Chapter 49: Water Logging – Causes, Effects and Remedial Measures

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Introduction

Water logging is a critical issue in water resources engineering that adversely affects soil productivity, plant growth, and land usability. It is defined as a condition where the root zone of the soil remains saturated with water, restricting normal crop growth due to insufficient air in the soil pores. This problem is especially prevalent in irrigated agricultural lands, low-lying areas, and regions with poor drainage systems. For civil engineers, especially those working in irrigation, drainage, and land development projects, understanding the causes, consequences, and remedies of water logging is vital for sustainable land and water resource management.

49.1 Causes of Water Logging

Water logging is the result of both **natural** and **anthropogenic** factors. The primary causes include:

49.1.1 Over-Irrigation

- Excessive application of water to agricultural fields beyond crop requirements causes percolation beyond the root zone.
- This increases the groundwater table, leading to saturation of the root zone.
- Common in regions with assured irrigation like canal command areas.

49.1.2 Seepage from Canals, Reservoirs, and Ponds

- Unlined or poorly lined irrigation canals and water bodies lead to seepage losses.
- This seeped water accumulates underground and raises the water table.
- The seepage becomes significant in areas with clayey or poorly drained soils.

49.1.3 Inadequate or Poor Drainage

- Lack of natural or artificial drainage systems prevents the removal of excess surface and subsurface water.
- Stagnant water accumulates on the surface and within the soil profile.
- In flat terrains or areas with heavy rainfall, poor drainage is a major contributor.

49.1.4 Flat Topography and Impermeable Subsoil

- In regions with little or no land slope, water movement is restricted.
- Soils with impermeable layers (like clay or hard pan) hinder percolation, causing water to accumulate above them.

49.1.5 High Groundwater Table

- Naturally high water tables due to geological conditions may result in water logging with minimal addition of water from external sources.
- Seasonal rainfall or nearby irrigation activities can exacerbate this.

49.1.6 Deforestation and Urbanization

- Deforestation reduces the water-holding capacity of soil and increases runoff.
- Urbanization leads to the replacement of permeable soil with impermeable surfaces, reducing natural infiltration and increasing surface accumulation.

49.1.7 Monocropping and Traditional Farming Practices

- Continuous cultivation of water-intensive crops (e.g., paddy) without rotation can saturate the soil profile.
- Traditional flood irrigation methods waste water and raise the water table.

49.2 Effects of Water Logging

The impacts of water logging are far-reaching, affecting **agriculture, environment, infrastructure, and socio-economic conditions**.

49.2.1 Agricultural Effects

- **Reduction in Crop Yield:** Roots suffocate due to lack of oxygen, inhibiting growth.
- **Soil Degradation:** Leads to salinization and reduction in fertility.
- **Crop Diseases:** High humidity and stagnant water promote fungal growth and pest attacks.

49.2.2 Environmental Effects

- **Loss of Soil Microbial Activity:** Beneficial aerobic microbes perish in saturated soils.
- **Degradation of Groundwater Quality:** Water logging can cause salt mobilization, contaminating aquifers.
- **Impact on Biodiversity:** Alters the local ecology and may lead to habitat loss.

49.2.3 Structural and Infrastructural Effects

- **Weakening of Foundations:** Buildings, roads, and pipelines in water-logged zones face foundation failures.
- **Damage to Road Networks:** Roads may crack or subside due to reduced soil bearing capacity.
- **Deterioration of Utility Services:** Water logging affects sewage, electric poles, and storm water drains.

49.2.4 Socio-economic Impacts

- **Reduction in Farmer Income:** Due to low yield and frequent crop failure.
- **Displacement:** In chronic cases, water logging may force people to migrate.
- **Health Hazards:** Stagnant water becomes breeding ground for mosquitoes, causing diseases like malaria and dengue.

49.3 Remedial Measures of Water Logging

Effective solutions to water logging require **preventive, curative, and management-oriented approaches**.

49.3.1 Improvement of Drainage Systems

a) Surface Drainage

- Construction of surface drains to carry away excess rainfall and irrigation water.
- Useful in areas with heavy rainfall and slow infiltration.

b) Subsurface Drainage

- Installation of tile drains, mole drains, or perforated pipes at shallow depths.
- Helps lower the water table and remove excess soil moisture.

49.3.2 Canal Lining

- Prevents seepage losses from irrigation canals.
- Lined canals reduce water infiltration into the adjacent soil.
- Materials like concrete, stone masonry, or plastic linings are commonly used.

49.3.3 Controlled and Efficient Irrigation

- **Adoption of Modern Techniques:** Drip and sprinkler irrigation to minimize water wastage.
- **Scheduling Irrigation:** Based on soil moisture and crop requirement, using tools like tensiometers.
- **Avoid Over-Irrigation:** Educating farmers and enforcing policies in command areas.

49.3.4 Recharging Groundwater Through Wells

- Pumping of groundwater from open or tube wells lowers the water table.
- Conjunctive use of surface and groundwater helps maintain balance.

49.3.5 Tree Plantation and Agroforestry

- Deep-rooted trees like eucalyptus absorb groundwater, reducing saturation.
- Afforestation improves soil structure and drainage capacity.

49.3.6 Construction of Interceptor Drains

- These drains intercept seepage from canals before it enters agricultural land.
- Usually built parallel to canals at a safe distance.

49.3.7 Land Grading and Leveling

- Facilitates uniform distribution and removal of water from fields.
- Reduces water stagnation and encourages proper infiltration.

49.3.8 Policy and Institutional Measures

- Water user associations for better irrigation management.
- Government-funded drainage projects in chronic waterlogged regions.
- Land use zoning and planning to avoid urban water logging.
