GEAVET TRAINING PROGRAMME FOR CSA

CLIMATE SMART AGRICULTURE:

NIGERIA

UNIT I.I INSTALLATION/MAINTENANCE OF DRIP IRRIGATION

ENGLISH VERSION

GEAVET Project n° 101129027

Open Educational Resources

PART I – LEARNING MATERIAL

1.Introduction

Water scarcity and inefficient irrigation practices remain major challenges limiting agricultural productivity in Nigeria (Wudil *et al.,* 2023; Adeoyolanu & Okelola, 2024). As the demand for sustainable food production grows, there is an urgent need to adopt modern irrigation technologies that optimise water use and enhance crop yield. Drip irrigation is an efficient system that delivers water directly to the root zone of plants, offering a viable solution for improving water management, reducing wastage, and increasing farm profitability.

This curriculum on Training in Installation and Maintenance of Drip Irrigation Systems is designed to build the technical capacity of farmers, agricultural technicians, extension workers, and students in the practical aspects of drip irrigation. It aims to equip participants with the knowledge and hands-on skills required to design, install, operate, and maintain drip irrigation systems suitable for different agro-ecological zones in Nigeria.

The training will foster understanding of the principles of drip irrigation technology, system components, troubleshooting methods, and sustainable management practices. Ultimately, the training programme seeks to promote climate-smart agriculture, improve water-use efficiency, and contribute to national food security and rural livelihood development.

2. Irrigation

Irrigation is the deliberate application of water to soil or crops through artificial means such as canals, sprinklers, or drip systems to supplement natural rainfall and ensure adequate moisture for optimal plant growth. It is a key agricultural practice that enhances crop productivity, stabilises yields, and promotes efficient water use, especially in areas with irregular or insufficient rainfall.

Image 1. Drip Irrigation (Dripworks, 2024)

2.1. Relevance of Irrigation to Climate-Smart Agriculture (CSA) in Nigeria

Climate-Smart Agriculture aims to sustainably increase agricultural productivity, enhance resilience to climate change, and reduce greenhouse gas emissions where possible. Irrigation supports these goals by ensuring reliable water supply, reducing climate-related risks, improving resource efficiency, and enabling farmers to produce more with less water.

Irrigation directly contributes to each of the three main pillars of Climate-Smart Agriculture in the following ways:

- **Increased Productivity:** Irrigation enhances productivity by providing a reliable water supply that allows farmers to produce crops consistently, regardless of rainfall fluctuations. It enables multiple cropping cycles per year, increases land use efficiency, and supports the cultivation of high-value crops that require steady moisture availability. This reliable water management leads to higher and more stable yields, contributing to food security and improved livelihoods of Nigerians.
- **Enhanced Resilience (Adaptation):** Irrigation strengthens resilience and adaptation to climate change. By reducing dependence on unpredictable rainfall, irrigation has the ability to assist Nigerian farmers to sustain production during droughts or dry spells. It enables cultivation in arid or semi-arid regions of the country and helps buffer against the impacts of extreme weather events. As such, irrigation improves the adaptive capacity of Nigerian farming

systems and reduces vulnerability to climate variability across agro-ecologies.

- **Reduced Emissions (Mitigation):** Irrigation contributes to mitigation by promoting efficient water and energy use, especially when modern systems like drip irrigation are adopted. These systems minimise water losses through evaporation or runoff, reduce the energy required for water pumping, and decrease nutrient leaching and greenhouse gas emissions from soil. Through precision water application, irrigation supports sustainable resource management and environmental conservation.

2.2. Relationship between Installation/maintenance and Irrigation efficiency

The efficiency of any irrigation system largely depends on how well it is installed and maintained. Proper installation ensures that all components of the irrigation system such as pipes, emitters, filters, valves, and pumps, are correctly fitted, aligned, and calibrated to deliver water uniformly to the crops. When installation is done accurately, water is distributed at the right pressure and flow rate, minimising losses due to leakage, runoff, or uneven distribution. Conversely, poor installation can lead to blockages, pressure imbalances, and inefficient water delivery, thereby reducing system performance and crop productivity.

Maintenance plays an equally critical role in sustaining irrigation efficiency over time. Regular inspection, cleaning of filters and emitters, repair of leaks, and adjustment of system components help prevent water wastage and maintain uniform flow. In drip irrigation systems, for example, emitters can become clogged by sediment or algae, leading to uneven watering and reduced crop performance if not properly maintained. Routine maintenance also extends the lifespan of the system and ensures that energy and water resources are used optimally.

In summary, the relationship between installation, maintenance, and irrigation efficiency is direct and complementary. Proper installation establishes a solid foundation for effective operation, while regular maintenance helps maintain performance and reliability. These elements ensure that irrigation systems operate efficiently, minimise water wastage, increase crop yields, and contribute to sustainable and climate-smart agriculture.

2.3. Inventory for Installation of a Drip Irrigation System in Nigeria

An inventory for installing a drip irrigation system is a comprehensive list of all materials, tools, and equipment needed to successfully set up and operate the system. Preparing a proper inventory is crucial for ensuring smooth installation,

minimising delays, and promoting efficient water delivery to crops. In Nigeria, where factors such as water quality, power supply, and farm sizes vary significantly, the inventory must be tailored to local conditions and available resources.

The inventory can be categorised into four main groups: a) system components, b) water supply and filtration units, c) installation tools and accessories, and d) operational support materials.

A. System Components

These are the primary parts of the drip irrigation system responsible for conveying and distributing water. They include:

- **Mainline pipes:** Usually made of PVC or HDPE, used to convey water from the source to sub-main lines.
- **Sub-main pipes:** Distribute water from the mainline to laterals.
- **Laterals (drip lines):** Polyethylene tubes fitted with emitters (drippers) that deliver water directly to the root zone of plants.
- **Emitters (drippers):** Control the discharge rate of water, usually between 2–8 litres per hour.
- **Fittings and connectors:** These include tees, elbows, couplers, end caps, and grommets for connecting various components.
- **Valves:** These are used to control the flow of water in different sections of the system.

Image 2. Laterals pipes with emitters

Image 3. Valve

Source: Indiamart

B. Water Supply and Filtration Units

Efficient water delivery depends on a reliable source and proper filtration to prevent clogging:

- **Water source:** Borehole, well, surface tank, river, or reservoir.
- **Pump unit:** Electric, solar, or petrol-powered pump to ensure adequate water pressure.
- **Filtration system**: Essential for removing sediments and impurities. This includes:
    - Screen filters (for coarse particles)
    - Sand or gravel filters (for organic matter and algae)
    - Disc filters (for fine filtration)
- **Fertilizer injector (Venturi or tank type):** For fertigation i.e. applying fertilizers through the irrigation system.
- **Pressure gauges:** To monitor system pressure and performance.

C. Installation Tools and Accessories

These are the hand tools and support items needed for assembling and installing the system. They include:

- Hole punch or dripper insertion tool
- Pipe cutter or hacksaw
- Measuring tape
- Spanners, pliers, and screwdrivers
- PTFE (Teflon) tape for sealing threads
- Pegs or stakes for securing laterals
- Shovel and hoe for minor trenching or alignment
- Marker pens and labeling materials for layout identification

D. Operational and Support Materials

These materials aid in system management and ensure long-term functionality:

- Flow meters for monitoring water discharge
- Water testing kits (to check pH, salinity, and suspended solids)
- Repair kits for leak or emitter replacement
- Spare emitters and connectors

- Instruction manuals or layout maps for reference
- Safety gear (gloves, boots, and goggles) for the installation team

A well-prepared inventory ensures that all necessary materials and tools are available before installation begins, preventing delays and costly errors. In Nigeria, sourcing locally available components such as pipes, emitters, pumps, test kits etc. can reduce costs and simplify maintenance. Moreover, the choice of equipment should consider farm size, crop type, water availability, and energy sources. Proper inventory planning not only guarantees efficient installation but also contributes to the long-term sustainability and effectiveness of drip irrigation systems in achieving water-efficient, climate-smart agriculture.

2.4. Planning and Layout for Installation of a Drip Irrigation System in Nigeria

Planning and layout are the foundation of a successful drip irrigation system. They ensure that water is distributed efficiently, evenly, and economically to crops. In Nigeria where farms vary from smallholder plots to commercial plantations—careful design adapted to local soil, water, and crop conditions is crucial. A well-planned layout and accurate calculations determine not only system performance but also cost-effectiveness and sustainability.

A. Site Assessment and Planning

The planning process begins with assessing the site characteristics, including topography, soil type, crop pattern, water source, and climatic conditions. Flat or gently sloping lands are ideal for uniform water distribution, but for undulating terrain, pressure-compensating emitters or zoning may be required.

- **Soil:** Sandy soils require emitters placed closer together (e.g., 30–40 cm apart) with higher irrigation interval, while clay soils require wider spacing (e.g., 50–60 cm) with less frequent irrigation.

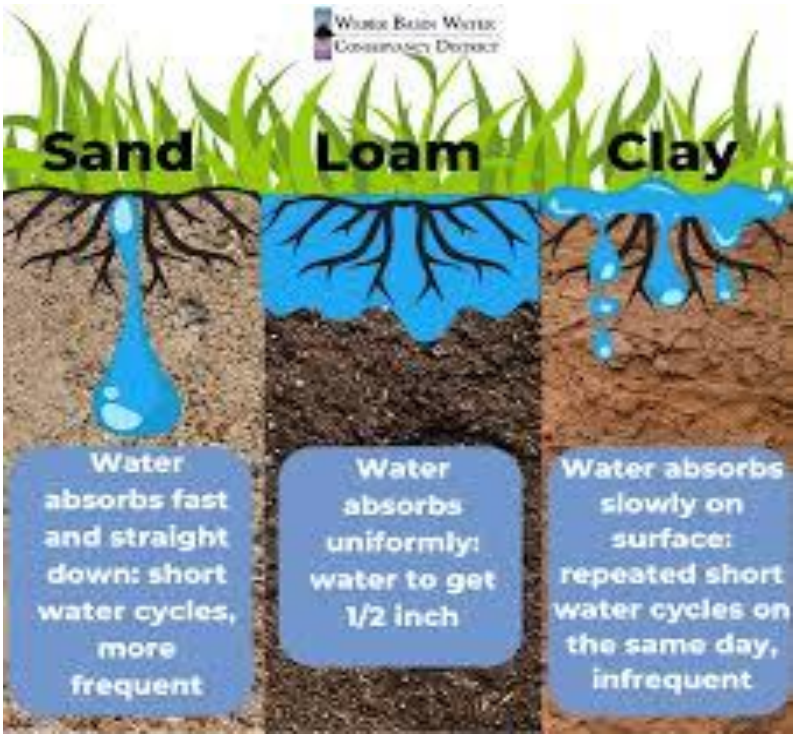

Image 4. Water movement in different soil types (weberbasinwater, 2025)

- **Water Source:** The type (borehole, river, or well), pressure, and quality must be verified, and filtration needs must be planned to prevent clogging.
- **Crop Water Requirement:** Each crop's evapotranspiration (ET) i.e. loss of water through evaporation and transpiration from plant stomata and growth stage determine the irrigation schedule and flow rate required.

B. System Design and Layout Components

A drip irrigation system layout typically includes:

- **Water Source and Pumping Unit** – provides the required water pressure and flow.
- **Filtration Unit** – removes sediments and organic materials.
- **Mainline** – carries water from the pump to the field.
- **Sub-main Lines** – distribute water to different plots or sections.
- **Laterals (Drip Lines)** – deliver water directly to plants through emitters.
- **Emitters/Drippers** – control the flow rate, typically 2–8 L/hr.
- **Valves and Fittings** – regulate and connect sections of the system.

C. Typical Layout Examples

Example 1: Vegetable Farm (e.g., Tomato or Pepper)

Field size: 1 hectare (100 m × 100 m)

Crop spacing: 1 m between rows, 0.5 m between plants

Emitter spacing: 0.5 m

Emitter discharge: 2 L/hr

Layout design:

100 lateral lines, each 100 m long, spaced 1 m apart.

Each lateral has 200 emitters (100 m ÷ 0.5 m = 200).

Total number of emitters = 100 × 200 = 20,000 emitters.

Total discharge = 20,000 × 2 L/hr = 40,000 L/hr (40 m³/hr).

If irrigation is done for 2 hours per day, total daily application = 80 m³/day (80,000 L/day).
To meet this, the pump should supply at least **40 m³/hr** at a pressure of **1–1.5 bar**.

Layout pattern:

Water source → pump → mainline (PVC 63–75 mm) → sub-mains (50 mm) → laterals (16–20 mm) laid along rows.

Example 2: Tree Crop (e.g., Citrus or Oil Palm)

Field size: 2 hectares

Tree spacing: 6 m × 6 m → 278 trees/ha

Emitters per tree: 4 emitters

Emitter discharge: 8 L/hr

Calculation:

Total emitters = 278 trees × 4 emitters × 2 ha = **2,224 emitters**.

Total discharge = 2,224 × 8 L/hr = 17,792 L/hr (≈17.8 m³/hr).
The system may operate for 3 hours daily, delivering approximately 53 m³/day.

Layout pattern:

Mainline runs along the farm's central access.

Sub-mains branch out per row of trees.

Four microtubes or drippers circle each tree to ensure uniform wetting.

D. Field Mapping and Installation Procedure

After design, the field should be surveyed and mapped to mark the positions of mainlines, sub-mains, and laterals. Use pegs and ropes to maintain alignment and spacing accuracy. Installation starts from the water source and proceeds sequentially to the filtration unit, mainline, sub-mains, and finally the laterals. Nipple installation

- Pressure testing is carried out before planting.
- Filters must be cleaned, and emitters checked for uniform discharge.
- Valves should be installed at strategic points for easy isolation and maintenance.

E. Calculations for Pressure and Flow Requirements

Pressure head (*H*): Must be sufficient to overcome friction losses in pipes and deliver water evenly to emitters.

$$H = Hp + Hf + Hr$$

Where:

H_p = pressure required at the emitters (usually 10–15 m)

H_f = friction losses in the pipes (depends on pipe diameter and flow)

H_r = height difference due to elevation (if applicable)

- **Flow rate (Q):**

$$Q = Ne + qe$$

Where:

N_e = number of emitters

q_e = flow per emitter (L/hr)

These calculations help determine the pump size, pipe diameter, and pressure regulator specifications.

F. Evaluation and Adjustment

After installation, the system is tested for uniform water distribution by measuring emitter discharge at different points using catch cans. Adjust the pressure if necessary and repair any leaks. Record water use, flow rate, and irrigation time regularly to maintain efficiency.

3. References/Sources

Adeyolanu, D. T., Okelola, O. E. (2024), Irrigation Water Management and Food Security in Nigeria. Research Journal of Agricultural Economics and Development 3(2), 117-132. DOI: 10.52589/AJAFS-PFPU1QN7

Garcia-Caparros, P., Contreras, J. I., Baeza, R., Segura, M. L., & Lao, M. T. (2017). Integral Management of Irrigation Water in Intensive Horticultural Systems of Almería. *Sustainability*, *9*(12), 2271. https://doi.org/10.3390/su9122271

Serrano, A., Cazcarro, I., Martín-Retortillo, M. and Rodríguez-López, G. (2024) Europe's orchard: The role of irrigation on the Spanish agricultural production. *Journal of Rural Studies*, Volume 110, 103376. https://doi.org/10.1016/j.jrurstud.2024.103376.

Vanella, D.; Consoli, S.; Continella, A.; Chinnici, G.; Milani, M.; Cirelli, G.L.; D'Amico, M.; Maesano, G.; Gentile, A.; La Spada, P.; et al. (2023) Environmental and Agro-Economic Sustainability of Olive Orchards Irrigated with Reclaimed Water under Deficit Irrigation. *Sustainability* 15, 15101. https://doi.org/10.3390/ su152015101

Wudil, A. H., Ali, A., Usman, M., Radulescu, M., Sass, R., Prus, P., & Musa, S. (2023). Effects of Inequality of Access to Irrigation and Water Productivity on Paddy Yield in Nigeria. Agronomy, 13(9), 2195. https://doi.org/10.3390/agronomy13092195

Dripworks (22 April, 2024) Cost-Benefit Analysis of Installing a Drip Irrigation System. Retrieved December 18, 2025, https://www.dripworks.com/blog/costbenefit-analysis-of-installing-a-drip-irrigation-system?srsltid=AfmBOorkf4RRHOYPb08bsGorV6VBEoUm01CY_K88P5H55Ld73oFDf2cp

Indiamart (n.d) Drip Irrigation System Lateral Pipe, Size: 1/2 inch. Retrieved December 3, 2025 from https://www.indiamart.com/proddetail/drip-irrigation-system-lateral-pipe-9656931833.html?srsltid=AfmBOorcn5Z_K9NQ75qUiQ-1HM-qH_-Y9IYuXlSNg5D3qbwSV530zFmr.

Weberbasinwater (2025) Different Soils Call for Different Water Schedules!. Access December 23, 2025, available at https://www.instagram.com/p/DJra-CjyP4p/

YouTube. (n.d.).Nipple installation Retrieved December 6, 2025, from https://www.youtube.com/shorts/btrNkwn1tjk

YouTube. (n.d.).Irrigation pipes maintenance. Retrieved December 6, 2025, from https://www.youtube.com/watch?v=R2iON4sJhM0

PART 2 - CURRICULUM

Learning Objectives:

KNOWLEDGE	SKILLS	ATTITUDES
Students should be able to: ● Explain the components of a drip irrigation system (mainline, sub-main, laterals, emitters, filters, valves, pumps, storage tanks). ● Understand water requirements of different crops and how drip irrigation meets these needs. ● Describe site preparation, water quality considerations, and layout design for drip systems. ● Identify common causes of emitter clogging, leakages, and system inefficiencies. ● State safety measures and environmental considerations in drip irrigation installation and maintenance.	*Students should be able to:* ● Select appropriate tools, pipes, and fittings for system assembly. ● Measure and mark field layouts for drip irrigation installation. ● Assemble and install mainlines, sub-mains, laterals, emitters, and filters correctly. ● Perform flushing, backwashing, and cleaning operations to maintain system efficiency. ● Detect and repair faults such as leaks, blockages, or broken emitters. ● Conduct system performance checks (flow rate, uniformity, pressure regulation). ● Document installation and maintenance activities.	*Students should be able to:* ● Demonstrate teamwork and cooperation during group installation exercises. ● Show responsibility in handling tools, equipment, and water resources. ● Develop a culture of preventive maintenance rather than reactive repairs. ● Cultivate environmental awareness by promoting water-use efficiency and sustainability.
Transversal Skills ● **Communication Skills** ○ Explaining ideas clearly during group work.		

- Interpreting technical instructions/manuals.
- Reporting installation/maintenance outcomes to supervisors or farmers.

- **Teamwork and Collaboration**
  - Working effectively in groups during system installation.
  - Sharing roles/responsibilities for pipe-laying, fixing emitters, and flushing systems.
- **Problem-Solving and Critical Thinking**
  - Diagnosing system faults (leakages, blockages).
  - Proposing cost-effective repair or maintenance solutions.
  - Adapting designs to site-specific conditions.
- **Numeracy and Measurement Skills**
  - Measuring field layouts accurately.
  - Calculating flow rates, pressure, and water distribution.
  - Estimating materials and costs.
- **Digital Literacy**
  - Using mobile applications for irrigation scheduling.
  - Basic data entry (logging maintenance records).
  - Interpreting digital manuals, CAD layouts, or videos.
- **Safety, Health and Environmental Awareness**
  - Applying occupational health and safety practices on site.
  - Managing water resources responsibly.
  - Promoting environmental sustainability through efficient water use.
- **Work Ethics and Professionalism**
  - Punctuality and reliability in project execution.
  - Accountability for tools, materials, and outcomes.
  - Respect for colleagues, farmers, and clients.

Digital Skills Associated with Drip Irrigation Installation and Maintenance Practices

- **Basic ICT Competence**
  - Using computers/smartphones for documentation of field activities.
  - Typing reports on maintenance activities using word processors.
  - Saving and organizing files (drawings, manuals, photos).
- **Digital Measurement and Mapping Tools**
  - Using mobile GPS apps to measure field size and layout.
  - Employing simple CAD or farm mapping software to design drip layouts.
  - Capturing and storing digital field maps for reference.
- **Data Collection and Analysis**

- Recording irrigation schedules, water flow data, and maintenance logs in spreadsheets.
- Using mobile data collection apps (e.g., Google Forms, KoboToolbox, ODK) for field inspections.
- Simple data visualization (charts/graphs) to monitor system performance.

- **Digital Communication and Collaboration**
  - Using WhatsApp/Telegram/email for team coordination, farmer advisory, and customer support.
  - Participating in online training, webinars, or drip irrigation forums.
  - Sharing troubleshooting videos/photos with supervisors or clients.
- **Mobile Applications for Irrigation**
  - Familiarity with apps for irrigation scheduling (based on soil moisture or crop needs).
  - Weather forecasting apps for planning irrigation intervals.
  - Mobile calculators for flow rate and pressure loss.
- **Digital Troubleshooting and Learning Resources**
  - Accessing YouTube or e-learning platforms for repair guides and demonstrations.
  - Downloading and interpreting digital manuals from manufacturers.
  - Using QR codes on drip kits for quick product information.
- **Entrepreneurship and E-Marketing Skills**
  - Using social media to advertise irrigation installation services.
  - Mobile money or online payment handling for service delivery.
  - Maintaining an online portfolio of completed drip irrigation projects.

Green Skills Associated with Drip Irrigation Installation and Maintenance Practices

- **Sustainable Water Management**
  - Applying drip systems to minimize water wastage.
  - Scheduling irrigation to match crop water needs and avoid over-irrigation.
  - Monitoring and preventing water losses from leaks.
- **Resource Efficiency**
  - Correct selection of pipes, filters, and emitters to reduce material wastage.
  - Using renewable energy (e.g., solar-powered pumps) where possible.
  - Promoting reuse of treated wastewater for irrigation.
- **Waste Reduction and Recycling**
  - Safe disposal or recycling of damaged pipes and plastic components.
  - Reusing fittings and connectors where technically feasible.
  - Promoting circular economy approaches in irrigation projects.
- **Soil and Ecosystem Protection**

- Preventing soil erosion and nutrient leaching through precise water delivery.
- Maintaining soil health by avoiding waterlogging.
- Encouraging biodiversity by reducing land degradation.

- **Energy Conservation**
  - Operating pumps efficiently to reduce fuel/electricity use.
  - Promoting low-pressure drip systems to save energy.
  - Exploring integration with renewable energy sources.
- **Climate Change Adaptation and Mitigation**
  - Using drip irrigation as a climate-smart technology to cope with irregular rainfall.
  - Reducing greenhouse gas emissions by lowering energy and fertilizer use.
  - Educating farmers on how efficient irrigation supports climate resilience.
- **Health, Safety and Environmental Awareness**
  - Promoting safe handling of water sources (avoiding contamination).
  - Reducing exposure to chemicals by applying water and fertilizers directly to roots (fertigation).
  - Encouraging safe workplace practices that protect workers and the environment.
- **Environmental Stewardship and Ethics**
  - Developing responsibility towards water conservation.
  - Instilling a culture of sustainable farming practices.
  - Advocating drip irrigation as a tool for food security and environmental care.

Implementation plan of pedagogical activities (Scheme of work / Session plan)

Duration: 3 hours 15 minutes

Description of participants:

Secondary school leavers, diploma trainees, or vocational learners with basic literacy and numeracy skills between the ages of 18-30 years old who require hands-on competency-based training on practical installation, troubleshooting, and maintenance of drip irrigation systems.

No of Activity	Timing	Training Methods/Activity	What do trainers do	What do participants do
1.	50 min	Orientation, Safety Briefing & Identification of Irrigation Components	● Present overview of drip systems	● Students participate actively

			• Demonstrate safe handling of tools/materials • Demonstrate each component • Explain function and selection criteria	and ask questions
2.	35 min	Demonstration on Field Layout Design & Measurement	• ·Guide students in measuring plots • Marking pipe routes	• Students participate actively and ask questions
3.	55 min	Installation of drip facility (Mainline, Sub-mains, Laterals, Emitters, Filter and Valve Assembly)	• Demonstrate cutting, joining, and laying of pipes • Demonstrate assembling filters and valves • Explain flushing system	• Students participate actively and ask questions
4.	20 min	System Testing and Performance Check (flow rate, pressure, uniformity)	• Demonstrate water flow tests • ·Guide on reading results	• Students participate actively and ask questions
5.	50 min	Maintenance Practices (flushing, backwashing, clogging prevention, leak detection), Troubleshooting & Fault Repair Simulation.	• Demonstrate flushing/backwashing techniques • Show repair of leaks • Present common faults (leakage, clogging,	• Students participate actively and ask questions

			breakages) and repair steps	

Materials (What trainers need to have prepared):

- Teaching and Learning Aids
  - Training manual/handouts with diagrams of drip irrigation components.
  - Multimedia resources (PowerPoint slides, videos, posters).
  - Whiteboard/flip chart and markers for sketches.
  - Sample layout drawings / maps of drip irrigation systems.
  - Safety guidelines and checklists.
- Tools and Equipment
  - Pipe cutters or hacksaws.
  - Punch tools for emitter insertion.
  - Pliers, wrenches, screwdrivers.
  - Measuring tapes, rulers, pegs, and string lines for layout marking.
  - Pressure gauges and flow meters.
  - Buckets, jerry cans, and water storage tanks.
  - Personal Protective Equipment (PPE): gloves, safety boots, goggles, helmets.
- Drip Irrigation Components (for practical exercises)
  - Mainline pipes (PVC/HDPE).
  - Sub-main pipes.
  - Lateral pipes (LDPE).
  - Emitters (inline or online types).
  - Connectors, couplers, tees, elbows, end caps, grommets.
  - Control valves (gate/ball valves).
  - Filters (screen filters, sand filters, or disc filters).
  - Pumps (electric or diesel; optional solar pump for green skill integration).
  - Fertilizer tank/venturi injector for fertigation demonstration.
- Maintenance and Repair Materials
  - Sealants and Teflon tape.
  - Spare emitters and fittings.
  - Small repair clamps or sleeves.
  - Cleaning brushes and filter backwash kits.
- Field Setup and Support Materials
  - Demonstration plot (farm/garden site for installation).
  - Water source (tank, borehole, or reservoir).
  - Soil moisture meters (optional, for digital/green skills).
  - GPS device or mobile app (for digital field mapping).
  - First aid kit (for safety training).

PART 3 – ACTIVITY GUIDE

DESCRIPTION OF ACTIVITIES

1. Orientation, Safety Briefing & Identification of Irrigation Components

The purpose of the activity "**Orientation, Safety Briefing & Identification of Irrigation Components**" is to provide learners with a strong foundation before engaging in practical installation and maintenance of drip irrigation systems. This activity ensures that learners clearly understand the training objectives, expectations, and relevance of drip irrigation to efficient water management, improved crop productivity, and climate-smart agriculture. By beginning with an orientation session, learners are guided on how the course is structured and how the skills acquired can be applied in real farm and workplace settings.

The safety briefing component is designed to promote safe working habits by familiarizing learners with potential hazards associated with irrigation installation, such as handling tools, pressurized water systems, and field operations. It emphasizes the correct use of personal protective equipment (PPE) and helps learners develop a responsible attitude toward occupational health and safety.

The identification of irrigation components enables learners to recognize and understand the function of each part of a drip irrigation system, including pipes, filters, valves, and emitters. This knowledge reduces errors during installation, improves system efficiency, and supports effective maintenance and troubleshooting. Overall, the activity builds learner confidence, promotes teamwork, and prepares participants for hands-on tasks by combining safety awareness with essential technical knowledge.

1. Aim of the activity: To introduce safety practices and enable correct identification and understanding of key drip irrigation components

2. Duration: 50 min

3.Step-by-step instruction of the task/practical exercise/case study:

- **Orientation Session:** The facilitator welcomes learners, explains the objectives of the training, and outlines the importance of drip irrigation in water efficiency, crop productivity, and climate-smart agriculture. The structure of the course and expected learning outcomes are briefly discussed.
- **Safety Briefing:** Learners are introduced to basic workshop and field safety rules. The facilitator explains common risks associated with irrigation work, such as sharp tools, pressurized water, and exposure to dirt or chemicals. Proper use of

PPE is demonstrated, and learners are instructed on safe handling, lifting, and storage of irrigation materials.

- ➢ **Introduction to Drip Irrigation Systems:** Using charts or diagrams, the facilitator explains how a drip irrigation system works, highlighting water flow from the source through filters, pipes, and emitters to the crop root zone.
- ➢ **Identification of Irrigation Components:** Learners observe real irrigation components laid out on a table or floor. Each component is introduced one at a time, with its name, function, and position in the system explained. Learners are encouraged to handle components carefully and read labels.
- ➢ ·**Component Grouping and Labelling:** Learners work individually or in small groups to match components with their correct names and functions using labels or tags. The facilitator corrects misconceptions and reinforces learning through discussion.
- ➢ **Review and Reflection:** The session concludes with a brief question-and-answer discussion to assess understanding. Learners summarize key safety rules and identify at least five drip irrigation components and their functions.

References/Sources/Further materials:

Basic Irrigation Manual
Manufacturer Catalogues

2. Demonstration on Field Layout Design & Measurement

This activity is designed to equip learners with practical knowledge and skills required to plan and measure farm fields accurately for drip irrigation installation. Learners will understand the importance of proper field layout in ensuring uniform water distribution, efficient use of materials, and long-term system performance. The activity enables learners to interpret basic field dimensions, crop spacing, and plot orientation in relation to water sources and land slope.

Through guided demonstration, learners will learn how to take accurate field measurements using simple tools such as measuring tapes, ropes, and pegs. They will be able to mark out mainlines, sub-mains, and lateral positions according to crop layout and irrigation design principles. The activity also aims to improve learners' ability to minimize errors during installation by correctly aligning irrigation components and avoiding unnecessary pipe overlaps or sharp bends.

In addition, learners will develop teamwork, communication, and problem-solving skills by working collaboratively during layout exercises. Emphasis is placed on safety, precision, and good workmanship. By the end of the activity, learners are expected to

confidently prepare a field layout that supports efficient drip irrigation installation, reduces water losses, lowers maintenance challenges, and enhances crop productivity under different farm conditions.

1. Aim of the activity: To develop learners' skills in accurate field layout design and measurement for drip irrigation.

2. Duration: 35 min

3. Step-by-step instruction of the task/practical exercise/case study:

- ➢ **Introduction and Explanation:** The facilitator explains the purpose of field layout design and its role in effective drip irrigation installation, highlighting accuracy and efficiency.
- ➢ **Site Observation and Assessment:** Learners observe the field to identify boundaries, slope direction, water source location, and obstacles such as trees or pathways.
- ➢ **Selection of Measurement Tools:** Measuring tapes, ropes, pegs, and markers are introduced, and their correct use is demonstrated.
- ➢ **Taking Field Measurements:** The facilitator demonstrates how to measure field length and width accurately, while learners observe and record measurements.
- ➢ **Marking Field Boundaries:** Learners place pegs at corners and along boundaries, using ropes or lines to ensure straight alignment.
- ➢ **Designing the Layout:** Mainline, sub-main, and lateral positions are marked based on crop spacing, field shape, and water flow direction.
- ➢ **Learner Practice:** Learners repeat the measurement and marking process in small groups under supervision.
- ➢ **Review and Feedback:** The facilitator reviews the layout with learners, corrects mistakes, and discusses improvements.

References/Sources/Further materials

3. Installation of Drip Facility (Mainline, Sub-mains, Laterals, Emitters, Filter and Valve Assembly)

The objectives of this activity are to develop learners' hands-on competence in the installation of a functional drip irrigation system. Learners will understand the correct sequence for assembling system components, starting from the water source through filtration, control, and distribution lines to the emitters. The activity aims to strengthen learners' ability to correctly install mainlines, sub-mains, laterals, emitters, filters, and valves according to design specifications and field layout plans.

Learners will gain practical experience in cutting, joining, and fixing pipes and fittings while ensuring proper alignment and secure connections to prevent leakages and pressure losses. Emphasis is placed on the importance of filtration and valve placement for protecting emitters and enabling efficient system control. The activity also promotes correct spacing of laterals and emitters based on crop requirements and field conditions.

In addition, learners will develop good workmanship, safety consciousness, and teamwork during installation tasks. They will learn to identify common installation errors and apply corrective measures. By the end of the activity, learners are expected to install a drip irrigation facility that operates efficiently, delivers water uniformly, is easy to maintain, and supports sustainable water use in agricultural production systems.

1. Aim of the activity: To equip learners with practical skills for installing complete drip irrigation systems.

2. Duration: 55 min

3. Step-by-step instruction of the task/practical exercise/case study:

- **Preparation and Safety Check:** Learners wear appropriate PPE and review the installation plan, field layout, and safety guidelines.
- **Installation of Filter and Valve Assembly:** The facilitator demonstrates how to install the filter near the water source, followed by control valves, ensuring correct flow direction.
- **Laying the Mainline:** The mainline pipe is laid along the marked route, cut to required lengths, joined with fittings, and secured properly.
- **Installation of Sub-mains:** Sub-mains are connected to the mainline using tees or connectors and aligned according to the layout design.
- **Laying Laterals:** Laterals are laid across crop rows, fixed at correct spacing, and secured to prevent movement.
- **Installing Emitters:** Emitters are fixed on laterals at specified intervals, ensuring firm attachment and correct orientation.
- **End Caps and Flushing:** End caps are installed, and the system is flushed to remove dirt before final closure.
- **System Testing and Adjustment:** Water is released gradually to check for leaks, pressure balance, and uniform emitter discharge.
- **Review and Reflection:** The facilitator inspects the installation with learners and discusses improvements and maintenance tips.

References/Sources/Further materials:

Short videos on Installation Demonstrations

- *YouTube*. (n.d.). Short Drip Irrigation Install Guide (playlist). Retrieved December 16, 2025, from https://www.youtube.com/playlist?list=PLJJkltXqDNreLxhqRafqnrZczJKdf7-gt&utm

- *YouTube*. (n.d.). Drip Irrigation Installation Practical Demo. Retrieved December 16, 2025, from https://www.youtube.com/watch?v=yR-t7Kks0EM&utm

- *YouTube*. (n.d.). Complete Drip Irrigation Guide (longer demo). Retrieved December 16, 2025, from https://www.youtube.com/watch?v=ZbHLLHFXWyw&utm

4. System Testing and Performance Check (flow rate, pressure, uniformity)

The objectives of this activity are to enable learners to evaluate the operational performance of installed drip irrigation systems. Learners will understand the importance of system testing in ensuring efficient water delivery, preventing crop stress, and reducing water losses. The activity focuses on building practical skills for measuring flow rate, checking operating pressure, and assessing water distribution uniformity across the field.

Learners will be trained to use simple field tools such as measuring containers, stopwatches, pressure gauges, and observation methods to collect accurate performance data. They will learn how to compare measured values with design specifications and manufacturer recommendations. The activity also aims to develop learners' ability to identify common system problems, including leakages, blockages, pressure imbalances, and uneven emitter discharge.

In addition, learners will gain skills in making basic adjustments, such as valve regulation, flushing lines, or replacing faulty emitters, to improve system performance. Emphasis is placed on safety, accuracy, and record keeping during testing procedures. By the end of the activity, learners are expected to confidently test a drip irrigation system, interpret results, and recommend corrective actions that enhance system efficiency, reliability, and long-term sustainability.

1. Aim of the activity: To assess and optimize drip irrigation system performance through systematic testing procedures.

2. Duration: 35 min

3. Step-by-step instruction of the task/practical exercise/case study:

- **Preparation and Safety Check:** Learners wear PPE and ensure the system is properly installed and flushed before testing begins.
- **System Start-Up:** Water is gradually released into the system, allowing pressure to stabilize before measurements are taken.
- **Pressure Measurement:** Pressure gauges are checked at the filter, mainline, and selected laterals to confirm operating pressure levels.
- **Flow Rate Measurement:** Learners collect water from selected emitters into measuring containers over a timed period to calculate flow rates.
- **Uniformity Check:** Flow measurements from different points in the field are compared to assess uniform water distribution.
- **Identification of Problems:** Learners inspect the system for leaks, blocked emitters, or pressure drops and note observations.
- **Adjustment and Correction:** Valves are adjusted, lines flushed, or faulty components replaced to improve performance.
- **Re-testing and Confirmation:** Measurements are repeated to confirm improvements after adjustments.
- **Documentation and Review:** Results are recorded, discussed, and reviewed with the facilitator to reinforce learning.

References/Sources/Further materials:

Short videos on pressure & flow measurement

- *YouTube*. (n.d.).How to Measure Water Pressure & Flow. Retrieved December 17, 2025, from https://www.youtube.com/watch?v=EMs-atBcszU&utm
- *YouTube*. (n.d.).How to Check the Flow Rate of your Water. Retrieved December 17, 2025, from https://www.youtube.com/watch?v=tGxJaqQeg94
- *YouTube*. (n.d.).Flow Rate for Irrigation (DIY) (step-by-step flow test). Retrieved December 18, 2025, from https://www.youtube.com/watch?v=cBmAlOTGZtU&utm
- *YouTube*. (n.d.).Flow Rate for Irrigation (DIY) (step-by-step flow test). Retrieved December 18, 2025, from https://www.youtube.com/watch?v=NvLJ2VPZUxg&utm

5. Maintenance Practices (flushing, backwashing, clogging prevention, leak detection), Troubleshooting & Fault Repair Simulation

The main purpose of this activity is to equip learners with essential skills for routine maintenance and effective troubleshooting of drip irrigation systems. Learners will understand the importance of regular maintenance practices in preventing system failure, improving water use efficiency, and extending the lifespan of irrigation components. The activity focuses on practical maintenance tasks such as flushing laterals and sub-mains, backwashing filters, preventing emitter clogging, and detecting leaks.

Learners will gain knowledge of common causes of system faults, including sediment buildup, biological growth, pressure imbalance, and physical damage to pipes and fittings. Through guided simulations, learners will learn how to identify symptoms of poor system performance, such as reduced flow, uneven wetting patterns, or visible leaks. The activity also aims to strengthen learners' problem-solving skills by enabling them to diagnose faults and select appropriate corrective actions.

Emphasis is placed on safe working practices, correct use of tools, and proper handling of irrigation components during maintenance and repair. Learners will also develop skills in record keeping and maintenance scheduling. By the end of the activity, learners are expected to confidently perform routine maintenance, troubleshoot common problems, and carry out basic repairs to restore efficient system operation.

1. Aim of the activity: To develop practical skills for maintaining, troubleshooting, and repairing drip irrigation systems.

2. Duration: 50 min

3. Step-by-step instruction of the task/practical exercise/case study:

- **Orientation and Safety Briefing:** The facilitator explains the importance of maintenance and reviews safety precautions before starting work.
- **System Inspection:** Learners visually inspect the system to identify signs of leaks, blockages, or damaged components.
- **Flushing of Lines:** End caps are opened, and water is allowed to flow to remove sediments from mainlines, sub-mains, and laterals.
- **Filter Backwashing:** Learners observe and practice proper backwashing of filters to remove trapped debris.
- **Clogging Prevention Practices:** The facilitator demonstrates correct filtration checks and basic preventive measures to reduce emitter blockage.
- **Leak Detection:** Learners check joints, fittings, and pipelines for leaks and pressure drops.

- ➢ **Troubleshooting Simulation:** Common faults are intentionally introduced, and learners diagnose the problems using observed symptoms.
- ➢ **Fault Repair and Correction:** Learners repair leaks, clean or replace blocked emitters, and adjust valves as needed.
- ➢ **System Restart and Verification:** The system is restarted to confirm faults have been corrected.
- ➢ **Review and Reflection:** Learners discuss lessons learned and maintenance schedules with the facilitator.

References/Sources/Further materials:

None required.