Agricultural TVET College

Small Scale Irrigation Development

Level II

MODEL TTLM

Learning Guide #02

Unit of Competence: Assist the Operation of Gravity Fed Irrigation

Module Title: Assisting the Operation of Gravity Fed Irrigation

LG Code: AGR SSI1 M02 LO1-11

TTLM Code: AGR SSI1 02TTLM 1218V_2

Nominal Duration: 30 Hours

Instruction Sheet	Learning Outcome 1-3

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

- Set up field for gravity fed irrigation
- Carry out irrigation Operations
- Clean and store irrigation equipment as required

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 –

- ✓ Set up fields for irrigation
- ✓ Check rot buck area for irrigation set up and taking action
- ✓ Check water delivery mechanisms for irrigation set up and taking Action
- ✓ Position and secure tarpaulins or other water control devices
- ✓ Open and shut gates and/or valves
- ✓ Achieve and maintain required head and water levels in head ditch
- ✓ Perform basic operation of gravity fed irrigation system
- ✓ Start /open required number of siphons
- ✓ Monitor progress of water flow in furrows
- ✓ Lift siphons where completing irrigation
- ✓ Carry out and marking irrigation change
- ✓ Shift irrigation equipment
- ✓ Clean, load and store equipment

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".**

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

Information Sheet 1	**LO1. Set up field for gravity fed irrigation**

INTRODUCTION
Definition:

Surface irrigation is the application of water by gravity flow to the surface of the field. Either the entire field is flooded (basin irrigation) or the water is fed into small channels (furrows) or strips of land (borders).

The surface irrigation **system components** are:

- water supply (channel, ditch, river, dam)
- Water conveyance or delivery (field channel/ditch, check, parshal flume, lay flat pipe etc.)
- Water use (furrow, border, etc.)
- drainage

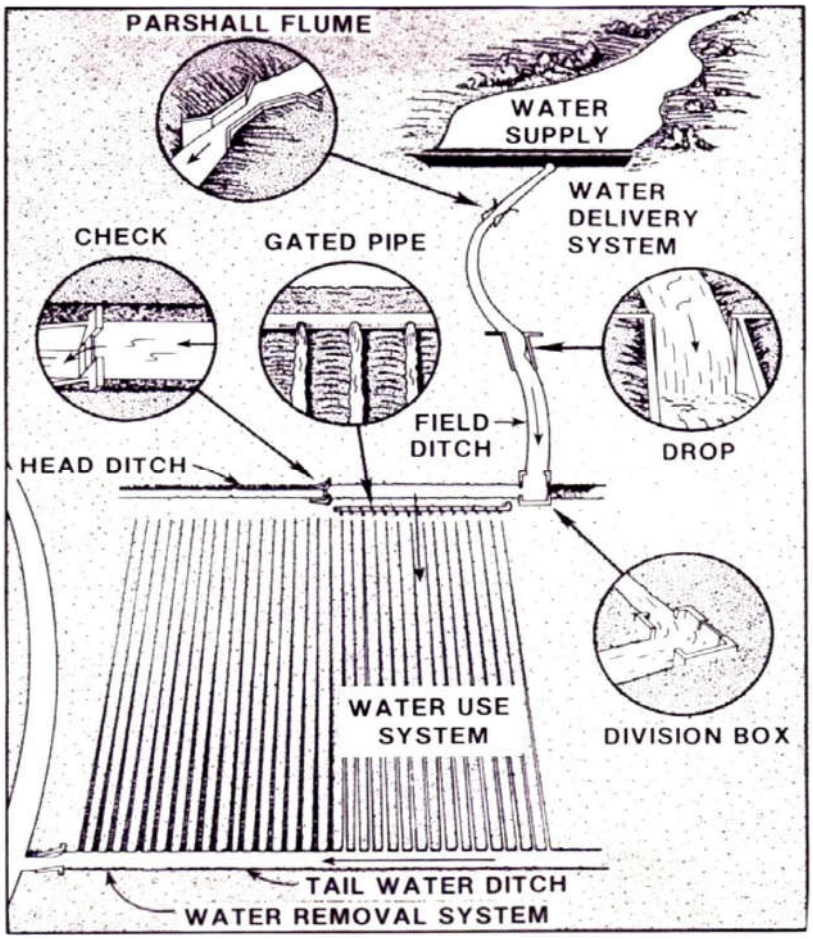

Figure_1.Typical component surface irrigation system

Type of surface irrigation:

1. Basin irrigation

Basins are flat areas of land, surrounded by low bunds. The bunds prevent the water from flowing to the adjacent fields. Basin irrigation is commonly used for rice grown on flat lands or in terraces on hillsides (see Figure 1). Trees can also be grown in basins, where one tree is usually located in the middle of a small basin. In general, the basin method is suitable for crops that are unaffected by standing in water for long periods (e.g. 12-24 hours).

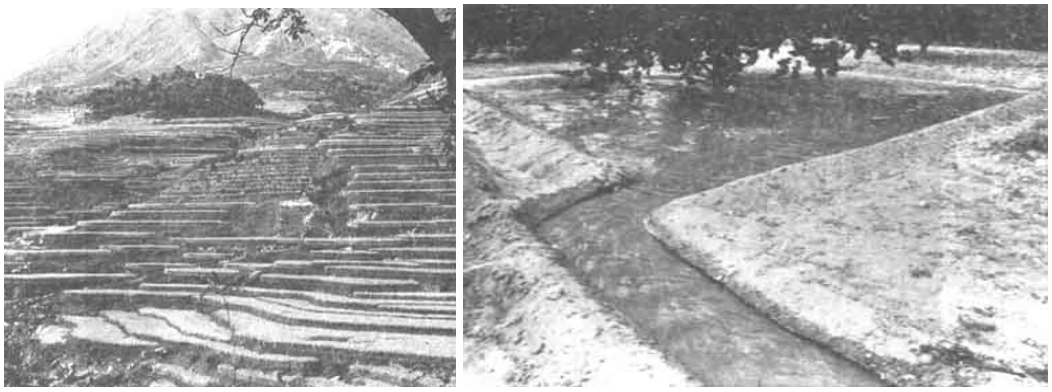

Figure_2. Basin irrigation on hillside (left) and basin irrigation for tree (right)

2. Border irrigation

Borders are long, sloping strips of land separated by bunds. They are sometimes called border strips.

Irrigation water can be fed to the border in several ways: opening up the channel bank, using small outlets or gates or by means of siphons or spiles. A sheet of water flows down the slope of the border, guided by the bunds on either side (Figure 2).

The strip of the land has no cross slope and has uniform gentle slope in the longitudinal direction. This method is suitable for forage crops requiring least labour. Mechanized farming can be adopted in this method.

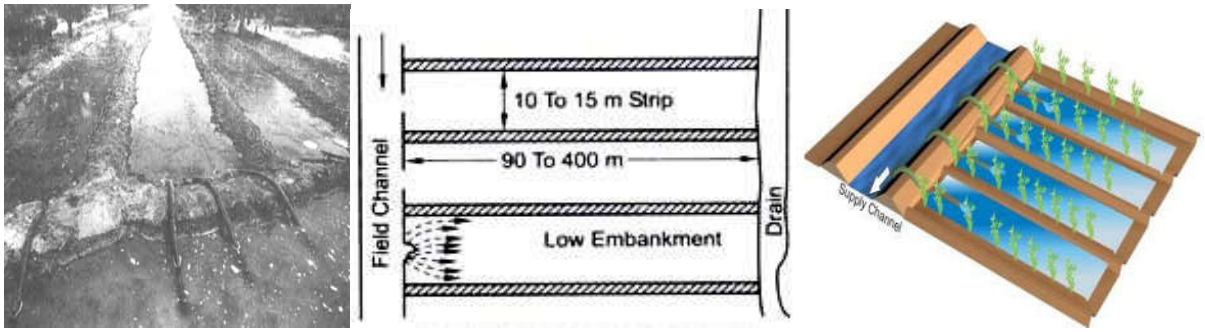

Figure_3. Border irrigation, using siphons, opening up channel bank (middle) and flexible pipe (right)

3. Furrow irrigation

Furrows are small channels, which carry water down the land slope between the crop rows. Water infiltrates into the soil as it moves along the slope. The crop is usually grown on the ridges between the furrows (see Figure 3). This method is suitable for all row crops and for crops that cannot stand in water for long periods (e.g. 12-24 hours). Irrigation water flows from the field channel into the furrows by opening up the bank of the channel, or by means of siphons or spiles.

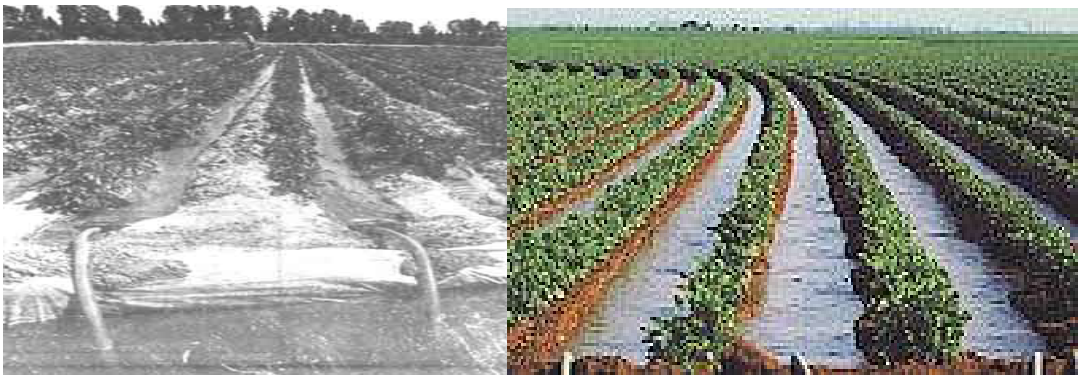

Figure_4: Furrow irrigation, using siphons

4. Wild flooding

In this method water is applied by spreading water over the land to be irrigated without any preparation. There is no restriction for the movement of water. It follows the natural slope of the land. The water may be applied to the land directly from a natural stream during season of high flow as in inundation irrigation. This method is suitable for flat and smooth land but involves wastage of water and hence it can be practiced where water is abundant and inexpensive.

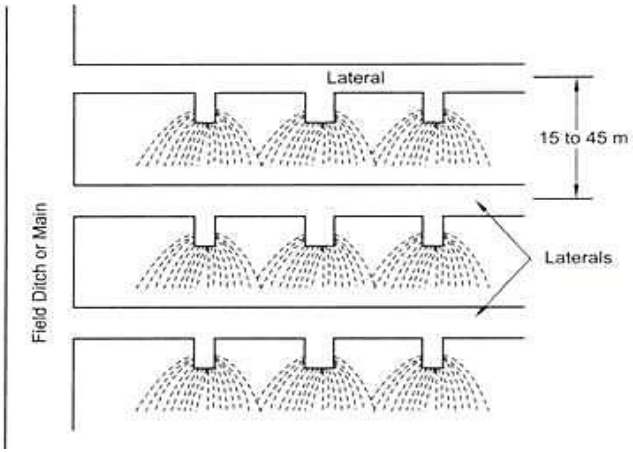

Figure_5. Free flooding method for erodible soil

5. Gravity fed drip irrigation

Gravity drip irrigation system consists of water storage, water filtration, water conveyance and distribution and water application to subsystem

The basic system is very simple consisting of an elevated reservoir with a pipe coming out the bottom that feeds water into a basic drip irrigation system that is all controlled either by hand or with a very efficient battery powered timer that controls the rate at which the crop is watered.

The components needed include:

1. A water reservoir
   - ✓ It must be able to contain at least one days worth of water
   - ✓ The greater the capacity of the reservoir is proportional to how often it must be refilled
   - ✓ The complication of having a very large container is that you must elevate it above the crop and refilling a very high container is more work
   - ✓ The reason to elevate the tank is that it adds pressure which needs to be kept consistent at the point where the drip lines are fed so that the water is distributed equally
2. A structure to support the water reservoir
   - ✓ Can be constructed of anything that can support the weight of the container when it is filled with water
   - ✓ It must also be able to withstand outside forces such as the wind
3. Piping
   - ✓ There must be a pipe at the base of the reservoir that lets water flow out and having a shut off valve at this connection point is a good idea if the reservoir is larger than one days worth of water.
   - ✓ The piping if using the timer method then feeds the water through a filter
   - ✓ Different sized piping should be used to increase the pressure
   - ✓ This is done by gradually decreasing the size of the lines being used .
4. Timer and Filter
   - ✓ There are many models of battery powered timers that can be set up and run for a whole season
   - ✓ These timers control the frequency that water is emitted into the drip lines
   - ✓ A filter must be installed in the water line before the timer valves
   - ✓ This prevents the smaller lines from becoming clogged
5. Valves and Drip lines
   - ✓ Shut off valves should be placed between the reservoir pipes and the irrigation pipes and before the timer valves
   - ✓ Drip lines are the average lines and emitters.

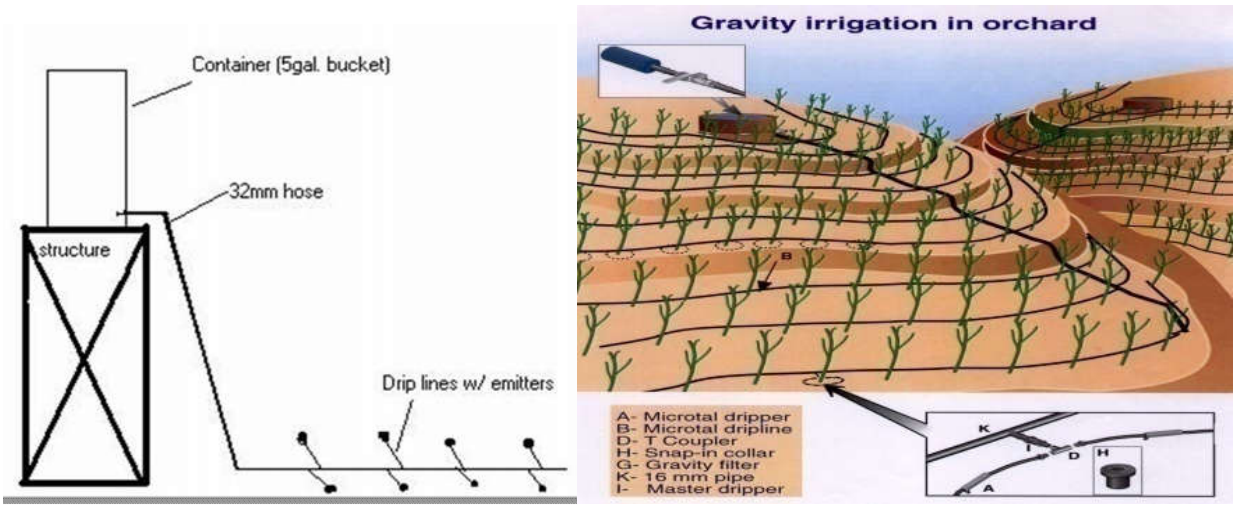

Figure_6: Drip irrigation system

1.1. Handling irrigation equipment safely

Irrigation systems move and deliver water that is vital for the survival of agricultural crops. Moving equipment, electricity, water pressure, pumping systems, and field conditions related to irrigation and agriculture require workers to follow safety protocols.

To be safe, read the operator's manual and receive training for each irrigation system and specific equipment components that you use and maintain. Follow all of the manufacturer's suggestions for inspection, maintenance, and repair schedules and procedures.

Canal Safety

- Canals contain water that is quickly moving. Fast-moving water in a narrow channel can knock a person off their feet. Even water that is only a foot deep, if it is moving fast enough, would cause you to lose your balance and be carried away.
- For this reason, we do not allow any swimming, fishing, playing, or other recreational activities in or around our canals.
- Debris (trash and garbage) and other dangerous things can be found in canals.
- Dry canals are not safe because there is no way to know when water may be released and you may be trapped by a surge of water.
- Canals can have deep water. If you cannot swim or if you are hurt, falling into deep water could prove fatal. In addition to swift currents, irrigation canals may have undertows and turbulence that could drag even a strong swimmer under water.
- Canals have steep slopes and slippery walls. The concrete or earthen sides of ditches and canals are sometimes steep and possibly slippery, making them difficult to climb out.

- Canals have grates, culverts, spillways and in-water energy dissipation devices. If a person were to fall into a water-filled ditch or canal, additional hazards include becoming caught up in or striking an object or structure. This may cause someone to become submerged and/or lose consciousness.
- There are pipelines and side gates in the canals and laterals where water is being diverted. These structures can cause a suction effect trapping a person underwater.
- The water's helical motion makes it difficult to swim to safety.

During hot weather, the water may look still and inviting but, there are strong currents underneath the surface which can trap even a strong swimmer very quickly. Please stay away from canals, they're not safe places for anyone to play around or swim in – big or small, young or old.

Keep in mind, canals are private property and it's considered trespassing should you enter without permission. We have regular canal patrols and camera systems monitoring our facilities in order to ensure the safety and security of our canal system and those near it.

Water and Electricity

Because electricity and water are often in close proximity to each other in agricultural applications, it's important to keep a few safety rules in mind at all times.

When moving equipment or irrigation pipes, survey your surroundings and look up and all around you for power lines that could come in contact with the equipment or pipes you're attempting to move. Any contact with electrical lines can cause serious injury or death.

Keep these tips in mind for safe operation of irrigation equipment.

- Make sure that irrigation system wiring is properly grounded. Before the start of each irrigation season, have a qualified electrician check the pump and wiring.
- If fuses continually blow or circuit breakers repeatedly trip, have a professional check the wiring. This could indicate a potential electrical hazard.
- If you're using irrigation pipe, be sure to store any unused pipes far away from power lines or electrical equipment and position irrigation pipes at least 15 feet away from any power lines when in use. In case of lightning, stay away from the piping and install lightning arresters to protect your equipment.
- When moving irrigation pipe, keep them parallel to the ground rather than vertical to minimize the risk of contact with power lines. If an irrigation pipe comes in contact with a power line, never try to remove it yourself.
- Always shut off and lock the master electrical control switch before servicing equipment.

The following suggestions are aimed at ensuring the safety of the irrigator as well as preventing damage to the equipment.

- Read and follow directions in the owner's manual for each piece of equipment, paying particular attention to the safety precautions and features listed. Make sure that all employees also read and understand all directions and precautions.
- Look overhead and note electric power lines that are within reach of the long pipes. When Lifting and transporting the pipe sections, keep clear of the power lines.
- Avoid moving irrigation equipment on windy days when pipes could be blown into nearby power lines and keep pipes horizontal to the ground rather than vertical to minimize the risk of contact with power lines.
- Disconnect electric power before servicing a machine by personally shutting off and locking the master control. Also make sure that everyone is clear of the machine before it is turned back on.
- Stay away from the equipment during an electrical storm.
- When working with irrigation hydrants and valve openers care must be taken to prevent a sudden release of water pressure which could cause severe injury. When setting valve openers onto field irrigation hydrants make sure the valve opener locking lever is swiveled far enough clockwise to lock it onto the hydrant ears. Always do a quick visual check to make sure the valve opener is locked onto the hydrant ears before turning the water on or off.
- Stay out of the way of high-pressure water streams, such as end guns.
- Be sure the engines used to power pumps are equipped with safety devices that will stop them before damage occurs from overload, overheating, loss of oil pressure or runaway (if pump becomes disconnected or loses its prime).
- Be sure all pumps are equipped with devices that will shut off the electric motor or engine if there is a break in the suction or loss of pressure in the main pipeline.
- Make sure that service or auxiliary equipment is not in the path of the irrigation system.
- If chemicals have been added to the irrigation water, avoid exposure to spray drift; and make sure that the spray does not blow past the area of intended operation.

1.2. Positioning irrigation equipment /component

The equipment and materials required for gravity fed irrigation should be available as much as needed and located at the spot where irrigation takes place.

Equipment for open canal/surface irrigation systems

1. ***Water Control devices***. In open canals, water flow is controlled with1 different kind of devices. The most common one are gates. Gates are used in canal turnouts. A special type is the downstream constant level gates, commonly known as Neyrpics.

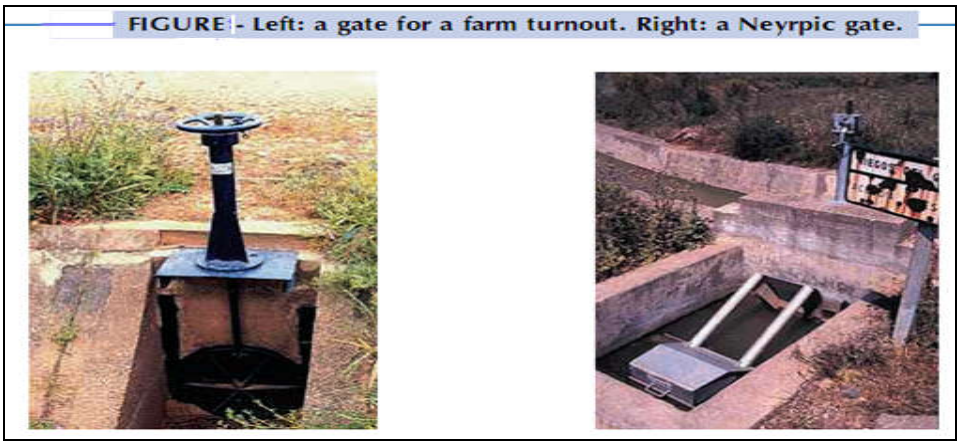

Figure_7: Water Control devices

2. *Flow measurement devices*. Discharges can be measured with weirs or flumes. Weirs are sharp-crested, overflow structures that are built across open canals. The water level upstream of the structure is measured using a measuring gauge. The discharge corresponding to that water level is then read from a table which is specific for the size and type of weir being used. Flumes consist of a narrowed canal section with a particular, well-defined shape. Like measurements with weirs, the water level upstream of the flume is a measure of the discharge trough the flume, and when the head has been measured the discharge can be obtained by reading the value on a diagram which is specific for the flume being used.

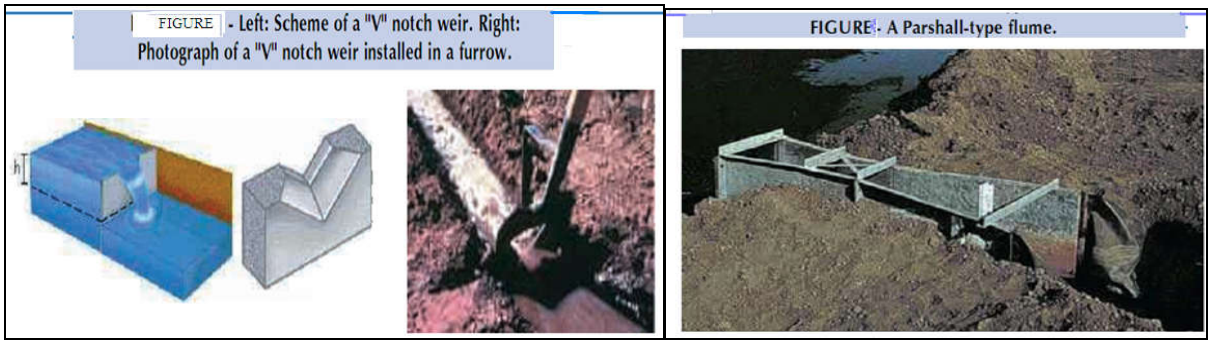

Figure_8: Flow measurement devices a) V-Notch **b) Parshal flume**

3. *Water application devices*.

Siphons and gated pipes are commonly used in surface irrigation. A siphon is a curved pipe filled with water and laid over the channel bank at any irrigation system. Gated pipes are used to control the water applied to individual furrows.

Figure_9: Water application devices

1.3. Setting up fields for gravity fed irrigation

Common preparation requirements and features are as follows

Prepare the area to be irrigated. This could be simple land preparation or involve the formation of planting beds.

- For best results, drip systems are used to irrigate level beds. If the drip tubes go uphill, downhill or around corners, the system will not give equal water flow from each dripping outlet.
- Construct the water container stand. Ensure that it can support the weight of the container and water when full.
- Mount the water container on the stand so that the water outlet is at the height necessary to provide the pressure required to operate the system.
- Mount the container water outlet, water filtration and flow regulator fittings.
- Lay the water distribution system components that connect the water container to the individual drip lines. Make sure that the open ends are closed to avoid foreign materials entering the pipe.
- Unroll the lines and lay them along the full length of each row of plants to be irrigated.
- Connect the drip lines with the water distribution system (header pipes).
- Flush the system to remove any foreign matter may have entered the pipe lines.
- Close the end of the drip lines.

- It must emphasize that any training or advice on the use of drip kit system should not only cover its actual installation and maintenance but also all aspects of growing vegetables under drought condition since the purpose is to increase farmers yield. Thus training and advice should include lessons about bed preparation and composting, transplanting, water irrigation management and pest and disease control.

1.4. Checking area for irrigation set up and taking action

The blocks can be demarcated (lay out) in the field. The assumption is made that the land has been cleared and soil preparation has been done, and that other infrastructure items, such as roads and waterways, has already been demarcated.

Care must be taken when laying out the irrigation blocks that it is done correctly and precisely, even if it may take a day or two longer to obtain an accurate lay out. Remember, the result will determine the lifespan of the irrigated crop. The same principles are used for demarcation of other types of irrigation systems.

The corners of the blocks are first pegged out roughly to see the relation of the blocks to one another. The lengths of the sides of the blocks are now measured on the irrigation design plan, and the scale of the plan is used to calculate the actual length. The scale is a ratio that shows the relation between the measurement on the plan and the actual distance on the ground. The corners of the blocks can now be marked precisely. Make sure the corners are in the right spot and that the pegs are driven in well. These corner-markers will be the used to lay out the rest of the block, so if they are wrong, the rest of the layout will also be wrong.

1.5. Checking water delivery mechanisms for irrigation set up and taking action

Plan irrigation activities and undertake pre-start Checks

In the same way that valves and fittings control water flow in pipes, there are various structures in channels that have a similar function. These include:

- gates to control the direction of flow of water
- checks and weirs to stop water flow and increase the height of the water level in the channel
- drop structures, where it is necessary to bring water to a channel lower in height
- Culverts, where access roads are required to cross the channel.

As part of the planning process for conducting gravity fed irrigation, you need to ensure that all these structures are in good working order. You should also check: the irrigation equipment and its availability for the allocated fields to be irrigated the availability of the water pumps, bores and other water delivery mechanisms.

Once these are all in working order and in place, you should position pipes and siphons as required and in accordance with enterprise standards.

The work crew should be briefed on the requirements of the irrigation activities to be undertaken and any other pre-start checks should be done before the irrigation activities start. These may include priming pumps, checking that there is sufficient fuel and lubricants available, and checking that gates and controls are in the correct position (either opened or closed, depending on the situation).

Ensure that the system is ready for watering without breakdown or interruption, by:

- checking the pumps and motors, including fuel, oil and water
- seeing that the channels are ready, with any breakouts having been repaired
- checking that gates are closed ready for the supply system to be filled to watering level
- ensuring that trash screens have been cleaned
- ensuring that all fields are ready to water, with siphons in place (or bay gates closed) and checks set to the correct level
- Checking that emergency overflows are operational.

1.6. Positioning and securing tarpaulins or other water control devices

Canal lining sheets that are extensively used by biotech farms and other establishments (see figure below). Range of canal lining sheets are made up of UV stabilized and rot & weather resistant materials. Quality material makes them durable and simple design enables easy set up. Available in different thickness and sizes, the sheets can also be customized as per the requirement of the client.

Figure_10: Canal lining sheets

1.3.2. Checking water delivery mechanisms for irrigation set up

Irrigation water is delivered to the basic irrigation unit by using the following delivering mechanism:

Pumping

Pump is the device which lifts water from deep elevated water level to the upper land surface or to irrigation field. But it is not always advisable to pumping water directly to field of irrigation. It justified only if the field to be irrigated is at higher place than the canal. For efficient operation of the pump, the water depth and discharge in the field channel must be comparatively large than all other methods.

Figure_11: Pump station

Siphons:

A siphon is a curved pipe, often made of a plastic such as PVC. The pipe or tube is filled with water and laid over the channel bank at any irrigation. Siphon tubes convey water over the canal bank in to the field or the furrows. Good water flow control is possible by changing the number of siphons, the diameter of the siphons or both

Disadvantage is the price of the pipes. Also, for efficient operation, the water level in the field channel needs to be some 10 cm above the field.

Figure_12: Irrigation using siphon

Gate intake

A gated intake structure is made of wood, masonry or concrete, and is equipped with a gate (like a door to a room)

It enables the farmer to control the water inflow.

Figure_13: Gate Intake

Self-Check # 1	**Written Test**

Name: _____ Date: _____

Directions: Answer questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Define surface irrigation. (5 point)
2. Describe different types of surface irrigation. (5 point)
3. Write different water control device. (5 point)

Note: Satisfactory rating – 15 points above Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.

2.1: Opening and shutting gates and/or valves

2.1.1: Introduction to flow control devices

Any device installed in a water supply system, in order to ensure that the water reaches the desired destination, at the proper time, in the required amount (the flow rate), and under the right pressure and head, is called a control appliance.

As such an appliance controls proper operation of water, selecting its type, size and placement is of uppermost importance and ought to be done with the full knowledge of the various features of the device and with complete understanding of the way it performs. Equally important is proper maintenance in order to ensure faultless and sound performance of the appliance.

Water control devices can be divided into three main classes:

- **Directional devices gates or valves:-** These serve to directly regulate the water flow. Installed in the intake outlet, turnouts and division boxes, pipeline, they enable starting or stopping the flow, and setting its rate, pressure, head and direction. Examples of such devices are the gate, stop valves, the check valves and the regulating gates or valves.
- **Measuring devices or valves:-** In order to ensure the appropriate flow regime, just regulating the flow is not enough. It is also necessary to obtain accurate information about flow parameters, so that adjustments can be made, as required, to achieve the desired flow conditions. Water and flow meters and pressure gauges belong to this group.
- **Auxiliary devices:-** These do not directly influence fluid flow, but ensure an undisturbed functioning of a system. To this group belong air valves and safety valves.

Water control devices	Types of control devices	Examples
Directional devices or valves	Gates	- Penstocks (Vertical Winches) - Sluice Gates - Flap Gates
	Shut-off valves (stop valves)	- Ball valves - Gate valves - Butterfly valves - Disk valves (globe, angle and oblique or Y valves) - Radial valves
	Check valves (non-return valves)	- Swing check valve - Parallel check valve
	Regulating valves	- Disk* valves (globe, angle and oblique or Y valves)

		- Radial valves
Measuring devices	Meters	- Water meters
		- Flow meters
	Gauges	- pressure gauges
Auxiliary devices	Air valves	
	Safety valves	
	Energy dissipaters	
	Drop structures	

2.2 Achieving and maintaining required head and water levels in head ditch

Required head and water levels in head ditch should achieve and maintain to ensure sufficient water flow and availability to crops:-

There are various factors which may influence the head and water levels in head ditch. Some of these factors may include;

- **Topography:** topography is a major factor affecting irrigation, particularly surface irrigation. Of general concern are the location and elevation of the water supply relative to the field boundaries, the area and configuration of the fields, and access by roads, utility lines e.t.c.

- **Soil type:-** In sandy soils water infiltrates rapidly. Earthen canal head ditches and furrows should be short, so that water will reach the downstream end without excessive percolation losses. In clay soils, the infiltration rate is much lower than in sandy soils. Furrows and head ditches can be much longer on clayey than on sandy soils.

- **Stream size: -** When larger stream sizes are available, water will move rapidly down the canals and so generally head ditches and furrows can be longer.

- **Irrigation depth:-** Applying larger irrigation depths usually means that head ditch can be longer as there is more time available for water to flow down the furrows and infiltrate.

- **Cultivation practice**:- When the farming is mechanized, furrows should be made as long as possible to facilitate the work. Short furrows require a lot of attention as the flow must be changed frequently from one block to the next.

- **Field size:-** It may be more practical to make the head ditch water level proportional to the irrigable area.

Structures used to control the head water level

Required head and water levels in head ditch can be achieved and maintained in the following structures;

Distribution control structures

Distribution control structures are required for easy and accurate water distribution within the irrigation system and on the farm.

Division boxes

Division boxes are used to divide or direct the flow of water between two or more canals or ditches. Water enters the box through an opening on one or more canals or ditches and flows out through openings on the other sides. These openings are equipped with gates

Turnouts

Turnouts are constructed in the bank of a canal. They divert part of the water from the canal to a smaller one. Turnouts can be concrete structures or pipe structures.

Checks

To divert water from the field ditch to the field, it is often necessary to raise the water level in the ditch. Checks are structures placed across the ditch to block it temporarily and to raise the upstream water level. Checks can be permanent structures or portable.

2.3 Performing basic operation of gravity fed irrigation system

2.3.1. Starting /opening required number of siphons

Starting a siphon:

The siphon must be **primed** (filled with water) before they will start reliably transferring water. However, once primed and positioned correctly, they will continue transferring water from the head ditch to the furrow.

The steps to starting a siphon are:

1. Place the head ditch end of the siphon beneath the water surface in the head ditch
2. Push the siphon into the water (leave the field end of the siphon open)

3. Close off the field end of the siphon with your free hand and pull this end away from the head ditch and towards the field (always leave the head ditch end submerged)
4. Repeat Step 3 until the siphon is filled with water (usually only 1 or 2 thrusts are needed depending on the amount of head available)
5. Once air is expelled you remove the seal formed by your hand so water will flow from the field end of the siphon and place it in the roto-buck (making sure the head ditch end remains submerged). Ideally the field end should be placed below the rotobuck water level.

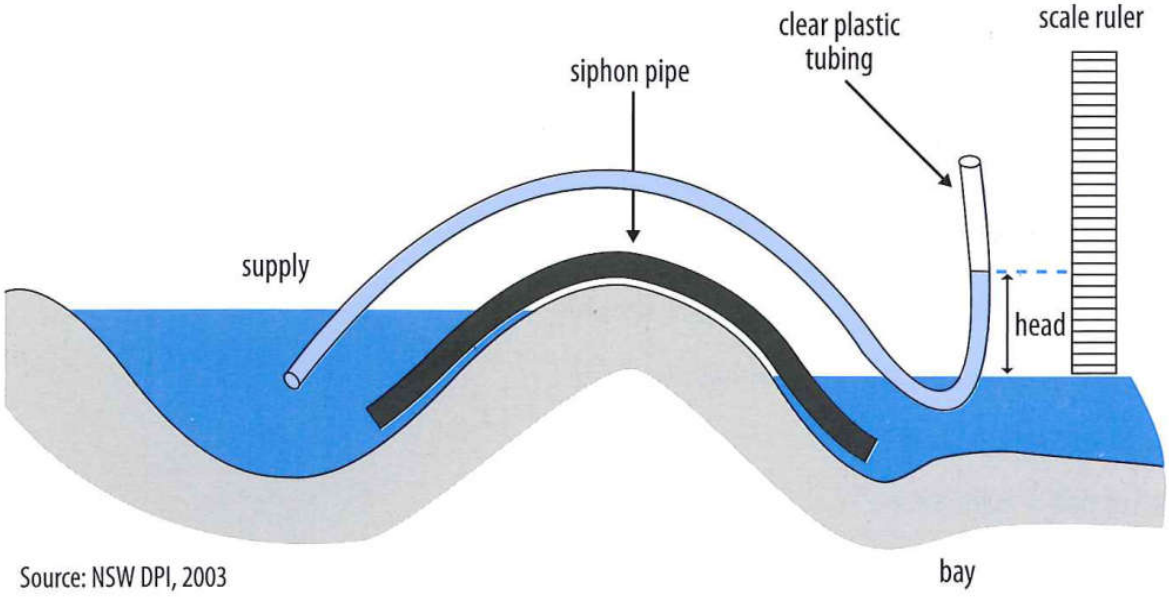

Figure_ 14:– A brickie's level in siphon

For siphons up to 75mm diameter and 4.3 meters long this is all easily done by one person without any other tools.

All siphons should be placed perpendicular to the head ditch. Placement of siphons at different angles to the flow in the head ditch causes preferential flow into some siphons that result in flow variations and uneven watering.

The flow rate of water into a head ditch determines how quickly water can be applied, and how much of the crop can be irrigated in a given time. It is important that the correct numbers of siphons are started in a set so that the water level in the head ditch remains static – the water entering the head ditch must equal the volume being applied by the siphons. Anything that alters

the flow or water into or out of a head ditch will affect the head and the effectiveness of the irrigation.

2.3.2: Monitoring progress of water flow in furrows

If the flow of water entering a head ditch is much greater than that being applied to the field through siphons the water level in the head ditch will rise. This can result in overtopping of the head ditch and possible breaches of the head ditch. If the water level in the head ditch is falling this will lower the available head and result in siphons stopping.

There are several possible causes of water level fluctuations in a head ditch. If this is observed you should immediately contact your manager to decide on a course of action.

2.3.3: Lifting siphons where irrigation

Changes in cross-sectional area of siphons will also affect flow rate. Walking on siphons or accidentally pushing them into the ground when starting them may cause kinks, reducing their cross-sectional area. The cross-sectional area may also vary between different brands of siphons so take care when replacing siphons or substituting ones within a set or field. In order to avoid siphons must be lifted where irrigation is complete.

2.4. Carrying out equipment shift and marking irrigation change

2.4.1. Introduction to shifting irrigation

Ideally shifting and marking of irrigation system and equipments is highly depending on the timing of irrigation.

Timing of irrigation

Crop should be planted into a seedbed which has adequate soil moisture. If there has been inadequate rainfall, irrigation may be applied prior to planting to ensure there is adequate root-zone moisture – this is referred to as a pre-irrigation.

In situations where soil moisture may be marginal following planting it may be necessary to apply an irrigation after planting to assist with establishment of the crop – this is called ‘watering up’ the crop.

The number of in-season irrigations used after the crop has established varies with location, the frequency of rainfall and soil type – on average there may be further four to five irrigations, at ten day intervals.

The time the crop really needs water the most is during that time. This is when the temperatures and evaporative demand is highest, and the fruit on the plant (referred to as bolls) is starting to mature and fill. The timing of irrigation is crucial to achieve high yields (quantity) and high quality crops.

2.4.2. Implementing irrigation shifts:

The irrigation time is the time needed to supply the required irrigation depth in mm. The irrigation time depends on the stream size l/sec, the required irrigation depth in mm and the size of the field to be irrigated in ha. The following formula is used to determine the irrigation time

$$\text{Irrigation time (hours)} = \frac{2.78 \times \text{irrigation depth(mm)} \times \text{field size (ha)}}{\text{Stream size l/sec}}$$

Example: if for example the required irrigation depth is 50mm the available stream size is 20l/sec and the size of the field is 75 x 50m, the irrigation time is calculated as follows:

Step 1: determine the field size in hectares

The size is 75m x 50m = $3750m^2$ = $3750m^2/10000m^2$ = 0.375 ha

Step 2: determine the irrigation time

$$\text{Irrigation time (hours)} = \frac{2.78 \times \text{irrigation depth (mm)} \times \text{field size (ha)}}{\text{Stream size l/sec}}$$

$$= \frac{2.78 \times 50 \text{ mm} \times 0.375 \text{ ha}}{20 \text{l/sec}} = 2.6 \text{ hours} = 156 \text{ minutes}$$

Applying the quarter time rule it would mean that the water has to reach the end of the furrow or cover the basin in 156/4 = 39 minutes. If it takes longer the stream size per furrow or basin has to be increased or the furrow length or basin size reduced.

Self-Check # 2	**Written Test**

Name: _____ **Date:** _____

Directions: ***Answer all the questions listed below.***

1. Describe the factors which may influence the head and water levels in head ditch*? (10 points)*
2. Write at least five structures *used to attain* head and water levels in head ditch*? (10 points)*

Note: **Satisfactory rating – 10 points** **Unsatisfactory – below 10 points**

OPERATION SHEET # 1	**LO#2. Starting /opening Siphons**

Title: Starting /opening siphons

Objectives:

At the end of this session / activity the trainee will be able to:

- Undertake starting /opening siphons

Equipment, Tools and Materials:

- Siphon tubes with 75mm diameter

Procedure:

Procedures of starting /opening siphons:

1) Dip the siphon in water and fill completely with water,
2) Close one end of the tube tightly with the palm of the hand,
3) Keep the other end dipping in water, and
4) Take out the close end and release at the ground surface.
5) Lifting siphons where completing irrigation

Quality Criteria:

- The land must be cleared first before leveling start
- Furrows must be properly prepared

INFORMATION SHEET#3	LO#3:Clean and Store Irrigation Equipment as Required

3.1. Cleaning and preparing equipment

Irrigation Equipment is cleaned and prepared for storage, as necessary. So you have to make it a priority to take a good look at your irrigation equipment before storing it. If possible, remove equipment from the field and store it in a clean, dry, covered storage area.

Here are a few general tips for preparing your irrigation system for storage:-

Travelers

- Drain the hose, use compressed air if possible (rolling the hose up dry is an option however, it can cause damage from miswrapping)
- Check hose for any cracks, damage or loose connections
- Open gate valve and drain plug on turbine assembly
- Complete all lubrications recommended in your operation and maintenance manual
- Disassemble, clean, inspect and re-pack the main chassis wheel bearings
- Touch up any scratched, chipped or rusted areas of chassis
- Check tires for wear and cracks
- Reduce tire pressure to 25 psi for off-season storage
- Change engine oil
- Clean or replace engine air filter

Pumps

- Flush suction and discharge lines
- Check for leaks and replace worn gaskets
- Remove lowest plug on pump and drain casing
- Complete all lubrications recommended in your operation and maintenance manual

- Clean surface of pump
- Prime and paint any exposed metal
- Seal all pump openings to keep out dirt, small animals or insects

3.2 Loading Equipments

Loading is way of taking tools, equipments, materials to transporter machine for storage.
Transport may include- utility, flatbed trucks, pipe trailer, or four-wheel.

3.3 Storing Equipments

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.

Self-Check #3	Written Test

Name: _____ ***Date:*** _____

Direction 1: Answer the following questions

1. Why do we prepare irrigation equipment for cleaning?(5pts)
2. Why do we prepare irrigation equipment for storage?(5pts)

Note: Satisfactory rating: 10 and above pts. ***Unsatisfactory rating: below 10pts***

Lap Test	Practical Demonstration

Name: _____ Date: _____

Time started:_____ Time finished:____

Instructions:

☞ You are required to perform the following activity:

- ✓ Task_1: Perform starting/shifting siphon:
- ✓ Task_2: Clean and Store Irrigation Equipment as Required.
- ✓ Task_3: Opening and shutting gates and/or valves.