Government of the Punjab
Agriculture Department

HIGH EFFICIENCY IRRIGATION SYSTEMS

TECHNICAL BRIEF
7

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BACKGROUND

Irrigation water (not land) is the limiting factor in improving agricultural production in Pakistan. Moreover, irrigation efficiencies at the farm level are dismally low (50%) that is another factor in harvesting potential production from otherwise highly fertile lands of the country. There is, therefore, an enormous potential of maximizing agricultural output by making effective, efficient, and judicious use of irrigation water.

The adoption of high efficiency irrigation systems (HEISs) can give boom to Pakistan's agriculture as current water application methods not only consume (in fact waste) colossal amount of water but also limit effectiveness of other inputs. As such, use of HEIS can not only shift existing conventional inexact crop water application practices to exact and precise irrigation but will also increase productivity of fertilizers, energy, labor, pesticides, weedicides etc..



INTRODUCTION

Drip and sprinkler irrigation enables timely application of water and other inputs (fertilizers, nutrients etc.) as per plant requirements at various stages of its growth. These systems enable irrigating variety of soil conditions e.g. uneven topography, odd field configurations, rolling sandy areas, long lengths of run etc. The drip is best suited for orchards and high value row crops such as vegetables, cotton, maize, sugarcane etc. whereas sprinkler systems are more suitable for field crops e.g. wheat, fodder, gram etc.



Drip and sprinkle irrigation technologies enhance agricultural production manifolds as well as improve quality of produce by enabling precise and timely application of water and all other nutrients. These systems are versatile in their applicability and provide complete control in irrigation operations. Very little labour is required to operate drip and sprinkler equipment, which almost alleviates drudgery of irrigation functions. These systems can rather be automated to further minimize labour requirements besides achieving more precision in application of water and other inputs to the crops.



BENEFITS

The impact assessment studies for performance evaluation of drip/sprinkler irrigation on sugarcane, citrus, potato, wheat, and gram have exhibited following impacts vis-a-vis conventional irrigation methods.

Water saving (75 percent)	Increase in yield (20 to 100 percent)	Reduction in production cost (20 to 35 percent)	Less requirement of labour for irrigation management (30 percent)
Enhancement in irrigated area	Better produce quality	Uniform and better seed germination	Suitable for uneven topography



PRINCIPLE OF DRIP IRRIGATION

Drip irrigation, also called as trickle/micro irrigation, is the most efficient technology that makes highly effective use of water, fertilizers, and other nutrients for crop production. Its main principle is to apply water and other inputs slowly, regularly, and frequently as close to the plant roots as possible through emitters installed on plastic pipes laid out in the field.

FILTRATION

The filtration of the irrigation water is essential to avoid blockage/clogging of the system, especially the emitters. The type of filter used depends on the kind of impurities contained in the water and the degree of filtration required on the emitters.

Types of Filters

a) Gravel Filter

- Prevent entry of large particles and unbroken organic impurities (e.g. Algae)
- Sharp edged silica sand traps suspended material that exits through the outlet at the bottom of the tank
- Used when water source is exposed to sunlight (e.g. canal water stored in a pond)

b) Hydrocyclone Filter

- Heavier particles (sand) are thrown towards periphery resulting into their separation from water
- Separates sand or silt from well or river water through the creation of a centrifugal force by a tangential flow inside the filter
- Centrifugal force drives the solids downward to a collecting chamber attached below and lets the clean water out
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Secondary Filters

a) Disc Filter

- Prevent entry of large particles and unbroken organic impurities (e.g. Algae)
- Sharp edged silica sand traps suspended material that exits through the outlet at the bottom of the tank
- Used when water source is exposed to sunlight (e.g. canal water stored in a pond)



b) Screen Filter

- Used for final filtration as a safeguard for either moderate quality water or following a primary filtration with gravel or hydrocyclone filters
- Removes small size suspended materials (e.g. fine sand) or a little amount of algae
- Made of stainless steel / nylon / polyester mesh equipped with interchangeable perforated filtering elements



Automatic Self-cleaning Filters

- Most of the filters can be supplied with automatic cleaning capability, as determined by pressure differential, duration of filtration, volume of water filtered, or by any combination of all these
- The cleaning mechanism, usually back flushing, for the removal of accumulated debris uses the system's water pressure

FERTIGATION/CHEMIGATION

- Application of fertilizers and other nutrients to crop in soluble form alongwith irrigation water
- Injection of chemicals (acids, chlorine) for system cleaning / maintenance

FERTIGATION EQUIPMENT

1) Fertilizer Tank 2) Venturi Injector 3) Injection Pump

SR. NO.	EQUIPMENT	MERITS	LIMITATIONS
1	**Drum**	• Easy to use • No separate energy • Low cost	• Low fertilizer application uniformity • Each irrigation turn requires fertilizer/nutrient replenishment • Not suitable for automation
2	**Venturi Injector**	• No external energy source required • Better fertilizer application uniformity • Suitable for automation	• High pressure loss • Limited operating range
3	**Injection Pump**	• High fertilizer application uniformity • No pressure loss in the system • Suitable for automation	• Relatively complicatedto operate • High cost • Requires external source of power • Limited operatin

IN-FIELD SYSTEM COMPONENTS

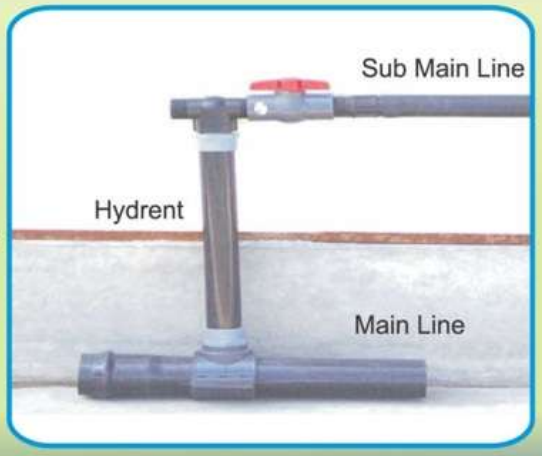
Water Distribution Pipes

a) Mainline

- **PVC made**
- **Placed underground**
- **Connect head control unit and sub-mains**

b) Sub-main

- **PVC / PE made**
- **Placed on surface / subsurface**
- **Connect mainline and laterals**



EMITTING DEVICES

a) Plain Laterals

- Made of Polyethylene (PE) and usually placed on surface and in some cases subsurface
- Take water form sub-main and supply it close to the crop roots in form of drops
- Emitters having 10 to 32 mm openings are fixed at desired spacings
- Suitable for orchards


b) Integrated Drip Line

- Emitters are inbuilt at different spacings
- Suitable for row crops
- Sizes varies from 12 to 25 mm
- Long Life
- High initial cost


c) Drip Tape

- Inbuilt labyrinth (hole) at different spacing
- Suitable for row crops
- More suitable for plain terrain
- Low initial cost
- Recyclable
- Short life


d) Drippers

i) Pressure Compensated

- Maintain uniform flow distribution irrespective of pressure variations in the system
- Suitable for undulating topography


ii) Non-Pressure Compensated

- Water supply to the crop changes with the pressures changes in drip line
- Suitable for plain topography



HAND MOVE LATERALS

- Main-line is buried or portable with valve outlets at intervals for attaching portable laterals
- Suitable for almost all crops
- Usable in every type of topography
- High labor requirements
- Susceptible to leakage at joints

GUN SPRINKLERS

Benefits

- Irrigate large area in one location
- Operate manually or automatically
- More suitable for supplemental irrigation
- Low initial cost

Limitations

- Not suitable for windy areas
- Large droplet size compact the soil
- High application rate causes runoff
- Require more energy

FIXED / PERMANENT SPRINKLERS

Permanently laid main, sub-main, lateral lines with stationary water source and pumping unit

Benefits

- Suitable for orchards, berries, grasses and ornamental plants etc.
- Require less labour
- Can be fully automated

Limitations

- High initial cost
- High energy requirements

CENTER PIVOT

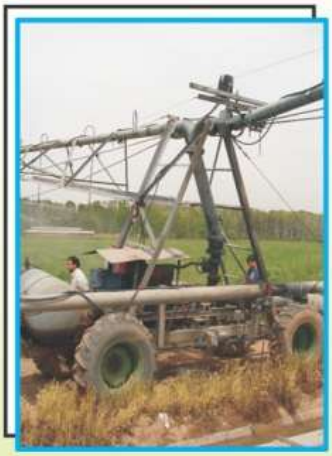
Sprinkles water from a continuously moving lateral pipeline around a pivot (fixed end of the lateral). The lateral line consists on number of sprinklers at specific spacings.

Benefits

- Better irrigation application uniformity
- Suitable for almost all crops
- Can be fully automated
- Very low labor requirement
- Optimal operation on large areas

Limitations

- High initial cost
- Requires field free from ground obstructions (electric poles, trees etc.)
- Difficult to cover field corners



LINEAR-MOVE

The system (lateral line & pumping unit) moves linearly across the field

Benefits

- Better irrigation application uniformity
- Suitable for almost all crops
- All field including corners are equally irrigated

Limitations

- High initial cost
- Only suitable for irrigating rectangular fields, free from ground obstructions (electric poles, trees etc.)

WATER MANAGEMENT ACTIVITIES

LASER Land Leveling

Watercourse Improvement

Sprinkler Irrigation

Drip Irrigation

Bed & Furrow Technology

Solar Water Pump

Hydro Flume Irrigation

Flexible Pipe Irrigation

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