Ethiopian TVET-System

Crop Production Level – I

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Training Module –Learning Guide 60-64

Unit of Competence: -Assist the Operation of Gravity Fed and Pressurized Irrigation Systems

Module Title:-Assisting the Operation of Gravity Fed and Pressurized Irrigation Systems

TTLM Code: AGR CRP2 M14 0919v1

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Module Title:-Assisting the Operation of Gravity Fed and Pressurized Irrigation Systems

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This module includes the following Learning Guides

LG 60 Set Up Of Movable Irrigation Components

LG Code: AGR CRP2 M14 LO 01-LG-60

LG 61: Set Up Field for Gravity Fed Irrigation

LG Code: AGR CRP2 M14 LO 02-LG-61

LG 62: Carry out gravity fed irrigation operations

LG Code: AGR CRP2 M14 LO 03-LG-62

LG 63: Carry out pressurized irrigation operations

LG Code: AGR CRP2 M14 LO 04-LG-63

LG 64: Clean and store irrigation equipment

LG Code: AGR CRP2 M14 LO 05-LG-64

Instruction Sheet	Learning Guide-60

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

- Handling irrigation equipment safely
- Positioning irrigation equipment in accordance with enterprise requirements
- Checking and acting Irrigation components in accordance with enterprise policy and procedures.
- assembling and joining Irrigation system components
- Checking Water outlets in accordance with enterprise practices

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 –**

- Handle safely Irrigation equipment accordance with OHS practices.
- Assemble and join Irrigation system components

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the information “Sheet
4. Accomplish each “Self-check respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to the next or “Operation Sheet
6. Do the “LAP test”

Information Sheet-1	Handling irrigation equipment safely

1.1. Irrigation equipment is handled safely in accordance with OHS practices.

What is irrigation?

Irrigation is the artificial application of water to the soil for the purpose of crop production. Irrigation water is applied to supplement rainfall. In many areas of the world, the amount and timing of rainfall are not adequate to meet the moisture requirement of crops and so irrigation is necessary to meet the needs of food and fiber designed to allow farming in arid and semi-arid regions to reduce drought. The increasing need for crop production for the growing population is causing the rapid expansion of irrigation throughout the world.The main principle of irrigation is to provide the root zone of the crop with usable amounts of water during periods of need. Application systems accomplish this goal by delivering irrigation water to a field and then distributing it within the field. The size and type of an irrigation system is primarily dependent on the available water source.Irrigation components may include- pumps, pipes, valves (including solenoids), and sprinkler heads/emitters.Irrigation systems may range from manual operation and monitoring to fully automated with computer control and monitoring.

Portable Systems.

In Maine, these include many variations of portable components including pumps, transmission piping, and distribution piping. The difference between fixed or portable (moveable) irrigation systems is the type of piping network used to supply water to the irrigation application hardware.The most common portable systems require that the transmission and distribution piping be moved with each application. While this may work well on small farms where fields are located close together, this system is very labor-intensive for larger farms that may have difficulty keeping up with plant demand during peak consumptive-use periods.In addition, portable piping systems require large quantities of additional pipe to be available to guarantee that transmission and distribution are ahead of actual irrigation.

1.2. Proper use of tools, materials and equipment

Tools, equipment and machineries are selected consistent with the requirements of the job. Select the right tool - not only for its function, but also for its length and weight to fit you.
Before each use, inspect your lawn and garden tools whether they are in proper condition or not. If the product is damaged, don't use it and don't attempt to make repairs yourselfEquipment, tools and materials should be prepared pre-season for effective operation in accordance with design specifications and enterprise standards.Mechanical equipment is serviced in accordance with the operator's manual or as directed.Use of personal safetydevices/clothing-Before using any tool or appliance, read and follow the manufacturer's use and care instructions that come with the product.

Emergency procedure- identifies physical and health hazards in the workplace.Physical hazards include moving objects, fluctuating temperatures, high intensity lighting, rolling or pinching objects and sharp edges. Health hazards include overexposure to harmful dusts, chemicals or radiation. Handling hazards-Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. **What is irrigation(3)**
2. **List the importance of irrigation (2)**

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Positioning irrigation equipment in accordance with enterprise requirements

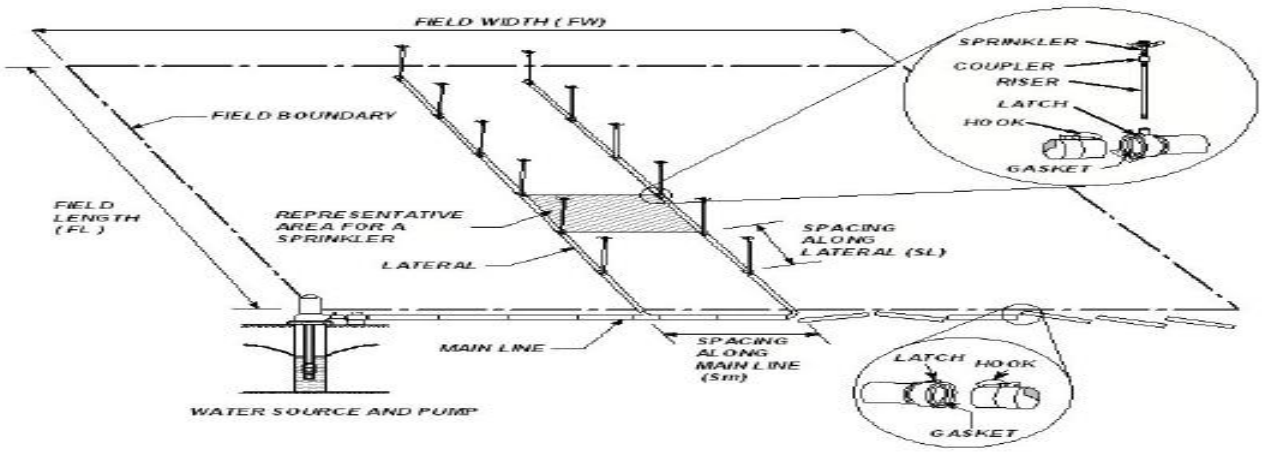
2.1. Irrigation equipment is positioned.

Figure: 1. sprinkler and drip irrigation

sprinkler irrigation

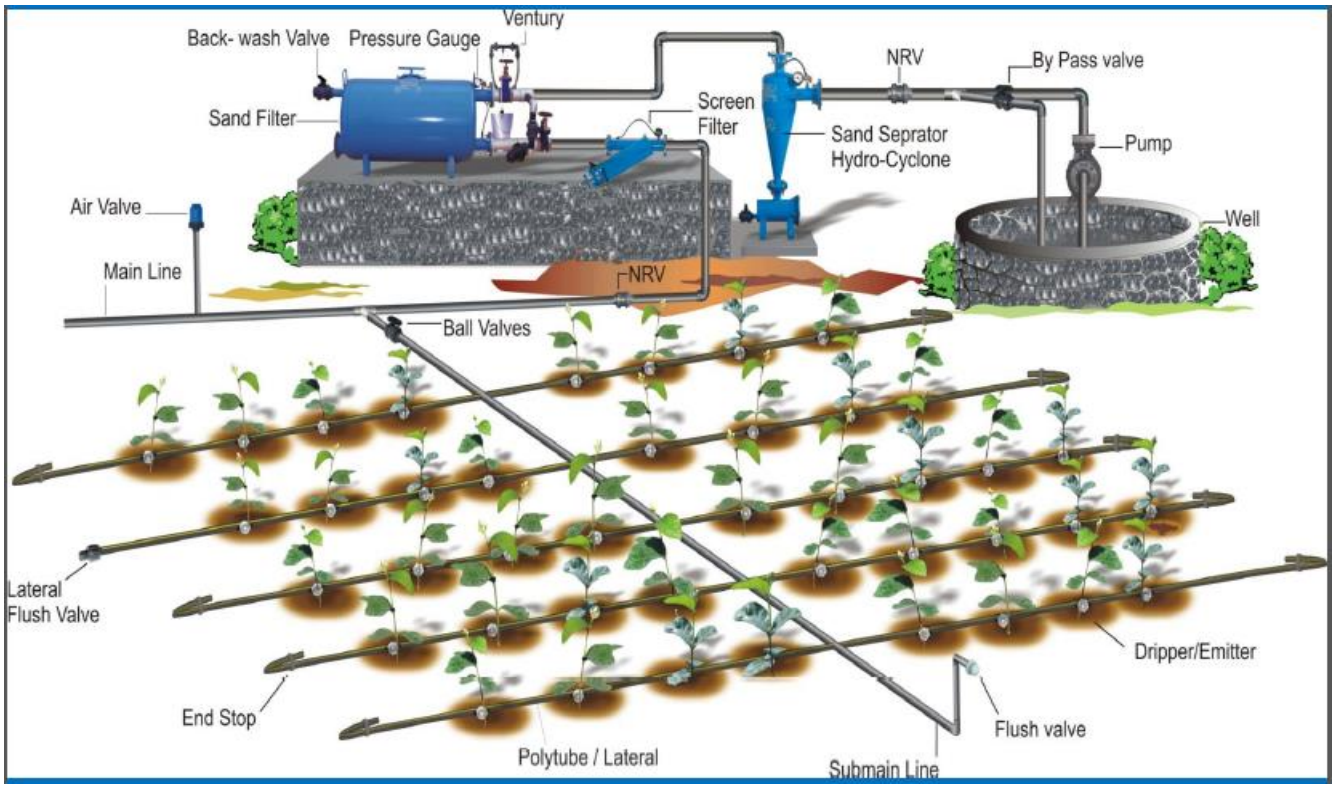
A typical sprinkler irrigation system consists of the following components: Pump unit- The pump unit is usually a centrifugal pump which takes water from the source and provides adequate pressure for delivery into the pipe system. The mainline and sub mainlines - are pipes which deliver water from the pump to the laterals. Laterals- deliver water from mainlines or sub mainlines to the sprinklers. They can be permanent but more often they are portable and made of aluminum alloy or plastic so that they can be moved easily. It consists of a system of lightweight aluminum or plastic pipes which are moved by hand.

A sprinkler irrigation system generally includes sprinklers, laterals, submains, main pipelines, pumping plants and boosters, operational control equipment and other accessories required for efficient water application. In some cases, sprinkler systems may be pressurized bygravity and therefore pumping plants may not be required. Figure 1



Drip or trickle irrigation

is one of the latest methods of irrigation, which is becoming increasingly popular in areas where there is water scarcity and salt problem. It allows water to be applied uniformly and slowly to the plant so that essentially all the water is placed in the root zone. In drip irrigation conventional losses, deep percolation, runoff, and soil water evaporation are minimized. Drip irrigation is categorized according to their placement in the field: surface drip system – water is applied directly to the soil surface, sub surface drip irrigation system- water is applied below the soil surface through perforated pipes. In this method, irrigation water is accomplished by using small diameter plastic lateral lines and a device called emitter or dripper at selected spacing to deliver water to the soil surface near the base of the plant (Black, 1976). Figure-2



The irrigation installer shall be:

• Before commencing/beginning installation, verify that water tap/ valves etc. /, flow rate and pressure meet design criteria.

• Install the irrigation system's components according to the design specifications and manufacturer's published performance standards, If a design does not exist, then go no further until one is created.

• Where deviations from the design are required (for example, adding sprinkler heads to an area larger than the plan shows), consult with the designer prior to making the change to ensure that the change is within design performance specifications.

• Furnish/provide record drawings to the owner of the system. The record drawings shall describe the system layout and components including all changes from the original design.

• Test the irrigation system to verify that the system meets the design criteria.

• Perform an irrigation audit using an accepted procedure and provide the end user (or owner) with system specifications and a zone performance summary report that includes individual zone precipitation rates in inches per hour.

• Explain to the end user (or owner) the location and operation of the controller, valves, sensors, pressure regulators, backflow device and sprinkler heads. Educate/train the owner on features and capabilities of the system including the maintenance requirements.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below.

1. List the type of pressurized irrigation?(5)
2. Write down the component part of each type?(5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory – below-5 points**

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 2	Positioning irrigation equipment in accordance with enterprise requirements

- **Purpose**: to identify sprinkler and drip irrigation components.
  - **Equipment, Tools and Materials: set of sprinkler and drip irrigation**

    - Main lines and sub mains
    - Laterals,
    - Emitters/drippers and sprinkler heads
    - End line
    - End plug
    - Different fittings/ valves, tee and head controllers, adaptors, ball valve, elbow etc./
    - PPE

- **Procedure:**

  1. Use PPE
  2. Prepare all the tools and materials
  3. Identify the different parts of the systems
  4. Check the components if they are factional
  5. Identify the different parts of the systems
  6. After identifying the components store the components properly

- **Precaution:** Use PPE, careful not to damage the components

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 30min.

Task 1. Identifying the components part of both pressurized irrigation?

Information Sheet-3	Checking and acting Irrigation components

3.1. Checking and takingaction on irrigation components.

Gravity fed irrigation: Usually the land in an area that uses irrigation is flat (often on a flood plain) allowing the water to be easily moved from the natural source to the irrigated area. That means you don't have to pump water up and down big hills, which requires expensive mechanical pumps.Surface irrigation systems, such as furrow and level basin systems, can apply water very uniformly if the irrigation area is properly selected, designed and operated. These systems work best on soils which contain large percentages of clay and silt.

- **Action** may include :

Remove, repair, replace or clean components. It may also include bleeding solenoid valves, lubrication and priming pumps.

- Irrigation equipments should be checked for efficient operation.
- Random checks of output from emitters throughout the system should be carried out on a regular basis.

➢ 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
   - An 880 gal container full weighs 4 tons
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 such as starting with a 2ft line at the base of the reservoir then decreasing the size every 1-4ft so that it would then be a 1ft, 6in, 3in, 1in, 1/2in, down to the 1/8in emitters in the drip lines

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 that can be purchased at any garden supply store.

3.2. Gravity feed type

Gravity fed irrigation systems may includeborder check, furrow irrigation, hillside flooding, andbasin irrigation .Border check systems may be either permanent or temporary earth, plastic or concrete devices for insertion in a drain for reticulating water, contour banks used to collect and distribute water along the perimeter of an irrigation plot, contour banks within a plot to collect/ distribute water, or larger scale systems to stop water exiting one area to another.

- Gravity fed systems may range from manual operation and monitoring to fully automated with computer control and monitoring.

Basin irrigation

Basin irrigation is the most common form of surface irrigation, particularly in regions with layouts of small fields. If a field is level in all directions, is encompassed by a dyke to prevent runoff, and provides an undirected flow of water onto the field, it is herein called a basin. A basin is typically square in shape but exists in all sorts of irregular and rectangular configurations. It may be furrowed

or corrugated, have raised beds for the benefit of certain crops, but as long as the inflow is undirected and uncontrolled into these field modifications, it remains a basin.

- **Border irrigation**

Border irrigation can be viewed as an extension of basin irrigation to sloping, long rectangular or contoured field shapes, with free draining conditions at the lower end. Water is applied to individual borders from small hand-dug checks from the field head ditch. When the water is shut off, it recedes from the upper end to the lower end. Sloping borders are suitable for nearly any crop except those that require prolonged ponding.

- **Furrow irrigation**

Furrow irrigation avoids flooding the entire field surface by channeling the flow along the primary direction of the field using 'furrows,' 'creases,' or 'corrugations'. Water infiltrates through the wetted perimeter and spreads vertically and horizontally to refill the soil reservoir. Furrows are often employed in basins and borders to reduce the effects of topographical variation and crusting. Furrows provide better on-farm water management flexibility under many surface irrigation conditions. The discharge per unit width of the field is substantially reduced and topographical variations can be more severe. A smaller wetted area reduces evaporation losses.

Furrows provide the irrigator more opportunity to manage irrigations toward higher efficiencies as field conditions change for each irrigation throughout a season. This is not to say, however, that furrow irrigation enjoys higher application efficiencies than borders and basins.

- **Any variations in output and distribution could be due to**:
    - incorrect pressure in the system
    - incorrect selection of components
    - wear in the components
    - blockages in the components
    - Faults/breakages in the components.

Repair or replace

Consider the following points:

- Components need to be replaced if they can't be repaired
- Consider replacing older components rather than repairing. If similar components in a system are starting to break down, consider replacing them all rather than repairing them.
- Repairing or replacing depends on costs of repairs and labor compared with costs of replacement parts and installation.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

- **List the component part of gravity feed type (5)**

Note: **Satisfactory rating -2. 5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 3	Checking and acting Irrigation components

Construct basin irrigation

Purpose: to provide the trainee with the skill of designing basin system.

Equipment, Tools and Materials:

- Tape meter
- String ,
- Spade, hoe, rake, shovel
- Peg
- PPE

Procedure:

- Use PPE
- Prepare all the tools and materials
- Lay out the area
- Cultivate and label the area
- Construct the bunds of the basin
- Level the basin
- Clean the tools and materials after the completion of the operation
- Store the tools and materials

Precaution: Use PPE

Quality Criteria:

- lay outing must be carefully done, level the basin properly

❖Trainees use PPE

Operation sheet # 3

Construct furrows irrigation

Purpose: to provide the trainee with the skill of designing furrow system.

Equipment, Tools and Materials:

- Tape meter
- String ,
- Spade, hoe, rake, shovel
- Peg
- PPE

Procedure:

- Use PPE
- Prepare all the tools and materials
- Lay out the area
- Cultivate and level the area
- Construct the furrows according to the given crop spacing
- Clean the tools and materials after the completion of the operation
- Store the tools and materials

Precaution: Use PPE

Quality Criteria:

- lay outing must be carefully done and ridges must be constructed at the right spacing of the crop
- Trainees use PPE

JOB SHEET # 2

A. Procedures:

Construct surface irrigation methods	Demonstration Checklist	
	Yes	No
1.Use PPE		
2. Prepare all the tools and materials		
3. Lay out the area		
4. Cultivate and label the area		
5. Construct both systems		
6. Level the basin		
7. Clean the tools and materials after the completion of the operation		
8. Store the tools and materials		

D. Safety Precaution:

- ❖ Use PPE
- ❖ Use tools and materials properly and store it

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.Construct furrows irrigation?

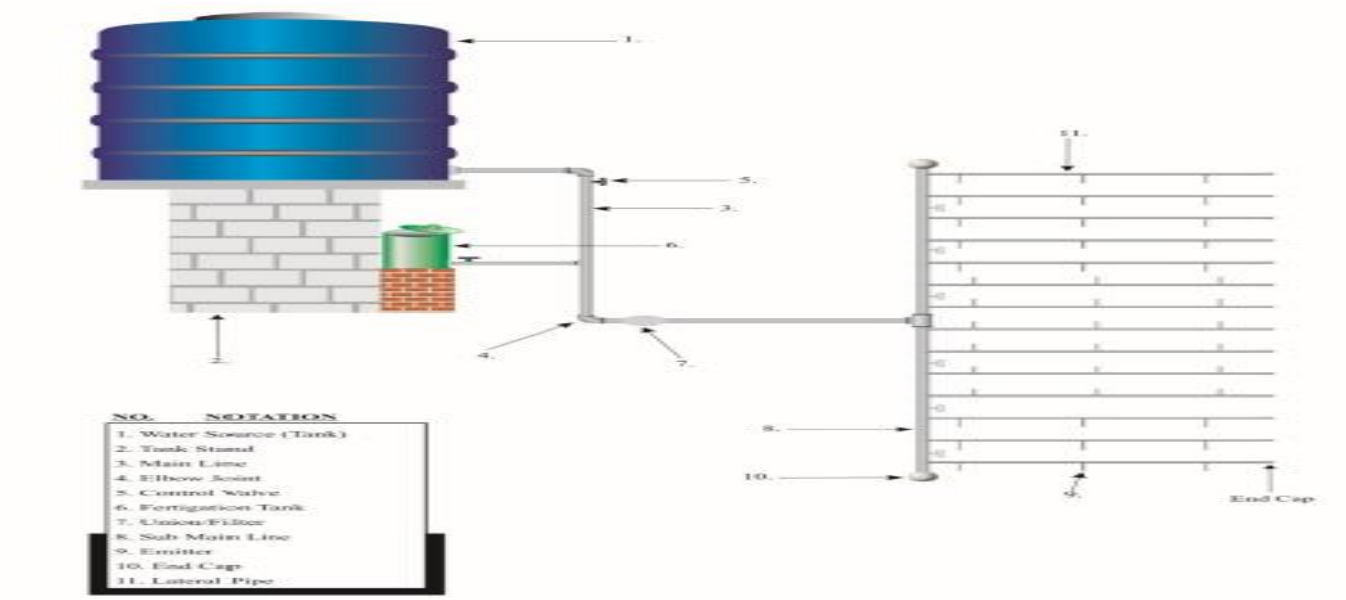
Information Sheet-4	Assembling and joining Irrigation system components

4.1. Assemble and join irrigation system components where required.

The lateral pipe is located in the field until the irrigation is complete. The pump is then switched off and the lateral is disconnected from the mainline and moved to the next location. It is re-assembled and connected to the mainline and the irrigation begins again. The lateral can be moved one to four times a day. It is gradually moved around the field until the whole field is irrigated. This is the simplest of all systems. Some use more than one lateral to irrigate larger areas.

4.2 Description of the Small Farm Drip Irrigation System

The materials that were used for the construction and installation of the small farm gravity drip irrigation system were: plastic water tank, mainline pipes, sub-mainline pipe, lateral pipes, water filter, valves/regulators, and micro emitters (improvised). The system was a complete irrigation unit, all the pipes were made of PVC and it operated by gravity from a plastic tank of 2000 litres placed 2.8 m above the ground level so that the system will have enough head for water pressure. It has a fertigation chamber attached to the mainline. The lateral lines which were connected to the submain lines were laid along the crop rows and micro emitters installed at spacing of 30cm. There is a drain tap at the bottom of the water tank for frequent flush out and cleaning from suspended solid particles. It did not use any external power for normal operation.figure-3



4.3. Installation of the Small Farm Drip Irrigation

The installation of the small farm gravity drip system was divided into three stages, this includes the followings:(i) Construction of the water tank stand, fertigation chamber stand and installation of the tanks(ii) Laying of pipes and fittings(iii) Testing of fittings and etermination of emitter flow rateA water tank stand of burnt bricks was constructed at a height of 2.8 m above ground level to achieve minimumpressure requirements. Water was supplied into the water tank (water source) by a water tanker vehicle. The systemwas connected to the water source and a simple filter was screwed into a union and connected to the mainline pipeto prevent clogging of emitters. Fertigation chamber on a stand of 1.00 m high was connected to the system throughthe main line pipe. Six control valves were installed on the sub mainline. The laterals were attached to the submainline slopping down the ground along the plant rows. Plates 1– 5 show the construction of the stands, laying andfixing of fittings into the pipes. Figure-4

Plate 1: Water source stand

Plate 2: Fertigation chamber and stand

Plate 3: Connecting lateral pipes

Plate 4: Monitoring flow rate of the emitters

Plate 5: Monitoring flow rate uniformity

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- **Irrigation systems generally consist of three major components**:
  - **Pumps**- A major component of any irrigation system is the pump. Water must be delivered to all sprinklers or emitters at the proper pressure and flow rate.
  - **Piping**- Piping is separated into two categories: transmission piping and distribution piping

    Transmission piping is the largest diameter piping required to transport water long distances without causing excessive pressures or "head loss".

    Distribution piping moves the water to the application hardware (nozzles, emitters, etc.). These pipes are generally smaller in diameter than transmission piping to handle the lower flow rates, but must be large enough to ensure that the pressure at the end of the system is adequate for the applicator

Note. Improper sizing of pumps and piping is a major cause of under- or over application of water. This is especially true for portable systems where pumping distance and changes in elevation vary from field to field

Application hardware- There are many choices for application hardware but, in general, the technology can be grouped into three basic delivery methods for the in-field distribution of water:

- big guns (includes center pivots),
- small sprinklers, and
- Micro-irrigation (spray, drip or trickle).

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

1. Listthe materials that were used for the construction and installation of the small farm gravity drip irrigation system(10)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below -5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Checking Water outlets in accordance with enterprise practices

5.1. Water outlets are checked in accordance with enterprise practices.

Outlets may include-drip lines, pipes, risers, valves, sprinklers and emitters .Damage or faulty pumps, valves, fittings, main/sub mains, laterals, electrical components and other materials and tools should be recorded and reported, and action taken to effect repairs.

- **Check valves, slopes, hillsides**:

Install check valves if the drip system is on a hillside of slope to prevent the water in the tubes from draining out through the lowest emitter each time the system stops running.

Flush valves and end caps

Install a flush valve or end cap at the end of each drip tube. Automatic flush valves are available; however manual flush valves are preferable.

Emitters & Sprinklers

When a zone comes on, the water flows through the lateral lines and ultimately ends up at the irrigation emitter (drip) or sprinkler heads. Many sprinklers have pipe thread inlets on the bottom of them which allows a fitting and the pipe to be attached to them. The sprinklers are usually installed with the top of the head flush with the ground surface. When the water is pressurized, the head will pop up out of the ground and water the desired area until the valve closes and shuts off that zone. Once there is no more water pressure in the lateral line, the sprinkler head will retract back into the ground. Emitters are generally laid on the soil surface or buried a few inches to reduce evaporation lose.

5.2. Checks of water, power, fuel and lubricants

There will always be pre-start checks that you need to make on your irrigation system.Checks of water, power, fuel and lubricants must be made to ensure that all are available and the control system is functional.Pumps will need to be primed as necessary and valves and controls are opened and closed as directed.Pressure and flow testing equipment may need to be calibrated.Refer to enterprise procedures and the operator's manuals for other pre-start checks that need to be undertaken.Your trainer will go through all the necessary pre-start checks for the system that you are using in your enterprise.

Self-Check -5	**Written Test**

Directions: Answer all the questions listed below.

1.How to handle irrigation equipment (5)

2. What will be check in irrigation components (5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below -5 points**

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 5	**Checking and acting Irrigation components**

- **Method of identify sprinkler and drip irrigation components.**

Equipment, Tools and Materials: set of sprinkler and drip irrigation

- Main lines and sub mains
- Laterals,
- Emitters/drippers and sprinkler heads
- End line
- End plug
- Different fittings/ valves, tee and head controllers, adaptors, ball valve, elbow etc./
- PPE

- **Procedure:**

7. Use PPE
8. Prepare all the tools and materials
9. Identify the different parts of the systems
10. Check the components if they are factional
11. Identify the different parts of the systems
12. After identifying the components store the components properly.

- **Precaution:** Use PPE, careful not to damage the components

Quality Criteria:

- Trainees identify the different components properly
- Trainees use PPE

B. **JOB SHEET #**

- Procedures:

Simple Layering Procedure	Demonstration Checklist	
	Yes	No
1. Prepare tools and materials		
2. Use PPE		
3. Prepare all the tools and materials		
4. Identify the different parts of the systems		
5. Check the components if they are functional		
6. Identify the different parts of the systems		

B. Safety Precaution:

1. Use PPE
2. Be careful not to damage the components

Instruction Sheet	Learning Guide -62

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

- Handling irrigation equipment safely
- Positioning irrigation equipment's
- Checking rot buck area for irrigation set up
- Checking pumps, bores and other water delivery mechanisms
- Positioning and securing tarpaulins or other water control devices

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 –**

- Handle and positioning Irrigation equipmentsafely in accordance with OHS practices.
- Check rot buck area for irrigation set up and take action asrequired.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number below3 to 6.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1,2,3,4,5" **in page:**34,37,39,41 and 44
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Handling irrigation equipment safely

1.1. Safely Handling of Irrigation Equipment

No farm can function without farm equipments. They save valuable time and are essential to agricultural productivity. They also represent an ever-present danger to the people who operate them. There are a host of hazards that makes agricultural machinery the leading cause of injury and death on farms.Safe equipment/machinery operation primarily depends on how you operate the equipment/machine. Equipments/Machines are inanimate objects; they cannot think, reason, or adapt to meet the needs of people. The responsibility for machinery safety rests with you. Just as we are told to drive defensively when operating an automobile, machine operators should always be thinking ahead and anticipating potential hazards. When examining Irrigation equipments, machineries and workshop areas take notice of the common hazards associated with the equipment and tools on farms. Train workers to use extra caution and handling when working with identified hazardous areas of equipment.

- **Irrigation equipments/machineries are handled safely in accordance with OHS practices as follow:**
- Turn off the equipment and take the key before making any repairs or adjustments.
- Block raised hydraulic equipment. Do not depend on hydraulic systems to keep the implement or attachment in a raised position.
- Ensure adequate working space for the job
- Provide and use appropriate personal protective equipment
- Check to ensure there is sufficient lighting and ventilation
- Keep walkways and exits clear
- Maintain required firefighting and first aid equipment in the work area.
- Ensure fuel, compressed air, electrical or other services are safely installed and maintained.
- Modify machinery considered hazardous or remove it from service if it cannot be made safe to operate.
- Ensure guarding is safely replaced after maintenance jobs are completed.
- Have guards designed and fitted for older machinery and newly purchased used machinery.
-

1.2. Criteria in the selection of a suitable irrigation method

- **Natural conditions**

The natural conditions such as soil type, slope, climate, water quality and availability, have the following impact on the choice of an irrigation method:

- **Soil type:**

Sandy soils have a low water storage capacity and a high infiltration rate. They therefore need frequent but small irrigation applications, in particular when the sandy soil is also shallow. Under these circumstances, sprinkler or drip irrigation are more suitable than surface irrigation. On loam or clay soils all three irrigation methods can be used, but surface irrigation is more commonly found. Clay soils with low infiltration rates are ideally suited to surface irrigation.

When a variety of different soil types is found within one irrigation scheme, sprinkler or drip irrigation are recommended as they will ensure a more even water distribution.

- **Slope:**

Sprinkler or drip irrigation are preferred above surface irrigation on steeper or unevenly sloping lands as they require little or no land leveling. An exception is rice grown on terraces on sloping lands.

- **Climate**:

Strong wind can disturb the spraying of water from sprinklers. Under very windy conditions, drip or surface irrigation methods are preferred. In areas of supplementary irrigation, sprinkler or drip irrigation may be more suitable than surface irrigation because of their flexibility and adaptability to varying irrigation demands on the farm.

- **Water availability**:

Water application efficiency is generally higher with sprinkler and drip irrigation than surface irrigation and so these methods are preferred when water is in short supply. However, it must be remembered that efficiency is just as much a function of the irrigator as the method used.

Water quality: Surface irrigation is preferred if the irrigation water contains much sediment. The sediments may clog the drip or sprinkler irrigation systems. If the irrigation water contains dissolved salts, drip irrigation is particularly suitable, as less water is applied to the soil than with surface methods. Sprinkler systems are more efficient than surface irrigation methods in leaching out salts.

- **Type of crop**

Surface irrigation can be used for all types of crops. Sprinkler and drip irrigation, because of their high capital investment per hectare, are mostly used for high value cash crops, such as vegetables and fruit trees. They are seldom used for the lower value staple crops.

Drip irrigation is suited to irrigating individual plants or trees or row crops such as vegetables and sugarcane. It is not suitable for close growing crops (e.g. rice).

- **Type of technology**

The type of technology affects the choice of irrigation method. In general, drip and sprinkler irrigation are technically more complicated methods. The purchase of equipment requires high capital investment per hectare. To maintain the equipment a high level of 'know-how' has to be available. Also, a regular supply of fuel and spare parts must be maintained which - together with the purchase of equipment - may require foreign currency.

Surface irrigation systems - in particular small-scale schemes - usually require less sophisticated equipment for both construction and maintenance (unless pumps are used). The equipment needed is often easier to maintain and less dependent on the availability of foreign currency.

- **Previous experience with irrigation**

The choice of an irrigation method also depends on the irrigation tradition within the region or country. Introducing a previously unknown method may lead to unexpected complications. It is not certain that thefarmers will accept the new method. The servicing of the equipment may be problematic and the costs may be high compared to the benefits.

Often it will be easier to improve the traditional irrigation method than to introduce a totally new method.

- **Required labour inputs**

Surface irrigation often requires a much higher labour input - for construction, operation and maintenance - than sprinkler or drip irrigation. Surface irrigation requires accurate land leveling, regular maintenance and a high level of farmers' organization to operate the system. Sprinkler and drip irrigation require little land leveling; system operation and maintenance are less labour-intensive

- **<u>Basin, border or furrow irrigation</u>**

The section discusses some of the important factors which should be taken into account when determining which surface irrigation method is most suitable gain, it is not possible to give specific guidelines leading to a single best solution, each option has its advantages and disadvantage.

❖ Factors to be taken in to account include:

- Natural circumstances(slope, soil type)
- Type of crop
- Required depth of irrigation application
- Level of technology
- Previous experience with irrigation
- Required labor inputs

- **Natural conditions**

  Flat lands, with a slope of 0.1% or less, are best suited for basin irrigation: however, the amount of land leveling can be considerable.Furrow irrigation can be used on flat land (short, near horizontal furrows) and on mildly sloping land with a slope of maximum 0.5% on steeper sloping land, contour furrows can be used up to maximum land slope of 3%. A minimum slope of 0.3% is recommended to assist drainage. Border irrigation on can be used on sloping land up to2% in sandy soil and5% on clay soil. A minimum slope of 0.05%is recommended to ensure adequate drainage. Surface irrigation may be difficult to use on irregular slopes as considerable land leveling may be required to achieve the required land gradients.All soil types, except coarse sand with an infiltration rate of more than 30mm/hour, can be used for surface irrigation. If the infiltration rate is higher than 30mm/hour, can be irrigation should be used.

- **Type of crop**

  Paddy rice is always grown in basins; many other crops can also be grown in basin, e/g maize, and sorghum. trees, etc. Those crops that cannot stand a very wet soil for more than 12-24 hours should not be grown in basins. Furrow irrigation is best used for irrigating how crop such as maize, vegetable and trees.

  Border irrigation is particularly suitable for close growing crops such as alfalfa, but border irrigation can also be used for row crops and trees

- **Required depth of irrigation**

  When the irrigation schedule has been determined it is known how much water in mm has to be given per irrigation application it must be checked that this amount can indeed be given,

with the irrigation method under consideration. Field experience has shown that most water can be applied per irrigation application when using basin irrigation, les with border irrigation and least with furrow irrigation. In practice, in small scale irrigation projects, usually 40-70 mm of water are applied in basin irrigation, 30-60mm in border irrigation and 20-50 mm in furrow irrigation.This means that if only little water is to be applied per application, **e.g.** on sandy soils and a shallow rooting crop, furrow irrigation would be most appropriate.

- **Level of technology**

  Basin irrigation is the simplest of the surface irrigation methods. Especially if the basins are small, they can be constructed by hand or animal traction. Their operation and maintenance is simple.

  Furrow irrigation with the possible exception of short, level furrow requires accurate fields grading. This is often done by machines this requires skill, organization and frequently the use of foreign currency for fuel, equipment and spares parts.

  Short, level furrows also called furrow basins can, like basins, be constructed and maintained by hand.

  Borders require the highest level of sophistication. They are constructed and maintained by machines. The grading needs to be accurate. Machine operation requires high level of skill, organization and usually foreign currency.

- **Proviso experience**

  If there is no tradition in irrigation, the most simple irrigation method to introduce is basin irrigation the smaller the basins the easier their construction, operation and maintenance. If irrigation is used traditionally, it is usually simpler to improve the traditional irrigation method than it is to introduce a previously unknown method.

- **Required labor inputs**

  The required labor inputs for construction and maintenance depend heavily on the extent to which machinery is used. In general it can be stated that to operate the system, basin irrigation requires the least labor and the least skill. For the operation of furrow and border irrigation systems more labor is required combined with more skill.

- **Water control devices are positioned and secured as required in accordance with enterprise procedures: -**

  Controllers, zones, and valves Most irrigation systems are divided into zones. A zone is a single irrigation valve and one or a group of drippers or sprinklers that are connected by pipes or tubes. Irrigation systems are divided into zones because there is usually not enough

pressure and available flow to run sprinklers for an entire yard or sports field at once. Each zone has a solenoid valve on it that is controlled via wire by an irrigation controller. The irrigation controller is either a mechanical (now the "dinosaur" type) or electrical device that signals a zone to turn on at a specific time and keeps it on for a specified amount of time. "Smart Controller" is a recent term used to describe a controller that is capable of adjusting the watering time by itself in response to current environmental conditions. The smart controller determines current conditions by means of historic weather data for the local area, a soil moisture sensors (water potential or water content), rain sensor, or in more sophisticated systems satellite feed weather station, or a combination of these.

- **Irrigation equipment is handled safely in accordance with OHS practices**

Personal protective equipment

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations.

Controlling a hazard at its source is the best way to protect employees. Employers must provide personal protective equipment (PPE) to their employees and ensure its use.

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.

- **Employees should:**

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. list the in which the Irrigation equipments/machineries should be handled safely (10)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Positioning irrigation equipment

2.1. Positioning Irrigation Equipment, Tools and Machineries

Once gates and valves and other equipments 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).Figure.1: Ridger plough: (a) wooden body, animal-drawn

Figure.2. Ridger plough: (b) iron type, animal-drawn

Figure.3: Ridger plough: (c) hand-drawn version

Figure.4.A ridger-drawbar behind a tractor makes four ridges simultaneously

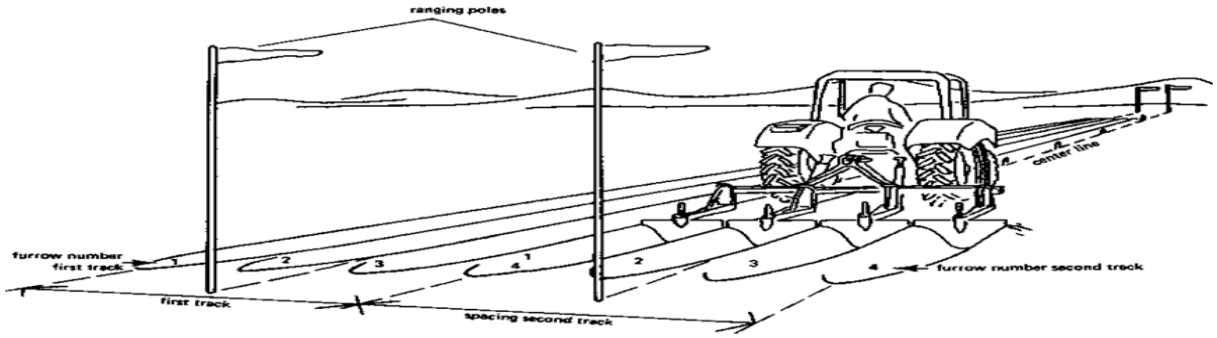
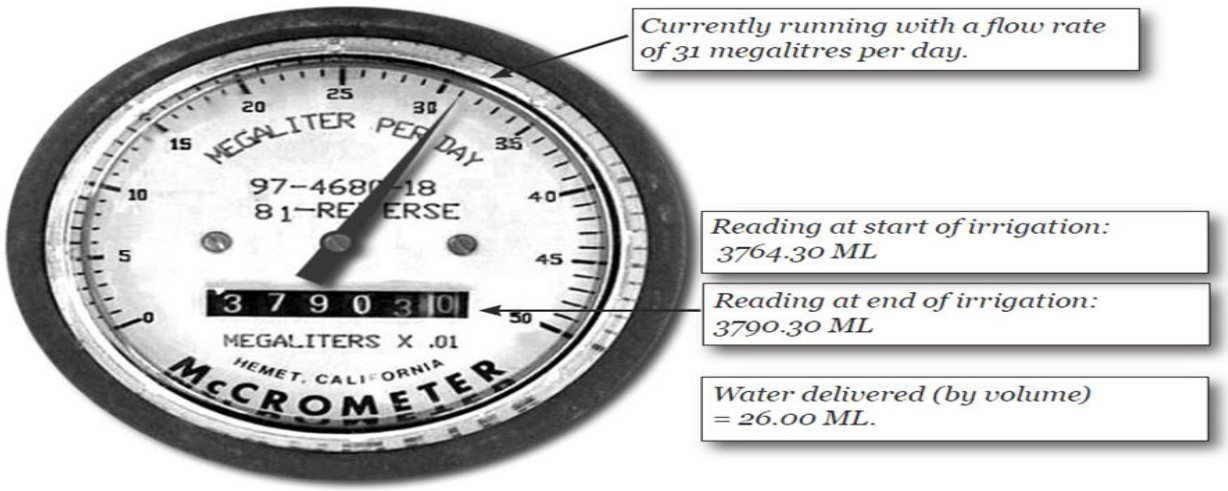


Fig.5. Laser Guided Land Leveling Equipment positioning in irrigation area.

Propeller meters have a counter that records the volume of water that supply to irrigation farm in megalitres and in some cases provides a way of determining flow rate in megalitres per day. The propeller meter generally reads to one-thousandth of a megalitre.

Fig.6. Propeller meters prepared for flow meter.



Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. list the purpose of positioning irrigation equipment(5)

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Checking rot buck area for irrigation set up

3.1. Checking Rotobuk/Suitable area for Irrigation set up

Information about the layout of the irrigation area is necessary for identifying priority irrigation areas and for positioning infrastructure (e.g. pump position, pipelines, etc.). For nurseries establish the growing structures in use – e.g. greenhouses, shade structures, hail net structures; and if the plants are grown in beds, on tables or on trough benches. The quantity and size of the containers relevant to the layout must also be established. Information gathered prior to the design of an irrigation system can help identify any site restrictions or potential logistical limitations (e.g. trees, rivers, roads, proximity to power lines, etc.). Consideration must also be made of any land restrictions such as specially protected environmental or cultural areas. A design must consider the Irrigator's current needs, and any additional needs into the foreseeable future.

For example, if any expansions to the irrigation system are planned, it is best to accommodate this within the current design wherever possibleGravity fed irrigation: Usually the land in an area that uses irrigation is flat (often on a flood plain) allowing the water to be easily moved from the natural source to the irrigated area. That means you don't have to pump water up and down big hills, which requires expensive mechanical pumps. Surface irrigation systems, such as furrow and level basin systems, can apply water very uniformly if the irrigation area is properly selected, designed and operated. These systems work best on soils which contain large percentages of clay and silt. **Fig**.1 Rotobuck area set up for irrigation

Once an irrigation system has been selected for the design and the design itself progresses, it should be constantly compared to performance Standards and checking targets are being met to ensure the system can deliver the required crop water requirements, and that it meets the needs of

the Irrigator.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. List the importance of checking area for irrigation set up(5)

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Checking pumps, bores and other water delivery mechanisms

4.1. Planning for checking the availability of irrigation water

Without an adequate and reliable water supply, it is difficult to realise the full benefits of an irrigation system. It is important the designer establishes the quantity of water available for irrigation and designs the system for this quantity of water. The quantity of water available is often limited for some or all of the irrigation season. For example:

- Bore yields may be limited
- Scheme or regulatory restrictions may apply
- Seasonal volumes
- Interference effects
- There may be reduced flows in the source streams
- Groundwater levels may fluctuate

As part of the planning process for conducting gravity fed irrigation, you need to ensure or should check the availability of the water, Pumps, bores and other water delivery mechanisms.

Fig. 1. Available Ground water source.

The simplest way to access groundwater is to dig a well. Wells can be dug manually to reach the shallow water table within the unconfined aquifer. However, if an aquifer is deeper than a few meters, a proper borehole needs to be drilled. Choosing a site, drilling method and bore construction are complex tasks requiring hydro geological knowledge, a skilled driller and specialized equipment.

Self-Check -4.	Written Test

Directions: Answer all the questions listed below.

1. Write down the importance of checking of the availability of irrigation (5)

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Positioning and securing tarpaulins or other water control devices

5.1. Operating the System

There are various methods of delivering and control of water from the channel into the head of the bay or furrow. These include:

- **Siphons.**

The water level in the channel is higher than the soil level in the bay or furrow. So it will easily siphon using plastic or aluminum tubes. Normally one siphon is used for each bay or furrow. The siphon is started manually at the start of the irrigation and the irrigation can be stopped by draining the channel or by removing the siphon. The use of siphons is labor intensive and costly, although larger diameter siphons are shifted and started by machines.

Figure: 1. “Priming" of a siphon

- **The gated pipe system**

Gated pipe systems utilize portable rigid pipes or flexible tubing with uniformly-spaced rectangular adjustable outlets for diverting water into the furrows. Water flow from each outlet is regulated by adjusting the size of the outlet opening. Short flexible sleeves may be attached to the outlets to dissipate energy and minimize erosion at furrow inlets. When the desired depth of water has been infiltrated at the lower end ofthe field, outlets along the head end of the field where the next irrigation set is to occur are opened and the previous ones are closed. The newly flowing outlet openings are then adjusted to provide nearly equal flow to all furrows in the irrigationset.

- **Gates.** Used with bays, a gate is opened in the wall of the channel.

- **Pipeoutlets.** Also used with bays, a pipe is installed in the wall of the channel at the time Of construction. A cap or plug is removed to allow water into the channel.
- **Various types of rigid and 'lay-flat' plastic pipes** are available as alternatives to channels in furrow irrigation layouts. In some applications, buried pipes with risers at each furrow head are used.

You should note that there are many versions of tarpaulinstechniques in use. The operation of the system will vary according to the water delivery mechanism, so you should check with the workplace supervisor to determine the specific enterprise procedures.

Figure.2. Plastic gated pipe for furrow irrigation

- **In some intensive agricultural and horticultural applications**, alternative distribution methods are common using low pressure pipelines. In the gated pipe system a pipeline is installed at the top of the field with gates allocated to correspond with each furrow.**Figure.3.**Gated pipe

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

1.List the various methods of delivering and control of water from the channel into the head of the bay or furrow (5)

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Instruction Sheet	Learning Guide 63

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

- Opening and shutting gets and/or valves
- Achieving and maintaining required head and water level in head ditch
- Starting/opening required number of siphons
- Monitoring progress of water flow in furrows
- Lifting siphons where irrigation completed
- Carrying out and marking irrigation change
- Shifting irrigation equipment's

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 –**

- achieve and maintain required head and water levels in head ditch to
  Ensure sufficient water flow and availability to crops
- Shift irrigation equipment as required, for irrigation changes in accordance with OHS guidelines

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number below 3 to 6.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1,2,3,4,5,6,7" **in page:49,53,55,58,60,64, and 66**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Opening and shutting gets and/or valves

1.1. Gates and/or valves are opened and shut as necessary in accordance with enterprise procedures-

An open canal, channel, or ditch, is an open waterway whose purpose is to carry water from one place to another. Channels and canals refer to main waterways supplying water to one or more farms. Field ditches have smaller dimensions and convey water from the farm entrance to the irrigated fields. Efficient use water for irrigation depends largely on measurement. Accurate measurement of irrigation water permits more intelligent use of these voluble natural recourses. Such measurement reduces excessive wastes and allows the water to be distributed among users according to their needs and right.Information concerning the relationships between water, soil and plant cannot utilize in irrigation practices without the measurement of water.

- **Irrigation structures:-**

Irrigation system consists of intake (main) or pumping station (main), conveyance, distribution, field application and drainage systemsIntake or pumping station (main):- is built at the entry to the irrigation system. Its purpose is to direct water from the original source of supply in to the irrigation system.Conveyance and distribution system: - consists of canals transporting the water through the whole irrigation system. Open canals (channel or ditch):- is an open waterway whose purpose is to carry water from one place to another, channels or canals refer to main waterways supplying water to one or more farms, field ditches have smaller dimensions and convey water from the farm entrance to the irrigated fields

- **Canal characteristics**: - rectangular, triangular, trapezoidal, circular and irregular or natural earthen canals: - simply dug in the ground and the bank is making up from the removed earth. Disadvantages of the se canals are collapsing of the side slopes, the water loss due to seepage and require continuous maintenance .Lined canals: - lined with impermeable materials, prevent excessive seepage and growth of weeds, control canal bottom and band erosion. The materials used are concrete, brick or rock masonry and asphalted concrete (a mixture of sand, gravel and asphalt).

- **Canal structures**: - the flow of irrigation water in the canals must always be under control. These canal structures help to regulate the flow and deliver the correct amount of water. Four main types of structures. Erosion control structures:- soil particles along the bottom and banks of an earthen canal are lifted, carried away, and deposited downstream where they may block the canal and silt up structures there for drop structures are required to reduce the bottom slop of canals lying on steeply sloping land in order to avoid high flow velocity and erosion risk.
- Distribution control structures: - are required for easy and accurate water distribution within the irrigation system and on the farm.

a. Division boxes: -

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.

b. 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.

c. 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

Crossing structures: - used to carry irrigation water across roads, hillsides and natural depressions

A. flumes:

- Carry irrigation water across gullies or other natural depressions

- open canals make of wood metal or concert which often need to be supported by pillars

B. culverts:

- carry the water across roads

- consists of masonry or concrete headwalls at the inlet and outlet connected by a buried pipeline

4. Water measuring structures: - the principal objective of measuring irrigation water is to permit efficient distribution and application the most commonly used water measuring structures are weirs and flumes. The water depth is read on a scale which is part of the structure. Using this reading, the flow rate is then computed from standard formulas or obtained from standard tables prepared specially for the structure.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. List the Canal characteristics (5)

Note: **Satisfactory rating –2.5 points** **Unsatisfactory - below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Achieving and maintaining required head and water level in head ditch

2.1. Required pressures and water flows are achieved and maintained to ensure sufficient water availability.

❖ **Maintenance activities fall into three general categories:**

• **Routine Maintenance** - Activities that are conducted while equipment and systems are in service. These activities are predictable and can be scheduled and budgeted. Generally, these are the activities scheduled on a time-based or meter-based schedule derived from preventive or predictive maintenance strategies. Some examples are visual inspections, cleaning, functional tests, and measurement of operating quantities, lubrication, oil tests, and governor maintenance.

• **Maintenance Testing** - Activities that involve using test equipment to assess condition in an offline state. These activities are predictable and can be scheduled and budgeted. They may be scheduled on a time or meter basis but may be planned to coincide with scheduled equipment outages. Since these activities are predictable, some offices consider them “routine maintenance” or “preventive maintenance.” Some examples are governor alignments and balanced and unbalanced gate testing.

• **Diagnostic Testing** – Activities that involve using test equipment to assess the condition of equipment after unusual events, such as equipment failure/ repair/replacement or when equipment deterioration is suspected. These activities are not predictable and cannot be scheduled because they are required after a forced outage. Each office must budget for these events. Some examples are governor troubleshooting, unit balancing, and vibration testing.

- Achieving and maintaining the required pressures and water flows to ensure that the crops get the required amount of water.
- wetting pattern

- the wetting pattern from a single rotary sprinkler is not very uniform
- the area wetted is circular
- the heaviest wetting is close to the sprinkler

- for good uniformity several sprinkler must be operated close together so that their patterns overlap
- for good uniformity the overlap should be at least 65% of the wetted diameter
- uniformity of sprinkler applications can be affected by wind and water pressure
- Spray from sprinklers is easily blown even by a gentle breeze and this can seriously reduce uniformity.
- To reduce the effects of wind the sprinklers can be positioned more closely together
- Sprinklers work well at the right operating pressure recommended by the manufacture. If the pressure is above or below the standard then the distribution will be affected

❖ **Application rate**

- The average rate at which water is sprayed on to the crops and is measured in mm/hr
- Depends on the size of sprinkler nozzles, the operating pressure and the distance between sprinklers
- The average application rate must be less than the basic infiltration rate of the soil to reduce evaporation and runoff

❖ **Sprinkler drop size**

- As water sprays from a sprinkler it breaks up into small drop between 0.56and 4mm in size.
- Small drops fall close to the sprinkler
- Larger drops fall close to the edge of the wetted circle
- Large drops can damage delicate crops and soil, so in such conditions it is best to use the smaller ones.
- Drop size is controlled by pressure and nozzle size

❖ **Determining required water volume**

- Efficient water use for irrigation depends on measurement. Accurate measurement of irrigation water permits more intelligent use of these voluble natural recourses. Such measurement reduces excessive wastes and allows the water to be distributed among users according to their needs and right.
- Information concerning the relationships between water, soils, and plant cannot utilize in irrigation practices without the measurement of water

2.2. Required head and water levels in head ditch for sufficient water flow

Water Fall Head is the energy that drives water through an irrigation system. Put simply, it is a measure of water pressure. Head is measured in millimeters, meters or kilopascals (1 m = 9.806 kPa = 1.42 psi).

In surface systems, we are mainly interested in the head associated with elevation and gravity. Maintaining head in surface irrigation is important, because the energy maintains flow rate and the movement of water through the system.

For free discharge or sufficient water flow, the head is the difference between the water level in the farm channel and the outlet from the pipe. For drowned or submerged discharge, the head is the difference between the water level in the farm channel and in the field. Discharge/ water flow can be changed by a change in pipe diameter or a change in the head.

Figure1.Photos showing how to measure the head (ft) in a gated pipe system. The head is the distance between the water level in the tube and the center of the pipe.

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

1. list and discus over them the common Maintenance activities (10)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below -5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Starting/opening required number of siphons

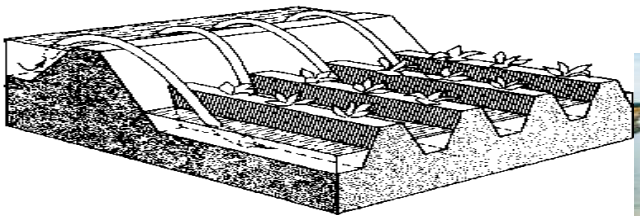
3.1. Siphon operation, cleaning and lifting after Operation of Irrigation

Siphon tube systems utilize curved aluminum or plastic pipes that are laid over the bank of an open ditch to divert water into the furrows. Water flows into the submerged end of the tube, is siphoned over the bank of the open ditch, and delivered into the furrow when there is sufficient operating head and the tube is positioned correctly and primed. The flow rate of the siphon tube is controlled by its diameter and the elevation difference (head) between the water level in the open ditch and the center of the outlet end. The advantage of siphon tubes is the ease with which nearly equal inflows to all furrows can be achieved. When the desired depth of water has been infiltrated at the lower end of the field, the siphon tubes are collected and redistributed along the head of the field where the next irrigation set is to occur and each is primed again.Trash screening is often required to remove floating debris from the water to prevent clogging the siphon tubes. A nearly constant water supply is required to ensure that siphon tubes do not stop flowing (loose prime) during the irrigation. Farmers often spill 3 to 6 percent of this water at the end of the ditch to reduce flow fluctuations to their siphon tubes.

3.2. **Siphons for application of gravity fed irrigation**

Siphons are small diameter pipes used to convey water over the channel embankment/ furrows. Furrows are small, parallel channels, made to carry water in order to irrigate the crop. The crop is usually grown on the ridges between the furrows.

Figure: 3 Siphons on operation.



Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. Define and discus aboutsiphons (5)

Note: **Satisfactory rating –2.5 points Unsatisfactory – below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Monitoring progress of water flow in furrows

4.1. Monitoring the Progress of Water Flow (Co-Ordinate Irrigation Activities – Monitor System)

An irrigation system should have adequate access for water control, stock, and machinery, but each structure will cause some head loss. Your system should have the minimum number of structures feasible for your management purposes.

In general, there are three types of structures:

- culverts
- checks
- outlets

Culverts: Pipe culverts are installed to allow access across supply channels and tail water drains. They should:

• have minimal head loss

• Flow full without sucking air (overtaxing)

• be large enough in capacity and length for future developments

• incorporate headwalls (these reduce head losses and erosion and make crossings more visible)

• be constructed to combine checks and drop checks to reduce the number of structures used

• be long enough to allow ease of access across for machinery and trucks.

Checks: Checks are used to reduce the earthworks needed in channel construction and to control height and thus manage flow. Overshot drop board checks are used to control upstream channel levels. Undershot checks (gated) control downstream levels and flow, particularly where supply rates fluctuate.

Checks should:

• have minimal head loss at full flow

• be large enough for any future development

• be easily accessible

Gravity fed irrigation systems have two principal sources of inefficiency, deep percolation and surface runoff or tail water the remedies are competitive. To minimize deep percolation the advance phase should be completed as quickly as possible so that the intake opportunity time over the field will be uniform and then cut the inflow off when enough water has been added to refill the root zone.

This can be accomplished with a high, but non-erosive, discharge onto the field. However, this practice increases the tail water problem because the flow at the downstream end must be maintained until a sufficient depth has infiltrated. The higher inflow reaches the end of the field sooner but it increases both the duration and the magnitude of the runoff.

There are three options available to solve this problem, at least partially: (1) dyke the downstream end to prevent runoff as in basin irrigation; (2) reduce the inflow discharge to a rate more closely approximating the cumulative infiltration along the field following the advance phase, a practice termed 'cutback'; or (3) select a discharge which minimizes the sum of deep percolation and tail water losses, i.e., optimize the field inflow regime.

Once the gravity fed irrigation activity has started as shown in figure below the water flow progress in the whole elements/components of surface irrigation, you should monitor the crew activities for efficient team work and provide the appropriate directions and instructions. The water levels in the ditches and channels must be monitored and maintained to provide sufficient head.

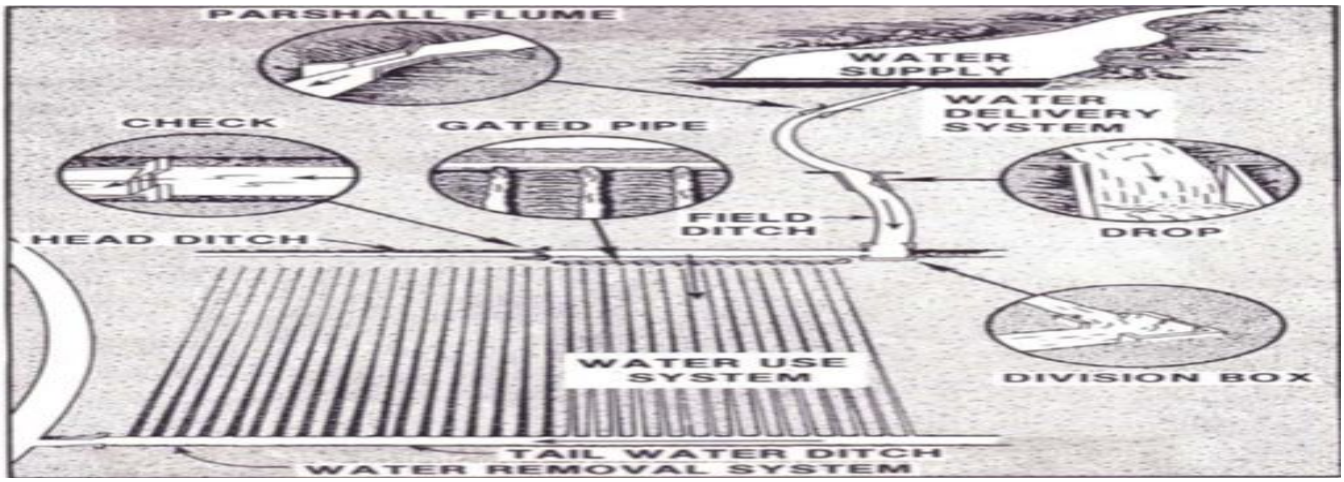


Figure: Typical elements/components of a gravity fed irrigation system. (From U.S. Department of Agriculture, Soil Conservation Service, 1967.)

Depending on the available flow in the farm channel, several furrows can be irrigated at the same time. When there is a water shortage, it is possible to limit the amount of irrigation water applied by using 'alternate furrow irrigation'. This involves irrigating alternate furrows rather than every furrow.

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

1. Discus about monitoring progress of water flow in furrows (5)

Note: **Satisfactory rating –2.5 points Unsatisfactory – below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Lifting siphons where irrigation completed

5.1.Siphon operation, cleaning and lifting after Operation of Irrigation

Siphon is small diameter pipes used to convey water over the channel embankment/ furrows. Furrows are small, parallel channels, made to carry water in order to irrigate the crop. The crop is usually grown on the ridges between the furrows.Water flows into the submerged end of the tube, is siphoned over the bank of the open ditch, and delivered into the furrow when there is sufficient operating head and the tube is positioned correctly and primed. The flow rate of the siphon tube is controlled by its diameter and the elevation difference (head) between the water level in the open ditch and the center of the outlet end.

The advantage of siphon tubes is the ease with which nearly equal inflows to all furrows can be achieved. When the desired depth of water has been infiltrated at the lower end of the field, the siphon tubes are collected and redistributed along the head of the field where the next irrigation set is to occur and each is primed again.Trash screening is often required to remove floating debris from the water to prevent clogging the siphon tubes. A nearly constant water supply is required to ensure that siphon tubes do not stop flowing (loose prime) during the irrigation. Farmers often spill 3 to 6 percent of this water at the end of the ditch to reduce flow fluctuations to their siphon tubes.

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

1. list the advantage of siphon tubes operating and cleaning? (5)

Note: **Satisfactory rating –2.5 points Unsatisfactory – below 2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Carrying out and marking irrigation change

6.1 Progress of water flow in furrows is monitored in accordance with enterprise procedures

- **Canal structures-**The flow of irrigation water in the canals must always be under control. For this purpose, canal structures are required. They help regulate the flow and deliver the correct amount of water to the different branches of the system and onward to the irrigated fields. There are four main types of structures: erosion control structures, distribution control structures, crossing structures and water measurement structures.
- **Irrigation change is carried out and marked as required**.

An irrigation change must indicate that when to apply irrigation water and how much quantity of water to be applied, several approaches have been used for irrigation changes by irrigation experts and farmers that includes:

- **Soil moisture depletion: -** the available soil moisture in the root zone is a good criterion for irrigation change. When the soil moisture in a specified root zone depth is depleted to a particular level (in most cases 50-60%) it is too replenished by irrigation
- **Plant basis or indices:** - it can be taken as a guide for irrigation change. The deficit of water will be reflected by plants it self such as dropping, curling or rolling of leaves and change in foliage colour as indication for irrigation change or indication for watering the crop.
- **Climatologically approach:** - Evapotranspirtion mainly depends up on climate that includes temperature, humidity, radiation, wind and rainfall. The amount of water lost by Evapotranspiration is estimated from climatologically data and when ET reaches a particular level irrigation is applied
- **Critical crop growth stages:** - in each crop, there are some growth stages at which moisture stress leads to irrevocable yield loss. These stages are known critical periods or moisture sensitive periods. If irrigation water is available insufficient quantities, irrigation is scheduled whenever soil moisture is depleted to critical moisture level, say 25 or 50% of available soil moisture.

6.2. Irrigation equipment is shifted, as required, for irrigation changes in accordance with OHS guidelines.

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

Irrigation time (hours) = 2.78 x irrigation depth (mm) x field size (ha)

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: - Irrigation time (hours) = 2.78 x irrigation depth (mm) x field size (ha)

Stream size l/sec

= 2.78x 50mm x o.375ha = 2.6 hours = 156 minutes

20l/sec

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.

- **Irrigation depth: -** the amount of water that needs to be applied to an irrigated system when soil water is reduced to the specified depletion level
- **Irrigation intervals:** - refers to the number of days between irrigation during periods without rainfall. it is a function of crop, soil and climate.
- **Irrigation interval** = allowable soil moisture depletion

  Daily water use

In implementing irrigation shifts determine the area to be irrigated, irrigation time, irrigation depth, and irrigation frequency according to the crop water need which is affected by crop growth stage, climatic factors, and soil moisture depletion.

6.3. Irrigation Site change

- There may be a number of fields to be irrigated. The operator must be aware of the schedule so that as one field is shut down, the next field is started. Any malfunctions to equipment, damage to water courses, blockages, seepage or leakage are corrected or repaired immediately and reported in accordance with enterprise agreements.

- Changes to, or closure of, a site can result in product being lost to ground as a result of either deliberate or accidental release during dismantling and removal of pipe work or other

infrastructure or from abandoned plant and equipment. In addition, a risk could arise off-site if ontaminated pipes and equipment are not disposed of in an appropriate manner.

- Key considerations include:
  - Whether proposed methods for changing/decommissioning the site could result in release of product to ground or surface water?
  - Will any redundant equipment containing solvent remain in situ (e.g. in pipes, drainage system, tanks, bunds)?
- If there is a risk of release of product to the ground or surface water, or if solvents would remain in situ in redundant equipment, the decommissioning proposals should be readdressed. In general it is preferable to remove all redundant pipe work and equipment. Specific care needs to be taken with respect to changing or decommissioning underground storage tanks. Consideration should be given to the relevant section of the “Groundwater Protection Code: Petrol stations and other fuel dispensing facilities involving underground storage tanks”.

Self-Check -6	Written Test

Directions: Answer all the questions listed below.

1. Listthe several approaches should be used for irrigation changes (5)
2.What is the importance ofCarrying out and marking irrigation change?(5)

Note: **Satisfactory rating – 5 points Unsatisfactory – below 5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Shifting irrigation equipment's

7.1. Importance of irrigation equipment shifting

Irrigation system components and equipment can be moved periodically from one field to another including pumping unit. This system is commonly used in supplemental irrigation system. Comparatively, the initial investment on this type of sprinkler system is not high but the labor cost is more.

Fig: 1.Tractor PTO driven pump (entirely portable system)

- **Transport of plastic pipes**

Transport of corrugated pipes over long distances is rather expensive, because of the high volume/weight ratio (it boils down to the expensive transport of air). To counteract these pipes ought to be produced as close as possible to the site of installation. Mobile factories have even been produced in the past, but these proved to be expensive and complicated because of necessary power supply and cooling. They are hardly used any more: transferring the production line from one factory hall to another is far simpler to do. Comparative studies indicate that transporting the production facilities to a location close to the construction site is economical if the distances are more than 300 - 500 km. The importing of large quantities of plastic drain pipes is therefore not considered to be a rational option.FIG:2

Self-Check -7	Written Test

Directions: Answer all the questions listed below.

1.What is the importance ofirrigation **equipment shifting?** (5)

Note: **Satisfactory rating –2. 5 points Unsatisfactory – below2. 5 points**

Name: _____ Date: _____

Short Answer Questions

Instruction Sheet	Learning Guide #-

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

- Opening and shutting valves
- Achieving and maintaining required pressure and water flow
- Relocating equipment's

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 –**

- Open and shut Valves as necessary, in accordance with enterprise procedures.
- Achieve and maintain required pressures and water

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number below 3 to6.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1, 2, 3" **in page: 73,79, and 81**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Opening and shutting valves

1.1 Gates and/or valves are opened and shut as necessary in accordance with enterprise procedures

An open canal, channel, or ditch, is an open waterway whose purpose is to carry water from one place to another. Channels and canals refer to main waterways supplying water to one or more farms. Field ditches have smaller dimensions and convey water from the farm entrance to the irrigated fields.

- **What is a pressurized irrigation system and how does it work?**

A pressurized system is a system that relies on water pressure for the system to work. If the system is connected to the pressurized water main (mains pressure) no pump is needed, however, if the water source is not pressurized, then a pump will be needed to pressurize the system.

- ✓ **Drip irrigation/trickle irrigation/**

- Water is delivered at or near the **root zone of plants**, **drop by drop**.
- Much less wasted water! For this reason drip is the **preferred method of irrigation in arid area**s.
- The most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized,
- Means of delivery of fertilizer known as fustigation.
- Easy to install, design, inexpensive, and can reduce disease problems associated with high levels of moisture on some plants.
- If you want to grow a rain forest however, drip irrigation will work but might not be the best choice!
- The high efficiency of drip irrigation results from two primary factors.
  - The first is that the water soaks into the soil before it can evaporate or run off.
  - The second is that the water is only applied where it is needed, (at the plant's roots) rather than sprayed everywhere.
- Consists of an extensive network of pipes, usually of small diameter, that deliver filtered water directly to the soil near the plants.
- The water outlet device in a pipe is called an emitter discharging only a few liters per hour.
- From the emitters, the water spreads laterally and vertically by the soil capillary forces. The area wetted by an emitter depends upon the flow rate, soil type, soil moisture, and vertical and horizontal permeability of the soil.

1.2.Advantages and Limitations of drip irrigation

- ❖ **Advantages**

. Uniform and controlled water distribution close to plant roots along plant rows
. Application of water and fertilizer at optimum rate to the root system
. Minimizes loss of water by deep peculation below root zone
. Eliminates land leveling and irrigation on steeper slopes
. Efficient water application to orchards
. Restrict weed growth to wetted areas
. Permits use of poor quality water and frequent irrigation

❖ **Limitations**

❖ Higher initial cost of installation
❖ Clogging of openings in the emitters
❖ Presence of dissolved salt left in the soil.

❖ **Design of drip irrigation system**

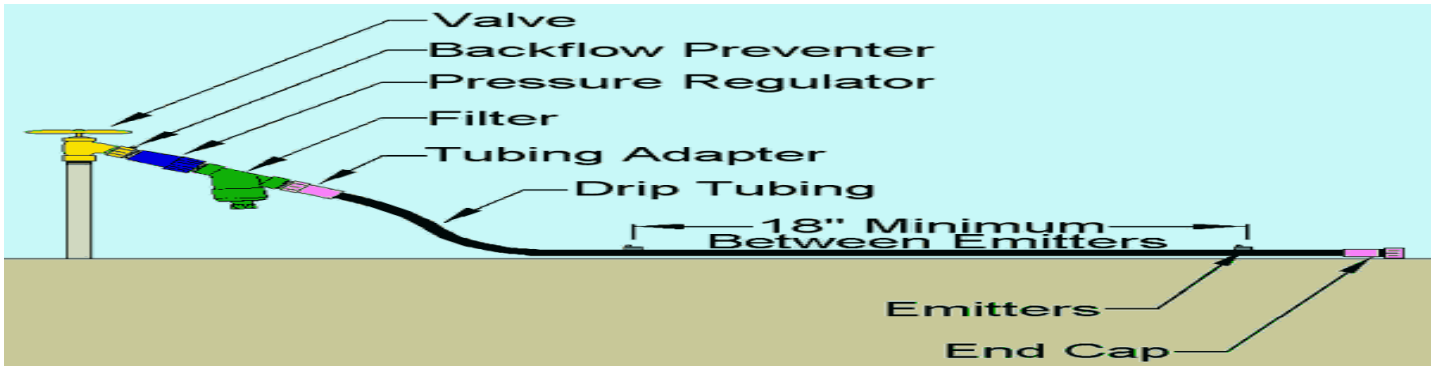
❖ The design of the drip irrigation system consists in deciding size of pumping unit, size of main line and laterals, location of emitters, their discharge capacity etc.
❖ The design of the system is done taking into consideration the following points:
1. Water source such as a well or a tank
2. Plant spacing and irrigation requirements of crops
3. Topographic condition
4. Infiltration ate, water holding capacity, texture, structure and bulk density of soil.
5. Hydraulic characteristics of the pipelines and components used
6. Available material

1.3. Components of drip irrigation system

❖ **the system essentially consists of:**

❖ Main line
❖ Sub mains
❖ Laterals
❖ Emitters**/**drippers
Auxiliary components include
❖ Filters
❖ Pressure regulators
❖ Valves
❖ Fertilizer application components.

The main line delivers water to the sub mains and the sub mains into the laterals. The emitters which are attached to the laterals distribute water for irrigation. The mains, sub mains and laterals are usually made of black PVC tubing's. The emitters are also usually made of pvc material. So they are not damaged when distributing saline water or water mixed with fertilizers. Appropriate connections are to be used between pipe lines and other equipments. Emitters supply water at the desired rate. The discharge rate of the emitters generally ranges from 2 to 10 litres per hour.FIGURE-1



1.4. Sprinkler irrigation

❖ When to use sprinkler irrigation

- ❖ Method of **applying irrigation water which is similar to rainfall**.
- ❖ Water is distributed through a system of pipes usually by pumping.
- ❖ Spray water into the air and irrigate the entire soil surface through spray heads
- ❖ The water breaks up into small water drops which fall to the ground.
- ❖ Sprinklers provide efficient coverage for small to large areas and are suitable for use on all types of soil properties.
- ❖ It is also adaptable to nearly all irrigable lands since sprinklers are available in a wide range of discharge capacity.
- ❖ All the products are made out of high strength & chemical resistance engineering plastics to achieve functional satisfaction and to maintain cost economics.
- ❖ Suitable for almost all field crops like wheat, gram, pulses as well as vegetables, cotton, soya bean, tea, coffee, and other fodder crops.

✓ **Advantages** - unsuitable or uneconomical for leveling
- Suitable for sandy soil
- Ideally suited to steep slopes or irregular topography
- Rate of flow available is too small to distribute water efficiently by surface irrigation
- Used for irrigating high valued crops like tea, coffee, orchards, etc.
- Higher water application efficiency
- For frequent and small amount application of water
- For application of fertilizer and pesticides

✓ **Limitations:** - Large initial investment and high annual depreciation

- Unsuitable for very fine textured soils
- Requires well organized service facilities
- Uneven water distribution caused due to high winds
- Evaporation losses when operating under high temperature
- Requires water free from silt and debris.

1.5. Valves are opened and shut, as necessary,

- Opening the valves to let the water through - turning the irrigation system on.
- Closing the valves when the operation is complete - turning the irrigation system off.
- Turning the system on and off - main line water supply
- If the system is attached to mains water, turning an irrigation system on and off will just be a matter of turning a valve on or off. You should do this slowly (when turning on and off) to prevent a sudden surge in pressure through the lines which results in water hammer.
- Turning the system on and off - pump water supply
- Where it is necessary to start a pump to operate the system, it is important that there are sufficient irrigation lines open. This prevents an excessive pressure build up which may cause damage to the irrigation lines and the pump. The check valve on the discharge side of the pump prevents the weight of water held in the lines bearing down on the pump when it is not in operation so that the pump does not start under load. As the pump builds up pressure it forces water through this one-way check valve and into the lines.
- Sometimes the foot valve on the end of the suction line may leak allowing water out and allowing air into the suction line. If this happens, after a short time the pump will stop pumping. To rectify this, you need to prime the pump. This involves refilling the suction line. If this continues to happen, the foot valve may need replacing. Your trainer or workplace supervisor will show you how to turn a system with a pump on and off and how to prime the pump.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. What is a pressurized irrigation system (5)?
2. List the component of Drip irrigation (5)?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below -5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Achieving and maintaining required pressure and water flow

2.1. Carrying out pre- and post-season maintenance

2.1.1. Pre-season preparation of the equipment

- **Pre-season Maintenance**

Before you begin irrigating each year, you should prepare your irrigation system for the new season. Many temporary repairs made last year will probably need attention. Irrigation systems are more than just a method to deliver water to the crop. They are becoming a management tool. A properly designed and maintained system allows the grower to supply precise amounts of water, nutrients, and other materials to the crop. Careful management and preseason maintenance can allow the grower to realize the full benefits of irrigation system.

- weed control,
- motor servicing,
- Desilting channels,
- Descaling and equipment service
- flushing and supply distribution

- **Flushing/Draining the System:**

Place the Disconnect Switch in the “OFF” position. Only water is required for this procedure – the System does not need to move. DO NOT start the flushing procedure while the System is under water pressure. Removing Sand Trap Caps while the System is under pressure can cause personal injury or death! Remove the Sand Trap Cap and pump water through the System. This will flush out any foreign material that might plug the Sprinkler Heads or Sprinkler Valves. This is particularly important on newly installed Systems, because of possible straw, dirt or any other material may be accumulated in the pipe during erection. After the Sand Trap Cap is back in place, pump water through the System and check the Sprinklers for proper operation. The arc travel of the End Gun should be set as the diagrams show on page 16 of the owner’s manual. Also, check the System water pressure to see if it is operating at the proper pressure.

- **Flush the main line.** Depending on the system and pump capabilities, it may be a good idea to close a portion of the system to increase the pressure and velocity. Find out what the safe maximum operating pressure is before flushing.
- **Flush tubing in the field.** Hose ends are now opened and again, a portion of the laterals may be closed to ensure good pressure and velocity for a thorough flushing of the drip tubing. After the entire system has been flushed, the system needs to be checked line by line. One of the most efficient methods utilizes an irrigator walking and checking every row, wearing a cloth pouch like you would find in a lumber store. In it are emitters, couplings, punch, plugs, and hose ends to make the necessary repairs.

For example, if your utility company offers off-peak rates you may be able to save on your power bill by irrigating at night. If the power is off for a length of time you may not know that the field did not receive all of the water you had scheduled without such a recording device.

- **FILTERS**

Several items need to be checked on both screen and media filters prior to start-up. On filters that flush automatically, the controller and valves should be checked for proper operation. If the controller is equipped with a pressure differential switch, the setting should be checked against the manufacturer's specifications. A differential can be created by removing one of the leads to simulate a high differential. If the differential switch is operating correctly, this will initiate a flush cycle. Once the equipment that filters and delivers the water to the field has been checked and repaired, the drip lines, emitters, and peripheral equipment need to be inspected. A thorough flushing of the system is the first priority, and this should be done in steps.

- **Visual Inspection:**

Make a visual check of all bolts in the System making sure something has not become loose during the idle period. When the System has been newly installed, all the bolts should be checked with an end wrench to make sure they have been tightened by the erection crew. One loose bolt may cause serious structural damages. Check the electrical boxes and wiring of the System to make sure the Ground Wires are secured and rodents or insects have not damaged the Systems' mechanisms.

- **Lubrication:**

Grease fittings are located on the Power Tower Cart (Lateral Move only), Pivot Point, at any optional Steel U-joints (1 each), and on any Towable Gearboxes (2 each). These fittings should be greased with good quality grease. Check the oil level in the center Drive and Wheel Gearboxes. Water condenses in the Gearboxes and should be drained. The water may be drained by loosening the drain plug on the bottom. When the plug is removed, if there is any water, it will be the first to drain out. Do not overfill any of these Gearboxes! Overfilling may result in seal damage. NOTE: Refer to the Reinke Wheel Gearbox Maintenance Section.

- **Tires:**

Tire pressure should be maintained according to the chart in the owner's manual. Also, inspect the Tires for impending problems (cuts, breaks, etc.).

2.1.2 Post season maintenance of the system and making resistant to damage

- **Cleaning Water Lines**

If there is heavy scaling on the collector and/or blocked water passages, consult for cleaning recommendations.

Chlorine present in tap water is harmful to the klystron water passages. Thorough flushing with de ionized water will remove all traces of chlorine. *Never* use tap water for final refill or for makeup water.

- **Other cleanliness issues**

The sight glass and float of the water-flow indicators must also be kept clean to achieve efficient system operation. The water-flow indicators usually become contaminated during use, and this contamination collects on the sight glass and float, making the readouts difficult to see. If too much contamination is present on the glass and float, they may stick and produce an erroneous reading. The detergent and cleaning solutions may not remove all of this contamination. If this is the case, the flow meter must be removed and cleaned and the glass surface brushed.

- **Flushing the Klystron Water Lines**

It is good engineering practice to flush all cooling passages before installing the device. VEDs that have been in service for some time will develop scale on the collector. Contaminated water also contributes to dirty water lines. The following back flushing procedure is suggested for units having contaminated water lines, corrosion, scale, or blocked passages.

2.1.3 Post-season Equipment storing

- **Retrieval and Storage Instructions**

The extensive scope of irrigated fields' demands updated conveyance methods for drip line, which will ensure satisfactory performance and efficient storage of the valuable equipment.

- **General Instructions**

1. Reel in only one lateral length at a time and close off both tubes ends with a plug or by bending and tying up.
2. Pack carefully, layer upon layer and avoid pressure on the edges of the reel. Ensure that the drip line is not flattened.
3. When winding, leave10 cm. at the outer edge of the reel so that the drip line does not touch the soil. The reels sink during storage.
4. It is recommended to store the drip line in an orderly way in a shady place.
   Store on shelves to keep clean and avoid attack by vermin.

2.2. Required pressures and water flows are achieved and maintained to ensure sufficient water availability

The long-term operation of the irrigation installation depends upon simple maintenance carried out by the farmer. The periodic servicing of pumping plants and the repair of special devices (filters, injector, etc.) is carried out by trained maintenance and repair personnel. Maintenance is carried out during a period of non-use to prepare the system: a) for the off-season shut-down; and b) for use before the next season. All equipment requires a certain amount of care in handling for storage and maintenance. For every installation there is a procedure which concerns various aspects of the distribution network and the pumping unit.

- Achieving and maintaining the required pressures and water flows to ensure that the crops get the required amount of water.
- wetting pattern
- the wetting pattern from a single rotary sprinkler is not very uniform
- the area wetted is circular
- the heaviest wetting is close to the sprinkler
- for good uniformity several sprinkler must be operated close together so that their patterns overlap
- for good uniformity the overlap should be at least 65% of the wetted diameter
- uniformity of sprinkler applications can be affected by wind and water pressure

- Spray from sprinklers is easily blown even by a gentle breeze and this can seriously reduce uniformity.
- To reduce the effects of wind the sprinklers can be positioned more closely together
- Sprinklers work well at the right operating pressure recommended by the manufacture. If the pressure is above or below the standard then the distribution will be affected

❖ **Application rate**

- The average rate at which water is sprayed on to the crops and is measured in mm/hr
- Depends on the size of sprinkler nozzles, the operating pressure and the distance between sprinklers
- The average application rate must be less than the basic infiltration rate of the soil to reduce evaporation and runoff

❖ **Sprinkler drop size**

- As water sprays from a sprinkler it breaks up into small drop between 0.56and 4mm in size.
- Small drops fall close to the sprinkler
- Larger drops fall close to the edge of the wetted circle
- Large drops can damage delicate crops and soil, so in such conditions it is best to use the smaller ones.
- Drop size is controlled by pressure and nozzle size

❖ **Determining required water volume**

- Efficient water use for irrigation depends on measurement. Accurate measurement of irrigation water permits more intelligent use of these voluble natural recourses. Such measurement reduces excessive wastes and allows the water to be distributed among users according to their needs and right.
- Information concerning the relationships between water, soils, and plant cannot utilize in irrigation practices without the measurement of water

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

1. List the importance and time of Maintenance (5)
2. What is pre-season maintenance? Explain it. (5 pts)
3. List the advantages of pre-season maintenance? (5pts)
4. What is the purpose of flushing and cleaning the system? (5pts)
5. Write some of the equipments used in a gravity feed irrigation system?(5pts)

Note: **Satisfactory rating -12.5 points** **Unsatisfactory - below 12.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Relocating equipment

3.1. Safely Handling of Irrigation Equipment

Farmers, now a day's probably hire others to help run their farm operation. The farm is no longer just a "family farm". It is a business enterprise involving "employer-worker" relationships in similar way as irrigation investment. As the employer, you experts are responsible to safety of all irrigation equipment and ensure the health and safety of all people working on irrigation farm. Just as you need to know crop management, you also need to know what is required by Ethiopian government occupational health and safety legislation. The legislation can be used as farm management equipments which can help the irrigation farm more safely and more profitably.

No farm can function without farm equipments. They save valuable time and are essential to agricultural productivity. They also represent an ever-present danger to the people who operate them. There are a host of hazards that makes agricultural machinery the leading cause of injury and death on farms. Safe equipment/machinery operation primarily depends on how you operate the equipment/machine. Equipments/Machines are inanimate objects; they cannot think, reason, or adapt to meet the needs of people. The responsibility for machinery safety rests with you. Just as we are told to drive defensively when operating an automobile, machine operators should always be thinking ahead and anticipating potential hazards. When examining Irrigation equipments, machineries and workshop areas take notice of the common hazards associated with the equipment and tools on farms. Train workers to use extra caution and handling when working with identified hazardous areas of equipment.

3.2. Equipment is relocated, if necessary, in accordance with enterprise procedures and OHS guidelines

If the crops require more water, or some of the crops are not receiving enough water, you may be required to relocate and/or reposition or adjust the irrigation equipment as required.Your will need to:

- recognize the symptoms of over-watering plants
- recognize the symptoms of under-watering plants (water stress)
- adjust the irrigation system to suit the requirements of the crop
- measure sprinkler output and performance
- take soil moisture readin

- gs before and after irrigation

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. list the requirement of relocating irrigation equipment (5)
2. what the condition should be considerd to relocating(5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Name: _____ Date: _____

Short Answer Questions

Instruction Sheet	Learning Guide 65

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

- Cleaning and preparing equipment's for storage
- Loading equipment's for transporting safely
- Storing equipment's

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 –**

- Clean and prepareequipment for storage, as necessary, in accordance with enterprise policy and procedures.
- Load Equipment for transport safely, if necessary, in accordance with OHS practices

➢ **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number below3 to6.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1, 2, 3" **in page: 86,88 and 92**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Cleaning and preparing equipment's for storage

1.1. Equipment Cleaning for loading, transportation and storing for sustainable use

The irrigation equipment always after operation carefully dismantles and need to clean in order to prepare for loading, transporting and storage. Canal weed cleaning equipment wash by flushing jet of water in a similar way other equipment that clean by water. Farm operation equipment collected from the farm and clean well for next operation. Clean farm equipment have their own impact on operation or initiate the operators during the working time. Closed irrigation pipes flushed with pressurized water in order to protect the pipe from blocked by dirt's, debris, silts and other plant residue materials.

Gravity fed irrigation/ farm equipment cleaning:

- protects the equipment from resting
- enables the equipment to properly function
- Ensure sustainable/durable use
- makes the operation simpler

The irrigation equipment after cleaning need to count and record item by item. This enables farm expert or farm supervisor easily to manage as well to prepare these farm equipment for next operation. Recording this equipment also enable to identify damaged equipment further to report for enterprise for replacement. Pumps, siphons and other gravity fed irrigation equipments are monitored during operation and rubbish is cleared from outlets. It may be necessary to back flush the filters and if this does need to be done, it should be done in accordance with enterprise procedures. If water reuse systems are used, they should be checked for clearance and freedom from weeds.

1.2. Prepare Your Irrigation Equipment for Storage - fall is here!

Make it a priority this fall to take a good look at your irrigation equipment before storing it for the winter. All components of your system need maintenance and some may require repair or replacing. Your user's manual should help you decide on the regular maintenance your equipment requires. Here are a few general tips for preparing your irrigation system for storage. If possible, remove equipment from the field and store it in a clean, dry, covered storage area.

- **Sprinklers;**

Big guns

- Check nozzle for wear
- Use machinist's calipers to check ring nozzle for appropriate diameter
- Replace ring if worn
- Cover the inlet of the gun to keep out dirt or small animals

♦ **Sprinklers**

Check nozzles for wear

- Replace dented or worn brass nozzles
- Replace cracked, chipped or worn plastic nozzles
- Tape over the sprinkler nozzle and pipe base to keep out dirt, small animals or insects

♦ **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 andClean 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

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. List the purpose of cleaning irrigation equipment (5)

Note: **Satisfactory rating -2.5 points** **Unsatisfactory – below2.5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Loading equipment's for transporting safely

2.1. Equipment loading for transport

Gravity fed irrigation equipments primarily gather from the farm after every operation, and clean; then sort and set the equipments for loading to take to the store for storage. Transportation vehicle or farm equipment transporting tractors prepared and ensured that having sufficient place and load the equipment in item by item and in safe way to protect from disorderly loading damage.

- **When preparing for loading the expert need to consider the following important points:**

✓ The equipments collect from the farm, cleaned and order in item.
✓ Need to check enough space for loading as well enough space in the track.
✓ Require to assign a person that well know the equipment for good management
✓ Loading carefully in order and item by item.
✓ The loaded equipment should be based on the carrying capacity of the transport vehicle
✓ The driver also need to know about the loaded equipment

- **During loading the expert need to consider the following important points**:

✓ Checking the equipments that are loaded
✓ Counting and recording the loaded equipments
✓ Safely loading on the space of the vehicle
✓ Covering and tying the equipments in order to protect from damage

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

1.List the condition should be considerd during loading and before loading (10)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Storing equipment

3.1. Storing an Equipment after operation

Safely and orderly loaded farm equipments transport to the store, safely unloading on the way not causing damage. The unloaded farm equipment orderly set by item in the store in order to easily managing, controlling, and recording.

- ❖ **Before storing the equipments need to do the following important points**:
- ✓ Need to proof that unloading have enough space
- ✓ Need to safely unload the equipment
- ✓ Important to check the transport accesses of the store
- ✓ Proofing the preparation of transporting vehicle
- ✓ Important to check the store have enough space for the farm equipment
- ✓ Identify damage of equipment before loading and record the damage to report for enterprise
- ✓ Identify damage of equipment during transport and record the damage to report for enterprise
- ✓ Check whether all the equipments are timely returned
- ✓ The store keeper should approve all the returned equipments are functional
- ❖ **During Storing the Store Man/keeper need to follow the following important points**
- ✓ Check the equipment not changed
- ✓ Check the equipment not have the problem
- ✓ Store the equipment in its proper place and arrangement
- ✓ Cross check the equipment stored and the recorded number

3.2. Irrigation Equipment and Other Safety Inspection Check List

Irrigation equipments need to handle safely and you the expert need to inspect based on the check list below:

Date inspected: Inspected by:	**OK**	**NO**	**If No, document any deficiencies/irregularities**
First Aid, Personal and Protective Equipment			
Is the farm civic address and emergency phone			

numbers posted in prominent places (e.g. by telephones and in main work areas)?			
Is your civic address and farm entrance clearly visible			
PERSONAL PROTECTIVE EQUIPMENT (PPE)			
Is properly maintained personal protective equipment available for all hazards present on the farm?			
Have all workers been instructed to use appropriate personal protective equipment at all times?			
Is personal protective equipment (including gloves,			
Machinery			
Are shields and guards in place and in proper working order on all powered equipment?			
Are key warning decals on all machinery readable?			
Are shields and guards in place on all belts, pulleys and chain drives on feed grinding and handling equipment?			
Are all rotating augers, belts, pulleys and chains on loading and unloading machinery shielded?			
Are all loading troughs on augers, elevators and conveyors covered with a guard or grating?			
Is equipment used on the highway properly equipped with slow-moving vehicle signs?			
Tool Safety			
Is access to and from work spaces free of obstructions?			
Are all hand and power tools in proper working order and equipped with proper shields and guards?			
Are all stationary power tools grounded and all portable power tools either double insulated or of the three-wire grounded type?			
Are portable power tools always disconnected when not in use?			

Are all stationary tools such as grinders and saws properly shielded and the shields always in place?			
Tractors			
Are farm equipment instructional manuals readily available to operators?			
Are ROPS (roll-over protective structures) and seat belt systems properly installed on all tractors and in working condition?			
Are all tractors and self-propelled machines equipped with a dry chemical fire extinguisher?			
All Terrain Vehicles(ATV)			
Are all safety guards in place and in good condition?			
Is the ATV is good mechanical repair?			
Is the operator trained in operating the ATV?			
Does the operator have and wear the proper safety gear? Ex. Helmet, gloves, boots, long shirt and pants			
Is the operator familiar with the terrain and associated hazards?			
Others:			
Farm Chemicals			
Are the Material Safety Data Sheets (MSDS) or labels readily available to workers?			
Pesticide applicators certified in accordance with the Pesticide Control Act?			
Is there a list of all chemicals available to workers?			
Are the containers triple rinsed and returned to the dealership?			
Are containers secured during transport?			
Are all pesticides stored in a marked and secure location as required under Prince Edward Island Pesticide Control Act?			
Are signs posted next to all chemical storage areas to warn of the potential hazards inside?			
Are chemicals always stored in their original containers with the labels clearly intact?			

Is your chemical mixing area either outside or in an open, well-ventilated area?			
Are non-compatible chemicals in storage always physically isolated from one another?			
Other:			

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below.

1. List the condition should be considerd during storing and before storing (10)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Name: _____ Date: _____

Short Answer Questions