), WLRC (Water, Land Resources Centre - Ethiopia), WRC (Water Research Centre, Sudan) and HU (Heliopolis University, Egypt). The project aims to develop an in-depth understanding of small to large-scale water and agricultural resource dynamics and management and people's resilience to climate through innovative research, modelling, and capacity building approaches.

The overarching objective of the project is to enhance sustainability of agricultural water management and resilience of agro-ecosystems to climate change in East Africa and Egypt. The specific objectives include: (1) National Ministries and Research Institutions improve their knowledge and management of water in agriculture; and (2) Farmers and local actors, cooperatives and Water User Associations implement innovative/sustainable solutions and skills on water management.

The A2.2 Training and Capacity Building initiative aim to empower local stakeholders in effectively implementing Best Management Practices (BMPs) and Innovations within their respective regions and communities. Emphasis is placed on advocating for the adoption of targeted BMPs while nurturing sustainable development. The training program comprises three modules, each spanning a week.

The 1st module took place from December 11th to 16th, 2023, hosted at the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) in Bari - Italy.

Experienced lecturers were professionals in soil science, genetics, agronomy, and engineering, and officers from valued international organizations such as FAO.

Fifteen delegates from universities and local governing bodies in Kenya, Ethiopia, and Egypt, alongside an additional five participants joining remotely from Sudan, were selected by WATDEV project Partners to attend the 1st module of the Course. Participants included junior researchers, government officials, and extension workers actively involved in the implementation of BMPs and innovation projects within their respective regions.

After the training, participants collaborated closely with local partners to transfer the newly acquired knowledge to local farmers, thereby promoting sustainable development within their communities.

1. Introduction

1.1 Preamble

The Climate Smart **WAT**er Management and Sustainable **DEV**elopment for Food and Agriculture in East Africa (WATDEV) aims to enhance sustainability of agricultural water management and resilience of agro ecosystems to climate change in Easter Africa and Egypt. Agenzia Italiana per la Cooperazione e lo Sviluppo (AICS) is the executing agency, while CIHEAM-BARI is the leading scientific institution, working closely with the Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Kenya Agricultural and Livestock Research Organization (KALRO), Water, Land Resources Centre – Ethiopia (WLRC), Water Research Centre (WRC), Sudan and Heliopolis University (HU), Egypt.

The project develops an in-depth understanding of small to large-scale water and agricultural resource dynamics and management and people's resilience to climate through innovative research, modelling, and capacity building approaches.

The overarching objective of the project is to enhance sustainability of agricultural water management and resilience of agro-ecosystems to climate change in East Africa and Egypt.

The specific objectives include: (1) National Ministries and Research Institutions improve their knowledge and management of water in agriculture; and (2) Farmers and local actors, cooperatives and Water User Associations implement innovative/sustainable solutions and skills on water management.

1.2 Purpose, Context and Scope of this Deliverable

The **main objective** of the A2.2 Training and Capacity Building is to provide support to local actors in effectively implementing Best Management Practices (BMPs) and Innovations in their respective territories and communities. The focus will be on promoting the adoption of selected BMPs and fostering sustainable development.

1.3 Structure and Content of the Deliverable

Deliverable D2.2.1 Two (2) reports on performed training and capacity building sessions

The structure for the D2.2.1 report is as follows: (i) executive summary, (ii) introduction (purpose, context, scope of the deliverable, and structure, content of the deliverable), (iii) context (organization of the Training, target audience, and impacts), (iv) conclusion; (v) references; and (vi) annexes. This first document (D2.2.1(a)) contributes to the final deliverable providing information on the program and feedback received from participants to the 1st Module carried out at the end of December 2023.

2. Course structure

The training course is structured into three (3) modules, each spanning a duration of one week. These modules have been carefully designed to address the identified training needs and are outlined as follows:

Module 1: Introduction to BMPs and Innovations

- Comprehensive introduction to the selected Best Management Practices (BMPs) and Innovations, focusing on their technical aspects and providing participants with the knowledge necessary for successful implementation.
- Training on assessing the sustainability of BMPs, covering environmental, economic, and social dimensions. Participants will gain insights into evaluating the long-term viability and impact of BMPs in these key areas.

Module 2: Innovative Technologies in Agriculture and Water Management

- Exploration of cutting-edge technologies in agriculture and water management, equipping participants with an understanding of the latest advancements and their practical applications.
- Introduction to digital agriculture and decision-support tools, enabling participants to leverage technology for data-driven decision-making in agricultural practices and efficient water management.

Module 3: Networking for cooperating, Project design and Funding Opportunities

- Guidance on navigating the landscape of project design and funding opportunities. Participants will learn how to design or contribute designing a competitive and effective project idea to submit to international and local institutions for funding.
- Strategies for creating synergies at both the local and regional levels, fostering collaboration and knowledge sharing among stakeholders for enhanced outcomes.
- Training on techniques for accurate reporting and effective communication of results to end-users and decision-makers.

By structuring the training course in this manner, participants will acquire a comprehensive understanding of BMPs, innovations, sustainable practices, advanced technologies, project funding avenues, and effective communication strategies.

The course will provide participants with the necessary skills and knowledge to make meaningful contributions to the adoption and successful implementation of BMPs and innovations in their respective contexts.

2.1 Summary of Training course contents

The training course is strategically designed with a regional focus, aiming to have a broad impact on the target countries. It adopts the Training for Trainers (ToT) concept, emphasizing the multiplier effect by equipping participants to disseminate knowledge and skills within their local communities. The content of the training course has been developed based on the training needs identified during the A1.3 Multi-Actors' Regional Meeting that took place in Nairobi, Kenya, on 8th March 2023.

The primary beneficiaries of this training course are people from Egypt, Ethiopia, Sudan, and Kenya, who will play key roles in water management in food and agriculture through implementing relevant Best Management Practices (BMPs) and innovations within their respective regions.

The course features a combination of lectures and interactive work, providing participants with practical experiences and valuable insights.

To ensure the delivery of high-quality instruction, experienced international tutors will facilitate the training sessions. Their expertise and diverse perspectives will enrich the learning experience and foster knowledge exchange among participants. At the end of the course, attendees will be awarded attendance certificates issued by CIHEAM-Bari, acknowledging their active participation and successful completion of the training program. These certificates can serve as valuable credentials, highlighting the participants' commitment to advancing BMP implementation and innovation in their professional capacities.

Organizer and Contributing Partners

CIHEAM-Bari (Lead Partner)

CNR

ASARECA

HU

WLRC

WRC

KALRO

2.2 Beneficiaries

The A2.2 Training and Capacity Building Course targets a range of beneficiaries involved in the implementation of Best Management Practices (BMPs).

Target selected beneficiaries are end-users, extensionists, junior researchers, public officers, and young innovators engaged in BMPs implementation and innovation projects. By involving this diverse group of beneficiaries, the training aims at building a strong network of expertise with knowledge and skills able to enhance sustainable development in their respective fields.

Five participants for each country were selected by local partners (HU, KALRO, WRC, WLRC).

2.3 Participants' selection

The selection to enrol for the training and capacity building course on "Water, soil and crop management in a Climate-smart agriculture" was opened on **1st August 2023**.

The timeline of the selection procedure is in the table here below.

Table 1 – Timetable for the selection procedure

Selection start	1st August 2023
Selection closure	1st September 2023
Consensus phase	10th September
Communication of the selected participants	up to 15th September 2023
Start of the Course	Mid-December 2023

The selection of participants was conducted by the Local Partners to ensure the highest impact and enhance the capacity of local personnel to effectively disseminate knowledge acquired during

the training course. While the Local Partners primarily handled the selection process, CIHEAM-Bari played an advisory role, especially in establishing the minimum requirements for participants.

This collaborative approach helped identify individuals with the potential to maximize the benefits of the training and contribute significantly to BMP implementation and innovation in their communities.

2.4 Participants' profiles

The A2.2 Training and Capacity Building Course was open to individuals with diverse educational backgrounds and expertise. The course welcomed graduates in scientific disciplines such as agronomy, ecology, geology, civil engineering, and agricultural engineering. While participants with professional experience were preferred, the course recognized the value of inclusivity and encourages individuals at various stages of their careers to participate.

There was no age limit for participants, and special consideration was given to young people showing a strong commitment to making a positive impact in their fields. By prioritizing the involvement of young participants, the training aimed to empower and nurture the next generation of leaders in BMP implementation and innovation.

Proficiency in the English language is essential as the training is conducted entirely in English.

This requirement ensures effective communication and facilitates seamless knowledge sharing among participants from diverse backgrounds.

Overall, the participant profile was characterized by a blend of educational qualifications, professional experience (where applicable), and a shared enthusiasm for advancing sustainable practices in BMPs and innovations. The course values diversity and encourages participants to bring their unique perspectives, contributing to a dynamic learning environment that fosters collaboration and cross-disciplinary knowledge exchange.

Table 2 - Participant Profile Criteria

Criteria	Requirement
Professional Experience	Preferred, but not mandatory
Age limit	No age limit
Foreign language knowledge	Proficiency in English
University degree	Graduates in relevant scientific disciplines

2.5 The Modules' structure and Duration

The first two modules of the Course will take place in CIHEAM-Bari Campus "Cosimo Lacirignola" (Valenzano, Bari- Italy): https://www.iamb.it/education/student-life/.

Each module is thoughtfully divided into various components to provide a comprehensive learning experience:

- Theoretical Lessons:

Participants were engaged in in-depth theoretical sessions led by subject matter experts. These sessions covered the fundamental concepts, principles, and theoretical frameworks related to the course topics.

- Practical Exercises:

To reinforce the theoretical knowledge, participants actively participated in practical exercises. These exercises provide hands-on experience, allowing participants to apply their learnings in simulated scenarios or real-world situations.

- On-Field Technical Visits:

To provide a practical understanding of the course topics, participants have the opportunity to embark on on-field technical visits. These visits enabled them to observe and learn from real-life implementations of Best Management Practices (BMPs) and innovations.

The course structure ensures a balanced blend of theoretical knowledge, practical application, and real-world exposure. This approach aims to enhance participants' understanding and skills, enabling them to effectively implement BMPs and innovations in their respective contexts.

The overall duration of the course's modules is the following:

Table 3 - Dates and Duration of the modules

Module no.	Duration (hours/days)	Date	Venue
1	42 hours (6 days)	11-16 December 2023	CIHEAM-Bari Campus
2	20 hours (5 days) 35 hours (5 days)	9-13 September 2024 (online) 16-20 September 2024	CIHEAM-Bari Campus
3	20 hours (4 days)	November-December 2024	online

Language

The course is held in English.

3. Methodology

3.1 Abstract of the Module 1

Module 1 of the training course focused on providing participants with a comprehensive understanding of selected Best Management Practices (BMPs) and innovations, as well as the technical aspects involved in their successful implementation. This module, led by experienced lecturers and experts in their respective fields, aimed to equip participants with the necessary knowledge and skills to promote sustainable agriculture and water management practices.

The module began with a deep dive into soil health, emphasizing the importance of manuring, crop rotation, and soil conservation techniques. Participants learned about soil properties, such as texture, structure, organic matter, and fertility, and how they contribute to ecosystem services. They also explored methods for producing quality manure, selecting appropriate crops, and implementing effective crop rotation strategies.

Next, the module explored the significance of improved seeds in agricultural practices. Participants gained insights into the process of seed selection, the production of improved-quality seeds, and the role of farmers' organizations in advocating for the use of high-quality seeds. They also delved into subsidy programs linked to improved seeds, fostering an understanding of the policies and support mechanisms that promote their adoption.

The module further explored the concept of agroforestry and intercropping, highlighting the vital role of vegetation in protecting soil. Participants learned about afforestation techniques, including species selection, site preparation, maintenance, and bio-engineering techniques for watershed maintenance. This knowledge will enable participants to leverage the benefits of agroforestry and intercropping in soil conservation, erosion control, and associated ecosystem services.

Additionally, participants explored the critical aspects of water management through the lens of Water Users' Associations. They gained insights into improving water use efficiency, managing irrigation schemes, automating irrigation operations, and enhancing drainage systems. The module also addressed water governance, focusing on equitable water allocation, participatory irrigation management, and market access considerations.

To reinforce the theoretical lessons, participants were engaged in practical exercises. They visited the Consorzio di Capitanata, Candelaro Irrigation Scheme, and Rignano Garganico’s bio-engineering interventions to halt soil erosion (both locations are in the Puglia region, South Italy). These visits provided real-world exposure to irrigation schemes, modern technologies, and other relevant sites, allowing participants to observe and learn from on-the-ground implementations.

Overall, Module 1 sets the foundation for participants to understand and implement selected BMPs and innovations. By equipping them with theoretical knowledge, technical skills, and practical insights, this module aimed to empower participants to drive sustainable practices and make positive contributions to their respective fields and communities.

Table 4 - Module 1 contents

Module 1	**Introduction to BMPs and Innovations**
Title	*Contents*
Theoretical and technical aspects for selected BMPs/Innovation, implementation	**Soil health: Manuring and Crop rotation:** • Basics of Soil properties (Texture, structure, soil organic matter and soil fertility, soil water retention) and associated ecosystem services. • Soil conservation techniques. • Production of quality manure. • Crops selection. • Rotations (examples).
	Improved Seeds: • Basics of seeds selection. • Improved-quality seeds production. • Awareness on use improved seeds. • Role of farmers organizations on the use of quality seed • Subsidy programs linked to improved seeds.
	Agroforestry and Intercropping: • Role of vegetation in soil protection (erosion control, windbreaks, water retention, associated ecosystem services). • Afforestation techniques (species selection, site preparation, sowing, seedling, propagation material and forest nurseries, maintenance). • Basics of bio-engineering techniques for the watershed maintenance (terraces, rubble walls, gabions, …).
	Water Users' Association: • Water use efficiency. • Management of irrigation schemes. • Automation of irrigation operation. • Irrigation intervals. • Improve drainage system. • Water governance (conflict on resource use, equitable water allocation). • Participatory Irrigation Management (PIM). • Market access (marketing).
BMPs sustainability assessment	**Biophysical and socioeconomical sustainability of BMPs:** • Basics of sustainability. • Sustainability indicators/indices. • Techniques for feasibility study. • Practical exercise: feasibility study on the implementation of BMPs in the 4 pilot areas.
Technical visit	• Consorzio di Capitanata (Foggia) • Rignano Garganico (Foggia): bio-engineering interventions

3.2 Abstract of the Module 2

In Module 2 of the training course, participants will delve into the exciting realm of innovative technologies in agriculture and water management. This module is designed to equip participants with a comprehensive understanding of the latest advancements and their practical applications in these fields.

The module begins with an exploration of cutting-edge technologies in agriculture and water management, including the use of modern technologies in water resources management. Participants will be introduced to a wide range of innovative solutions that have the potential to revolutionize farming practices and water resource management. The focus will be on understanding the principles and underlying concepts behind these technologies, as well as their benefits and applications in real-world scenarios.

One of the key areas covered in this module is precision agriculture and smart farming. Participants will learn about the use of sensing technologies for precise monitoring and management of crops and soils. They will discover how remote sensing techniques, such as satellite imagery and drones, can provide valuable data for optimizing agricultural practices. The module will also delve into the integration of automation and robotics in agriculture, exploring how autonomous systems and robotics can enhance efficiency and productivity in farming operations.

Another crucial aspect of Module 2 is digital water management systems. Participants will gain insights into the role of digital technologies in water resource management. They will learn about the use of Internet of Things (IoT) applications, smart sensors, and real-time monitoring systems for efficient water utilization and conservation. The module will also cover the use of remote sensing techniques for water resources assessment, enabling participants to understand how satellite-based observations and data analysis can support effective water management.

Throughout Module 2, participants will have the opportunity to engage with expert lecturers who specialize in innovative technologies in agriculture and water management. The module is designed to enhance participants' knowledge and skills, enabling them to leverage technology-driven approaches for sustainable and efficient agricultural practices and water resource management.

By the end of this module, participants will have a solid understanding of the latest advancements in agriculture and water management. They will be equipped with the knowledge to identify and adopt appropriate technologies for optimizing farming practices, improving resource utilization, and addressing water management challenges.

Table 5 - Module 2 content

Module 2	**Innovative Technologies in Agriculture and Water Management**
Title	*Contents*
Introduction to Precision Agriculture (Online part, joined with the CIHEAM Bari's Advanced Specialized Course in Precision Agriculture)	• Opening • Presentation of the advanced specialized course • General concepts of Precision Agriculture (PA) • Practical knowledge for an effective PA application • Mechanisation, robotics & Artificial Intelligence (AI) • Drivers and challenges of PA: a socio-technical perspective • The role of technology producers & service providers • The Southern Mediterranean context: the need of a tailored PA • Contribution of PA to sustainable water management • CIHEAM Bari innovations for precision pest surveillance & water management at landscape level
Innovative Technologies in Agriculture and Water Management	**Sensing Technologies and renewable energy integration** • Remote sensing techniques (satellite imagery, drones) • Sensor technologies for soil and crop monitoring • Data collection, analysis, and interpretation • Powering precision agriculture technologies with renewable energy. • Solar energy applications in agriculture • Irrigation systems, and farm operations
	Water resources management and monitoring • Integrated Water Resources Management approach • Hydraulic modelling • Flood Risk Management with Transboundary Conflict
Digital agriculture and decision-supporting tools	**Digital solutions for Water Management** • Overview of water management challenges • Role of digital technologies in water management • Integration of sensors and data in water monitoring
	Remote Sensing and IoT Applications • Remote sensing techniques for water and soil monitoring • Satellite-based observations of precipitation and evapotranspiration • Mapping and analysis of water availability, quality, and soil conditions • Smart sensors and network systems • Real-time monitoring and control of water resources
	Water Data Analysis and Decision Support • Data-driven approaches for water management • Water data analytics and modeling • Decision-support systems for efficient water allocation and conservation

Module 2	**Innovative Technologies in Agriculture and Water Management**
Title	*Contents*
Technical visit	• Digital Technologies for Agriculture & Smart farming: Installation of the base pack and monitoring practices and training with XFARM platform. • No-till seed drill with 4.0 technology La Valle Verde farm, Gravina di Puglia - Bari

3.3 Abstract of the module 3

Module 3 will allow learners to examine in-depth the field of international funds and project management to develop the agronomic sector in East Africa and Egypt. Participants will acquire theoretical and technical knowledge of this strategic field to support sustainable and competitive development of Agriculture.

The importance of networking and multi-level cooperation will be examined through relevant policies, projects and experiences carried out in the geographic area of interest. The Module is also particularly centred on international funding opportunities in the agronomic sector which involve East Africa and Egypt. Participants will learn about how development cooperation raised and evolved throughout the years, and which are the main international donors which can support development projects in their countries.

The Module will explore methodologies and techniques of project design so that it can address local needs, set a reliable activity plan to achieve long-term results and be eligible for funding opportunities. It focuses on the importance of involving relevant actors to identify problems, set relevant and appropriate project objectives, establish a coherent workplan and project management structure.

Participants will then have the opportunity to delve into crucial aspects for smooth project management, in particular, they will get insights on reporting obligations, principles of good reporting, and the documentation needed to prove the expenditures incurred during the project implementation per each budget heading.

Regarding the project implementation phase, this Module also provides knowledge on how to enhance project action and objectives to create impact and strengthen partnerships through the dissemination of results.

By the end of this module, participants will be able to understand the complexity of actors and policies around international project design and management, will be able to identify potential funding opportunities for their business or territory and conceive or contribute to formulate effective and relevant projects in cooperation with local and international stakeholders.

Table 6 - Module 3 contents

Module 3 (online)	**Networking for cooperating, project design and funding opportunities**
Title	*Contents*
International cooperation and funding opportunities	• Networking and cooperation in the agronomic sector at local and international level
	• Development cooperation: definition, history, and funding opportunities.
	• European Union policies and funding opportunities for external action.
	• Local microcredit for small enterprises and farmers
Project design, Reporting and communication of results	• Project cycle management: from the idea to the project formulation and evaluation.
	• Logical Framework and Theory of Change: how to design a project to generate a long lasting and sustainable change which is evident, assessable, quantifiable, and qualifiable.
	• Reporting a project funded by EU or international institutions: principles of transparency, traceability, recording of documentation to provide evidence of financial expenditures.
	• Communication of results: strategic planning, objectives, audiences, and channels of communication

4. 1st Module - Principles of the Best Management Practices and Innovations

4.1. Participants list

Table 7 – 1st Module participants list

Name	Surname	Country	Affiliation	Contacts
Mahmoud	Eid	Egypt	Research assistant, Faculty of Organic Agriculture, Heliopolis University	mohammed.moustafa@hu.edu.eg
Salma	Eladly	Egypt	Research assistant, Faculty of Engineering, Heliopolis university	salma.wael@hu.edu.eg
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Rehab	Ibrahim	Egypt	Research assistant at the Egyptian Biodynamic Association	Rehab.ibrahim@sekem.org
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*Mr. Bekele Hailu Belay did not arrive to CIHEAM Bari on the planned arrival date and did not attend the training Module.

4.2. Programme

Sunday 10th December	
Arrival of participants from Egypt, Ethiopia, and Kenya*. *Participants from Sudan will attend the training Module online.	
Monday 11th December	
07.00 - 08.30	Breakfast at the hotel
08.40 - 08.50	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
09.00 - 09.30	**Welcome of participants by:** 1. **Biagio Di Terlizzi** – Deputy Director of CIHEAM Bari 2. **Claudio Bogliotti** – CIHEAM Bari, DESIRA Programme Coordinator
09.30 – 10.00	**Presentation of the training Course and field visits** • **Gaetano Ladisa** – CIHEAM Bari Scientific Administrator & WATDEV scientific team leader • **Silvia Lecci** – CIHEAM Bari, Member of WATDEV Coordination team
10.00 – 10.30	**Presentation of the participants**
10.30 - 11.00	**Soil health: Manuring and Crop rotation** 1. Fundamentals of Soil properties (Texture, structure, soil organic matter and soil fertility, soil water retention) and associated ecosystem services. **Lecturer: Pandi Zdruli** – Soil Scientist (CIHEAM Bari)
11.00 - 11.15	Coffee break
11.15 - 13.30	**Soil health: Manuring and Crop rotation** 2. Fundamentals of Soil properties (Texture, structure, soil organic matter and soil fertility, soil water retention) and associated ecosystem services. **Lecturer: Pandi Zdruli** – Soil Scientist (CIHEAM Bari)
13.30 - 14.30	Lunch at CIHEAM-Bari canteen
15.00 - 16.00	**Soil health: Manuring and Crop rotation** 3. Soil conservation techniques 4. Production of quality manure **Lecturer: Pandi Zdruli** – Soil Scientist (CIHEAM Bari)
16.00 - 16.15	Coffee break
16.15 - 17.30	**Soil health: Manuring and Crop rotation** 5. Crops selection *6.* Rotations (examples) **Lecturer: Pandi Zdruli** – Soil Scientist (CIHEAM Bari)
17.30 - 18.00	Tour of the CIHEAM-Bari Campus
18.00 - 18.30	Transfer to Federiciano Hotel
	Free dinner

Tuesday 12th December	
07.00 - 08.30	Breakfast at the hotel
08.30 - 08.50	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
09.00 – 11.00	**Improved seeds** 1. Fundamentals of seeds selection. 2. Improved-quality seeds production. **Lecturer: Domenico Pignone** – Genetist (CNR)
11.00 - 11.15	Coffee break
11.15 – 13.30	**Improved seeds** 3. Awareness on use improved seeds. **Lecturer: Domenico Pignone** – Genetist (CNR)
13.30 - 14.30	Lunch at CIHEAM-Bari canteen
15.00 - 16.00	**Improved seeds** 4. Role of farmers organizations on the use of quality seed **Lecturer: Domenico Pignone** – Genetist (CNR)
16.00 - 16.15	Coffee break
16.15 - 17.30	**Improved seeds** 5. Role of farmers organizations on the use of quality seed **Lecturer: Domenico Pignone** – Genetist (CNR)
18.00 - 18.30	Transfer to Federiciano Hotel
19.30	Transfer from Federiciano Hotel to Bari city centre
20.00 – 23.30	**Social dinner in Bari city centre**

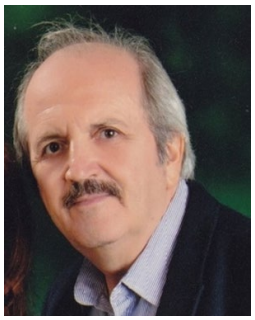
Wednesday 13th December	
07.00 - 08.30	Breakfast at the hotel
08.30 - 08.50	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
09.00 – 11.00	**Agroforestry & Intercropping** - Role of vegetation in soil protection (erosion control, windbreaks, water retention, associated ecosystem services). **Lecturer: Elaine Springgay – Forestry Officer (FAO)**
11.00 - 11.15	Coffee break
11.15 – 13.30	**Agroforestry & Intercropping** - Agroforestry and intercropping management (species selection, site preparation, sowing, seedling, propagation material and forest nurseries, maintenance). **Lecturer: Elaine Springgay – Forestry Officer (FAO)**
13.30 - 14.30	Lunch at CIHEAM-Bari canteen
15.00 - 16.00	**Agroforestry & Intercropping** - Agroforestry and intercropping management (species selection, site preparation, sowing, seedling, propagation material and forest nurseries, maintenance). **Lecturer: Elaine Springgay – Forestry Officer (FAO)**
16.00 - 16.15	Coffee break
16.15 - 17.30	**Agroforestry & Intercropping** - Community skills for agro-forestry management **Lecturer: Elaine Springgay – Forestry Officer (FAO)**
18.00 - 18.30	Transfer to Federiciano Hotel
	Free dinner

Thursday 14th December	
07.00 - 08.30	Breakfast at hotel
08.30 - 08.50	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
09.00 – 11.00	**Water Users' Association (WUA)** - Introduction to the course - Water use efficiency (definition and case-study) **Lecturer: Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
11.00 - 11.15	Coffee break
11.15 – 13.30	**Water Users Association (WUA)** - Management and Design-for-Management of irrigation schemes. - New Technologies and Automation of irrigation for a better operation. - Irrigation Delivery Schedules. **Lecturer: Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
13.30 - 14.30	Lunch at CIHEAM-Bari canteen
15.00 - 16.00	**Water Users' Association (WUA)** - Water governance (conflict on resource use, equitable water allocation). - Participatory Irrigation Management (PIM) **Lecturer: Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
16.00 - 16.15	Coffee break
16.15 - 17.30	**Water Users' Association (WUA)** - Market access (marketing). **Lecturer: Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
18.00 - 18.30	Transfer to Federiciano Hotel
	Free dinner

Friday 15th December	
07.00 - 08.00	Breakfast at hotel
08.15 - 08.30	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
08.30 – 10.00	Travel to Consorzio di Bonifica di Capitanata headquarter Briefing on the field trip - **Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
10.00 – 12.30	Arrival to the Irrigation scheme District 10 managed by the Capitanata Consortium Meeting with the Director of the Agricultural Dept. of the Capitanata Consortium Presentation of Technical and Institutional aspects related to the Capitanata Consortium, including new technologies and automations. **Lecturers: Luigi Nardella** – Agronomist (Consorzio Bonifica Capitanata) and **Nicola Lamaddalena** – Hydraulic Engineer (CIHEAM Bari)
12.30 – 14.30	Transfer to restaurant and lunch
14.30 – 15.30	Transfer to Rignano Garganico (FG)
15.30 – 17.00	Visit to Consorzio di Bonifica Montana del Gargano bio-engineering interventions in Rignano Garganico **Lecturers: Giovanni Russo** – Forestry officer (Consorzio Bonifica Gargano) and **Gaetano Ladisa** – Forestry expert (CIHEAM Bari)
17.00 – 19.00	Transfer to CIHEAM Bari Campus / Federiciano Hotel
	Free dinner

Saturday 16th December	
07.00 - 08.30	Breakfast at hotel
08.40 - 08.50	Transfer to CIHEAM Bari Campus "Cosimo Lacirignola"
09.00 – 11.00	**Biophysical and socioeconomical sustainability of BMPs** - Fundamentals of sustainability **Lecturer: Moses Odeke** – Technical officer (ASARECA)
11.00 - 11.15	Coffee break
11.15 – 13.30	**Biophysical and socioeconomical sustainability of BMPs** - Sustainability indicators/indices - Techniques for feasibility study **Lecturer: Moses Odeke** – Technical officer (ASARECA)
13.30 - 14.30	Lunch (at CIHEAM-Bari canteen)
15.00 - 16.00	**Techniques for feasibility study** - Practical exercise: feasibility study on the implementation of BMPs in the 4 pilot areas **Lecturer: Moses Odeke – Technical officer (ASARECA)**
16.00 - 16.15	Coffee break
16.15 – 18.00	**Techniques for feasibility study** - Practical exercise: feasibility study on the implementation of BMPs in the 4 pilot areas. **Lecturer: Moses Odeke – Technical officer (ASARECA)**
18.30 – 19.00	Transfer to Federiciano Hotel
	Free dinner
Sunday 17th December	
Departure of participants	

4.3. Lecturers' short bios



Pandi Zdruli (zdruli@iamb.it)

Professor, Soil Scientist – CIHEAM Bari

Pandi Zdruli is Senior Research Scientist with the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) Mediterranean Agronomic Institute of Bari in Italy since 1999 where he teaches soil science and natural resources management. Prior to joining the Bari Institute, he was Visiting Scientist (for two years) with the European Commission's Joint Research Centre at Ispra, Italy and Senior Fulbright Research Scholar (for five years) at the USDA – Natural Resources Conservation Service in Washington, D.C. He graduated in 1981 from the Agricultural University of Tirana in his native Albania and after working for 13 years in his home country he pursued graduate studies and research in the USA sponsored by the Fulbright Foundation. Prof. Zdruli has published more than 80 papers and technical reports on relevant soil management topics and has edited 12 books. Among others, he is member of International Union of Soil Science, Soil, Crop and Agronomy Society of America, Italian Society of Soil Science, European Soil Partnership, European Society for Soil Conservation, Fulbright Association, editorial board member of the Soil Atlas of Asia and many other relevant publications, as well as board member of the EU European Joint Programme on Soil, EU's mission Soil Deal for Europe and other prestigious boards.

Domenico Pignone (domenico.pignone@gmail.com)

Emeritus Researcher, Geneticist - CNR

Domenico Pignone is a plant geneticist in crop plants evolution, agrobiodiversity conservation and utilization, and in advanced methods for trait selection in crops. During his career he has directed the Institute of Plant Genetics and the AgroFood Department of the National Research Council (CNR). He has also served as a consultant for the Italian Ministry of Agriculture on arguments regarding agrobiodiversity, as well as of the Italian Ministry of Foreign Affairs for projects regarding international cooperation in agriculture. He also has a long-lasting cooperation with the CIHEAM.

Elaine Springgay (Elaine.Springgay@fao.org)

She is FAO's Forestry Officer for Agroforestry and has 15 years of experience working in international development on integrated, community-based natural resources management and climate-smart agriculture. A Canadian national, she identifies as a global citizen having lived in 12 countries on 6 continents.

Prior to joining FAO HQ in Italy in 2015, Elaine worked with NGOs or government agencies in Canada, Ghana, the Philippines and Uganda, primarily focused on community forest management, rural livelihoods and capacity development initiatives. She has a BSc in both Environmental Geography and History from the University of Toronto, and a Masters in Forestry from the Australian National University.

Nicola Lamaddalena (lamaddalena@iamb.it)

Hydraulic Engineer, Former Deputy Director – CIHEAM Bari

Holding a MSc in Hydraulic Engineer at Polytechnic of Bari and a PhD. in Irrigation Engineering at the Technical University of Lisbon, Nicola Lamaddalena has been working for more than 30 years on agricultural engineering and water resources management, with a focus of design, performance analysis and management of large-scale distribution systems, new delivery technologies with associate modelling development under water scarcity conditions, governance models of Water Users Associations. He served as University Professor at the Polytechnic of Bari (Italy) and provided consulting services to public and private sectors. Scientific and technical activities have been conjugated with the management of many water-related development projects in Southern Europe, North Africa and Near East, also in cooperation with International Research Centres and Universities. Author of over 100 publications in scientific journals and books, reviewer for several scientific journals, he is the author, among others, of the FAO Irrigation and Drainage paper n. 59. Past-Vice-President of the International Section Board on Land and Water - CIGR (International Commission of Agricultural and Biosystems Engineering). Chairman of the Task Team for the preparation of the Policy workshop on “Water for Food Security and Nutrition” (FAO-CFS) and Special Rapporteur at Policy workshop on “Water for Food Security and Nutrition” - FAO-CFS 42. Board member of the Ital-ICID and the Global Water Partnership – Mediterranean session. He joined CIHEAM Bari Institute in 1986 where he was the Head of the Land & Water Dept. from 2005 to 2019, Deputy Director from 2019 to 2023. He is currently International Senior Water Advisor.

Moses Odeke (m.odeke@asareca.org)

He holds the position of Acting Head of Programs at the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). In this role, he continues to exhibit his commitment to advancing agricultural research and development in the region. As the Acting Head of Programs, he oversees the planning, implementation, and evaluation of various programs aimed at enhancing agricultural productivity, sustainability, and resilience. Besides, he is also a Coordinator for Bilateral Projects in ASARECA.

Previously, he served as the Chair for the CAADP-XP4 Technical Committee (TC) for the period 2022/2023. In this capacity, he demonstrated exemplary leadership, guiding the committee towards achieving its objectives and fostering collaboration among stakeholders in the pursuit of agricultural development goals.

Moses Odeke is a seasoned professional in the field of Monitoring, Evaluation, and Learning (MEL), with a rich background in agricultural development and program management. Over the past seven years, he has dedicated his expertise to the role of MEL Manager, contributing significantly to the success and impact of various initiatives in the agricultural sector.

With a track record of leadership and a commitment to excellence, Moses stands as a driving force in the agricultural development landscape, playing a pivotal role in shaping and implementing initiatives that address the challenges and opportunities in the sector.

4.4. Knowledge Self-Appraisal before the start of the 1st Training Module

A simple survey was delivered to the participants to understand their level of knowledge on the different BMPs (Manuring, Crop Rotation, Improved Seeds, Agroforestry, Intercropping, Water Users' Association) before the participation to the Training of Trainers.

Such an evaluation would allow to collect inputs to feed the outcome indicator linked to the Specific Objective 1 (SO1): "No. of national research institutions and corresponding staff members strengthened with capacity building and training activities."

Here below the Questions posed and the synthesis of results. The tool adopted to collect this information was Mentimeter (Menti.com).

The number of responses collected were 17, subdivided as follows:

- Egypt: 4
- Ethiopia: 5
- Kenya: 5
- Sudan: 3

The questions and answers are listed here below.

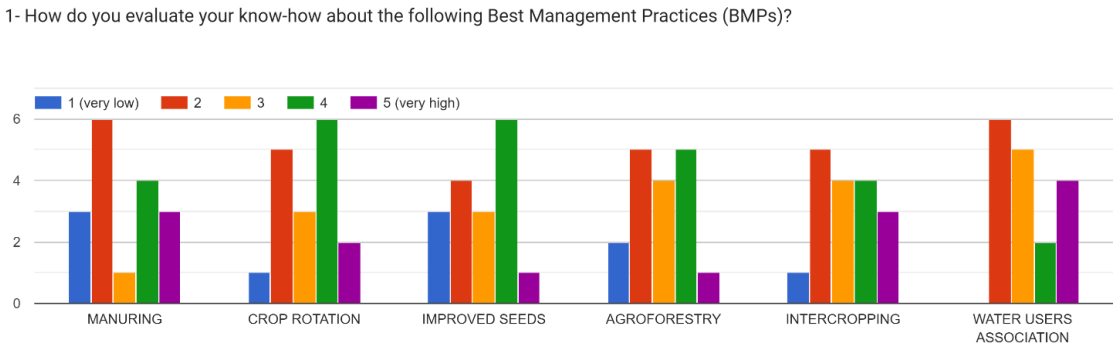


Figure 1 – Level of knowledge about BMPs (ranked from 1-very low to 5-very high) before the Training course (17 responses)

The level of knowledge was significatively low for Manuring (53% of respondents evaluate their knowledge from 1 to 2) and quite higher for Crop Rotation (47% of respondents evaluate their knowledge from 4 to 5).

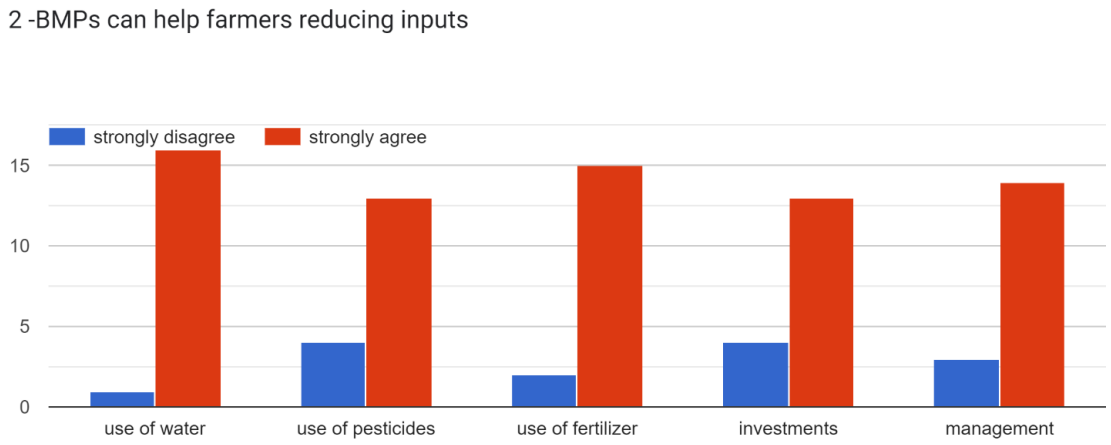


Figure 2 - Level of disagreement/agreement about how BMPs reduce the inputs (water, pesticides, fertilizers, investment, management) before the start of the 1st Module.

Most of the respondents consider that the implementation of BMPs can reduce inputs (water, fertilizers, management, pesticides and investments, respectively)

3 - List the main obstacles to spread the BMPs in your country

According to the Trainees' answers, the main obstacles to spreading agricultural best management practices (BMPs) in the East African Countries (EAC) can be summarized as follows:

1. **Lack of Awareness and Knowledge**:
   - Farmers often lack awareness and understanding of BMPs and their benefits.
   - There is a significant knowledge gap regarding effective resource management practices, such as soil enrichment and water conservation.
2. **Educational and Skill Deficiencies**:
   - Insufficient education and training for farmers and extension workers.
   - Limited expertise and commitment from agricultural experts and leaders.
3. **Financial Constraints**:
   - High-cost implications of implementing BMPs.
   - General economic challenges and financial limitations hinder adoption.
4. **Infrastructure and Resource Scarcity**:
   - Poor infrastructure, including transportation networks, impedes access to markets and resources.
   - Scarcity of necessary inputs and technologies for effective BMP implementation.
5. **Resistance to Change and Traditional Practices**:
   - Cultural resistance to adopting new agricultural practices.
   - Prevailing traditional farming methods that do not align with BMPs.
6. **Climatic Risks and Environmental Challenges**:
   - Unpredictable climatic conditions and climate change impact agricultural planning and BMP effectiveness.

- Current conflicts and wars in some regions add to the instability.

7. **Coordination and Extension Work**:
    - Inadequate extension services and weak coordination among stakeholders.
    - Insufficient outreach and support to educate and assist farmers in implementing BMPs.

By addressing these obstacles through enhanced education, financial support, improved infrastructure, and better coordination, the EAC can more effectively promote and implement agricultural best management practices.

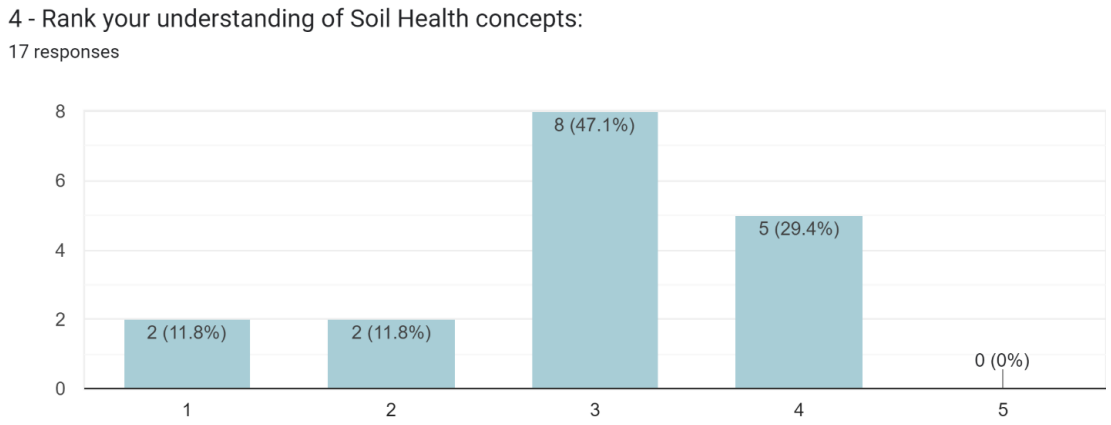


Figure 3 – Self-assessment of the knowledge level about the Soil Health concepts (before the training).

Respondents (76.5%) declares to have a medium-to-good level of knowledge about Soil Health.

5 - Can you define **Soil Health** with keywords?

From the sentences provided by the trainees, the following keywords (and Soil Health indicators) can be extracted:

- Soil physics
- Soil chemistry
- Soil fertility
- Infiltration
- Water holding capacity
- Cation exchange capacity
- Biodiversity
- Organic carbon
- Soil type
- Soil constituents
- Soil organisms (diseases, pests)
- Productivity
- Diversity
- Environmental services

- Nutrients
- Crop production
- Plant growth
- Salinity
- Acidity
- Soil covering (physical and biological measures)
- Texture
- Structure
- Workability
- Clean air
- Sustainable environment
- Soil management
- Soil organic matter
- Water and nutrients
- Carbon matter
- Oxygen
- Vitality
- Efficiency

6 - What are the key benefits of **Manuring**?

From the responses provided, the following benefits can be synthetized:

1. **Nutrient Enrichment**:
    - Adds essential nutrients to the soil, promoting healthy plant growth.
    - Increases nutrient availability and soil fertility.
2. **Soil Structure Improvement**:
    - Enhances soil structure, making it more workable and productive.
    - Improves soil aeration and water holding capacity.
3. **Biological and Chemical Benefits**:
    - Increases soil microbial activity and biodiversity.
    - Reduces soil acidity and minimizes nutrient pollution to water resources.
4. **Environmental and Economic Advantages**:
    - Environmentally friendly and organic, reducing the need for chemical fertilizers.
    - Locally available, cost-effective, and does not require foreign currency.
5. **Soil Health and Sustainability**:
    - Enriches soil organic matter, building healthy and renewable soils.
    - Helps prevent soil erosion and retains irrigation water.
6. **Crop Productivity and Growth**:
    - Increases crop productivity and vegetative growth.

- Strengthens plant roots and facilitates nutrient uptake.

7. **Pest and Disease Management**:
    - Reduces diseases caused by chemical fertilizers and promotes organic crop production.
8. **Practical Benefits**:
    - Economical and easy to prepare, often available on farms.
    - Provides humus to the soil, improving its physical condition without side effects.

By incorporating manure, farmers can significantly enhance soil health, boost crop yields, and contribute to sustainable agricultural practices.

7 - What are the key benefits of **Crop Rotation**?

From the responses provided, the following benefits can be synthetized:

1. **Pest and Disease Control**:
    - Breaks the life cycle of insect pests and reduces pest and disease problems by changing host plants.
    - Protects soil from soil-borne pathogens and pests, reducing pest outbreaks.
2. **Soil Fertility and Nutrient Management**:
    - Improves soil nutrient content and fertility, such as nitrogen fixation by legumes (e.g., beans).
    - Adds organic matter to the soil, enhancing nutrient availability and soil health.
3. **Soil Structure and Health**:
    - Prevents soil structure degradation by avoiding repeated planting of the same crops.
    - Increases soil organic matter and improves soil structure and water holding capacity.
4. **Erosion Control**:
    - Reduces soil erosion by maintaining ground cover and improving soil stability.
    - Helps protect the soil from depletion and erosion.
5. **Increased Productivity and Yield**:
    - Enhances crop yield by optimizing soil health, nutrient availability, and pest control.
    - Ensures that crops can access the right nutrients, promoting better growth and productivity.
6. **Sustainable Land Management**:
    - Maintains long-term soil health and sustainability by managing soil organic matter and nutrients effectively.
    - Helps in better management of soil resources, reducing the need for chemical inputs.

By implementing crop rotation, farmers can achieve a more sustainable and productive agricultural system, improving soil health, controlling pests and diseases, and enhancing overall crop performance.

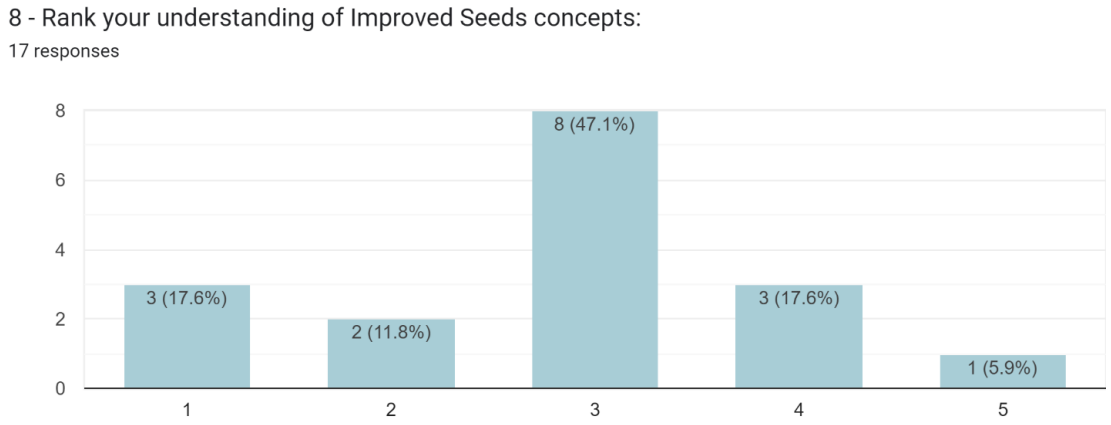


Figure 4 - Self-assessment of the knowledge level about the Improved Seeds concepts (before the training).

Respondents (76.5%) declares to have a medium-to-low level of knowledge about Improved Seeds.

9 - Can you define **Improved Seeds** with keywords?

From the sentences provided by the trainees, the following keywords (and indicators) can be extracted:

- Energy
- Germination test
- DNA
- Hybrid
- High yields
- Tolerance to pests and disease
- Tolerance to salinity
- Resistance to environmental conditions
- Resistance to Biotic/abiotic stresses
- Seed production channel
- Specific package of practices
- Superior than local cultivars
- Genetic potential
- Tailored for different climatic conditions
- Secure crop yields
- Increased productivity
- Disease resistance
- Better resistance
- High production
- Improved productivity

- Palatability
- Market-oriented
- Genetic and physical purity
- Physiological soundness
- Health status
- Increased crop yields
- Yield potential
- Quality crop yields
- Cope with existing environment
- Seeds preparation

10 - What are the key benefits of **Improved Seeds**?

From the responses provided, the following benefits can be synthetized:

1. **Increased Yield and Productivity**:
    - Improved seeds consistently yield higher crop output compared to traditional varieties.
    - They contribute to increased productivity, providing farmers with greater harvests.
2. **Early Maturity and Reduced Pest/Disease Instances**:
    - Improved seeds often mature earlier, allowing for quicker turnaround times between planting and harvest.
    - They exhibit reduced susceptibility to pests and diseases, leading to fewer instances of crop damage.
3. **Adaptability to Current Conditions**:
    - These seeds are tailored to suit contemporary agricultural conditions, ensuring optimal performance in various environments.
4. **Cost Reduction and Resource Efficiency**:
    - They help reduce production costs by yielding more compared to indigenous seeds while being tolerant to both biotic and abiotic stresses.
    - Improved seeds require less water supply, contributing to resource conservation and efficiency.
5. **Resistance and Resilience**:
    - They are resistant to pest attacks and diseases, minimizing the need for chemical interventions.
    - Improved seeds exhibit resilience to environmental stresses, such as drought or salinity, ensuring more stable yields.
6. **Improved Production and Quality**:
    - These seeds enhance crop production and productivity while maintaining high quality and nutritive value.
    - They offer increased immunity to diseases, ensuring healthier plants and higher-quality produce.

By utilizing improved seeds, farmers can achieve higher yields, better quality crops, and increased resilience to pests and environmental challenges, ultimately leading to improved agricultural production and food security.

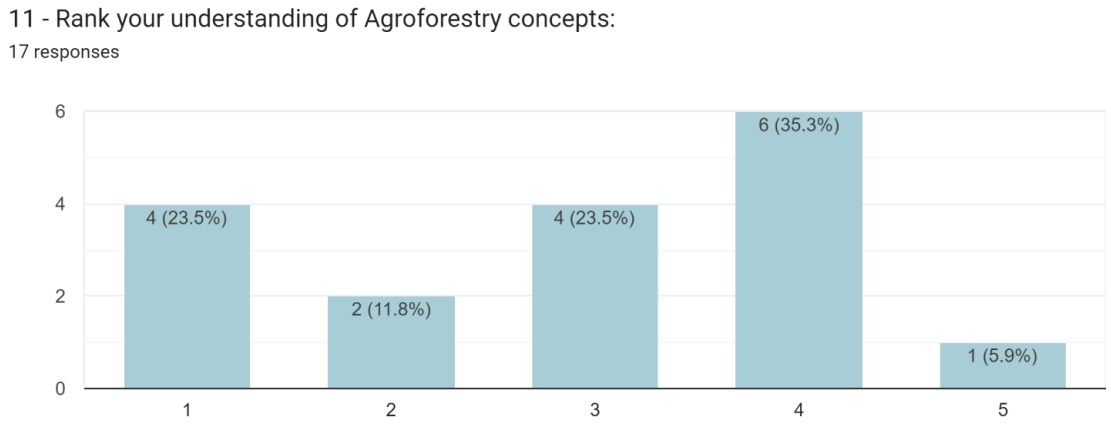


Figure 5 - – Self-assessment of the knowledge level about the Agroforestry concepts (before the training).

12 - Can you define **Agroforestry** with keywords?

From the sentences provided by the trainees, the following keywords (and indicators) can be extracted:

- Perennial plants
- Wood
- Seed
- Water conservation
- Production system
- Crops
- Trees
- Shrubs
- Biodiversity
- Soil fertility
- Organic carbon
- Climate change
- Land use management
- Integration
- Pastureland
- Agriculture
- Forestry
- Multiple benefits
- Sustainable
- Livestock

- Planting

13 - What are the key benefits of **Agroforestry** and **Intercropping**?

Here are the synthesized key benefits of both "agroforestry" and "intercropping" from the inputs provided by the respondents:

of both "agroforestry" and "intercropping" from the inputs provided by the respondents:

1. **Water Conservation and Soil Management**:
    - Both agroforestry and intercropping contribute to water conservation by covering the soil, reducing water runoff, and preventing soil erosion.
    - They stabilize the soil, increase soil fertility, and improve soil structure, enhancing overall soil health and productivity.
2. **Increased Yields and Productivity**:
    - Agroforestry and intercropping result in more yields by maximizing land use efficiency and providing multiple harvests from the same area.
    - They offer diversity in crop production, leading to higher yields and economic benefits for farmers.
3. **Environmental Benefits**:
    - Both practices support biodiversity by providing habitat for various plant and animal species.
    - They contribute to climate change mitigation by sequestering carbon dioxide, enhancing resource efficiency, and regulating microclimates.
4. **Economic Sustainability**:
    - Agroforestry and intercropping create additional sources of income for farmers through diversified income streams and increased productivity.
    - They provide work opportunities and improve livelihoods, contributing to economic sustainability for farming communities.
5. **Resource Efficiency and Climate Resilience**:
    - Both practices enhance resource efficiency by using limited land for multiple purposes and promoting sustainable land management.
    - They help counteract global warming, improve soil fertility, and enhance water availability, making farming systems more resilient to climate change.

Overall, both agroforestry and intercropping offer numerous benefits, including water conservation, increased yields, environmental sustainability, economic viability, and climate resilience, making them valuable strategies for sustainable agriculture.

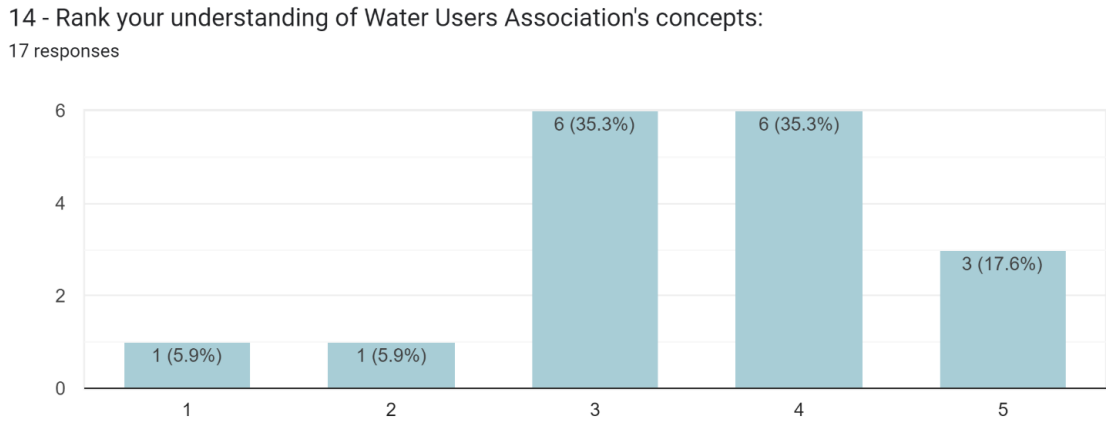


Figure 6 - – Self-assessment of the knowledge level about the WUAs concepts (before the training).

The majority of respondents show a more deepen knowledge of WUA's concepts: the 88,2% of the trainees declare to have a medium-to-high level of knowledge about this subject.

15 - Can you define **Water Users Association** with keywords?

From the sentences provided by the trainees, the following keywords (and indicators) can be extracted:

- Water scarcity
- Water efficiency
- Water use
- Commercial purposes
- Collective management
- Water allocation
- User participation
- Guidance
- Self-governed organization
- Farmers' organization
- Irrigation system
- Coordination
- Equitable distribution
- Utilization
- Common water source
- Team/organization
- Water management
- Monitoring
- Watershed
- Livestock production

- Fisheries
- Community-based
- Governance
- Sustainability
- Responsibility
- Collaboration
- Protection
- Land resources management

16 - What are the key benefits of **Water Users Association**?

Here are the synthesized key benefits of Water Users Association from the Trainees' answers:

1. **Conservation and Responsible Utilization of Water**:
    - Water Users Associations promote conservation and responsible utilization of water resources, ensuring sustainable management practices.
2. **Adaptation to Climate Change and Financial Sustainability**:
    - They facilitate adaptation to climate change through efficient water management practices and contribute to financial sustainability by optimizing water use.
3. **Capacity Building and Sustainable Agriculture**:
    - Water Users Associations focus on capacity building, empowering local communities to participate in decision-making and promoting sustainable agricultural practices.
4. **Guidance and Equity in Water Sharing**:
    - They provide guidelines for irrigation and domestic water use, ensuring equity in water sharing and resolving disputes related to water distribution.
5. **Efficient Water Management and Agricultural Productivity**:
    - Water Users Associations ensure efficient water management, leading to improved agricultural productivity and reduced water wastage.
6. **Community Engagement and Ownership**:
    - They engage local communities in decision-making processes, fostering a sense of ownership and responsibility for water-related issues.
7. **Dispute Resolution and Market Access**:
    - Water Users Associations play a role in dispute resolution among members, ensuring fair distribution of water and necessary inputs and creating market access for farmers.
8. **Knowledge Sharing and Best Practices**:
    - They bring farmers together to share knowledge on water conservation and exchange successful practices, contributing to collective learning and improvement.

Overall, Water Users Associations serve as effective platforms for promoting efficient water management, empowering local communities, resolving disputes, and fostering sustainable agriculture and environmental conservation.

17 - How can BMPs help with **environmental sustainability**?

Here are the synthesized ways in which Best Management Practices (BMPs) can help with environmental sustainability:

1. **Contribution to Carbon Sequestration and Climate Change Mitigation**:
    - BMPs such as agroforestry contribute to increased forest cover, acting as carbon sinks to remove CO2 from the environment, reducing global warming and avoiding climatic shocks.
    - Both crops and trees in agroforestry systems enhance soil organic matter content, improving soil fertility, water holding capacity, and humus content.
2. **Promotion of Sustainable Water Management**:
    - BMPs related to water management promote sustainable water use, efficient irrigation techniques, and protection of water quality, addressing issues like over-extraction and contamination.
    - Soil conservation practices reduce runoff and increase groundwater recharge, ensuring sustainable water supply.
3. **Efficient Resource Utilization and Pollution Reduction**:
    - Implementing BMPs ensures efficient utilization of resources such as water and reduces agricultural production inputs.
    - Minimizing the impact of human activities on ecosystems through erosion control measures, waste reduction strategies, and sustainable land-use practices helps conserve resources, reduce pollution, and protect water quality, soil health, and biodiversity.
4. **Enhancement of Agricultural Productivity with Reduced Environmental Impact**:
    - By reducing chemical usage and practicing agroforestry, BMPs decrease negative impacts of agriculture on the environment, leading to improved environmental conditions and enhanced farm productivity.
    - Adoption of good agricultural practices ensures fair utilization of the environment and provides better benefits for current and future generations.
5. **Innovation, Regulation Compliance, and Stakeholder Engagement**:
    - BMPs encourage finding innovative solutions for climate change mitigation and adaptation, resource conservation, and compliance with regulations.
    - Stakeholder engagement and knowledge sharing facilitate the implementation of BMPs and foster a good working environment for sustainable agriculture.

By incorporating BMPs into agricultural practices, we can achieve a more sustainable balance between human activities and the environment, conserving natural resources for the well-being of current and future generations while mitigating environmental impacts and adapting to climate change.

18 - How can BMPs help with **socio-economic sustainability**?

Here's a synthesized overview of how Best Management Practices (BMPs) can help with socio-economic sustainability:

1. **Increased Incomes and Resource Availability**:
    - BMPs that lead to increased yields provide farmers with more income, enabling them to reinvest in their farms, meet immediate needs, provide for their families, and

improve their living conditions. This improved financial situation allows for better access to resources like education and healthcare.

2. **Job Creation and Skill Development**:
    - Implementation of BMPs often involves adopting new technologies and practices, creating opportunities for job training, employment, and skill development within local communities. This contributes to economic growth and resilience.
3. **Income Generation and Business Opportunities**:
    - BMPs that improve agricultural productivity, resource use efficiency, or add value to products can contribute to increased income for farmers and businesses. This may include practices that optimize resource use, enhance product quality, or diversify income sources.
4. **Immediate Societal Needs**:
    - BMPs address immediate societal needs by promoting responsible and efficient use of resources. For example, in agriculture, BMPs may reduce soil erosion, enhance water quality, and optimize resource use, leading to improved yields and long-term economic viability for farmers.
    - oved yields and long-term economic viability for farmers.
5. **Livelihood Improvement and Environmental Protection**:
    - By applying BMPs such as soil conservation and proper utilization of soil and water resources, livelihoods are improved while environmental degradation is mitigated. This ensures sustainable economic growth and resource management.
6. **Community Development and Empowerment**:
    - BMPs foster a sense of community by encouraging collaboration, sharing of knowledge, and development of social norms. They facilitate a good working environment and aim to improve the standard of living for all members of the community.
7. **Awareness and Engagement**:
    - BMPs raise awareness for more rational and sustainable consumption and production practices. They engage and empower farmers and entrepreneurs, particularly women, in sustainable business ventures and community-based markets.
8. **Knowledge Sharing and Collaboration**:
    - Sharing experiences and useful techniques among farmers ensures continuous improvement and adaptation of BMPs to local contexts, further enhancing socio-economic sustainability.

In summary, BMPs play a crucial role in promoting socio-economic sustainability by increasing incomes, creating job opportunities, addressing immediate societal needs, improving livelihoods, protecting the environment, fostering community development, and facilitating knowledge sharing and collaboration.

19 - What are the factors that can influence the **feasibility** of a BMP?

Here's a synthesized overview of the factors that can influence the feasibility of Best Management Practices (BMPs):

1. **Financial Considerations**:
    - Costs: Financial feasibility is crucial, including initial investment, operational costs, and potential returns. High costs may hinder implementation.
    - Lack of finance and shortage of skilled manpower can impede feasibility.
2. **Technological and Infrastructural Factors**:
    - Technology and Infrastructure: Availability and accessibility of suitable technologies and infrastructure impact feasibility. Some practices may require specific equipment or facilities.
    - Slow acceptance of new ideas and resistance to hard work can hinder adoption.
3. **Regulatory Environment**:
    - Legislation and Regulations: Compliance with laws and policies is essential and changes in legal requirements can affect practicality.
    - Lack of awareness about guidelines and training may impede implementation.
4. **Knowledge and Skills**:
    - Knowledge and Skills: Adequate training and education programs are necessary for effective adoption and application.
    - Level of education and lack of extension work can affect feasibility.
5. **Social and Cultural Factors**:
    - Societal and Cultural Challenges: Cultural norms and attitudes towards new practices can influence acceptance.
    - Shortage of social knowledge and cultural barriers may hinder implementation.
6. **Climate, Terrain, and Site Characteristics**:
    - Climate and Weather Conditions: Site-specific climate and terrain conditions impact feasibility.
    - Investigating community and environmental factors and assessing physical feasibility at the site are crucial.
7. **Community Engagement and Collaboration**:
    - Capacity Building and Networking: Addressing the needs of communities and fostering collaborations can enhance feasibility.
    - Research, training, data collection, and collective platforms facilitate implementation.
8. **Farmers' Participation and Application**:
    - Farmers' Participation: Engaging farmers in decision-making and application of BMPs enhances feasibility.
    - Technical skills and financing are essential for successful implementation.

Overall, feasibility of BMPs is influenced by a complex interplay of financial, technological, regulatory, social, cultural, and environmental factors. Addressing these factors through adequate resources, training, community engagement, and tailored approaches is essential for successful implementation of BMPs.

4.5. Knowledge Self-Appraisal after the completion of the 1st Training Module

The Self-Assessment Evaluation form was distributed on the event site as well as sent by mail to participants (Annex 4).

After the completion of the Training event, the participants assessed their level of knowledge on the BMPs.

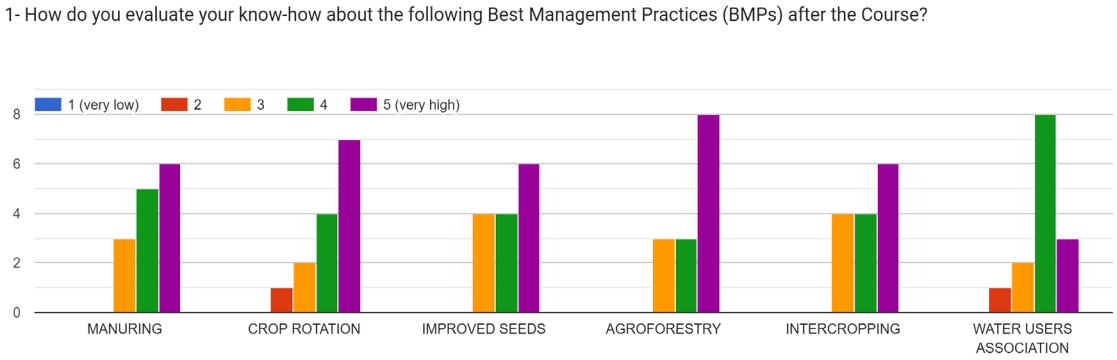


Figure 7 – Self assessment of the knowledge level about BMPs at the end of the 1st Module

As is clearly visible by comparing Figure 1 and Figure 7 the levels of Knowledge about the BMPs increased. The level ranked as 4-5 (high-very high) varied (as an average) from 40% before the training to 76% after the training. The levels of knowledge that increased more are those related to Agroforestry and WUAs (43%).

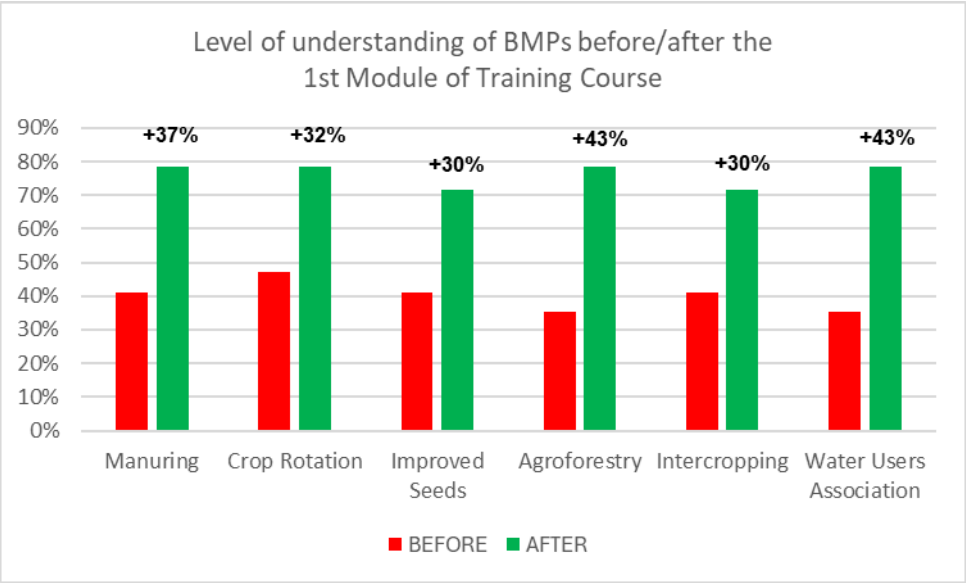


Figure 8 - Variation in the BMPs' level of understanding (before vs. after the completion of the 1st module of the Training Course)

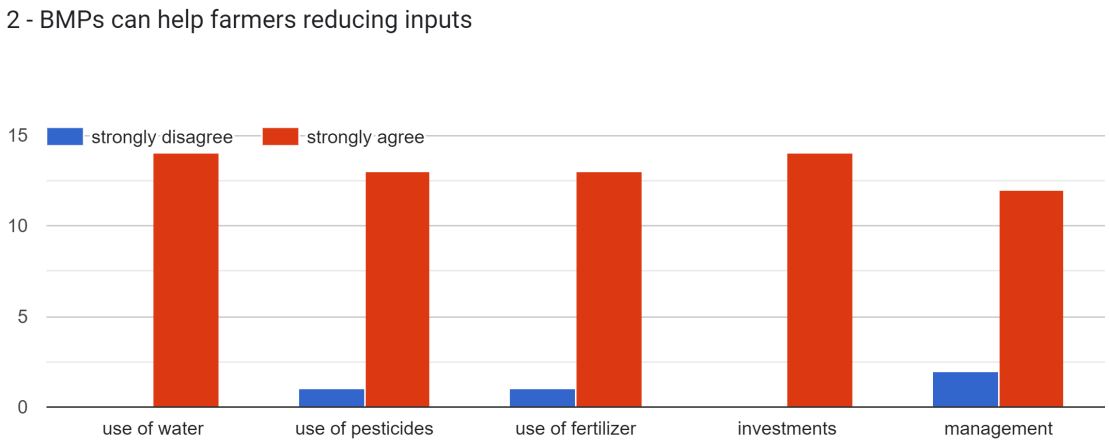


Figure 9 – Level of disagreement/agreement about how BMPs reduce the inputs (water, pesticides, fertilizers, investment, management) after the completion of the 1st Module.

By comparing the level of agreement on how BMPs can reduce inputs (water, pesticides, fertilizers, investments and management), before (see Figure 2) and after (Figure 8) the course, this increases in the most part of the answers (from 86% to 94% as an average). The level of agreement increases more when participants consider the reduction of investments (24%).

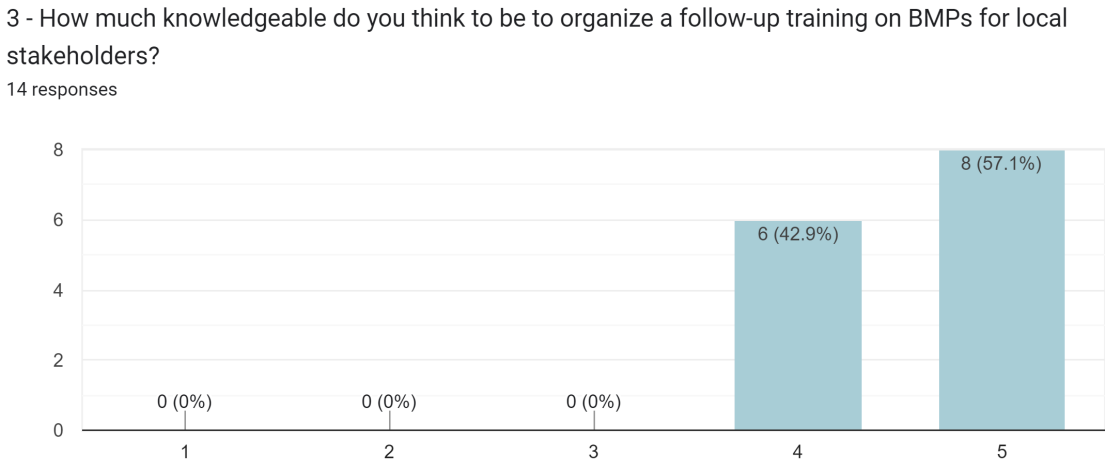


Figure 10 – Self-assessment of the level of competence in organizing a follow-up event for local stakeholders.

After the training, the participants declared to have a level of knowledge from high (42.9%) to very high (57.1%) to afford the follow-up trainings with local stakeholders.

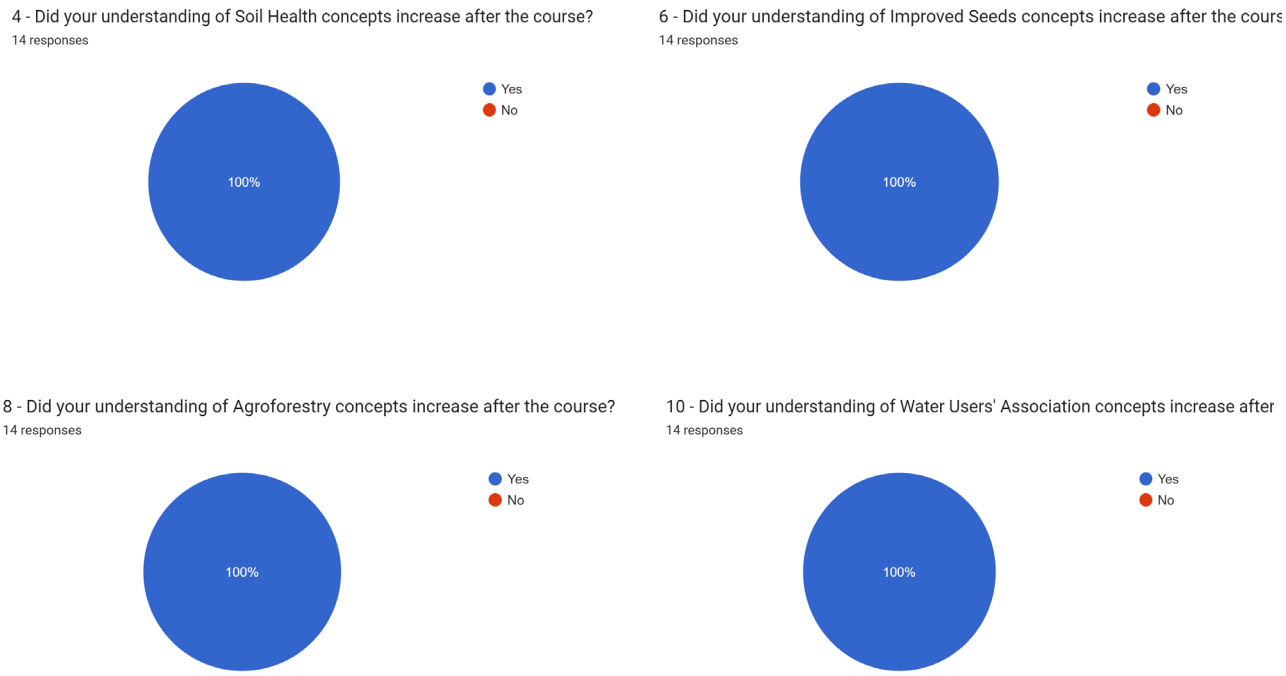


Figure 11 – Participants' level of understanding about the BMPs (after the training)

After the training, the level of understanding of the 4 main BMPs (Soil health, improved seeds, agroforestry and, WUAs, increase for all the participants.

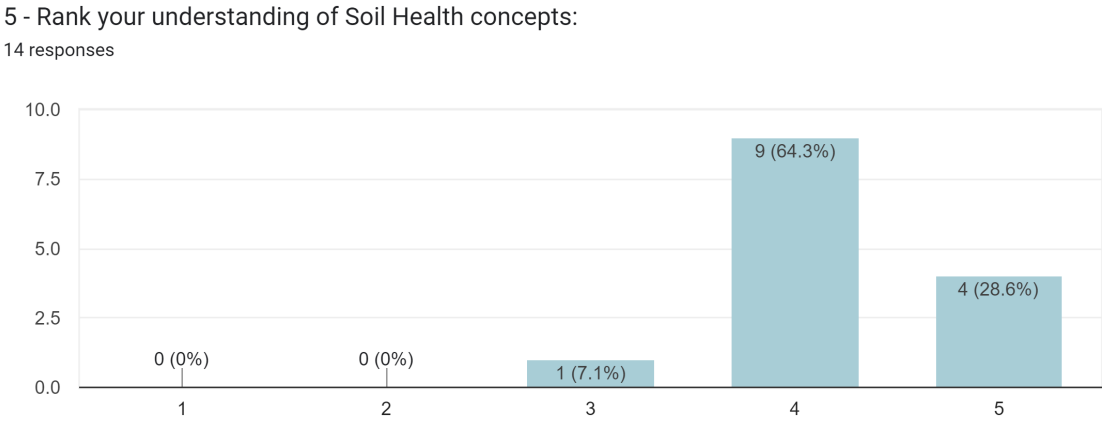


Figure 12 - Self-assessment of the knowledge level about the Soil Health concepts (after the training).

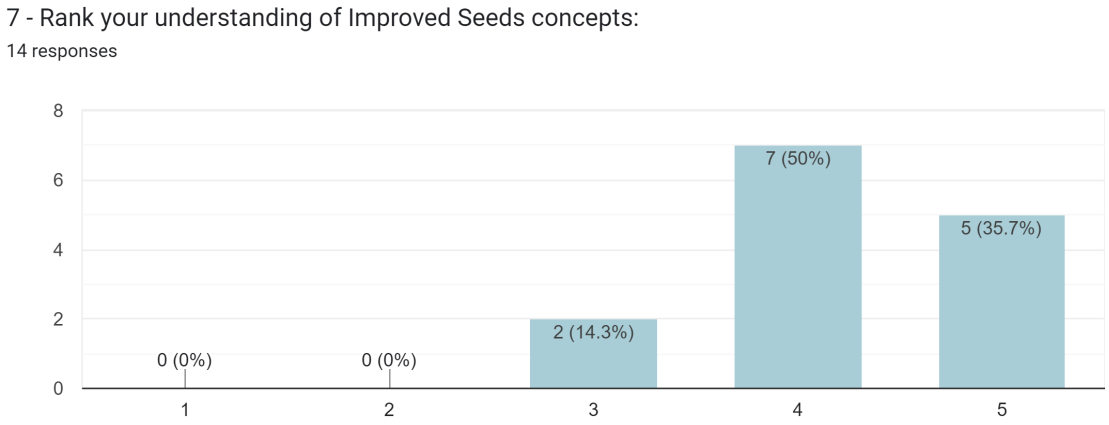


Figure 13 - Self-assessment of the knowledge level about the Improved seeds concepts (after the training).

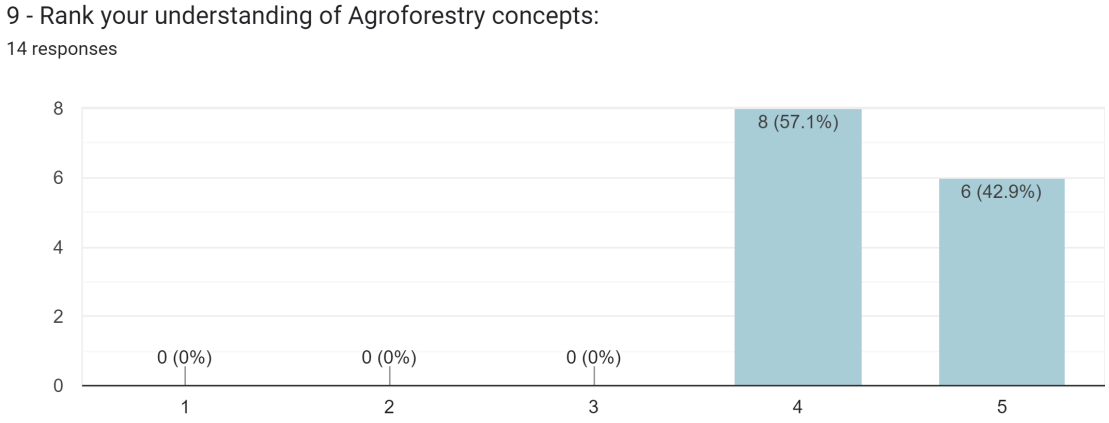


Figure 14 – Self-assessment of the knowledge level about theAgroforestry concepts (after the training).

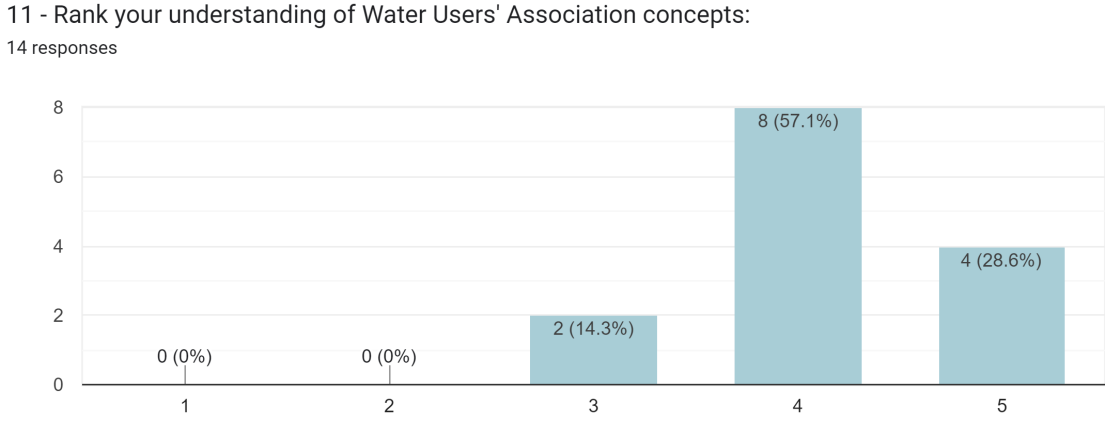


Figure 15 – Self-assessment of the knowledge level about the WUAs concepts (after the training).

Considering the differences (before vs. after the training) in the understanding's level (from 4-high to 5-very high) about the different BMPs, this one increase for all the practices (+43% as an average). In particular, the increase was higher for soil health concepts (+63%).

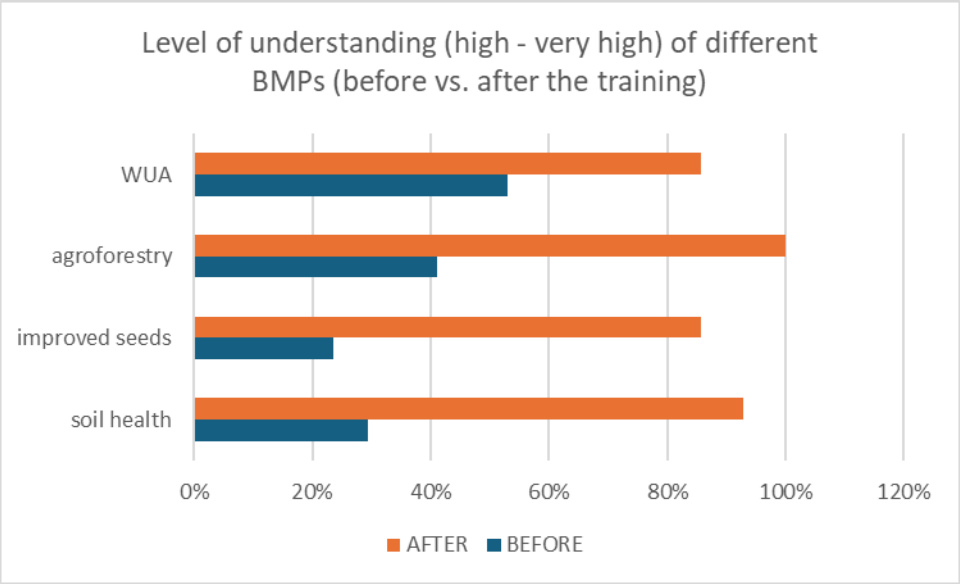


Figure 16 – Differences (before and after the training) in the knowledge level (only considering 4-high and 5-very high) about the BMPs

4.6. Outcomes from the participants' evaluation of the 1st Training Module

By means of an online questionnaire, all participants were invited to provide their inputs from 20/12/2023 until 09/01/2024 to an evaluation online survey on the quality of the program and overall organization of the training week: https://forms.gle/YhKqaepaBtm3kpBt8**.** 14 out of 19 participants answered the survey, whereas the 5 participants from Sudan who attended the module online, could not connect during this period.

The trainees declared that their interest for the topics was very high (71.4%).

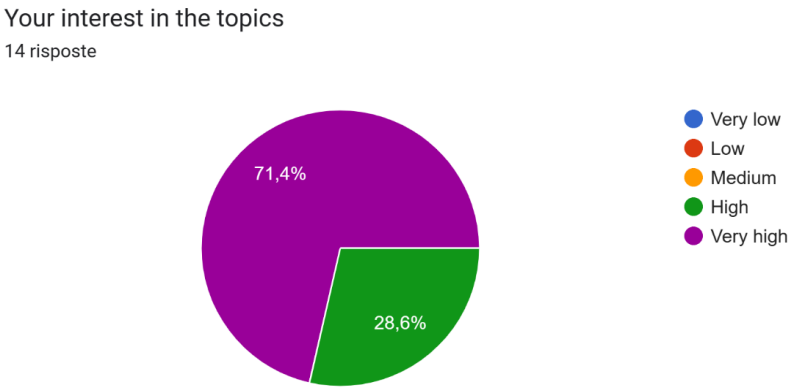


Figure 17 – Evaluation of the trainees' interest in the course topics.

The time devoted to each topic was evaluated as adequate (42.9%) or plenty (35.7%).

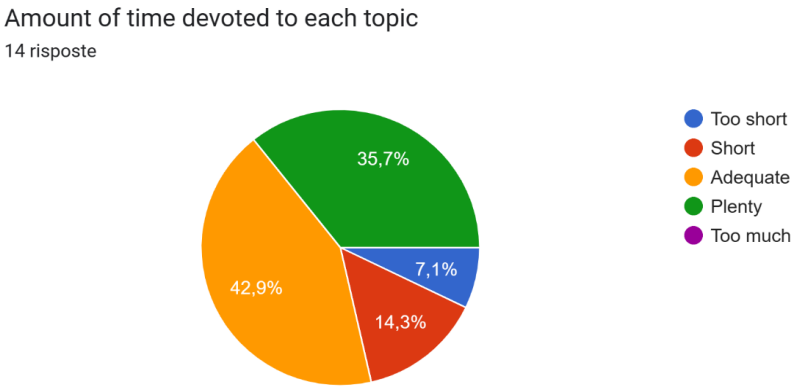


Figure 18 – Overall evaluation of the time devoted to each topic during the course.

85,7% of the participants declared that the topics examined during the 1st Module have a very high applicability to their work.

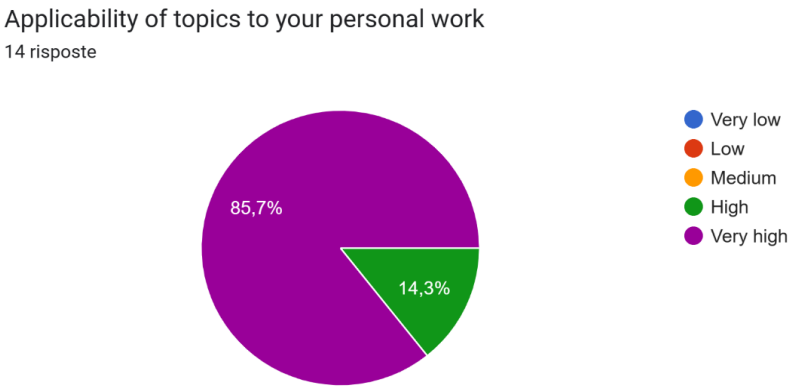


Figure 19 – Evaluation of the applicability of course's topics to the trainees' work

The quality of teaching was evaluated very high (57.1%) and high (42.9%)

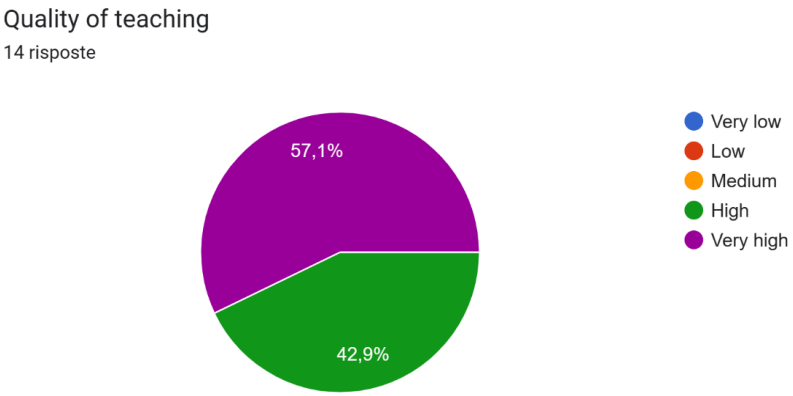


Figure 200 – Overall evaluation of the quality of teaching.

The quality of the training material was evaluated as very high (64.3%) and high (35.7%).

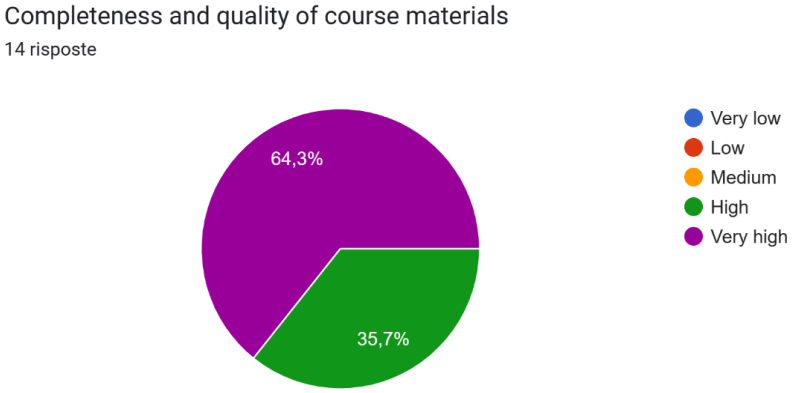


Figure 211 – Overall evaluation of the training material.

The course's activities (lectures, group's works, technical visits, …) allowed a good level of interaction both among trainees as well as between them and the lecturers.

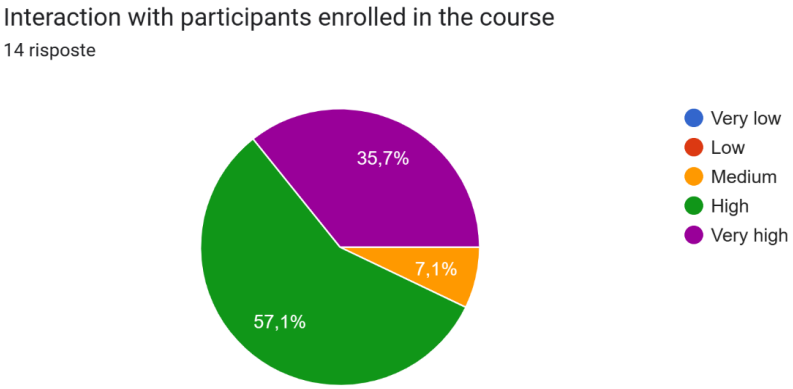


Figure 222 – Evaluation of the interaction's level among trainees.

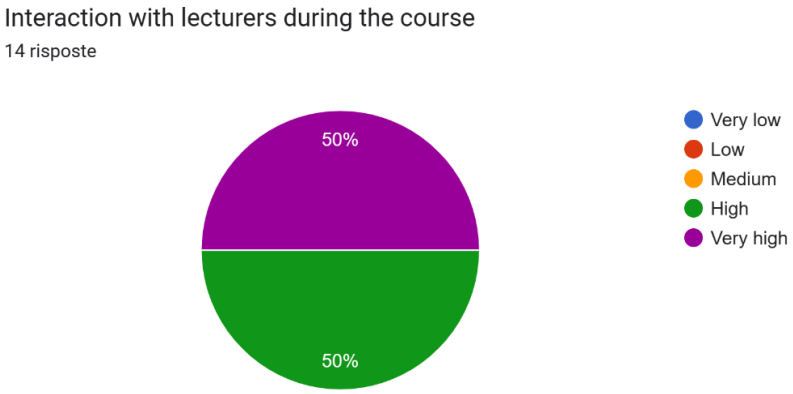


Figure 233 – Evaluation of the interaction's level between trainees and lecturers.

In the figure here below the different aspects of the course (programme, methodology, organization) and the benefits achieved were evaluated. The trainees estimated as excellent the quality level of the training.

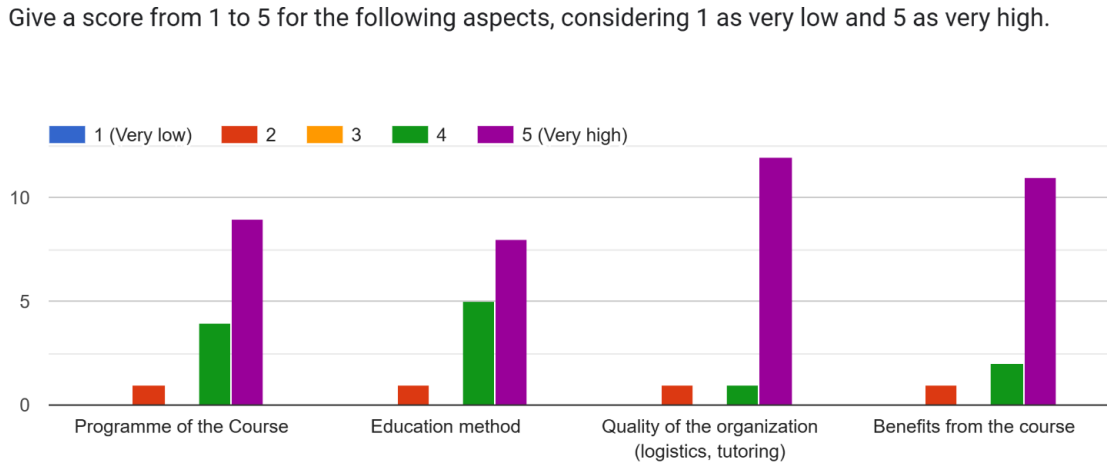


Figure 244 – Evaluation of different aspects of the training course

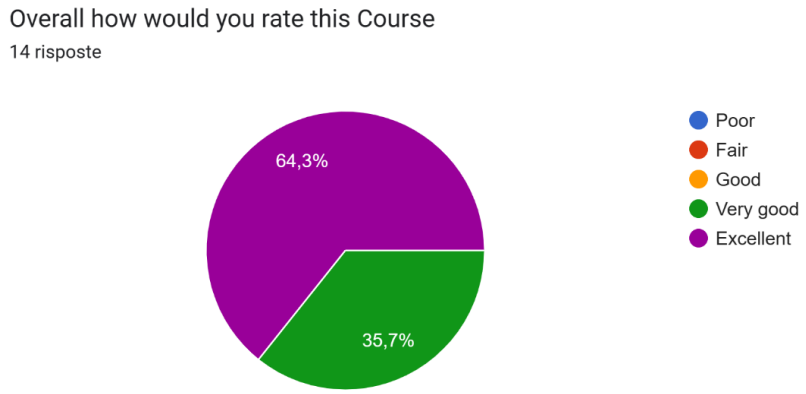


Figure 255 – Overall evaluation of the 1st Module of the Training Course

Here is a summary of the suggested topics for addition to a course program:

1. **Climate Change Adaptation**: Strategies and practices for adapting to the effects of climate change.
2. **Renewable Energy in Agriculture**: Utilization of renewable energy to support climate-smart agriculture and technical irrigation system design.
3. **Compost Making Methods**: Techniques and practices for creating compost.
4. **Pest Control and Disease Management**: Methods for managing pests and diseases in crops.
5. **Best Management Practices Packages**: Development of comprehensive packages for best management practices.
6. **Soil Health Moderation**: Approaches to moderating soil health based on country-specific conditions, challenges, and water scarcity.
7. **Irrigation Structures and Dam Safety**: Analysis of potential dam failure modes, monitoring, and inspection of irrigation structures, and catchment treatment activities.

8. **Organic Farming**: Principles and practices of organic farming.
9. **Regenerative and Sustainable Farming**: Techniques for regenerative and sustainable farming.
10. **Agro Produce Processing and Value Addition**: Methods for processing and adding value to agricultural produce.
11. **Soil and Fertilizer Management**: Understanding different soil types, appropriate fertilizer or manure application rates, and plant breeding in response to biotic and abiotic factors.
12. **Practical Program Integration**: Incorporation of practical programs into each course.
13. **Irrigation System Modeling**: Designing and modeling irrigation systems for efficiency, with a focus on specific regions like Tana River County.

These suggestions cover a broad range of topics aimed at enhancing agricultural practices, sustainability, and climate resilience.

5. Follow-up training workshops in the study areas

Moving from the A2.2 Training of Trainers (ToT) and Capacity Building on BMPs, held in Italy on 11-16 December 2023, three follow-up trainings were organized by Trainees and Local partners (HU, WRLC, and KALRO) in each case study area. Due to the terrible war in progress in Sudan for one year and an unstable internet connection, the Water Resource Centre (WRC) of Khartoum University decided not to deliver the follow-up training workshop in the study area or remotely, until when safety conditions are re-established.

These events were mainly addressed to disseminate the know-how acquired about BMPs during the 1st Training Module and were intended to be a bi-directional exchange between trainers and local farmers. With regards to farmers, the aim was to enable them to integrate the knowledge with their traditional know-how and competencies. Furthermore, the meeting aimed to offer the Local Partners as well as to the Task Lead Partner ASARECA, the opportunity to carry out a participatory feasibility and sustainability analysis for BMPs/Innovations to be simulated and applied in the case study areas.

During the A2.1 Awareness sessions (implemented with local stakeholders between June and July 2023), an exercise aimed at collecting from local stakeholders their perceptions about the BMPs objectives, was carried out. The results from this prioritization exercise will provide a guide for the sustainable management of the area in which the BMPs would be applied. Moreover, the objectives have been the basis for the selection of a set of indicators to evaluate the achievement of BMPs' goals. Across the Socioeconomic and Environmental dimensions, a set of indicators has been developed through a literature review and experts' elicitation.

Using the indicators mentioned above, will facilitate the collection of data on the socio-economic and environmental state of the case study areas before the introduction of BMPs/Innovation will be defined.

5.1. Objectives of the Follow-up Trainings and expected Outputs

The Follow-up training have 2 **main objectives**:

(i) adapt and share the knowledge on Best Management Practices acquired during the ToT;

(ii) agree with stakeholders on the feasibility indicators that best describe the situation in the case study areas from the socio-economic and environmental point of view.

The follow-up events are aimed to provide the following **outputs**, by the Local Partners (HU, WRC, WRLC, KALRO):

- Preliminary list of Stakeholders involved in the site of BMPs implementation.
- Training material shared with trainees.
- List of agreed indicators for prioritized "sustainability" objectives as well as plan for data collection for agreed indicators.
- Report on site-level Training event (to be collected in deliverable D2.2.2).

5.2. Target Groups (Beneficiaries)

The follow-up training is addressed to farmers (and other relevant stakeholders) potentially involved by BMPs or Innovations implementation, local communities at large (with a preference for young people and women), and smallholders' organizations. Particularly: (i) local technicians and practitioners engaged in agricultural projects' development and/or assistance to farmers, (ii) community stakeholders engaged in BMPs/innovation implementation, and (iii) public.

To let the farmers feel directly involved and engaged, the number of participants was kept around 50 people (as an average). The most suitable and needed stakeholders were identified based on the stakeholder analysis already conducted by Local Partners during the Awareness meetings (see deliverable D2.1.1).

The participation (per country and gender) is reported in the figure here below.

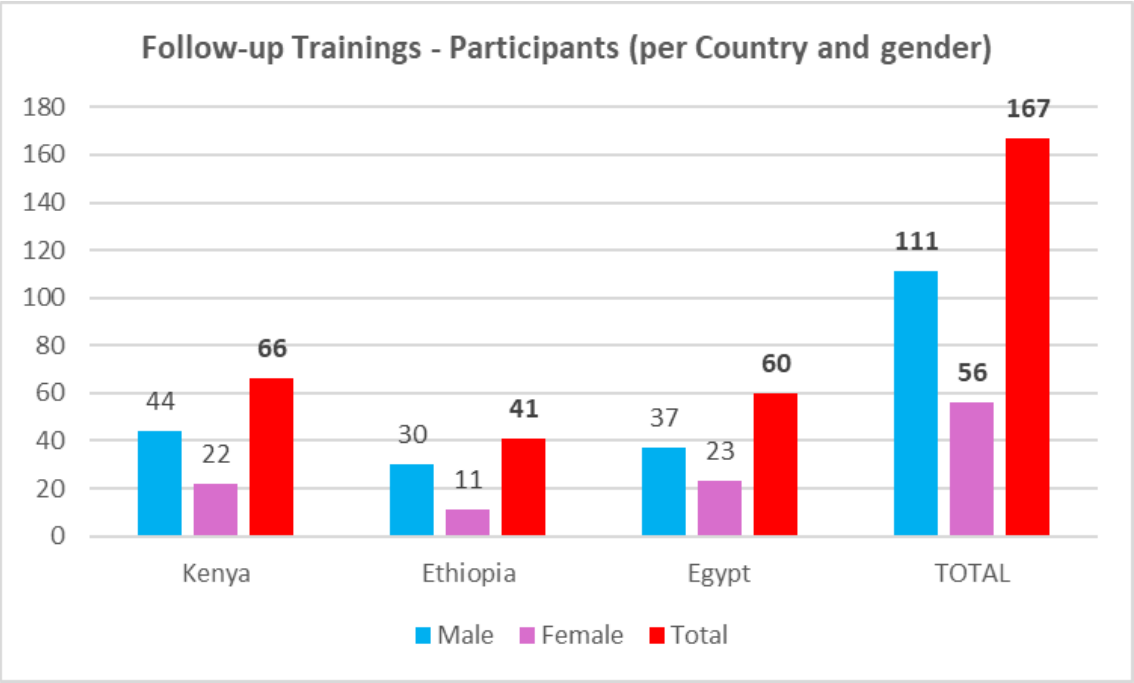


Figure 26 – Follow-up trainings: number of participants (per country and gender)

5.3. Venues and dates

The local partners identified the venue where the events were hold. Here below the final calendar of the events:

- Belbies (EG), 4-5 March 2024
- Tana River (KE), 8-9 April 2024
- Bahir Dar (ET), 19-20 April 2024.

Here below, an example of the 2-days Agenda for the Follow-up Training (in Belbies, Egypt).

Day 1: 4th March 2024	
Welcome and introduction (30')	
09.00-09.30	• Welcome (Prof. Wael Khairy) • Short presentation of participants (name and role/activity)
Preparing the ground for discussion (30') (Communication & Visibility)	
09.30-10.00	• The WATDEV Project: Objectives, methods and expected results (Eng. Salma Wael) • Meeting objectives and agenda (Mr. Moses Odeke)
Coffee break & Group photo (30')	
Training on selected BMPs (2h)	
10.30 – 12.00	• Presentation of selected BMPs: guided discussion on how practices are applied, how to reduce their impacts on the environmental system (water, soil, crop, atmosphere), how to improve sustainability/efficiency/productivity of selected BMPs (Eng. Rehab Ibrahim & Eng. Hend Hany)

Day 1: 4th March 2024	
	• Consultation with local actors on overall feasibility of the selected BMPs, pros/cons, needs/technical solutions for their implementation in the area. (Facilitator: Trainers)
Participatory selection of suitable scenarios	
12.0 – 13.30	• Presentation of the A3.2 Participatory identification of suitable scenarios (10 minutes) • Workgroups (45-60 minutes) Facilitators: Dr. Luuk Fleskens & Dr. Baartman Jantiene • Plenary feedback from workgroups (30 minutes) Facilitators: Dr. Luuk Fleskens & Dr. Baartman Jantiene
Buffet lunch (1h30')	
Training on selected BMPs (1,30h) (continuation)	
14.30 – 16.00	• Presentation of selected BMPs: guided discussion on how practices are applied, how to reduce their impacts on the environmental system (water, soil, crop, atmosphere), how to improve sustainability/efficiency/productivity of selected BMPs. • Consultation with local actors on overall feasibility of the selected BMPs, pro/cons, needs/technical solutions for their implementation in the area. Facilitators: Eng. Bothaina El-Hussainy & Eng. Mohamed Mostafa
Wrap-up and conclusion (30')	
16.00-16.30	• Wrap-up and closure • Next steps: Participatory selection of the feasibility indicators (A2.3) and suitable scenarios (A3.2). Facilitators: Prof. Wael Khairy & Mr. Moses Odeke

Day 2: 5th March 2024	
Welcome and introduction (30')	
09.00-09.30	• Meeting objectives and agenda (Mr. Moses Odeke)
Preparing the ground for discussion: the Awareness event's outcomes (30')	
09.30-10.00	• Presentation of the A2.1 Awareness Event's outcomes: reviewing the objectives prioritized for each BMP to be implemented in the case study area Facilitators: Dr. Rasha Hosny and Mr. Moses Odeke
Coffee break (30')	
Participatory selection of the feasibility indicators	
10.30-13.00	• Consultation with stakeholders to select Feasibility Indicators BMPs objectives for each sustainability dimension (Social, Economic, Environmental, Governance), to enhance feasibility study of BMPs. Facilitators: Dr. Rasha Hosny and Mr. Moses Odeke

Day 2: 5th March 2024	
Wrap-Up and Conclusion	
13.00-13.30	• Wrap-up and closure • Next steps: the feasibility study Facilitators: Prof. Wael Khairy & Mr. Moses Odeke
Buffet lunch (1h30')	

5.4. Methodology

The follow-up events are focused on sharing the knowledge acquired on the selected BMPs or Innovations during the A2.2 Training course, with the aim of building a common know-how, increasing absorption, and running capacity, applying technical solution to adapt BMPs to the local context.

ASARECA shall ensure the overall coordination of the event. The local partners (HU, WLRC, WRC, and KALRO) will contribute to support the trainers in selecting the stakeholder participants as well as in organizing the events in the study areas.

The events were carried out by following a series of phases:

Phase 1 – Presentation of WATDEV Project: Objectives, methods and expected results and overview of activities in the country were presented. These "Communication and Dissemination" activities were addressed to inform farmers and local communities at large about the project goals and how WATDEV activities can concretely influence their agricultural activities.

Phase 2 – Introduction of participants and participants' expectations, presentation of overall meeting objectives and programme: The self-introduction by participants contributed to "break the ice" and create a more conducive environment for them to share their expectations of the meeting in a more relaxed manner.

Phase 3 - Presentation of selected BMPs: The trainees of the 1st Module presented the "selected" BMPs/Innovations, pointing on how practices should be applied to mitigate their impacts on the environmental system (water, soil, crop, atmosphere) and how to improve their sustainability/efficiency/productivity.

Taking advantage from the information acquired during the 1st training module in Italy, the trainees share their knowledge with the participants. In most of the cases, the guided debate was addressed to put in evidence concerns and recommendations on how to implement the selected BMPs in each case study area.

Phase 4 - Group work on BMPs for Modelling Scenarios: In the participatory session (guided by the ISRIC team), local stakeholders were asked for their ideas for future scenarios to be developed and eventually simulated with the WATDEV modelling toolbox.

After a short presentation on the toolbox and its functionality, the local stakeholders were divided into groups either depending on the area that they were from or on other criteria (different per country). Each group was asked to discuss the following questions. The discussion within each group was guided by a member of the local partner (and in the local language).

- Please specify the objective: what do you want to improve?
- What BMPs would you consider?
- Can you specify the BMPs?
    - Intercropping: which crops, which trees?
    - Agroforestry: which crops, which trees?
    - Manuring: which type, what sources?
    - Water management: what changes? (e.g., source, distribution)
- Where would you implement the BMPs?
- Do you envisage a combination of BMPs?

After the group discussions, participants reported back to the plenary session the main findings (see tables here below).

Table 8 – Main findings of the Scenarios Modelling exercise - EGYPT

Composting
• Farmers have limited knowledge of how to use manure and plant waste for making compost. Composting is thus used in its raw form (not fully processed) and has negative effects. • The farmers are convinced that they should buy high-quality compost from authentic sources.
Intercropping With Trees/Agroforestry
• Intercropping with citrus trees is a profitable BMP, but the trees need a lot of care. In between (3-5 m) vegetables are grown, such as clover, beans, onions, and garlic during the winter season and intercrop citrus trees with maize, peanuts, green pepper, and sesame during the summer season. • Integrated pest management and integrated crop management is needed.
Water Users' Association
• There is a shortage of surface water, so groundwater is used, but there are increasing ener-gy needs and related high costs for pumping. The groundwater is getting deeper (e.g., in east El-Ismaillia Canal lands). On the western side of El-Ismaillia Canal lands, small diesel pumps are used for irrigation of crops (rice & maize) with shallow depths. Drip irrigation is used widely on the eastern side of El-Ismaillia Canal lands. In all areas, the cost of energy is high, so the farmers' profitability is low. This needs to be resolved via the application of the BMPs. • Water salinity is high in the area, thus affecting crop production. Water logging is a challenge in West El-Ismaillia Canal lands due to seepage. • Water distribution systems are inefficient.

Table 9 – Main findings of the Scenarios Modelling exercise - KENYA

Agroforestry
• Agroforestry is envisaged in three specific locations: 1) along feeder canals for stabilisation of canal banks and avoiding soil erosion; 2) in specific designated areas (corridors) as windbreaks; and 3) surrounding irrigated areas as windbreak. • The tree species selected include fruit trees (mango, citrus, pawpaw, coconut), indigenous trees and fodder trees. Fruit trees are suggested to enhance farm income, indigenous trees for environmental purposes and fodder trees to reduce conflicts between pastoralists and farmers.
Water Users' Association
There are major challenges with water availability in the scheme, especially near the tail end. Suggestions were: • An extension of the canal to be able to irrigate by gravity or, alternatively, by installing solar pumping to reduce the high fuel cost of pumping water from Tana River into the Hola irrigation scheme. • Seasonal desilting and cleaning of the main canals to ensure water can reach the irrigation areas. • Increase storage in the irrigation system by constructing more reservoirs enabling irrigation areas to better control water allocation. This is also specifically a requirement in case of solar pumping, to have night storage. • Field land levelling to have a better water distribution over the irrigated fields, to reduce water consumption and increase water use efficiency.

Table 10 – Main findings of the Scenarios Modelling exercise - ETHIOPIA

Agroforestry
• Farmers have limited knowledge of how to use manure and plant waste for making compost. Composting is thus used in its raw form (not fully processed) and has negative effects. • The farmers are convinced that they should buy high-quality compost from authentic sources.
Crop Rotations/Soil Health
• Avocado was the most preferred agroforestry tree by the farmers. Agroforestry is envisaged in three specific locations: 1) Hedges intercropping. Crops: Teff, Wheat, Barley, cabbage, Onion, Maize, Turmeric, Elephant grass; Trees: Avocado, Croton, Cordia-Avocado to be planted with

wheat/teff for four-year cycles. After four years Avocado will be combined with species like turmeric. 2) Trees in the farmland: Acacia, Croton, Cordia in Teff, Wheat, Barley, and Maize 3) Homestead agroforestry practices with crops such as tomato, ginger, cardamom, and carrot. Trees include Coffee, Rhamnus, Banana, Mango, and Avocado.
Water Users' Association
The issues of water distribution and allocation can be addressed by: • Developing irrigation water use programs for each crop type and implementing proper water allocation plans. • Addressing water loss and theft by enforcing bylaws through the irrigation water users' association platforms. • Promoting groundwater use to complement irrigation water by supporting water lifting devices and necessary materials to mitigate users' conflicts and water scarcity.

Phase 5 – Participatory selection of the feasibility indicators: The community of stakeholders (guided by ASARECA team) worked to select indicators for each objective of implementation of the BMPs that they had prioritized during their Awareness-raising Meetings. In selecting the indicators among the overall list, the following aspects were considered: (i) how the indicators apply to the local conditions or how they accurately describe the local conditions; (ii) availability of data; and (iii) ease of accessing data.

Moreover, the stakeholders discussed the following aspects: (i) which feasibility indicators apply to each case study; (ii) modalities for data collection; (iii) key stakeholders to be involved in data collection; and (iv) plans and timeframe for data collection.

Table 11 – Final list of selected indicators for each prioritized objective - EGYPT

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. Create job opportunities for locals.	1.1 Social co-benefits	• No. of people employed by value chain, by country, by gender (specify NUTS level, time period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	• Level of endorsement or support by the local governments (Likert scale) • No. of plans or projects or programs supporting implementation of the practice
	Governance	7. Organizations support learning about BMPs.	7.1 enabling conditions	• No. of farmers accessing agricultural extension services from extension agencies (…Number of extension contacts) • No. of organizations providing agricultural extension services to farmers • Number of farmers trained on BMP GAPs or practices
	Economy	10. Increase farmer's income.	12.1 economic co-benefits	• Total household Net farm income (GFI- Total production costs & expenses) • % increase in net farm income
Environmental	**Groundwater**	14. Enhance water quality.	14.1 Water quality	• Level of water salinity (standard methods) • Level of biological contamination (E. Coli, IBA, …)
	Soil	17. Maintain soil health	17.1 Soil health	• Soil Organic Carbon (t ha^{-1})
	Crop	20. To make crops healthier.	20.1 Crop healthy	• Amount of fertilizers / pesticides per unit of crop (Residues level in the product) • Nutrient (N, P) use efficiency (kg product/kg N, P)
	Surface water	24. Keep water flow safe.	24.1 Risk reduction potential	• Annual floods frequency (exceeding a certain threshold) • Proportion of land prone to flood risks (%)
	Atmosphere	27. Ensure a healthier environment for the community.	27.1 Risk reduction potential	• Air Quality Index (AQI)

Table 12 – Final list of selected indicators for each prioritized objective - KENYA

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. Create job opportunities for locals.	1.1 Social co-benefits	• No. of people employed by value chain, by country, by gender (specify NUTS level, time period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	• Level of endorsement or support by the local governments (Likert scale) • No. of plans or projects or programs supporting implementation of the practice
		6. Compliant with national regulations	6.1 Policy feasibility	• No. of national, regional, or local policies and regulations that are aligned with the BMP activities • Value (in US$) of government's contribution to implementation of the BMPs in the target communities
	Governance	7. Organizations support learning about BMPs.	7.1 Enabling conditions	• No. of farmers accessing agricultural extension services from extension agencies (…Number of extension contacts) • No. of organizations providing agricultural extension services to farmers • Number of farmers trained on BMP GAPs or practices
		8. Improve cooperation among value chain actors	8.1 Enabling conditions	• No. of value chain linkages established. • No. of agreements among value-chain actors/yr
		9. Improve collaboration between institutions and value chain actors	9.1 Enabling conditions	• No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	11. Increase crop production.	11.1 diversification of the production	• Crop yield (total production (Kg)/Total land area (ha) • Proportion of new crop enterprises
		12. Increase farmer's income.	12.1 economic co-benefits	• Total household Net farm income (GFI- Total production costs & expenses) • % increase in net farm income
Environmental	**Groundwater**	15. Ensure suitable groundwater access.	15.1 access to resource(s)	• No. of community members with access to water rights or secure water resource allocations
	Soil	16. Prevent soil erosion	16.1 Risk reduction potential	• Area affected by soil erosion (%, Km2): Proportion of the area affected by soil erosion (%)
		17. Maintain soil health	17.1 Soil health	• Soil Organic Carbon (t ha^{-1})
	Crop	19. To make crops productive.	19.1 Crop productivity	• Production yield of crop per unit of cultivated area (t ha-1)

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
	Surface water	24. Keep water flow safe.	24.1 Risk reduction potential	• Annual floods frequency (exceeding a certain threshold) • Proportion of land prone to flood risks (%)
	Atmosphere	27. Ensure a healthier environment for the community.	27.1 Risk reduction potential	• Air Quality Index (AQI)

Table 13 – Final list of selected indicators for each prioritized objective - ETHIOPIA

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	2. Create job opportunities for locals.	1.1 Social co-benefits	• No. of people employed by value chain, by country, by gender (specify NUTS level, time period)
	Policy	5. Legislations/Regulations Clarity	5.1 Policy feasibility	• Number of plans or strategies supporting BMP implementation
	Governance	8. Improve collaboration between institutions and value chain actors	9.1 Enabling conditions	• No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	13. Increase crop production.	11.1 diversification of the production	• Crop yield (total production (Kg)/Total land area (ha) • Proportion of new crop enterprises
		14. Increase farmer's income.	12.1 economic co-benefits	• Total household Net farm income (GFI- Total production costs & expenses) • % increase in net farm income
Environmental	**Groundwater**	16. Ensure suitable groundwater access.	15.1 access to resource(s)	• Intensity of water use by agriculture: Amount of irrigation water (mc) used per unit of cropped land (ha) • No. of community members with access to water rights or secure water resource allocations
	Soil	18. Prevent soil erosion	16.1 Risk reduction potential	• Proportion of the area affected by soil erosion (%) • Average soil loss (t ha^{-1} yr^{-1})
	Crop	21. To make crops productive.	19.1 Crop productivity	• Production yield of crop per unit of cultivated area (t ha^{-1})
	Surface water	25. Keep water flow safe.	24.1 Risk reduction potential	• Annual floods frequency (exceeding a certain threshold) • Proportion of land prone to flood risks (%)

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
	Atmosphere	28. Ensure a healthier environment for the community.	27.1 Risk reduction potential	• Air Quality Index (AQI)

Table 14 – Final list of selected indicators for each prioritized objective - SUDAN

Dimensions/ Sub-dimensions		Prioritized Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. Create job opportunities for locals.	1.1 Social co-benefits	• No. of people employed by value chain, by country, by gender (specify NUTS level, time period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	• Level of endorsement or support by the local governments (Likert scale) • No. of plans or projects or programs supporting implementation of the practice
	Governance	8. Improve cooperation among value chain actors.	8.1 Enabling conditions	• No. of value chain linkages established. • No. of agreements among value-chain actors/yr
		9. Improve collaboration between institutions and value chain actors	9.1 Enabling conditions	• No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	10. Make farm costs manageable.	10.1 Micro-economic viability	• Crop Yields (Tons/Ha) • Benefit-cost ratio of production • Price-Cost Ratio (compares selling price to cost of production) • Cost saving (US$) as a result of BMP adoption
Environmental	**Soil**	18. To help crops grow better.	18.1 Soil fertility	• Soil fertility (SOM, N, P_2O_5, K_2O) • Farmers perception on soil fertility (Likert scale) ---additional
	Crop	19. To make crops productive.	19.1 crop productivity	• Production yield of crop per unit of cultivated area (t ha^{-1})
	Surface water	24. Keep water flow safe.	24.1 Risk reduction potential	• Annual floods frequency (exceeding a certain threshold) • Proportion of land prone to flood risks (%)
	Atmosphere	27. Ensure a healthier environment for the community.	27.1 Risk reduction potential	• Air Quality Index (AQI)

6. Conclusions

Based on the suggestions provided by the trainees, here are some recommendations to improve the course:

- Increase Field Visits: Incorporate more field visits to various farms and agricultural setups, such as irrigation systems, agroforestry, and agro-silvopastoral systems.
- Enhance Practical Work: Allocate more time for practical sessions, group work, and hands-on activities to ensure learners gain practical exposure alongside theoretical knowledge.
- Develop Comprehensive Packages: Create detailed packages for best management practices to provide clear guidelines and reference materials for students.
- Expand Course Duration: Increase the overall duration of the course and provide more detailed coverage of each topic to ensure thorough understanding.
- Integrate Interactive Participation: Include more group work and group presentations to foster interactive participation and collaborative learning.
- Implement Breaks: Schedule short presentations of an hour followed by brief health breaks of 15-20 minutes to maintain student and lecturer engagement and well-being.
- Continuity and Advanced Modules: Ensure continuity by adding more advanced modules to the course over time. Consider integrating the course into broader academic programs, such as master's programs, for long-term participant inclusion and advancement.
- Maintain Current Level of Content: For those satisfied with the current content level, maintain the quality and depth of the existing material while making the above enhancements.

By incorporating these suggestions, the course can offer a balanced mix of theoretical knowledge and practical skills, thereby enhancing the overall learning experience and effectiveness.

7. Annexes

7.1. Training & Capacity Building 1st Module (11-16 December, CIHEAM Bari (Italy)

Training Materials: https://cloud.watdev.eu/index.php/s/DrsSdCHDwFetRj6

Programme: https://cloud.watdev.eu/index.php/apps/onlyoffice/s/DrsSdCHDwFetRj6?fileId=86961

Daily attendance register: https://cloud.watdev.eu/index.php/s/YCM9Gq7LCqDyEJo

1st Module photo gallery: https://cloud.watdev.eu/index.php/s/bEGQqgB5bzZP3n9

7.2. Follow-up Trainings workshops in the study areas

Report of the follow-up training workshop in Egypt (4-5 March 2024):

https://cloud.watdev.eu/index.php/s/Mac2nDDzyAPgZAA

Report of the follow-up training workshop in Ethiopia (19-20 April 2024)

https://cloud.watdev.eu/index.php/s/Y7nmXFCMYJLHKrW

Report of the follow-up training workshop in Kenya (08-09 April 2024):
https://cloud.watdev.eu/index.php/s/3mSyTDBxoFBj8r7

Egypt photo gallery: https://the-followup-trainin.watdev.eu/

Kenya photo gallery: https://the-followup-train-2.watdev.eu/

Ethiopia photo gallery: https://the-followup-train-3.watdev.eu/