



Agricultural TVET College



Small Scale Irrigation Development Level II

MODEL TTLM

Learning Guide #06

Unit of Competence: Maintain gravity-fed irrigation systems

Module Title: Maintaining gravity-fed irrigation systems

LG Code: AGR SSI2 06 0816

TTLM Code: AGR SSI2 TTLM06 1218V₂

Nominal Duration: 30 Hours

SSID TTLM, Version 2	Date: December 2018	Page 1 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

Instruction Sheet # 1	Unit	Observe and Report on Weather
	Module	Observing and Reporting on Weather
	LO#1-4	

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: –

- Carry out pre- and post-seasonal maintenance preparation
- Carry out routine and periodical maintenance activities on gravity fed irrigation delivery system
- Clear system of weeds using mechanical or chemical methods
- Record and report maintenance activities

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Plan gravity fed maintenance activities
- Carryout all routine and periodical maintenance activities according to standards.
- Check system for smooth running and is free of damage, leaks, and blockages in accordance with design specifications and enterprise procedures.
- Identify and report the adverse environmental impacts of the irrigation system.
- Control weeds in accordance with enterprise standards, OHS, and environmental requirements
- Record and report all routine maintenance activities in accordance with standards

Learning Activities

- 1. Read the specific objectives of this Learning Guide.**
- 2. Read the information written in the “Information Sheet”**
- 3. Accomplish the “Self-check”.**
- 4. If you earned a satisfactory evaluation proceed to the next “Information Sheet”. However, if your rating is unsatisfactory, see your facilitator for further instructions or go back to Learning Activity.**
- 5. Submit your accomplished Self-check. This will form part of your training portfolio.**
- 6. Read and Practice “Operation Sheets”.**
- 7. If you think you are ready proceed to “Job Sheet”.**

SSID TTLM, Version 2	Date: December 2018	Page 2 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

8. Request you facilitator to observe your demonstration of the exercises and give you feedback.

Information sheet # 1	Unit	Maintain Gravity fed Irrigation System
	Module	Maintaining Gravity fed Irrigation System
	LO#1	Carry out pre-and post-seasonal maintenance preparation

Introduction:

Maintenance is a repair to an existing structure to keep it in its existing state or proper condition or to prevent it from failure or decline.

Maintenance activities includes Inspection, upkeep, testing, fault detection, measurement, replacement of parts, Inspection, upkeep, testing, fault detection, replacement of parts, adjustment servicing lubrication, cleaning etc.

The irrigation network is perhaps the most costly element of an irrigation scheme and is designed to last a long time. Silt deposition, weed infestation, malfunctioning of structures and other undesirable situations make it practically impossible to control the flow in these canals.

Irrigation canals, especially earthwork constructions, are very much susceptible to damage. They, therefore, require a lot of maintenance as to ensure their continuous efficient functioning.

Various problems, which are posed by irrigation canals during their use and as such need constant attentions, are

- ✓ Silting of canals
- ✓ Weed and plant growth
- ✓ Failure of weaker banks
- ✓ Hollows created by burrowing animals, crabs causing seepage and piping
- ✓ Canal breaches due to
 - Piping or seepage
 - overflowing of canal
 - faulty design or construction of the canal banks
 - intentional cuts made by cultivators

As a result, the system is unable to deliver the necessary water and distribute it equitably.

Maintenance is critical to ensure continuous productivity, produce products of high quality and to keep company’s competitiveness, reduce wasted water, reduce pollution from run-off and over-irrigation and improve plant health by applying the correct amount of water where it can be utilized by the landscape.

A properly designed and maintained system allows the grower to supply

- Precise amounts of water
- nutrients
- Other materials to the crop.

1.1. Planning Maintenance Activities

A maintenance activity requires data for good planning. Without reliable data on costs for the different units of work and on productivity no realistic planning can be done.

Irrigation maintenance services require data for proper planning which can be obtained through regular monitoring of the system. Monitoring the maintenance of the irrigation system is extremely important with two main purposes:

Short term: means of management control, comparing the actual flow with designed flow.

Long term: uses information on performance, supply and demand as a guide to planning and implementation.

For proper functioning and good performance of the system, frequent observations, measurements and checks should be carried out frequently on the irrigation system. Only relevant information should be included and accuracy of the data should be checked not only on equipment but also on the staff who do the recording.

In order to be able to formulate a system maintenance program, the following steps must be taken at scheduled time.

- Make an inventory of all the works that require maintenance
- Determine the volume of maintenance activities to be undertaken
- Establish the optimum cycle of maintenance for each type of work
- Determine the machinery and manpower requirements to undertake the maintenance
- Budgeting and establishing the maintenance priorities

Good planning is particularly important in maintenance work since the time and resources available for its execution are limited.

There are several reasons for poor maintenance: just to mention the most important:

- Insufficient funds made available to the management.
- Lack of interest by the farmers in participating or collaborating in the maintenance work.
- Poor organization of the work.
- May also result from inadequate planning of such work, or it may be that the available resources have not been used to the best advantage.
- use low-cost technologies for scheme construction because of limited funds, then maintenance requirements is greater (selecting earthen canal than concrete lining)

1.2. Preparing tools and materials for pre-season effective operation

Pre-season maintenance is maintenance activity done before starting operation of irrigation system for new season. it can allow the grower to realize the full benefits of irrigation system.

Before you begin irrigating each year, you should prepare your irrigation system for the new season.

Pre-season maintenance activity include: Weed control, motor servicing for irrigation use like (pump, generator etc), flushing and supply water distribution channel, de silting water channels, and decaling and equipment service.

Before placing the system into service each season, it is necessary to check

SSID TTLM, Version 2	Date: December 2018	Page 4 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

- **Visual inspection of system components** is used to know whether the system is in proper way or not.
- **Flushing/draining the system** are used to remove unwanted particles from inside of the system through applying water in the system.
- **Lubrication:-**
 - ✓ Grease fittings are located on the
 - Power Tower Cart (Lateral Move only),
 - at any optional Steel U-joints and
 - On any Towable Gearboxes
 - ✓ These fittings should be greased with good quality grease.
- **Switches:-**
 - ✓ Main Control Panel Switches should be cycled and checked for proper System operation.
 - ✓ All automatic controls should be cycled to check for proper operation.
 - ✓ Consult your authorized Service Technician for assistance
- **Filters:-**
 - ✓ Several items need to be checked on both screen and media filters prior to start-up.
 - ✓ The controller and valves of filter should be checked for proper operation.
- **Generators:-**
 - ✓ If your System utilizes Generator Belts, check them for proper tension and wear.
 - ✓ Before starting the Engine, remove any rodent nests from the Engine Fan Cover.

1.3. Closing and making system resistant to damage during post-season

Post-season maintenance is the maintenance activity done after the completion of irrigation works or after completion of irrigation operation season.

Post-season maintenance may include:-Disconnecting electrics, motor servicing, reports of equipment and machinery damage or fault, flushing and draining system component, protection from environmental damage, and servicing equipment after use.

Activities undertaken during post-season maintenance may includes

Flushing/Draining the System is used to remove unwanted particles from inside of the system through applying water in the systems such as particulate matter, chemical precipitation and suspended materials.

Flushing procedures

- To flush and clean a drain, a reasonable supply of water must be available.

SSID TTLM, Version 2	Date: December 2018	Page 5 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

- A large volume of flow rather than high pressure should be used.
- The effect of jetting with high pressure will not be felt any great distance down the drain.
- If the water supply is limited, a catch basin, or hole at the upper end of the plugged section will serve as a water reservoir.
- Block off the upper end of the drain and fill the catch basin or hole with water,
- Then remove the block and allow the water to flush suddenly through the drain.

Cleaning Water Lines

- is used to prevent or remove unwanted particles when blockage of system exists.
- If there is heavy scaling on the collector and/or blocked water passages, consult for cleaning recommendations.

Closing Down Systems have to be closed down after post-maintenances activities to prevent systems from damages.

1.4. Storing Equipment During Post-season

After the completion of all the activities in the post season, equipments should have to be stored in a safe place from damage and other contamination areas. This will ensure satisfactory performance and efficient storage of the valuable equipment to increase their life time.

The ways of storing tools and equipments after the completion of maintenance activity are:-

1. **Dismantling equipments** is way of taking apart equipments in separate pieces according to their type
2. **Loading Equipments** - is way of carrying equipments to transporter machine either by labor force or by loading machine.
3. **Transporting** is a way of taking equipments from working place to storage area.
4. **Storing Equipments** is the process of keeping equipments in a particular safe place until it is needed.

Self-Check 1	Written Test
--------------	--------------

Name: _____ **Date:** _____

Directions: Answer all the questions listed below.

1. What is maintenance? Explain it. (2 pts)
2. Why maintenance is needed? (3pts)
3. What are the steps needed for maintenance planning? (3pts)
4. What is pre-season maintenance and activities done during pre-season maintenance?(3pts)
5. What is post-season maintenance and activities done during post-season maintenance?(3pts)
6. What is the purpose of flushing and cleaning the system? (4pts)
7. Why storing of equipment is needed? (2pts)

Note: satisfactory Rating-20 and above pts. Unsatisfactory Rating-below 20 pts.

You can ask your teacher for the copy of the correct answers

SSID TTLM, Version 2	Date: December 2018	Page 6 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

Operation Sheet#1	Unit	Maintain Gravity-fed Irrigation systems
	Module	Maintaining Gravity-fed Irrigation systems
	LO#1	

Project title: - Irrigation conveyance structures maintenance

Materials, Tools and equipments used:- oil, grease, water, shovel, spades, rope, hoe ,tape meter, line level, ranging pole plumb bob, hammer, peg, tractor, excavator, survey leveling instruments, PPE, etc....

Objective: The main objective of maintenance of an irrigation conveyance structure is to facilitate the timely delivery of the required irrigation water to farm and to keep the irrigation system in an optimum operating condition

Procedure:-

- The frame work of the maintenance steps are as follow:
 - Inspection of Damage
 - Quantifying Maintenance work
 - Prioritizing Maintenance work
 - Setting Work Methods for Maintenance
 - Budget Estimation and Securing Budget
 - Preparing Maintenance Schedule
 - Implementation the tasks as per the schedules
 - Monitor and evaluate the implementation

Information sheet # 2	Unit	Maintain Gravity fed Irrigation System
	Module	Maintaining Gravity fed Irrigation System
	LO#2	Carry out routine and periodical maintenance activities on gravity fed irrigation delivery system

2.1: Carrying out irrigation maintenance activities.

Maintenance activities for an irrigation scheme fall into three categories:

- Routine maintenance.
- Emergency works.
- Scheme improvement.

Routine maintenance

Routine maintenance activities have to be repeated throughout the lifetime of an irrigation scheme to keep it functioning. Some of these activities are daily routines which do not require special skills:

- Greasing of gates;
- Removing vegetation from embankments, canals and drains;
- Removing silt from canals drains and structures.

Other routine maintenance activities require skilled artisans, such as a mechanic, a mason, a carpenter and a painter. They may be needed to do routine maintenance work such as:

- ❖ Repairs to gates and measuring structures;
- ❖ Repainting of steel structures;
- ❖ Installation of water level gauges;
- ❖ Maintenance and small repairs of pumps and engines.

Emergency works

Emergency works require immediate and joint action by irrigation staff and farmers, to prevent or reduce the effects of unexpected events such as:

- ➔ Breach or overtopping of canal embankment or river dike, causing flooding;
- ➔ Critical failure of pumps or headwork, causing interruption of irrigation water supply; natural disasters such as floods, earthquakes or typhoons.

2.2: Elements of irrigation maintenance activities

The maintenance activities have been grouped according to the major elements of an irrigation system; some of these elements are:

- (i) Dam and reservoir;
- (ii) Irrigation network;
- (iii) Drainage network;
- (iv) Rural road network and flood protection dykes;
- (v) Pump stations; and
- (vi) Ancillary works.

i) Dam and reservoir

Maintenance activities in a reservoir itself comprises

- Controlling aquatic weeds
- Removing large debris floating in the water that may damage hydraulic works
- Monitoring the water quality not only from the salt content point of view ,but also from a biological stand point in order to detect possible sources of pollution
- Surveying the solid deposition in the bottom of a reservoir

These activities require little time because they are periodic with the exception of aquatic weed control, which is in any case only likely to be a severe problem in tropical and semi-tropical climates.

The most common water weed in reservoirs in semi-tropical and tropical areas is the water hyacinth (*Eichhornia crassipes*). This plant represents a serious problem because it forms an ideal environment for mosquito larvae and has evaporation several (2.2 to 13.4) times greater than an open surface of water. The plant has a very fast rate of growth: two plants can produce enough offspring to cover one acre in less than eight months.

The main maintenance activities for an irrigation dam are: *lubrication of gates, anti-corrosion treatment, cleaning of debris, control of filters, and some other minor work*. Earth dams require greater maintenance, especially the upstream slope where weed control is necessary once or twice a year. The electro-mechanical system of a dam must also receive proper maintenance, particularly electric engines, head gates, and the lighting system. The maintenance of these elements is rather specialized and the manufacturers of the equipment usually provide detailed instructions.

SSID TTLM, Version 2	Date: December 2018	Page 9 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

ii) Diversion weir:

Some of the problems are:

Problem	Causes	Recommended remedial measure
- Over topping (high flood)	- Un proper design and construction	- Scheme improvement
- D/S degradation	- Un proper design and construction	- Proper maintenance/scheme improvement
- Miss-use of Intake / sluice gate & its accessories	- Improper operation	- Proper operation and maintenance

iii) Irrigation Networks

The canals in irrigation networks are generally either of earth or concrete-lined and their maintenance characteristics are quite different.

a) Concrete - lined canals

Concrete-lined canals should require little maintenance, provided that they have been properly constructed and any potential problems studied (sub pressure, gypsum soils, swelling clays, etc.) and adequate technical solutions provided. One of the main reasons for constructing concrete-lined canals is precisely to reduce maintenance operations.

The routine activities include:

- Replacement of joints
- Replacement of damaged concrete slabs,
- Weed control in joints and on the surface of concrete slabs
- Control and treatment of filters
- Control and removal of silt.

In the case of concrete flumes, chemical sterilization is also needed around the supporting structures.

Under normal conditions, the silting in concrete-lined canals is not an important problem since water velocity is high and sand traps and silting basins are often provided to reduce the solid content of the water. Heavy rain may cause deposition of solid materials if the berms are not properly formed.

Removal of silt from concrete-lined canals is an expensive operation because it is mainly manual. Mechanical equipment can be used when specially adapted to avoid damaging the

SSID TTLM, Version 2	Date: December 2018	Page 10 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

lining. In some irrigation schemes, the technique of flushing "quick water" through the canal is used to remove silt from one place and concentrate it in another where it can be more easily removed or disposed of silts. For this purpose, the canal should be run at its maximum capacity to reach the highest possible velocity.

The main problem in concrete - lined canals is cracking of the lining and eventual eruption of concrete slabs due to sub pressure. Apart from repairing the damaged lining, corrective action must be taken. An alternative measure can be used such as the construction of a subsurface drainage system to lower the water level.

b) Earth canals

There are four main problems in earth canals requiring maintenance attention and, although they are closely interrelated, they will be treated separately.

Silting:

Excessive sedimentation is perhaps the most common problem affecting the performance of earth canals. Some causes for canal siltation:

Causes from defective in design	Causes of inefficient maintenance and Operation
<ul style="list-style-type: none"> ▪ Excessive silt entry at the main canal intake ▪ Disproportionate withdrawal by branches ▪ Prolonged heading up at control points ▪ Drifting sand ▪ Inadequate transport capacity of channels 	<ul style="list-style-type: none"> ▪ Re-entry of excavated material by agents ▪ Malfunctioning of intakes ▪ Haphazard sediment excavation ▪ Excessive weed growth ▪ Wrong channel regulation

Weed infestation

Weed infestation can seriously impede the flow of canal water not only in tropical conditions but also in semi-arid and arid climates. There are two groups of weeds:

- Earth weeds: they root in the soil and their habitat is not the water; they proliferate on the canal slopes and in the banks, benefitting from favorable soil moisture conditions;
- Aquatic weeds: they can either root in the water or the earth but their habitat is in the water

Water infiltration

Water leaks through canal banks can be caused by burrowing small crabs and water rats or by

rotting plants and roots which were not removed from the canal bank seat during construction. Ants are also known to be a problem even in concrete-lined canals.

Erosion of banks

Canal banks can be eroded by heavy rainfall or wind, improper canal operation, stock grazing or passage by drinking animals, and the transit of vehicles. Heavy rainfall or wind can cause serious damage to unprotected banks.

iv) Drainage network

The retention in good working order of open drains includes the following operations:

- light deforestation
- weed control in the canal section
- seeding grass in the canal section
- maintenance of flow gauges and other measuring devices
- removal of silt
- Maintenance of pumping stations where water cannot be evacuated by gravity.

For practical purposes, the maintenance of open drains is very similar to that of earth irrigation canals. However, all too often drainage networks receive much less attention than the irrigation ones.

Drainage maintenance should always be programmed from downstream to upstream and as far as possible completed within an irrigation season.

Tile drains are subject to two main problems:

- ☞ Obstruction due to silting and plant roots, and
- ☞ Mineral deposits.

v) Rural road network and flood protection dykes

Rural roads are of vital importance in irrigation schemes, especially at harvest time. Many post-harvest losses can be avoided and better marketing facilities obtained by having a fully serviceable rural road network.

vi) Pump stations

Pumping stations for irrigation schemes may be:

- a. main irrigation lift-pump stations (surface water or groundwater);
- b. booster-pump stations for additional lifts in the main or branch canals;
- c. Drainage-pump stations.

vii) Ancillary works

The hydraulic structures in an irrigation scheme include: gates, inlets, spillways, outlets, dividers, siphons, jumps, check dams and other minor structures.

Maintenance of such items, when they are constructed in concrete, is restricted to the removal of silt and obstructions.

The mechanical elements require periodic greasing. Iron elements require antirust treatment. The same applies to structures in drainage networks (culverts, drainage outlets) and those in road networks (bridges, culverts, crossings, etc.). Administrative buildings and some other special installations (stores, workshops) require a certain amount of upkeep and should not be overlooked.

2.3. Servicing Mechanical Equipment in accordance with the Operators' manual

Most irrigation mechanical equipments must be serviced based on the provided instructions of manufacturers manual. Maintenance recommendations are based on industry standards and experience in reclamation facilities. Other sources of information must be consulted (e.g., manufacturers recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

Servicing of mechanical equipments can be categorized as;

- Preventive Maintenance:-** is the practice of maintaining equipment on a regular schedule based on elapsed time or meter readings.
- Reliability-Centered Maintenance:-** RCM programs are gaining in popularity and have been piloted in a few Reclamation power facilities with good results.
- Condition-Based Maintenance:-** This program relies on knowing the condition of individual pieces of equipment.
- Combination of Condition-Based and Preventive Maintenance:-** A combination of CBM and PM is perhaps the most practical approach. Monitoring, testing, and using historical data and PM schedules may provide the best information on when equipment should be maintained.

2.4. Flushing and cleaning Supply and distribution system

To flush and clean a system, a reasonable supply of water must be available Line flushing is needed when

SSID TTLM, Version 2	Date: December 2018	Page 13 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

- Particulate matter not removed by filters accumulated in irrigation pipes and laterals
- Chemical precipitation may occur inside pipe lines after irrigation system shuts down
- Suspended materials will be carried with the irrigation water ,but as the water velocity decreases near the end of lines ,particles will settle

Flushing procedures for distribution system may includes

- Closing the valve on the water lines behind a system and disconnect the water lines from the system
- Opening the valve ,run water through the valve and dispose of water
- Closing the valve
- Reconnecting the water line to system inlet
- Opening the valve

2.5: Maintaining system inlets, outlets, structures and fittings.

Inlets:- are way of water which takes water from the source or from some diversion structures

Outlets:- are way of water which diverts or takes water for the required area for specific purposes from a given source of water.

Inlets and outlets:-

- Siphons, cups. Flumes, pipes, gates etc.
- **Irrigation structures** is any structure or device necessary for the proper conveyance, control, measurement or application of irrigation water

2.6: Checking system for Damage, leaks and Blockages

Irrigation systems which may have damages, leaks and blockage have to be checked for effective maintenance activities.

- Damages of structures may happen due overload, improper design of structures, miss management, unfencing of the canals, and improper places for animal watering and bathing etc.
- Blockages of systems happen due unwanted particles which come with irrigation water especially it is the main problems of pressurized irrigation systems such as sediments, particulate particles, and suspended particles. By constructing trash racks, screen filter, silt trap, silting basin it is possible to prevent such blockage problems.

SSID TTLM, Version 2	Date: December 2018	Page 14 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

- Leakage of water happens through canal banks can be caused by burrowing small crabs and water rats or by rotting plants and roots which were not removed from the canal bank seat during construction. Ants are also known to be a problem even in concrete-lined canals.

Collapse and blockage are the principal types of drainage failure. Each of these can have several causes. Collapse of irrigation canal (unlined canal) canal occurs through:

- erosion of the bottom and sides of the drain (scouring)
- excessive pressure of water in the ground beneath and beside the canal lining
- vehicles passing over or too close beside the canals
- root growth, especially from nearby trees
- Crown corrosion in closed canals containing sewage

The causes of blockage can be:

- accumulation of refuse, leaves and earth in the canals
- structures such as houses or bridge piers erected in the canal and obstructing the flow;
- excessive vegetation growing in channels
- Silt deposited in low sections owing to misalignment or where the slope is insufficient and cleaning is not regular enough.

2.7: Clearing silt from channels, drains, sumps, and crossings

Irrigation and drainage canals normally get silted during their course of flow. Whenever the flow velocity in the channel reduces, the silt carried by the water in suspension gets deposited on the beds and sides of the canal. The silt so deposited reduces the effective canal cross-section and the carrying capacity of the channel.

The deposited silt normally deforms the shape of a channel and reduces its carrying capacity. It must, therefore, be removed periodically by de silting operations.

The selection of machinery is mainly influenced by its reach and working conditions such as.

- Wet or dry conditions
- Accessibility
- Amount and type of work
- Weed infestation, etc.

SSID TTLM, Version 2	Date: December 2018	Page 15 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

2.8: Identifying and Reporting adverse Environmental Impact of irrigation system

- Environmental impacts of irrigation are:
 - The changes in quantity ,quality of soil and water as a result of irrigation
 - The ensuing effects on natural
 - Social conditions at the tail-end and downstream of the irrigation scheme.
- The impacts stem from the changed hydrological conditions owing to the installation and operation of the scheme. As a hydrological result it is found that:
 - downstream river discharge is reduced
 - evaporation in the scheme is increased
 - groundwater recharge in the scheme is increased
 - level of the water table rises
 - Drainage flow is increased (these may be called direct effects.)
- The reduced downstream river discharge may cause:
 - reduced downstream flooding
 - disappearance of ecologically and economically important wetlands
 - reduced availability of industrial, municipal, household, and drinking water
 - Reduced shipping routes.
 - Reduced fishing opportunities.
 - Reduced discharge into the sea
- The increased level of the water table can lead to
 - reduced agricultural production where water tables are shallow
 - Irrigation applications are reduced.
 - soil is no longer leached and soil salinity problems developed
- Stagnant water tables at the soil surface are known to increase the incidence of water borne diseases like
 - malaria
 - filariasis
 - yellow fever
 - schistosomiasis (Bilharzia) in many areas
- Methods to mitigate the adverse effects of shallow water tables and soil salinization,
 - Water table control
 - soil salinity control

- drainage system control
- Reduced downstream river water quality
 - waters may be salinized and polluted by agricultural chemicals like
 - ✚ Biocides
 - ✚ Fertilizers
 - the quality of the river water below the project area can deteriorate,
 - It may lead to reduced public health.
 - Polluted river water entering the sea may adversely affect the ecology along the sea shore.
- Lost land use opportunities
 - Irrigation projects may reduce the fishing opportunities of the original population and the grazing opportunities for cattle.
 - The livestock pressure on the remaining lands may increase considerably,
 - Overgrazing may increase, followed by serious soil erosion and the loss of natural resources.

2.9: Using appropriate Materials for Backfilling and Building/repairing Banks

The banks of the canal should be made in full designed width and should be maintained as such. Due to constant use by men and animals, the canal gets eroded at various places.

Sometimes, when a canal reach runs in filling, the banks are subjected to water pressure, in such case; there exists every possibility of damage occurring to the banks. In such cases, the banks must be given extra strength by increasing their sections. For lined canals a better footing drain can be constructing by sand, gravel, and filter fabric keep drain pipes flowing free.

It's best to backfill a foundation with coarse gravel and crushed stone. To Backfill with quick-draining material it's best to place coarse, granular material like crushed stone or bank-run gravel against the foundation to encourage drainage.

Self check #1	Unit	Observe and Report on Weather
	Module	Observing and Reporting on Weather
	LO#2	Check weather and climate information

Name: _____ **Date:** _____

Direction 1: Choose and write the correct answer for the following Questions

1. A type of maintenance activity which involves or describes a repair for the damage part that is caused by major disasters is called (3pts)

- a) routine b) normal c) special d) deferred
2. In servicing mechanical equipments for maintenances activities, which activity comes first? (3pts)
- a) Planning b) implementing c) monitoring
3. From the following which one is not correct about environmental impacts of irrigation systems? (4pts)
- a) Downstream river discharge is reduced
- b) Evaporation in the scheme is increased
- c) Level of water table is decreased
- d) Drainage flow is increased
4. The reduced downstream river discharge may not cause (4pts)
- a) Appearance of ecologically and economically important wetlands
- b) Reduced shipping routes.
- c) Reduced fishing opportunities.
- d) Reduced discharge into the sea

Note: *Satisfactory rating – 7 and above points, Unsatisfactory – below 7 points*

Direction 2s: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. what are the maintenance activities that have to be done for maintaining reservoirs?(5 pts)
-
-
-
2. what are the maintenance activities for an irrigation dam?(5pts)
-
-
3. Earth dam requires greater maintenance problems than lined or concrete dam. Why?(5pts)
-
-
4. What are the main maintenance problems which encounter earthen dams?(3pts)
-
-
5. What are the causes for canal siltation?(4pts)

-

6. What are the procedures that are required or needed for repairing a leak in unlined canals? (5pts).....

 7. Write the types of maintenance and discuss them briefly? (5pts)

 8. Write the adverse environmental impact of irrigation system in detail(10pts)

Note: Satisfactory rating - 21 points and above Unsatisfactory - below 21 points

You can ask your teacher for the copy of the correct answer

Operation sheet #1	Unit	Maintain Gravity fed Irrigation System
	Module	Maintaining Gravity fed Irrigation System
	LO#1	

Lap Test	Practical Demonstration
-----------------	--------------------------------

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

☞ You are required to perform the following activity:

- ✓ Task_1: Collect the recorded data of weather (temperature) data from the surrounding station or agency:

- ✓ Task_2: Conduct checking of the quality of the recorded data using the internal consistency checks.
- ✓ Task_3: Give the feedback/recommendation for the recorded information.

Information sheet #3	Unit	Maintain Gravity fed Irrigation System
	Module	Maintaining Gravity fed Irrigation System
	LO#3	Clearing system of weeds using mechanical or chemical methods

3.1 Removing/controlling weeds

Methods of Weed Control

Weed management decision vary according to plant life cycle, infestation size, environmental parameters and management objectives. Successful weed management requires proper plant identification, selection of effective management methods and monitoring the effect over time.

Selection of method of weeds and grasses control depends on: -

- The type and age of this crop;
- The type and size of the weed and methods of propagation;
- Timelines;
- The equipment /implement available; and
- The cost of owning and operating machine or employing manual labourers to effect weeds and grasses control and attain expected increase in yields.

Usually, a good weeds and/or grasses control involve combinations of the available methods, timelines and good farm practical management. Weeds and grasser are most effectively controlled when they are small (about 3-5cm tall), especially where the control method involves uprooting, covering under soil, flaming or the application of direct post emergence general contact Sprays. Cross cultivate if the crop is check rowed.

Preventive Control

Prevention is the most essential aspect of weed management. Once a noxious weed infestation becomes established, any increase in size and density creates increasingly more expensive management efforts. Awareness of weed seed sources and plant identification is a must. To set up a site visit, and recognize:

- Weed seed can be spread from neighboring properties, adjacent road rights-of-way and trails. Direct sources are often livestock, manure, seed, hay, vehicles and equipment.
- Disturbed ground is most vulnerable to weed invasion; new roads, pipelines and other sites where competitive vegetation has been removed. With no restoration (see cultural control) weeds will likely appear.

SSID TTLM, Version 2	Date: December 2018	Page 20 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

- Early detection and rapid response saves time and money. Aggressive management action on small, newly established infestations can result in eradication. "An ounce of prevention is worth a pound of cure."

Mechanical Methods (Tillage)

Mechanical cultivation or tillage is still the most important method for controlling weeds and generally the most economical methods where it can be used. In this method, the weed may be uprooted or covered under soil or cut off depending on the method of weeds or grasses propagation. One of the greatest problems encountered with mechanical method of weed control is killing weeds and grasses within established crop rows. Equipment and machineries used for this method of weed control may include graders, backhoes, front-end loaders, ploughs, and molding boards.

In the early stage of growth of some crops, implement such as the rotary hoe and spring tines or pencil point weeder can be operated directly over the rows. The action of these tools depends on the deferential resistance of the crop and weed. And there is some crop mortality. Indiscriminate “over-all” coverage of both the middle and the row with tool of the type is fast and economical and the power requirement is minimal. Finger and Hoe Weeding both employ human labour and are the most effective; but the methods can be tedious and uneconomical.

Flaming method

Selective burning or flaming showed some promising results for control of in-the-row weeds in certain crops such as corn, cotton and sugar cane whose stems are not injured by a short exposure to an intensive heat. The method is applied during the early stage of development of the crop.

Chemical method (Herbicides)

The importance of herbicides is increased because of the introduction of selective type chemicals such as 2, 4-D (Dichlorophenoxyacetic acid) which can effectively control weeds if properly selected and applied. Numerous herbicides are available that provide effective weed control and are selective in that grasses are not injured. Along with herbicide use is user responsibility and compliance with all product label requirements for herbicide handling, use, and cleanup. Always read the label and keep in mind the label is legally binding. When using herbicides be mindful of proximity to water, trees, shrubs and other desirable vegetation. The guide provides information necessary to help decide which herbicide is most appropriate for a particular weed in a particular setting.

SSID TTLM, Version 2	Date: December 2018	Page 21 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

The emergence spray - Contact herbicides kill almost all vegetation. This chemical is applied after planting but before emergence of the crop seedling. Disturbed the soil as shallow as possible but the plant should be of the kind that will not be injured by chemical. Direct Post Emergence - Contact herbicide has to be selective/ discriminate in their nature. Sometimes, the crop plant itself is effective in combating weeds by shading them, but other methods of controlling weeds are required until shading takes place.

Herbicides are applied by spot spraying - single nozzle application targeting individual plants, or broadcast spraying - multiple nozzles covering an entire area.

Biological Control

The goal of biological control is not eradication, but the use of living agents to suppress vigor and spread of weeds. Such agents can be insects, bacteria, fungi, or grazing animals such as sheep, goats, cattle or horses. Grazing produces results similar to mowing, and bacteria and fungi are seldom available for noxious weed management. Biological control is most commonly thought of as 'insect bio-control'.

3.2 Protecting crops and plants from damage

As In the case of weeds and grasses control, chemicals are the most important means of controlling insect and pests provided that they are applied at recommended rate economically. However, this method (chemical method of insect-pest control) is expensive since the application requires special machines such as sprayers and dusters, and power units, like tractors and airplanes in some cases, to operate them.

Cultural practice: - This method of insect-pest control involves: - Rotation of crop; Selection of crop, planting date in relation to insect-pest out-break; Use of resistant variety of crop; Proper preparation of seedbed; Elimination of crop residues, weeds and grasses which may harbour insects, pests and plant disease causing organisms (pathogens).

3.3. Checking Water flow from outlets.

All outlets should be regularly checked and set right, if found defective, in accordance which the detailed instructions issued by the department.

Outlet pipes should not be left lying about the canal. They should be carried to the nearest inspection house as soon as change in outlets have taken place and pipes are found surplus. They should be stacked neatly.

Water courses should have culverts/siphons wherever needed and should be properly maintained to avoid wastage water.

Register should be maintained and head of water (H) of each outlet i.e. the difference between the water level in the canal and the center line of the outlet at its exit end, when the canal is running at full supply level should be measured every month.

SSID TTLM, Version 2	Date: December 2018	Page 22 of 25
	Prepared by: Alage, wolaita sodo, O-Kombolcha, A-Kombolcha and Wekro Atvet college Instructors.	

It will be of great help for ensuring that the outlets draw their authorized share of canal water. The outlets should be so fixed that this draws their proportionate share of supplies/silt when compared to the supply in the parent channel. The working of the outlets can be evaluated from the register and these can be adjusted suitably during the month of April & October.

Self-Check 3	Written Test
---------------------	---------------------

Name: _____ **Date:** _____

Directions: Answer all the questions listed below.

1. What are the different methods of weed control? (10 pts)
2. Explain the purpose checking water flow? (10pts)

Note: Satisfactory rating - 15points and above

Unsatisfactory - below 15 points

You can ask your teacher for the copy of the correct answers

Information sheet #4	Unit	Maintain Gravity fed Irrigation System
	Module	Maintaining Gravity fed Irrigation System
	LO#4	Recording and reporting maintenance activities

4.1 Recording damage and blockage caused by pests and vermin

Each irrigation worker shall maintain any records and make any reports. The activities required by the conditions or by the rules, regulations, and orders of the enterprise. Records which are required by the regulations in this part or by license conditions must be maintained for a period specified by the appropriate regulations or by license condition.

Records which must be maintained pursuant may be the original or a reproduced copy or a microform if this reproduced copy or microform is capable of producing copy that is clear and legible at the end of the required retention period. The record may also be stored in electronic media: For producing legible, accurate, and Complete records during the required retention period.

Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

The reports shall include:

- specification of the quantity of each of the principal damage and blockage caused by pests and vermin ,
- specification of the quantity of each of the principal location and the section of the system affected
- Jungle clearance and earthwork on canal berms, dowels and service road, etc.
- a summary of licensee disposal unit survey and maintenance activities,
- a summary, by waste class, of activities and quantities disposed off,

4.2. Recording and reporting damage or faulty pumps and components.

Damaged or faulty pumps, valves, electrical components, etc in irrigation systems should be recorded and reported to the supervisor. Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.

The reports on damaged or faulty pumps, valves, electrical components shall include:

- specification of the quantity of each of the principal damage and blockage
- specification of the quantity of each of the principal location and the section of the system affected
- a summary of maintenance activities,
- a summary, by waste class, of activities and quantities disposed of, any instances in which observed site characteristics were significantly different from those described in the application for a license; and any other information the commission may require

4.3. Recording and reporting all routine maintenance activities

Maintenance of all structures should be listed. Such structures are bridges, aqueducts, syphons, falls, head and cross regulators, and measuring flumes. The quantities of work, unit costs and total costs should be cited in the report.

The record on routine maintenance activities of irrigation system includes at least the following operations:

- a record on light deforestation on drainage
- a record weed control in the canal section
- a record on seeding grass in the canal section
- a record on maintenance of flow gauges and other measuring devices
- a record on removal of silt

- a record on maintenance of pumping stations where water cannot be evacuated by gravity.

Drains are subject to two main problems:

- (a) Obstruction due to silting and plant roots, and
- (b) Mineral deposits.

The most common is the first. Mineral deposits of iron and manganese occur quite frequently in some irrigation schemes and the time necessary for such depositions varies widely from a few months to 30-40 years, depending on the mineral composition of the soil.

Note: After completing the records, a report has to be submitted to authorize personnel for corrective measures.

Self-Check 4	Written Test
---------------------	---------------------

Name: _____ **Date:** _____

Directions: Answer all the questions listed below.

1. Write how you could record damage and blockage caused by pests and vermin? (5 pts)
2. Write how you could report damage or faulty pumps, valves, electrical components and computer systems? (5pts)
3. Write how you could report routine maintenance activities? (5pts)

Note: Satisfactory rating - 15 points and above

Unsatisfactory - below 15 points

You can ask your teacher for the copy of the correct answers