Ministry of Agriculture

## Smallholder Agribusiness and Resilience Project

# Training Module for Operation and Maintanance of Minor Irrigation Systems

# Training Module for Operation and Maintenance of Minor Irrigation Systems

**Smallholder Agribusiness and Resilience Project (SARP)**

## Module 01

### Training objectives

At the end of this training session, trainees,

1) Being able to explain methods of irrigation water supply in minor irrigation schemes
2) Being able to define crop water requirements and five major importance of water to crop.
3) Being able to name four major climate factors that affect the crop water requirements
4) Able to estimate monthly crop water requirements based on evaporation pan data and the growth stages for paddy crops.
5) Able to define the field water requirement and irrigation water requirement.
6) Being able to mention 3 advantages of the rotational water distribution in minor irrigation schemes.
7) Being able to name three benefits that can be achieved by measuring water in the irrigation canal.
8) Being able to describe the activities in Alternative Wetting and Drying (AWD) methods for paddy cultivation.

## Module 02

### Training objectives

At the end of this training, the trainees

1) Being able to define what maintenance is.
2) To be able to specify 4 main maintenance types.
3) To be able to mention 5 advantages that can be achieved due to systematic maintenance.
4) To be able to specify 5 main benefits for minor irrigation maintenance.
5) Be able to specify 3 key information to be collected while preparing a list of Components.
6) To be able to specify 3 main methods by which irrigation maintenance can be carried out.
7) To be able to specify 5 key information to be collected while preparing a maintenance plan.

# Module 01

## Irrigation & Water Management for Minor Irrigation

# Content - Module 01

- **Lesson 1** - Crop water requirement for Paddy and Other Field Crops
- **Lesson 2** - Irrigation Efficiency and Irrigation water Requirement for Paddy & other field Cropsඛ
- **Lesson 3** – Rotational Water distribution in Minor Irrigation system
- **Lesson 4-** Alternative Wetting and Drying (AWD) Method for Water Supply
- **Lesson 5** – Field Practice on Water measuring equipment and AWD method

## Lesson 1 - Crop water requirement for Paddy and Other Field Crops

**01 Hour**

| Subject Matter and Training Instruction Notes | Training Methodology | Training Materials | Duration in Minutes |
|---|---|---|---|
| **1.1.Introduction**<br><br>Discuss and explain what happens to the water, we receive mainly from rainfall.<br><br>Water from rainfall enters the environment and undergoes a journey through various stages of the **hydrological cycle**,<br><br>which is the continuous movement of water on, above, and below the Earth's surface. Here's a breakdown of what happens to this water:<br><br>**1. Infiltration:**<br>• **Soaking into the ground**: Some of the rainfall soaks into the soil, a process called **infiltration**. Water that infiltrates the soil can be absorbed by plant roots or continue to percolate deeper to replenish underground water supplies, forming **groundwater**.<br>**2. Surface runoff:**<br>• **Flow over the land**: Not all water infiltrates the soil. Some flow over the surface as **runoff**, traveling into streams, rivers, lakes, and ultimately oceans. The amount of runoff depends | Power Point Presentations, Lectures, Discussions, Question & Answer | Multimedia Projector, White board, Flip charts | 15 |

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| on factors such as soil saturation, land cover, and topography.<br>**3. Evaporation:**<br>• **Back to the atmosphere**: Water on the surface (in rivers, lakes, and oceans) evaporates due to heat from the sun. This process converts liquid water into water vapor, which rises into the atmosphere.<br>**4. Transpiration:**<br>• **Released by plants**: Plants absorb water through their roots, and a portion of this water is later released into the atmosphere as water vapor through a process called **transpiration**.<br>• Together, evaporation and transpiration form **evapotranspiration**.<br>**5. Condensation:**<br>• **Forming clouds**: As water vapor rises, it cools and condenses into tiny droplets, forming clouds. This process is known as **condensation**.<br>**6. Precipitation:**<br>• **Rainfall returns**: When the clouds accumulate enough moisture, the water droplets combine and fall back to the Earth's surface as **precipitation** (rain, snow, sleet, or hail), restarting the water cycle. | | | |

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| Some of this water may be stored temporarily in glaciers, snowpacks, or man-made reservoirs, while some will be absorbed and cycled back through ecosystems and much of it will eventually flow back to the oceans, continuing the natural process | | | |
| **1.2. Discuss the benefits of water to the plant.**<br>a. **Photosynthesis**: Production of food by photosynthesis<br>b. **Water absorption**: Roots of the plant absorb water and minerals from the soil.<br>c. **Transport**: The water moves upward through the plant via the xylem, which are specialized tubes for water transport.<br>d. Transport the food to places where it is needed.<br>e. **Transpiration**: Water is released into the atmosphere as water vapor through tiny openings in the leaves called **stomata**. This process is part of a broader mechanism called **evapotranspiration**, which includes both water evaporation from soil and water loss from plants. | Power Point Presentations, Lectures, Discussions, Question & Answer | Multimedia Projector, White board, Flip charts | 20 |

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| f. Transpiration helps plants cool down and also creates a negative pressure in the leaves that pulls water upward from the roots. This is essential for the movement of nutrients and water throughout the plant.<br>g. Maintaining plant viability.<br>h. Regulating the temperature of the plant. | | | |
| **1.3.** Over 99% of the water absorbed by a plant is lost through transpiration, and only a tiny fraction is used for metabolic processes like photosynthesis, growth, and nutrient transport. | | | 05 |
| **1.4.** The **crop water requirement (CWR)** refers to the amount of water a specific crop needs for optimal growth, productivity, and full development in a given environment. It accounts for the total water lost through evapotranspiration (ET), which includes both evaporation from the soil surface and transpiration from the crop during its growing period. | PowerPoint Presentations, Lectures, Discussions, Question & Answer | Multimedia Projector, White board, Flip charts | 5<br><br>15 |

**1.5. Factors affecting crop water requirement**

Key factors influencing crop water requirement include:

- Climate conditions
  (temperature, humidity, wind speed, and solar radiation)
- Crop type
  (different crops have different water needs)
- Soil characteristics
  (soil texture and structure affect water retention)
- Growth stage of the crop
  (water needs vary at different stages, with higher demand during peak growth phases)

By meeting the crop water requirement, farmers can ensure maximum yield and avoid water stress that could lead to reduced productivity.

Methods for calculating the **crop water requirement (CWR)**:

I. **Modified Penman Method**

II. **Pan Evaporation Method**

In this method, **evapotranspiration** is estimated using the measurements from an **evaporation pan** (a large open pan of water). The water loss from the pan is used as a proxy

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| for evaporation from the surrounding landscape. A **pan coefficient** adjusts the evaporation rate to account for differences between the pan and the actual crop/soil surface.<br><br>Steps to Calculate Evapotranspiration (ET) Using the Pan Evaporation Method<br><br>Step 1: **Place the Pan in the Field**<br><br>Step 2: **Fill the Pan with Water**<br><br>Step 3: **Measure Daily Water Loss**<br><br>Step 4: **Adjust for Rainfall**<br><br>Step 5: **Calculate Reference Evapotranspiration ($ET_0$)**<br><br>Formula:<br><br>**$ET_0 = Ep \times Kp$**<br><br>Where:<br><br>• **$ET_0$** =Evapotranspiration (mm/day)for Reference crop<br>• **$E_p$** = Pan evaporation (mm/day)<br>• **$K_p$** = Pan coefficient (usually between 0.5 and 0.8)<br><br>Step 6: **Calculate Evapotranspiration for Crop(ETc)**<br><br>**$ETc = ET_0 \times Kc$** | | | |

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| • **ETc** =Evapotranspiration (mm/day) for crop<br>• **Kc** = Crop Factor<br><br>The amount of water lost through **evapotranspiration** from a healthy, well-fertilized crop that is growing in optimal conditions is referred to as the **crop water requirement (CWR)**. This term represents the total water necessary for a crop to grow optimally under specific climatic conditions and reach its full production potential. | | | |

## Lesson 2 - Irrigation Efficiency and Irrigation water Requirement for Paddy & other field Crops

**45 minutes**

| Subject Matter and Training Instruction Notes | Training Methodology | Training Materials | Duration in Minutes |
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| **2.1. Field water requirement (FWR)**<br>Define the amount of water to be supplied to the field to meet the crop water requirement is field water requirement.<br><br>The field water requirement **(FWR)** refers to the total amount of water that must be supplied to a field to meet the crop water requirement (CWR) or crop evapotranspiration (ETc). However, when water is diverted from its source (such as a Tank, Anicut or reservoir) and applied to the field, various types of losses occur. These losses mean that more water must be supplied than the actual crop needs.<br><br>**2.2. Irrigation water requirement (IWR)**<br>In irrigation systems, water losses through **seepage**, **percolation**, and **evaporation** are common, even in canals designed to minimize these losses.<br><br>**Key Water Losses in Canals:**<br>1. **Seepage**: Water escapes from the canal through cracks or porous soil underneath the canal lining. This is a significant loss in unlined or poorly maintained canals.<br>2. **Percolation**: Similar to seepage, but refers more to the movement of water through the | Power Point Presentations, , hand-outs, white board | Multimedia Projector, White board, Flip charts | 15<br><br>15 |

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| soil into deeper layers, beyond the reach of crops, eventually joining the groundwater.<br>3. **Evaporation**: Water is lost as vapor from the surface of the canal due to sunlight and wind, especially in hot and dry climates.<br><br>**Even in Concrete-Lined Canals:**<br>• **Concrete-lined canals** are designed to reduce seepage, but over time, wear and tear, cracks, and other damage can still cause water loss. This means that even in a well-maintained canal system, some inefficiency is inevitable.<br><br>**2.3.Efficiency of Small Irrigation Systems:**<br>• Small irrigation systems (especially in dry zones) are generally less efficient because they are often unlined or poorly maintained, which leads to higher water losses. (40% Losses &80% efficiency) small irrigation systems could potentially be much more efficient if improvements are made<br><br>**Increasing efficiency** could involve:<br>o Lining canals with more durable materials (such as better concrete or plastic).<br>o Repairing and maintaining damaged parts of the canal.<br>o Using more precise water delivery methods (like drip irrigation or sprinklers) to reduce application losses | | | 15 |

## Lesson 3 – Rotational Water distribution in Minor Irrigation system

**01 Hour**

| Subject Matter and Training Instruction Notes | Training Methodology | Training Materials | Duration in Minutes |
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| **3.1. Water Distribution methods in the irrigation system**<br>• **Continuous irrigation** provides a constant water flow but can lead to wastage and waterlogging.<br>• **Rotational irrigation** ensures equitable water distribution among fields but requires scheduling and management.<br>• **Intermittent irrigation** supplies water at intervals, helping to reduce water loss and control soil moisture.<br>• **Demand methods** allow for flexible water supply based on the crop's needs, optimizing water usage but requiring strong infrastructure and management.<br>Each method has its own advantages and disadvantages, and the choice of irrigation scheduling often depends on the crop type, water availability, and local conditions<br><br>Explain more about the Rotational water distribution method<br><br>**Rotational Irrigation:**<br>• In rotational irrigation, water is supplied to different fields or sections of a farm on a | Power Point Presentations, , hand-outs, white board | Multimedia Projector, White board, Flip charts | 20 |

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| rotation basis, meaning that each field receives water in turns at scheduled intervals.<br>• **How it works**: Water is distributed among multiple farmers or fields, with each getting a fixed amount of water for a specific period. After the allotted time, water is diverted to the next field.<br><br>• **Advantages**:<br>o Ensures fair distribution of water among all users or fields.<br>o Reduces the risk of waterlogging.<br>o Helps manage limited water resources more efficiently.<br><br>**3.2.Explain the required steps to prepare a Rotational water distribution with an example**<br>• Command Area Plan<br>• Issue Tree<br>• Farmer Groups for water distribution.<br>• Numbering method for Groups<br>• The extent of land belonging to each group<br>• Allotted time for water distribution (hour)<br>• Water receiving time per week for each group<br>• Flow measurement in irrigation canal (cubic feet per second /cubic meter per second)<br><br>**3.2.Flow measurement**<br><br>Explain that the standard methods can be used in minor irrigation schemes to measure water in canal systems. Water measurement is crucial in irrigation management, as it helps ensure that crops receive the | Power Point Presentations, , hand-outs, white board | Multimedia Projector, White board, Flip charts | 15 |

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| right amount of water for optimal growth. Various methods and instruments can accurately measure water flow and depth in irrigation systems. Here's an explanation of some standard methods and instruments used for measuring water:<br>• BRC Flume<br>• Partial flume<br>• Cutthroat Flume<br>• Wier Box etc.<br>These measurement methods and instruments are vital for effective water management in irrigation systems. They allow farmers and water managers to monitor water levels and flow rates, facilitating efficient water use and helping to optimize irrigation practices. By selecting the appropriate measurement method based on the specific needs and conditions of the irrigation system, users can achieve accurate and reliable water measurements, ultimately contributing to better crop production and sustainable water resource management. | | | 10 |

## Lesson 4- Alternative Wetting and Drying (AWD) Method for Water Supply

**45 minutes**

| Subject Matter and Training Instruction Notes | Training Methodology | Training Materials | Duration in Minutes |
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| **4.1. Introduction**<br>**Alternative Wetting and Drying (AWD)** is a water management technique primarily used in rice cultivation that optimizes irrigation practices by alternating between wet and dry soil conditions. This method is designed to reduce water usage while maintaining or even improving crop yield.<br><br>**4.2.Advantages of AWD**<br>• **Water Savings**:<br>o AWD can significantly reduce water use compared to continuous flooding by up to 30-50%, depending on climatic conditions and soil type.<br>o The practice allows for more efficient use of available water resources, which is crucial in water-scarce regions.<br><br>• **Improved Soil Aeration**:<br>o By allowing the soil to dry, AWD enhances soil aeration, promoting healthy root growth and reducing the risk of root diseases associated with waterlogged conditions. | Video, Power Point Presentations, , hand-outs, white board | Multimedia Projector, White board, Flip charts, PVC pipe (30–40 cm in length and 10–15 cm in diameter) | 10<br><br>35 |

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| • **Increased Crop Yield and Quality**:<br>  o Studies have shown that rice yields under AWD can be comparable to or even exceed those under continuous flooding, particularly when combined with proper nutrient management.<br>  o AWD can improve the quality of rice grains due to better root development and nutrient uptake.<br><br>• **Reduced Greenhouse Gas Emissions**:<br>  o Continuous flooding of rice paddies contributes to methane emissions, a potent greenhouse gas. By alternating wet and dry periods, AWD can help mitigate these emissions.<br><br>• **Increased Pest and Disease Management**:<br>  o Fluctuating water levels can disrupt the life cycles of certain pests and diseases, potentially leading to a reduction in their populations. | | | |

## Lesson 5 – Field Practice on Water measuring equipment and AWD method

**2 Hours**

| Subject Matter and Training Instruction Notes | Training Methodology | Training Materials | Duration in Minutes |
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| **5.1. Approach to practice**<br>Canal water measurement is crucial for irrigation water management to ensure the optimal distribution of water to fields, promote water conservation, and maintain agricultural productivity.<br>Explain why canal water measurement is necessary for irrigation.<br>Ask questions and explain it with comments.<br><br>**5.2. Tools & Equipment for water measurement**<br>Discuss the Tools used in Ancient Times and Standard Methods used today for Measuring Water in irrigation,<br>Introduce available Tools & Equipment at the site and explain the operation process.<br>• BRC Flume<br>• Current meter<br>• Canal depth gauge<br>• Sprit level<br><br>**5.3. Conducting canal water measurements using a BRC Flume or Current meter.**<br>Explain the Steps for Conducting Canal Water Measurement Using a BRC Flume<br>**Installation of the BRC Flume**<br>**Selection of Location**: | | | 10<br><br>10<br><br>40 |

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| • Choose a straight section of the canal, ideally where flow is uniform and steady. Avoid sections with turbulence, sharp bends, or obstructions that could affect flow patterns.<br>• Ensure that the canal bottom is stable and free from sediment buildup to avoid altering the flow characteristics.<br><br>**Setting Up the Flume**:<br>• Place the flume so that water flows smoothly over its broad crest. The flume should be installed perpendicular to the direction of the water flow.<br>• Ensure the base of the flume is level, and any supports or sidewalls are sealed to prevent water leakage.<br>• For accurate measurements, ensure that the flow upstream of the flume is not submerged (free flow condition).<br><br>**Positioning of Gauges**:<br>• Place water level gauges upstream of the flume. The ideal location for these gauges is between 1 to 3 times the width of the canal upstream from the crest of the flume.<br>• Make sure the gauge is installed in a section where water flow is calm and uniform to avoid incorrect readings.<br><br>**Taking Multiple Readings**<br><br>• To ensure accuracy, take multiple readings of the upstream water depth at regular intervals. | | | |

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| • Average the readings to minimize the impact of any temporary flow fluctuations or measurement errors.<br><br>Instruct trainees to measure the water discharge by changing the height of the water, by opening a Sluice at the tank.<br><br>**5.4. Practical - Alternative Wetting and Drying (AWD) method**<br>Start the Practical session with Remembering Lesion 4<br>The Alternative Wetting and Drying (AWD) method is an irrigation practice primarily used in rice cultivation to save water while maintaining crop yield.<br>Materials Needed:<br>• PVC pipe (about 30–40 cm in length and 10–15 cm in diameter)<br>• Hand drill or sharp tool to make holes<br>• Marker or tape to label the pipe (optional)<br>• Measuring tape for depth measurements<br>• Rubber mallet or tool to insert the pipe into the soil<br><br>**Explain Step-by-Step Preparation:**<br>Cut the PVC Pipe to Size<br>• Length: Cut a PVC pipe to a length of about 30–40 cm. This length is sufficient to allow both above-ground and below-ground measurements.<br>. Drill Holes into the Pipe | | | 60 |

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| • Purpose: The holes allow water to enter the pipe from the surrounding soil, making it easier to measure the water level beneath the surface.<br><br>Select the Location for Installation<br><br>• Location: Choose a spot in the rice paddy that is representative of the field's average water depth. Avoid areas near bunds (dikes) or slopes where water levels may differ significantly from the rest of the field.<br>• Consider Soil Type: Install the pipe in a part of the field where water movement and drying are typical for the entire area.<br><br>Insert the Pipe into the Soil<br>• Step 1: Push or gently hammer the PVC pipe into the ground using a rubber mallet. Insert it to a depth where the top 10 cm remains above the soil surface, while the bottom 20–30 cm is buried.<br>• Step 2: Make sure the pipe stands vertically, and it should not tilt, as this may affect the accuracy of water level readings.<br><br>Irrigation<br>• When the water level reaches the 15 cm mark inside the PVC pipe, flood the field again to a depth of about 5 cm. Then allow the water level to drop again, repeating the cycle until | | | |

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| the rice reaches its critical growth stages (like flowering).<br>4. Record Keeping<br>• Keep a record of water levels and irrigation events. This helps in optimizing water use and ensures consistent application of the AWD method across seasons.<br><br>2. Ensure Water Flow<br>• Check that the drilled holes in the pipe are below the soil surface, and allow water from the surrounding soil to flow inside the pipe.<br>Discuss the benefits of the AWD method for irrigation in paddy cultivation. | | | |

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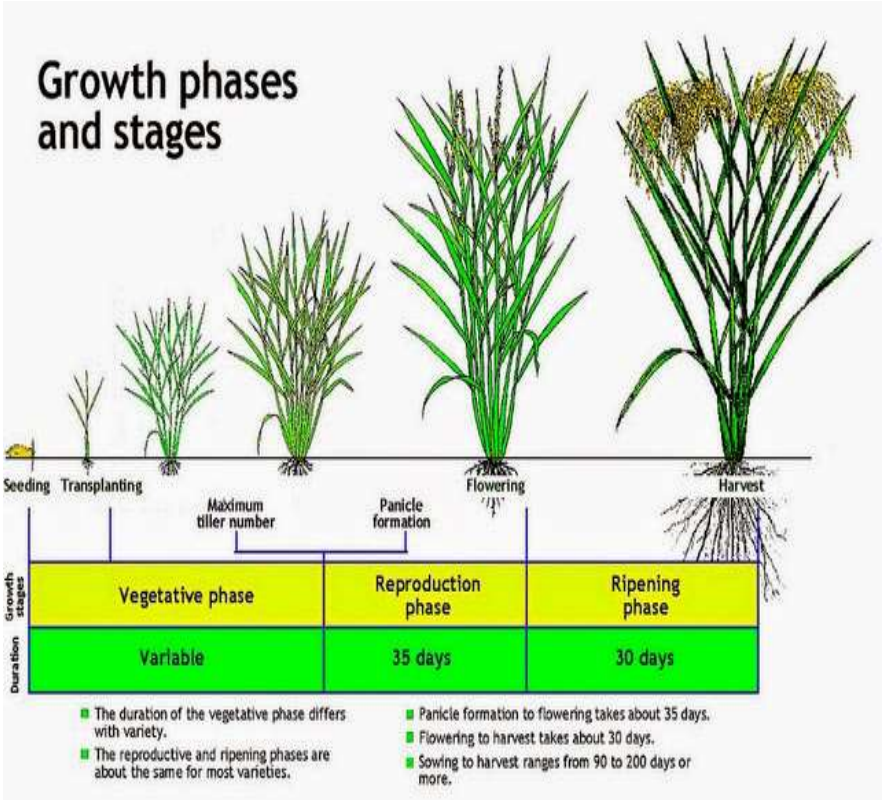
| **Evaporation Pan** |  |
| **Growth Phase and Stages** |  |

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| **Current Meter** |  |
| **Current Meter** |  |
| **BRC Flume** |  |

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| **Canal Depth Gauge** |  |

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| **Alternative Wetting & Drying (AWD)Method** |  |

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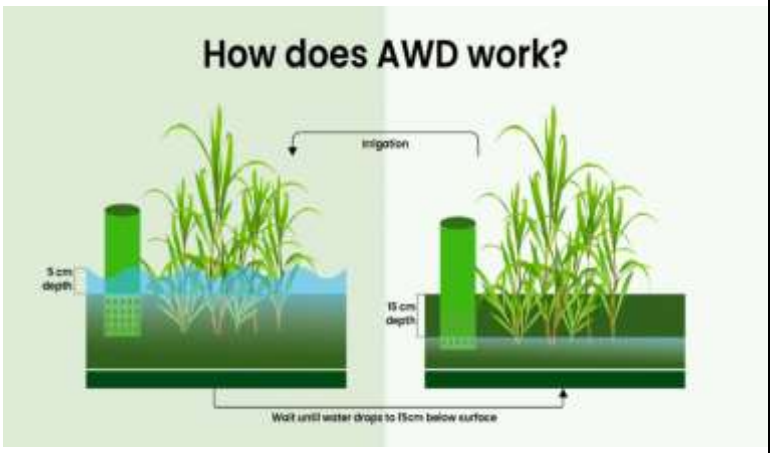
| **How Does AWD Work** |  |

# Module 02

# Maintenance of Irrigation systems

# Content - Module 02

- **Lesson 1** – Identification of Requirement for paddy and other field crops
- **Lesson 2** – Components of Irrigation System
- **Lesson 3** Village irrigation ecosystem

| **Subject Matter and Training Instruction Notes** | Training Methodology | Training Materials | Duration in Minutes |
|---|---|---|---|
| **1. <u>Approach</u>**<br>➢ What is the Maintenance of Irrigation system?<br>i. Explain by examples<br>ii. Explain the objectives of irrigation maintenance<br>➢ Why maintenance of irrigation system is needed?<br>i. Increasing of water efficiency in irrigation system.<br>ii. Increasing of the lifetime of irrigation system.<br>iii. Remind themself to reduce water problems. | Slides, Lectures, Discussions, Question & Answer | Multimedia, White board, Flip charts | 10 |
| **2. <u>Identification of Requirements for Maintenance of Irrigation systems</u>**<br>➢ Specify the components to be maintained for good water management in the Irrigation system.<br>❖ Tank Bund, Spill, Sluice, Irrigation Canal system, Canal Structures, Drainage channel, Water measuring structure<br>❖ Main Anicut, Anicut Gates, Retaining Walls, Irrigation Canal system, Canal Structures, Drainage channel, Water measuring structure | | | 15 |
| ❖ **Irrigation eco-system**<br>➢ The following features can be identified in "Dry" and "Intermediate" Village Irrigation ecosystems.<br>• Catchment area and Upstream waterways<br>• High flood area | Slides, Lectures, Discussions, Question & Answer | Multimedia, White board, Flip charts | 15 |

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| • Tank bed Immersion<br>• Tank Bund<br>• Sluices<br>• Spills<br>• Spill tail canal<br>• Interceptor<br>• Irrigation Canal System<br>• Drainage Canal<br>• Tree Belts (Forest area)<br>• Filtering area (Grass Lands)<br>• Sediments Pit<br>• Soil Ridge (Soil conservation bund)<br>• Water Level Measuring Gauge post<br>• Water flow Measuring Equipment<br><br>➢ Explain the places where maintenance needs should be identified and how to identify?<br>Use **"Inspection Report Format"** for irrigation system<br><br>Mention that it is advisable to adopt the following maintenance methods as well as safety measures to maintain the irrigation components in good condition.<br><br>**3. Catchment area**<br>➢ This refers to the upstream area which collects, retains the water required for the relevant irrigation system and releases water for waterways in a systematic manner and is surrounded by a higher elevation contour line ( Heenna). An irrigation system can be successfully maintained only by having a favorable stream area for it. | Slides, Lectures, Discussions, Question & Answer | Multimedia, White board, Flip charts, Hand outs | 10 |

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| .It will be extremely beneficial to maintain the water bodies in this catchment area without being allowed to be blocked, closed or altered, and to maintain a high forest percentage in the catchment area. Soil erosion caused by exposure to cultivation or other development activities without a soil conservation system (more than 3% of the land cover in the dry zone) in the catchment area will prevent the closure of waterways as well as silting the Tank Bed and causing frequent flooding and drought.<br><br>Silt Trap will be useful for cultivation of perennial crops in government reservations as well as Residential Lands as well as the construction of silt traps using Rubble packing to prevent erosion of streams and to hold silt.<br><br>**4. Tank Bund**<br>It is a major component, constructed using selected good soil & to be maintained seasonally and continuously. The dam has a definite shape to be maintained. In a small tank, it is advisable to maintain the bund top width of the surface of the tank bund between 8 and 10 feet, and if the surface of the tank is used as a vehicle route, it should be maintained between 10 -12 feet. Also, the side slopes of the tank bund should be maintained at 1 on 2 slope The maintenance is aimed at maintaining a strong tank embankment to retain the water collected in the tank as well as to control the water leakage through the bund. Under this, it is appropriate to pay attention to the following points: | Slides,<br>Lectures,<br>Discussions, | Multimedia,<br>White board,<br>Flip charts | 15 |

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| I. Maintaining the top level of the Bund:- For this purpose, it is advisable to install one level blocks for every 200 feet of the surface of the bund using concrete.<br><br>II. Removal of "termite nest" from the embankment:- During the removal of the "termite nest", 1/3 of the surface as well as 2/3 of the area under the ground should be cut off and the "Queen" should be captured and removed.<br><br>III. Where the washaways places and the surface level is low, the burrow earth from the tank bed should be cut and wiped, crushed places of embankments should be repaired annually, and the end of the rainy season is the most suitable time for this. For whatever reason, the soil is not removed from downstream of the embankment while cutting the soil, and one should be careful to cut the ditches more than 50 feet away from the end of the slope of the dam from the upstream of the bund slope. There is also no cutting from the water ways through which the water flows from the tanks.<br><br>IV. Water leakage through the tank bund a detectable distance along the dam, but in some cases there are cases where water is pumped out from only one point of the dam. Most of these conditions are caused by the decay of wood or roots buried through the dam, and in such cases, it is | | | |

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| necessary to identify the place where the water leakage starts from the bund and to control it, temporary measures such as blocking of sand bags and a permanent solution should be provided by a technical officer after the water level is low.<br><br>**IV.** Soils with heavy clay are not suitable for forming the surface of the dam because it are crushed, melted and easily escaped. Soils with a 60% - 40% sand-to-clay ratio are more suitable for surface repair of a dam, and their identification can be carried out by ribbon testing. Here, when trying to stretch a wet soil bundle into a ribbon with the thumb and thumb, due to the weight of the ribbon strap, it will break at one point. If the distance of the ribbon strap is less than an inch, then it is advisable to apply the soil to the bund formation.<br><br>**<u>5.0 Sluices</u>**<br>**There are mainly three types.**<br>**I. Ancient Village Type**<br>There is an ancient Sluice, method in which water is controlled in the Tank by removing one foot high vertical Hume pipe block one by one. The specialty of this sluice method is that the water on the surface of the tank is always released to the fields. | Slides,<br>Lectures,<br>Discussions | Multimedia,<br>White board,<br>Flip charts | 10 |

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| **ii. Head wall Sluice**<br>This type is designed on the assumption that when the water level height does not exceed 10 feet (3.0 meters), there will be no serious problems in emergency repair and maintenance.<br><br>**iii. Tower Sluice**<br>Hume pipes of diameter between 3 and 4 feet, made of Reinforced concrete, are used vertically for places where the water height of the Lake is more than 10 feet. Although the "Bisso Kotuwa" in the ancient great lakes of the country are somewhat similar in shape, the tower sluice has not yet been confirmed to have a life span as large as the "Bisso kotuwa" sluice.<br><br>➢ **Maintenance of Sluice**<br>The above-mentioned Head wall and tower sluices have control gates made of cast iron, and when each of these gates is closed, there is a unavoidable & negligible water leakage seeing, and in order to stop the leakage, if the gate is closed more than the required Level, it will not be possible to repair the lifting iron Rods. In order to protect the moving iron parts of the gate from passing and rusting, regular grease should be applied and other iron parts should be painted and protected.<br><br>The silt and waste deposited in the concrete box in the middle of the sluices of the tower should be removed annually and kept free. | | | |

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| ➢ **When the Tank is full of water, water leakage through the Sluice construct is likely to occur in some of the following ways**:<br><br>**a)** Excessive water leakage that may occur due to improper closing of the door of the sluices (minor water leakage is normal)<br><br>**b)** Leakage of water along the horizontal sluice pipe up to the underside<br><br>**c)** Due to the breaking or weakening of the jointed areas in the middle of the horizontal sluice pipe, the leakage of water from outside the sluice or through the sluice (outflow),<br><br>**As the above cases (b) and (c) pose a threat to the safety of the Tank, action should be taken to immediately report the situation to an Irrigation Technology Officer. Since these conditions cause many tank breaches to occur through the locations where The Sluice is located, a high priority should be given in this regard.** | | | |
| **6.0 Spill, Spill tail canal and approach**<br>Due to the excess water added to the tank, the dam is constructed to prevent the embankment from being overflows as well as to remove excess water from the tank in a systematic manner. These are mainly of two types.<br>**a). Natural Spill**<br>Created at the ground level using the natural location of the land. | Slides, Lectures, Discussions | Multimedia, White board, Flip charts | 10 |

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| **b) Clear overfall spill**<br>The upstream and the downstream are located at two significant levels, and the water flows into the tail Canal, after falling from the top to the bottom. It causes more waterlogging and energy loss than natural spill. In addition to this, morning glory is rarely seen<br><br>➢ **The length of the Spill** has been determined so that the excess water, that enters the tank can be removed without damaging the bund, even during heavy rains at the time of closure of all the spill of the tank. That is, by maintaining the length of spill, without being blocked, it is very important for the safety of the tank bund to maintain the flow of water from the tank at the spill level, as well as the flow of water from the tank, so that the water flowing out of the tank is not less than the length of the spill until it is some distance, as well as without interruption of trees, shrubs, etc.<br><br>➢ It will be the responsibility of every farmer's organization to cut and clean the Jungle before the onset of heavy rains at the beginning of the "Maha" season.<br><br>➢ It will be of utmost importance for the future design activities to record the time and date of the start and end of the spilling, the height of the spilling water.<br>➢ | | | |

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| **7.0, Irrigation Canal System,**<br><br>The canal system used to distribute irrigation water to the paddy field is called the "Irrigation Canal System", and it is necessary for each of these canals to have a specific shape.<br><br>• Side slope 1 to 1 for excavated canal cross section<br>• Side slope 1 to 1 1/2 for filled canal cross section<br>• The top width of the canal bund is minimum 2'-0"<br>• Protected width, Length from canal center line - 16 feet<br>➢ **Water measuring Structures**<br>Structures is necessary to maintain the efficiency of water use by providing the required amount of water distribute to on time. It will be important to measure the stagnant water entering the Tank, the water flowing in the irrigation canals, as well as the amount of rain water or evaporated water measurements are very important for good water management practices**.** | Slides,<br>Lectures,<br>Discussions | Multimedia,<br>White board,<br>Flip charts | |
| **8.0, Drainage Canal**<br>It will be necessary to maintain, this drainage canal, which removes excess water from the area formed along the lower valley of the paddy field, without any hindrance or obstruction, to maintain the **"salinity"** and **"Ferrous +"(Red colour)** condition of the paddy fields without improving. | Slides,<br>Lectures,<br>Discussions | Multimedia,<br>White board | 05 |

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| **9.0 , Village Irrigation Ecosystems**<br>The village Irrigation ecosystem, which is considered to be one of the most successful ecosystems in the world, is considered to be one of the most important factors affecting the long-term survival of irrigation.<br><br>➢ **Interceptor** (Kattakaduwa)<br>Kattakaduwa is the traditional name used for the water-logged wetlands between the Tank bund and the paddy fields on the Downstream side of the bund. Today, there is no Kattakaduwa, under the most of the village tanks, but there is still evidence that it existed in the past. There are three main stages of Kattakaduwa in the tanks that are found today. These three areas can be classified as water log area, wetland and high ground area. Some area cultivating various plants native to Kattakaduwa, the harmful chemical elements in the water have been removed and they have been prevented from crop of the paddy fields. It may be recalled that this technology is currently being successfully tested around the world under the name of "Bio-Remediation". Large plants such as aloe vera, dill, bee, as well as plants such as, Palmira, Areca nut, and aquatic plants such as Pan, Kohila, etc. are also common in this area. It is the responsibility of every farmer's organization to refrain from invading the land belonging to Kattakaduwa, to prevent the destruction of the plants there as well as to protect it from extinction. | Slides,<br>Lectures,<br>Discussions | Multimedia,<br>White board<br><br>Multimedia, | 30<br><br>30 |

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| ➢ **The tree range ("Gasgommana")**<br>This is the name of a large strip of trees planted around the upstream side of the Tank bed. The following main advantages can be obtained due to the cultivation of trees.<br>a). Soil erosion due to the strength of tree roots as well as control of the entry of silt into the Tank.<br>(b) Control the flow of tank water due to heavy winds especially in June, July and August of the year.<br>c). To control the water ripples in the tank water as it acts as a wind breaker, thereby controlling the washed-out conditions of the Tank bund.<br><br>➢ **Filtering Area (Grass Land)**<br>This is the name of the grass-fed field at the upstream side of the tank bed. This area, which is used to obtain the necessary food for the **"cattle**" and to feed the enemies freely, is also able to retain the **silt** in the water flowing from the ground surface to the Tank. Efforts have also been made to preserve the silt flowing from the catchment area by cultivating "Pan" species through the water ways flowing into the tank, so the risk of tank bed can be reduced by removing the silt annually even in those canals**.**<br><br>➢ **Sediments Pits ("Godawala")**<br>• It is expected that the water flowing from the catchment area through the canals before connecting the tank, the silt and waste parts in the water are expected to retain in the Pit. Thus, there can be several sediments pits, for each tank, and every year | Slides,<br>Lectures,<br>Discussions | White board | |

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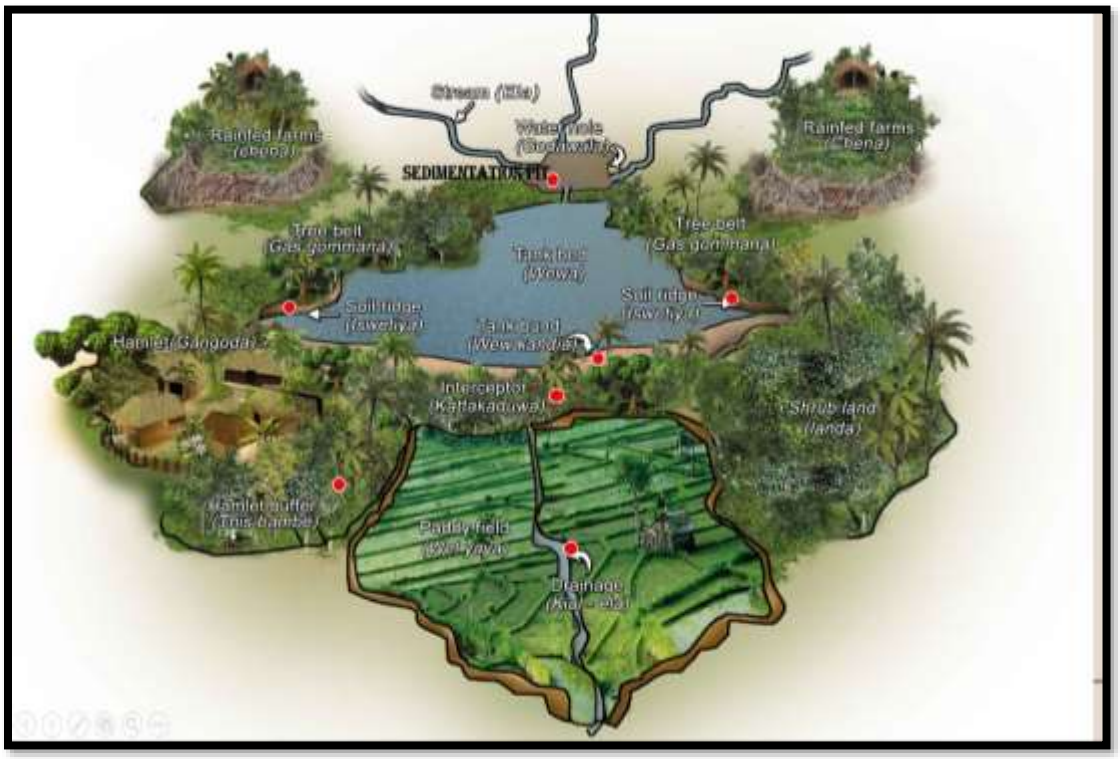
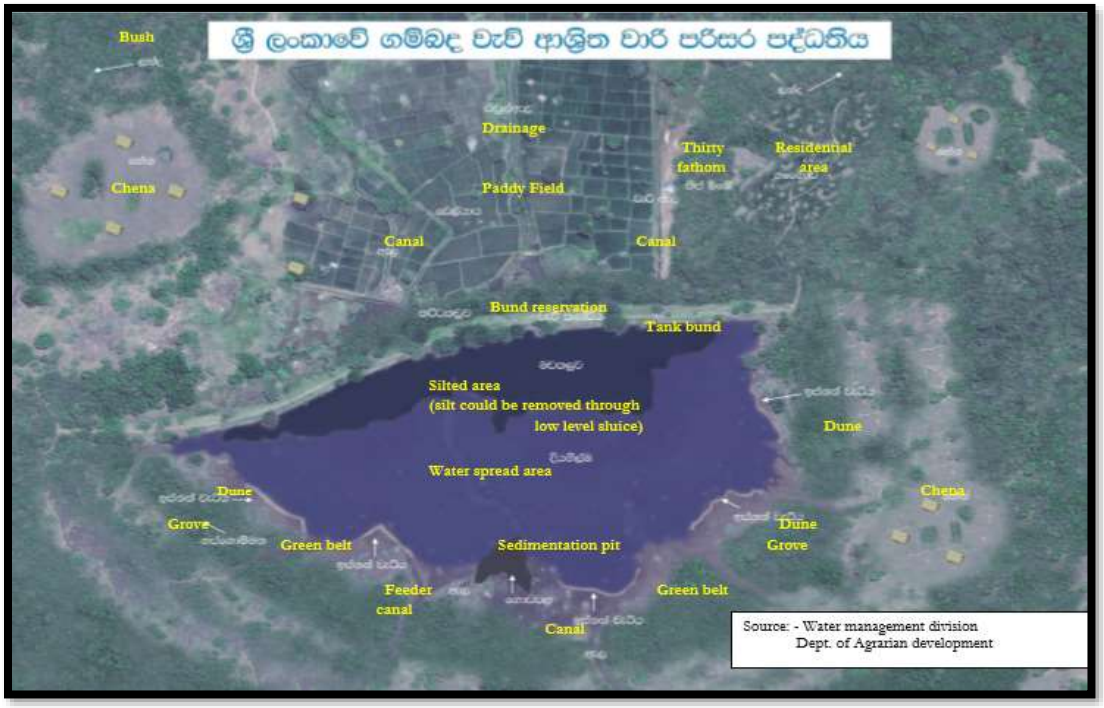
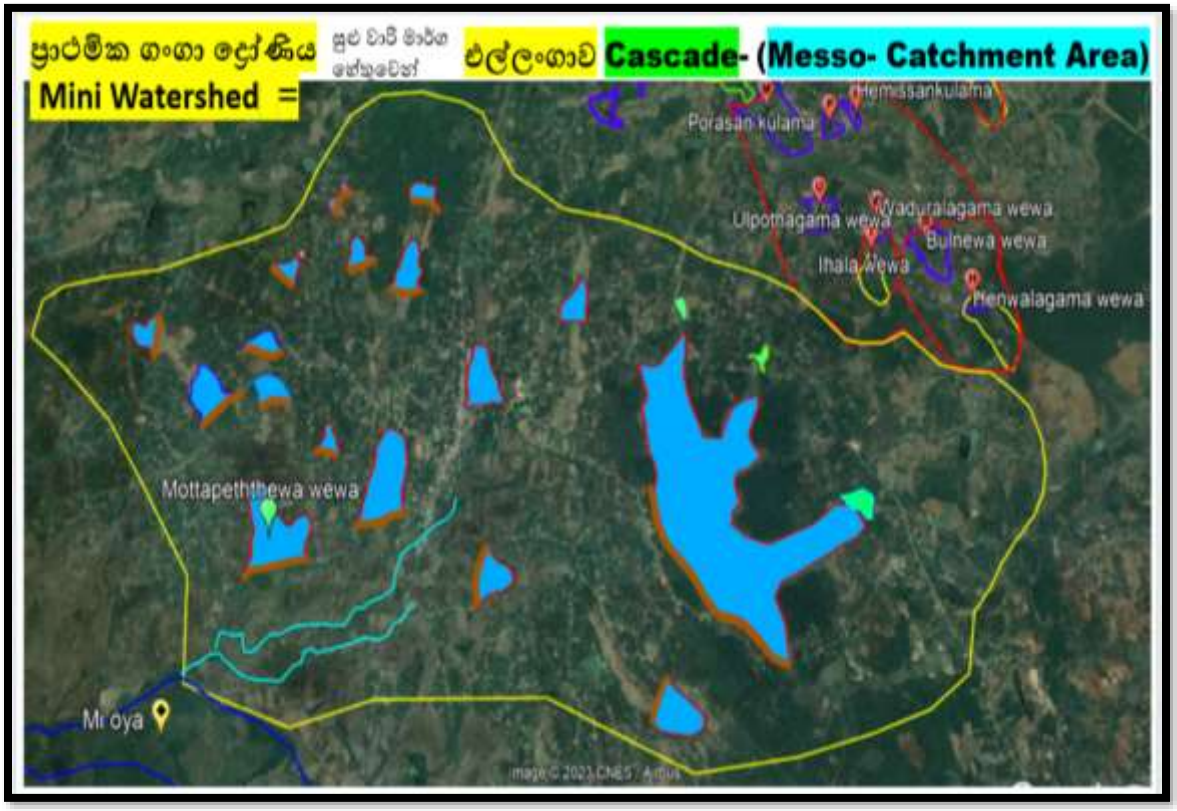
| the silt from the pits should be removed and applied to the high ground cultivated areas, and the Pits should be kept clean and free. It is also useful to obtain drinking water for animals such as buffaloes.<br>• It will be the responsibility of the farmer organizations to properly identify, protect and maintain the role of these strategic designs identified by man for water management in the past.<br><br>➢ **Soil Ridge ( soil conservation bund){ "Iswetiya"}**<br>Due to the little height soil ridge formed along the water spreading boundary Line of the Tank bed, is possible to reduce unnecessary water flow on ground surface in the upstream side as well as to control the accumulation of silt in the Tank bed. | | | |

Essential Components of Traditional Village Tank Systems




Ecosystem of Village Irrigation Schemes in Sri Lanka

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එල්ලංගාව Cascade- (Messo- Catchment Area)
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Porasan kulama
Ulpothagama wewa
Wadurulagama wewa
Bulnewa wewa
Ihala wewa
Henwalagama wewa
Mottapeththewa wewa
Mi oya
image © 2023 CNES / Airbus

Construction of Farm turnouts for water issuing to cultivated crop (Irrigable extent 2.5 to 3.0 Acers / FTO) and construction of field canal from FTO to field

Farmer Organizations should organized to sustainable Maintenance programmed for minimized water losses in conveyance system

## Down stream Development of Minor Irrigation schemes

Construction of Concrete Lining at the beginning of the Canal (down stream of the sluice) and fixing of flow measuring Gauge

Canal calibration for water Distribution programme using "Current meter"

Construction of Earthen canal with **designed section for required discharge** according to cultivable area

Smallholder Agribusiness and
Resilience Project,
1/2/2, Kandawatta Road,
Palawatta, Battaramulla