# Chapter 45: Methods of Applying Water to the Fields

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## Introduction

Efficient application of water to agricultural fields is essential to maximize crop yield, reduce water losses, prevent soil degradation, and ensure sustainable water resource management. The choice of irrigation method depends on various factors such as soil type, crop pattern, water availability, topography, and climatic conditions. Broadly, irrigation methods are classified into four main categories:

1. **Surface Irrigation**
2. **Sub-surface Irrigation**
3. **Sprinkler Irrigation**
4. **Trickle/Drip Irrigation**

Each method has its own engineering design principles, advantages, limitations, and appropriate contexts of use.

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## 1. Surface Irrigation

Surface irrigation is the most commonly used method worldwide. It involves the application of water by gravity flow over the soil surface. This method is suitable where land has a gentle slope and sufficient water is available.

### 1.1 Types of Surface Irrigation

#### 1.1.1 Basin Irrigation

- Land is divided into flat basins surrounded by bunds.
- Used for rice, wheat, sugarcane.
- Water is allowed to flood the basin and infiltrate gradually.

#### 1.1.2 Border Irrigation

- Water is applied through long parallel strips called borders.
- Width of border: 3–15 meters; Length: 100–400 meters.
- Used for close-growing crops like wheat, barley.

#### 1.1.3 Furrow Irrigation

- Water flows through small, shallow channels (furrows) between crop rows.
- Suitable for row crops: maize, cotton, sugarcane.
- Reduces contact with foliage, thus reducing fungal diseases.

### 1.1.4 Wild Flooding

- Water is released without defined control or channels.
- Practiced in undulating lands.
- Low efficiency and high water wastage.

### 1.2 Design Parameters

- Soil infiltration rate
- Land slope
- Stream size
- Field length and width
- Water application depth

### 1.3 Advantages

- Simple and low cost
- No high-tech equipment required
- Utilizes gravity

### 1.4 Limitations

- High water losses due to deep percolation and runoff
- Waterlogging and salinity risk
- Not suitable for sandy soils or steep terrains

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## 2. Sub-surface Irrigation

Sub-surface irrigation involves supplying water below the soil surface either artificially or naturally to maintain soil moisture in the root zone.

### 2.1 Types of Sub-surface Irrigation

### 2.1.1 Natural Sub-surface Irrigation

- Occurs in regions with high groundwater table.
- Capillary rise provides moisture to roots.
- Not controlled or engineered.

### 2.1.2 Artificial Sub-surface Irrigation

- Network of perforated pipes or tile drains laid below surface.
- Water flows through pipes and moves upward by capillary action.

### 2.2 Design Considerations

- Soil capillary properties
- Depth and spacing of pipes
- Crop root zone depth
- Water quality (no clogging minerals)

### 2.3 Advantages

- Minimizes surface evaporation
- No surface interference with farming operations
- Reduces weed growth

### 2.4 Limitations

- High installation cost
- Not suitable for all soil types (e.g., coarse sand)
- Maintenance of pipes is difficult
- Risk of waterlogging if not managed well

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## 3. Sprinkler Irrigation

Sprinkler irrigation simulates rainfall by spraying water through nozzles into the air. It is widely used where surface irrigation is not feasible due to uneven terrain, sandy soils, or scarcity of water.

### 3.1 System Components

- **Pump**: Provides required pressure.
- **Mainline and Laterals**: Transport water from source to field.
- **Sprinkler Heads/Nozzles**: Distribute water in droplets.
- **Control Units**: Timer, pressure regulators, valves.

### 3.2 Types of Sprinkler Systems

#### 3.2.1 Portable Systems

- Can be moved from one field to another.
- Suitable for small farms.

#### 3.2.2 Permanent Systems

- Underground piping and fixed risers.
- Used for large-scale or commercial operations.

### 3.2.3 Centre Pivot Systems

- A long arm rotates around a central pivot.
- Covers circular areas; used for large mechanized farms.

### 3.2.4 Raingun Systems

- High-pressure guns that can throw water up to 90 meters.
- Ideal for wide field applications.

### 3.3 Design Considerations

- Nozzle spacing and pressure
- Wind speed and direction
- Soil infiltration rate
- Uniformity coefficient

### 3.4 Advantages

- Suitable for almost all soil types
- Uniform distribution
- Efficient use of water
- Fertilizers can be applied through fertigation

### 3.5 Limitations

- High initial and maintenance cost
- Wind affects uniformity
- Clogging of nozzles
- Energy requirement for pumping

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## 4. Trickle/Drip Irrigation

Trickle or drip irrigation is a high-efficiency system where water is delivered directly to the root zone in small, frequent quantities.

### 4.1 System Components

- **Pump Unit**: Provides pressure.
- **Filter Unit**: Removes suspended solids to prevent emitter clogging.
- **Mainline and Sub-mains**: Distribute water.
- **Drip Laterals**: Small diameter pipes with emitters.
- **Emitters**: Deliver water drop by drop.

### 4.2 Emitter Types

- **Online Emitters**: Attached externally to lateral.
- **Inline Emitters**: Built into lateral during manufacturing.

### 4.3 Types of Drip Irrigation

#### 4.3.1 Surface Drip

- Emitters placed on soil surface.
- Common for vegetable crops, orchards.

#### 4.3.2 Subsurface Drip

- Laterals buried below the surface.
- Suitable for field crops; reduces evaporation losses.

### 4.4 Design Parameters

- Emitter discharge rate
- Operating pressure
- Spacing of laterals and emitters
- Soil wetting patterns

### 4.5 Advantages

- Maximum water use efficiency (90–95%)
- Reduced weed growth
- Less disease due to dry foliage
- Fertilizer efficiency improved via fertigation
- Suitable for water-scarce regions

### 4.6 Limitations

- High initial investment
- Maintenance of filters and emitters required
- Clogging issues in saline or hard water
- Requires skilled design and operation

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