

# Chapter 51: Drainage of Irrigated Lands – Necessity, Methods

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## Introduction

Drainage of irrigated lands is a critical aspect of sustainable agriculture and water resource management. While irrigation boosts crop production by ensuring adequate water supply, improper or excessive irrigation can lead to waterlogging, soil salinity, and declining crop yields. Efficient drainage systems are therefore necessary to maintain the health of the soil and ensure long-term agricultural productivity. This chapter explores the necessity for land drainage in irrigated regions and the various methods used to implement it effectively.

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## 51.1 Necessity of Drainage in Irrigated Lands

### 1. Prevention of Waterlogging

Waterlogging occurs when excess irrigation water accumulates in the root zone, saturating the soil and reducing oxygen availability to plant roots. This condition stunts plant growth and may cause root rot or even complete crop failure.

### 2. Control of Salinity and Alkalinity

In arid and semi-arid regions, the upward movement of groundwater brings salts to the surface. Without proper drainage, these salts accumulate in the root zone, leading to salinization and alkalization of soils, which severely hampers agricultural productivity.

### 3. Maintenance of Soil Structure and Aeration

Saturated soils lose their structure and porosity over time. Drainage helps maintain optimal soil moisture levels, which in turn supports good tilth, aeration, and microbial activity essential for healthy crops.

### 4. Protection of Civil Structures and Infrastructure

High groundwater tables can damage foundations, roads, and other infrastructure. Proper drainage ensures structural stability by keeping groundwater at a safe depth.

### 5. Increasing Crop Yield and Diversity

Well-drained fields support the growth of a wider variety of crops and increase overall productivity. Drainage also allows timely land preparation and harvesting,

reducing risks associated with delayed field operations.

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## 51.2 Classification of Drainage Systems

Drainage systems are classified based on their function and layout:

### 1. Surface Drainage Systems

These systems remove excess water from the surface of the land and include open ditches, land grading, and shaping.

- **a. Random Drainage:** Ditches are placed randomly to remove surface water from low spots.
- **b. Parallel or Bed Drainage:** Shallow parallel ditches constructed at regular intervals.
- **c. Cross-Slope Drainage:** Used for sloping lands; ditches run perpendicular to the slope.

### 2. Subsurface Drainage Systems

These systems remove water from the root zone and lower layers of the soil. They are also known as tile drainage systems.

- **a. Tile or Pipe Drainage:** Perforated pipes placed below ground to collect and transport excess water.
  - **b. Mole Drainage:** Unlined channels made using mole ploughs in clay soils.
  - **c. Vertical Drainage (Tube Wells):** Groundwater is pumped out to lower the water table.
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## 51.3 Components of a Drainage System

A complete field drainage system consists of:

1. **Field Drains:** Collect water from the field.
2. **Collector Drains:** Convey water from several field drains.
3. **Main Drains:** Transport water to the final outlet.
4. **Outlets:** Discharge drained water into rivers, reservoirs, or other safe areas.

Each component must be designed considering local soil, topography, and hydrological conditions.

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## 51.4 Factors Affecting the Design of Drainage Systems

1. **Soil Type and Permeability:** Determines how quickly water moves through the soil.
  2. **Topography:** Influences the direction and velocity of surface runoff.
  3. **Crop Type and Root Depth:** Affects the required water table level.
  4. **Rainfall and Irrigation Intensity:** Governs the total volume of excess water.
  5. **Water Table Level:** Helps determine depth and spacing of subsurface drains.
  6. **Salinity Levels:** Impacts the drainage layout and disposal requirements.
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## 51.5 Methods of Field Drainage

### 1. Surface Drainage Methods

Used when surface runoff is significant and soil infiltration is low.

- **a. Open Ditches:** Simple and cost-effective; must be maintained to prevent clogging.
- **b. Land Grading:** Reshaping land surface to direct water into drains.
- **c. Bedding Systems:** Raised beds for crops with furrows in between for water drainage.

### 2. Subsurface Drainage Methods

Used when the water table is close to the root zone.

- **a. Pipe Drainage (Tile Drainage):**
    - **Depth and Spacing:** Generally 1.2–2.0 meters deep, spacing varies with soil type.
    - **Layout Types:** Random, herringbone, gridiron, and interceptor layouts.
    - **Materials:** PVC, concrete, clay pipes.
  - **b. Vertical Drainage (Deep Wells):**
    - Suitable for soils with high permeability.
    - Groundwater is pumped out to maintain a deep water table.
  - **c. Mole Drainage:**
    - Effective in clay soils.
    - Inexpensive but short lifespan.
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## 51.6 Drainage Water Disposal Methods

Proper disposal of drained water is crucial to prevent downstream problems.

1. **Natural Water Bodies:** Streams, rivers, or lakes – when quality is acceptable.
  2. **Evaporation Ponds:** Especially for saline water in arid areas.
  3. **Reuse for Irrigation:** Treated or moderately saline water may be reused.
  4. **Drainage Wells:** Recharge aquifers when water is clean.
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## 51.7 Maintenance of Drainage Systems

Regular maintenance is essential for long-term effectiveness:

- **Desilting and de-weeding** of open drains.
  - **Inspection and repair** of tile outlets and junctions.
  - **Monitoring water table** levels.
  - **Cleaning silt traps** and screen intakes.
  - **Checking pipe gradients and blockages.**
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## 51.8 Environmental Considerations

Drainage can have significant environmental impacts:

- **Soil erosion** due to high-velocity surface drains.
- **Loss of wetlands** and associated biodiversity.
- **Contamination of water bodies** with agrochemicals.
- **Subsidence** due to excessive groundwater withdrawal.

Environmental safeguards include buffer strips, controlled drainage, and water quality monitoring.

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