Water Logging and salinity

By
Engr:Jebran khan
INU, Peshawar

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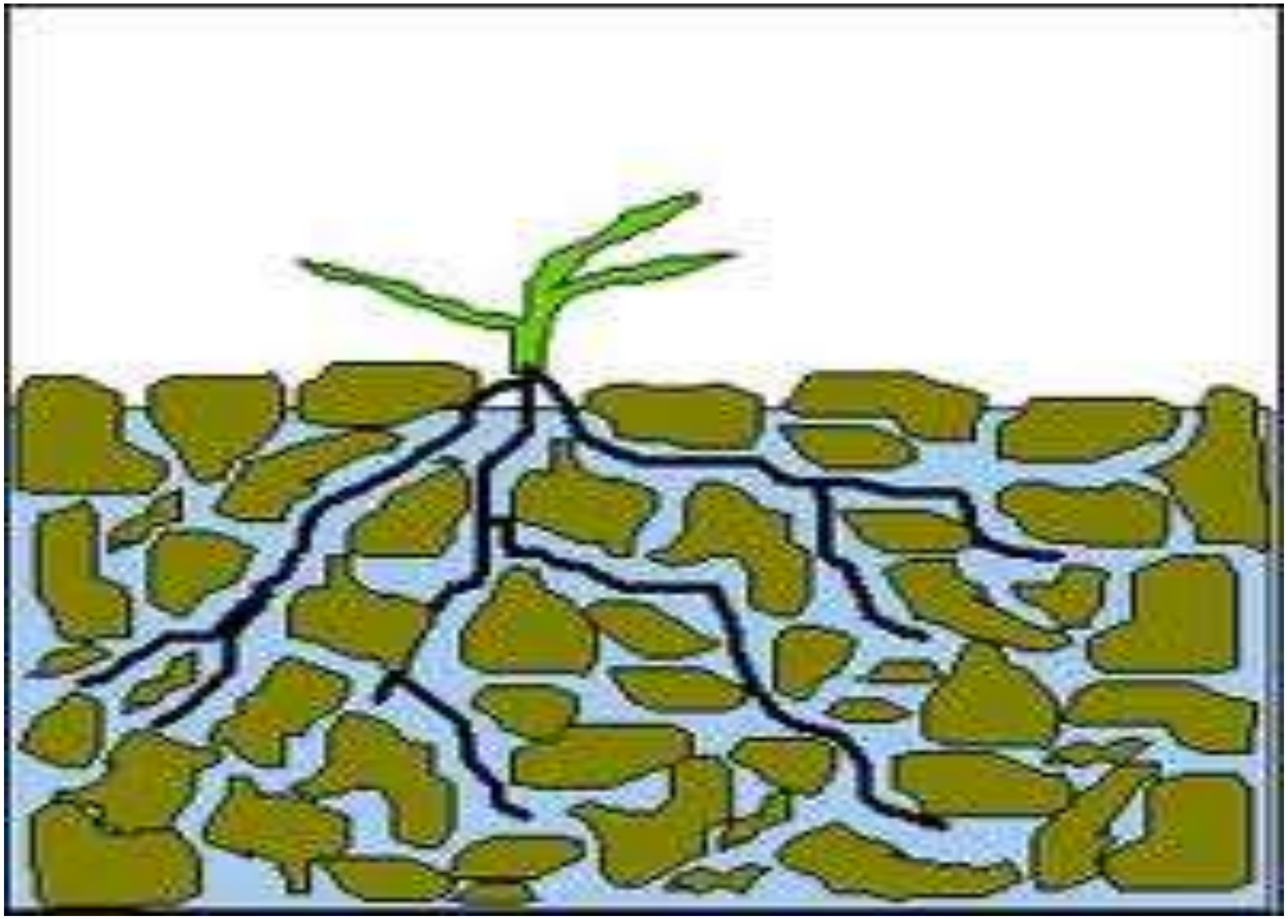
- What is water logging?
- Land is said to be water logged when its productivity is affected by high water Table(WT).
- High WT causes saturation of root zone.
- It leads ill aeration which causes the decay of nitrifying bacteria.
- This reduces the crop yield.

Water logging & ill aeration



Water logging in Pakistan

- Recharge of Ground water (GW): 1. Before canal system- 10 Million acre ft.(MAF). 2. after canal system- 41.9 MAF.
- WT risen 10 ft in half of canal irrigated area and 5 ft in 16 % of canal irrigated area.
- In Pakistan the total water-logged area is 2 MLN acres.
- GW Reservoirs: 1.Indus plain 2. Bannu basin 3.Warsak- Peshawar area.

Problems due to water-logging

- Delay in cultivation operations such as tilling, ploughing etc.
- Weed growth.
- Salinity.
- If WT has risen up or plant root happens to come up in capillary zone, water continuously evaporated by capillarity thus continuous upward flow of water to land surface is established.

Salts rise with water & deposits in root zone.
It reduces osmotic activity of plants and the plant decays.

CAUSES OF WATER-LOGGING:-

1. Intensive Irrigation: If max. area of land is irrigated, percolation of water takes place. This causes the rise of WT.

Extensive irrigation (irrigation spread over wider regions) to be followed to avoid water logging.

2. Seepage of water from adjoining high lands.
3. Seepage of water through canal reservoirs.

4. Impervious obstruction: water seeping below the soil moves horizontally. It may find obstruction & WT may rise.

5. Inadequate surface Drainage:

Storm water & excess of irrigation water should be removed. If proper drainage is not provided water percolates to rise water table.

6. Excessive Rains:

-Causes temporary water logging.

- No drainage causes permanent.

7. Submergence due to floods:

Continued floods causes the growth of water-loving plants which obstruct natural surface drainage & increase the water-logging.

8. Irregular & flat topography: In depressions, the drainage is poor, water detention is more. The percolation increases the water table.

WATER-LOGGING CONTROL:

-Quantity of water into soil below is reduced.

- Inflow into underground reservoir is reduced & outflow should be increased.

Methods of control of Water logging

1. **Lining of canals and water courses**:

   It reduces seepage of water.

2. **Reducing intensity of irrigation:**

- Only small portion of land should receive canal water in one particular season.

. Remaining areas can receive water in next season by rotation.

3. **By introducing crop rotation**:

- High water requiring crop should be followed by one requiring less water, and then by one requiring almost no water.

  Example: Rice followed by wheat and then by cotton.

4. **Optimum use of water:** Certain amount of water gives the best result. Less or more water reduce the yield. Cultivators should be educated so that not to use more water.

--.Revenue should be charged on the basis of quantity of water rather than the area of land.

5. Improving natural drainage of area:

- water should not be allowed to stay in one area.
- Natural flow is provided by bush and jungle cutting.

6. **Pumping or Tubewells or Vertical Drainage**:

Lift irrigation should be introduced to use GW.

Canal irrigation may be substituted by tube well irrigation.

7. Economical use of water according to need.

8. Adoption of sprinkler method of irrigation.

- Only predetermined amount of water is supplied to land
- No percolation losses from water courses

Reclamation of Saline lands

Alkali salts (Sodium chloride, Sodium Sulphate, and Sodium Carbonate) are injurious to agriculture.

NaCl--------- Least harmful

Na_2SO_4-----Medium harmful

Na_2CO_3------Most harmful

- The above salts are soluble in water
- When W.T rises up or roots are in capillary zone, the G.W moves upwards and salts are deposited in root zone and surface of soil

The phenomena of salts coming up in solution and forming a thin crust (5-7.5cm) on the surface after evaporation of water is called *Efforescence*

Land affected by efforescence is called saline soil

Salts surrounding the roots reduce the osmotic activity of plants

Diagram (OSMOSIS)

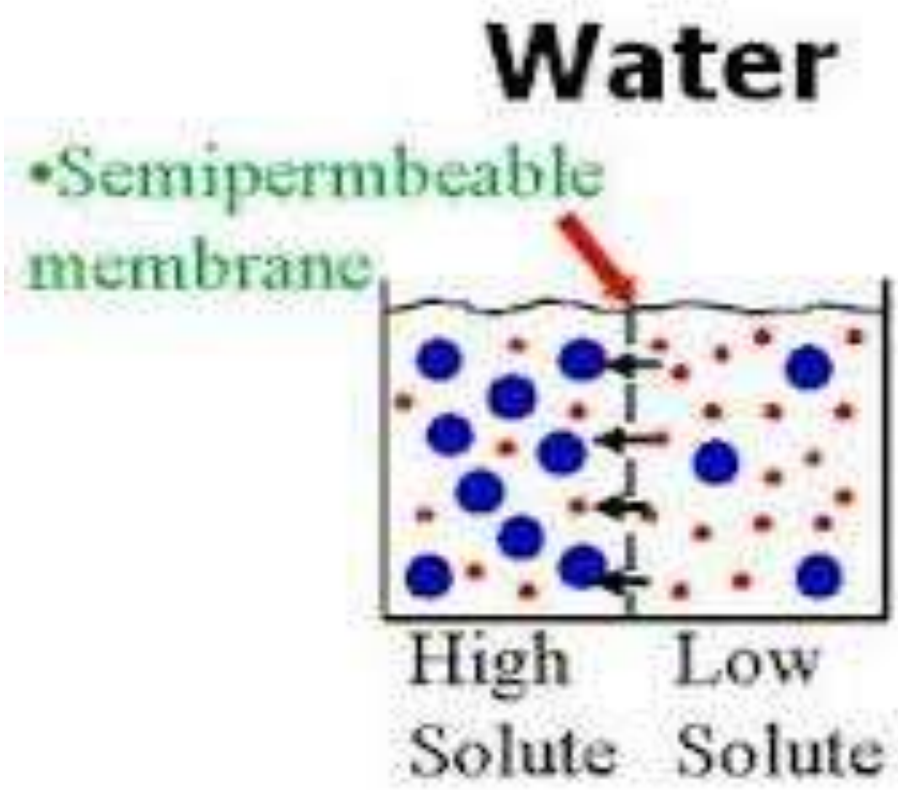
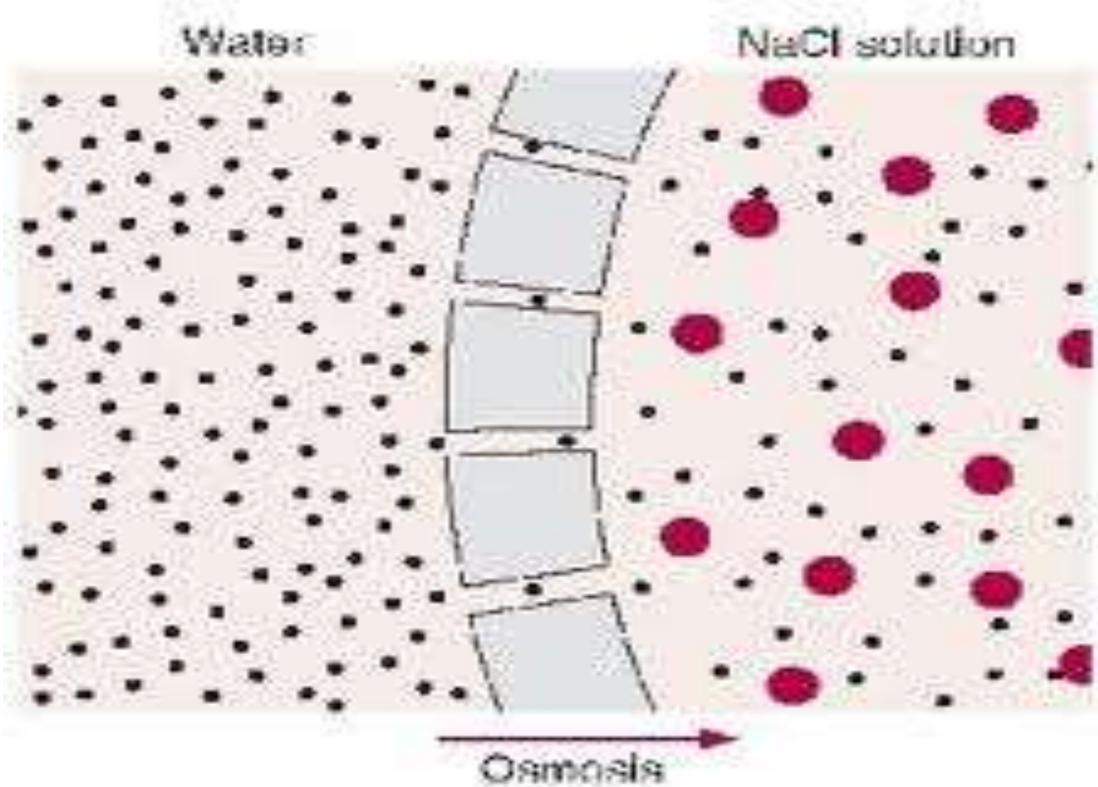


Diagram (OSMOSIS)



SALINITY


In arid regions, soil drainage is often poor, evaporation rates are high and the water table is low.
Poor drainage and evaporation concentrate salts on irrigated land. Even good quality irrigation water contains some dissolved salt and can leave behind tonnes of salt per hectare each year.
Unless salts are washed down below root level, soil salinity will stunt growth and eventually kill off all but the most resistant plants.
Irrigation can raise groundwater levels to within a metre of the surface, bringing up more dissolved salts from the aquifer, subsoil and root zone.

- By principle of Osmosis, the pure water from root flows outwards in a plant die due to lack of water
- Such soil is unproductive and is called Saline soil.
- If the salt efforescence continues for a longer period, a base exchange reaction with clay takes place, thus Sodiumizing the clay, making it impermeable, illaerated and highly unproductive.
- Such soil are called alkaline soils

Reclamation of Salt affected lands

How to avoid efflorescence?

- By maintaining the water table sufficiently below the roots
- Hence all the measures which were suggested for preventing water logging hold good for preventing salinity of lands
- An efficient drainage (surface and subsurface) must be provided to lower the water table in saline soils

LEACHING

In this process;

1) Land is flooded with water
2) Alkaline salts will be dissolved in water
3) Percolation to the ground water
4) Drained by sub surface drains

- High Salt resistant crops like rice are grown on leached land for 1 or 2 seasons
- Then ordinary crops like wheat or cotton are grown

- Then the land is said to have reclaimed
- When Sodium carbonate is present in the soil, gypsum is added before leaching
- Sodium sulphate is formed which is leached out easily

Na_2CO_3+$CaSO_4$--------->>Na_2SO4+$CaCO_3$

Land drainage (ASSIGNMENT)

1. Surface drainage
2. Subsurface drainage/Tile drainage

Surface Drainage

- Removal of excess of water using open ditches, field drains, land grading etc.
- Open drain which remove excess of irrigation and storm water are broad and shallow are called shallow surface drains.
- Shallow surface drains carry runoff to point of entrance to outlet-ditches. These Large and deep outlet ditches are called deep surface drains.

Land Grading

- It is a continuous land slope towards field drains.
- It is necessary for surface irrigation.
- **DEEP SURFACE DRAINS OR OUTLET DITCHES**: They carry the seepage water from tile drainage. They carry storm water and excess of irrigation water. They are designed for combined discharge.

SURFACE INLET

- A surface inlet is a structure constructed to carry the pit water into subsurface drain.
- The surface water from pot hole depressions, road ditches may be removed by: 1. random field drain or 2. inlet surface inlet.

Random Field Drain (diagram)

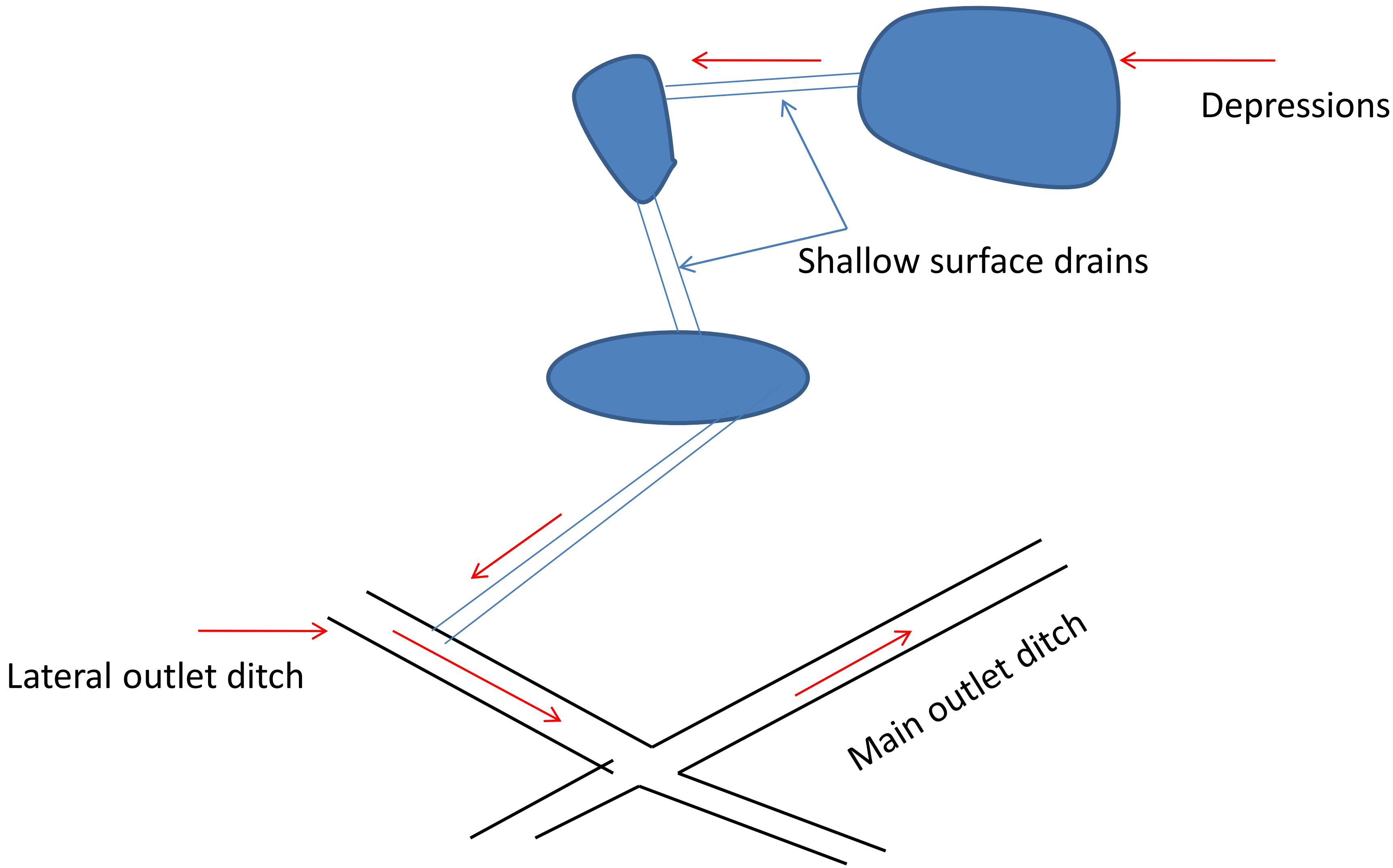
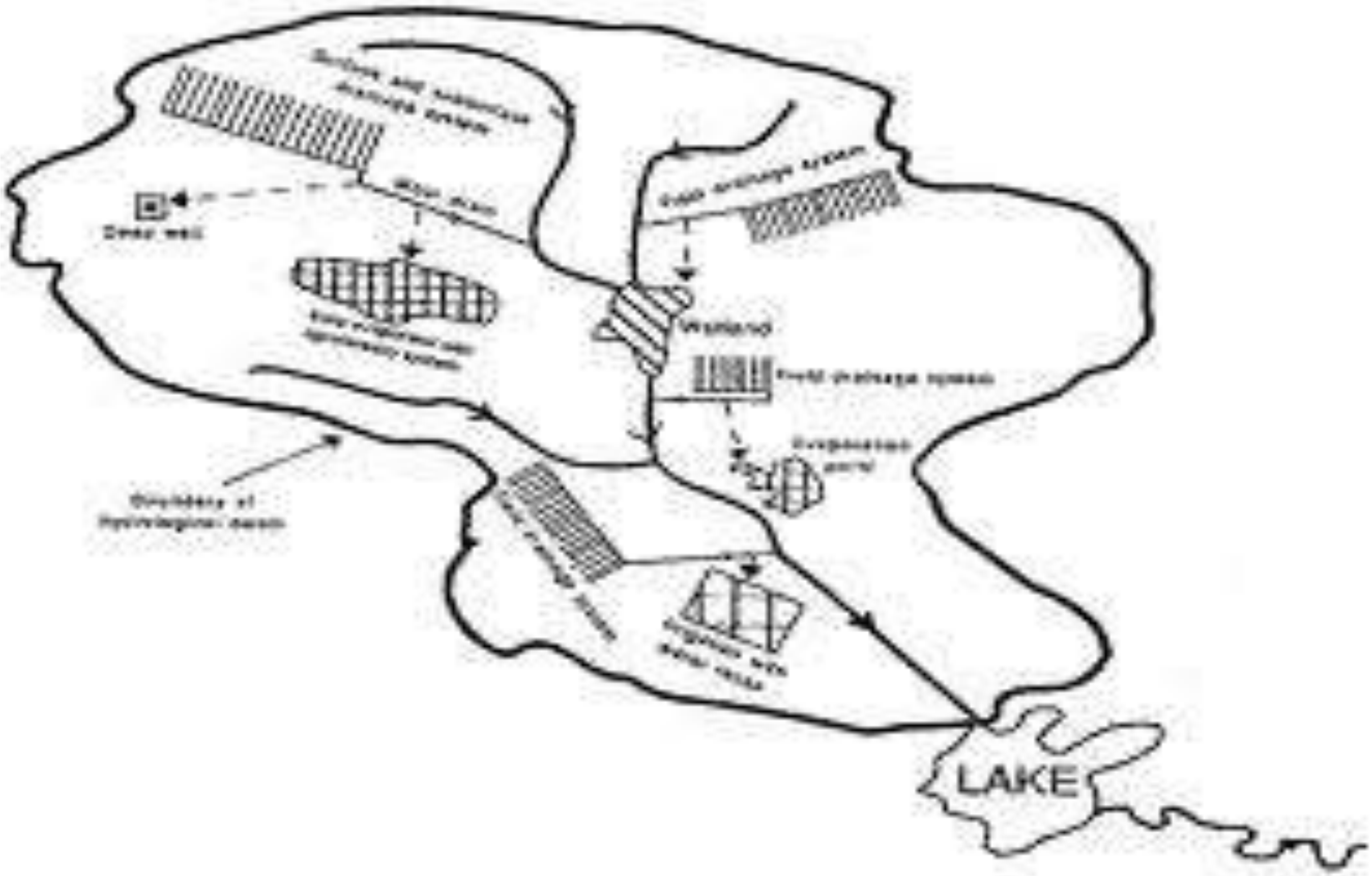


FIGURE 1 Drainage water disposal options within a watershed



Surface Drainage

- Surface drainage is often achieved by land forming and smoothing to remove isolated depressions, or by constructing parallel ditches. Ditches and furrow bottoms are gently graded and discharge into main drains at the field boundary. Although the ditches or furrows are intended primarily to convey excess surface runoff, there is some seepage through the soil to the ditches, depending on the water table position. This could be regarded as a form of shallow subsurface drainage. Surface drainage is especially important in humid regions on flat lands with limited hydraulic gradients to nearby rivers or other disposal points. There is also a need for good surface drainage in semi-arid regions which are affected by monsoons.

Subsurface drainage

- Surface drainage alone is seldom sufficient to remove excess water from the crop root zone. Deep ditches or subsurface pipe drainage systems enable a more rapid water table drawdown. The downstream ends of the laterals are normally connected to a collector drain. The required diameter of the pipe collectors increases with the area drained. Drain spacing is usually dependent on soil hydraulic conductivity and a design drainage rate coefficient. Depending on topography, land formation and proximity of a water receiving body, the collector may outlet by gravity to an open main drain or into a sump. In the latter case, the discharge is then pumped to another drain, or ultimately to a lake or stream.

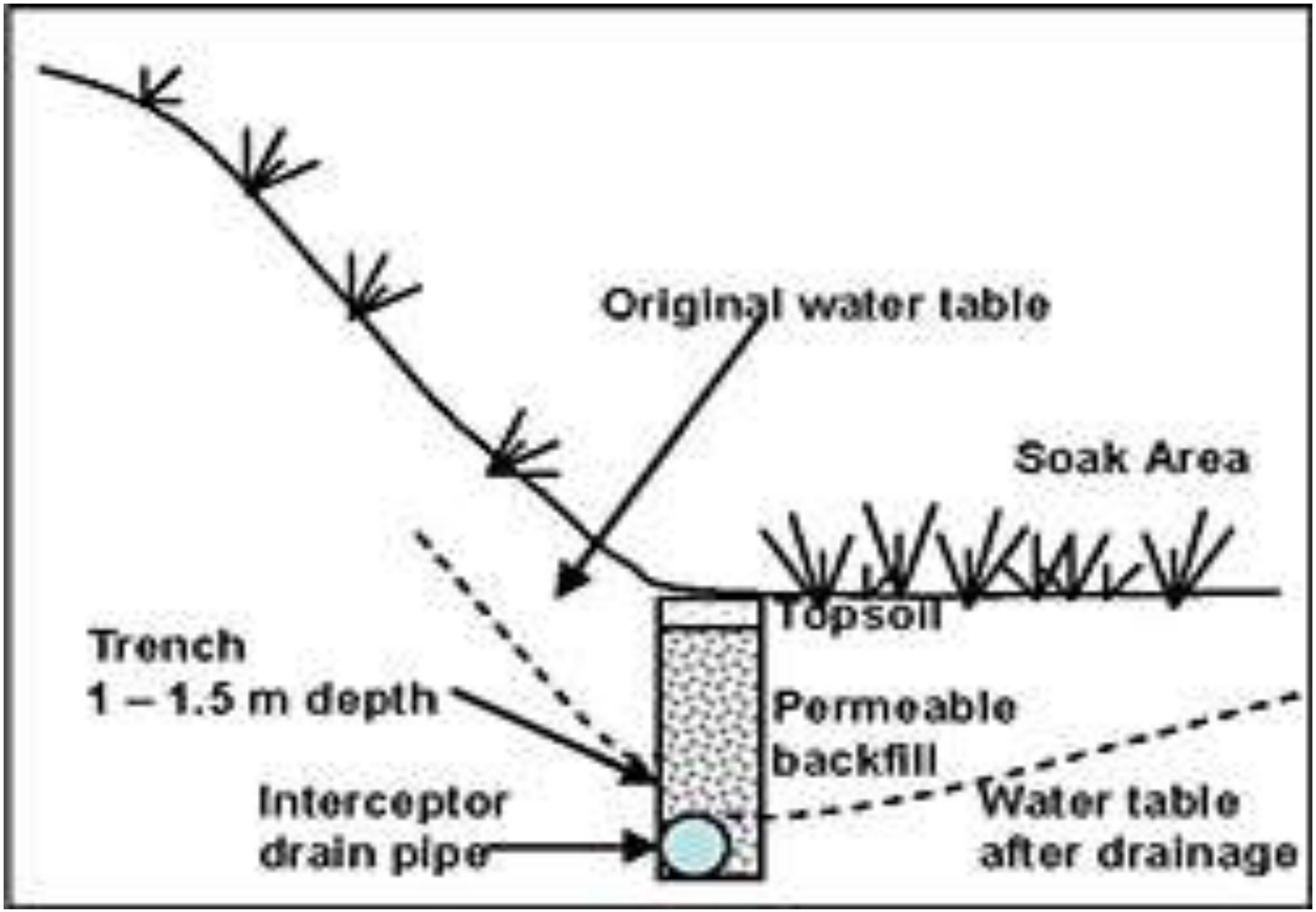
Subsurface drainage

- Horizontal subsurface drainage systems are used in irrigated arid and semi-arid regions to reclaim saline and waterlogged lands, and to maintain favourable long-term salt and water balances in the crop root zone. Salinity and waterlogging are caused by a build up of the water table due to deep percolation of normal excess water and canal seepage. Buried pipe drains are generally installed deeper in arid regions than in humid regions in order to control salinity. Water in excess of plant evapotranspiration (ET) needs is always unavoidably applied during irrigation. This additional quantity of water applied is known as the leaching fraction. Naturally occurring as well as applied salts are then leached from the root zone by this water, and removed from the field via the pipe drains. Deeper drain installation ensures that salts do not rise too rapidly to the soil surface due to capillary action. Drainage also prevents waterlogging of the root zone. The amount of irrigation water to be removed is generally less in arid than in humid regions

Subsurface Drainage

- . Vertical drainage by means of tube-wells is also used to control waterlogging and salinity in some parts of the world, e.g., India, Pakistan and central Asian republics. The primary purposes of tube-wells are the same as those of horizontal drains, and at the same time to extract groundwater for irrigation. As a result of pumping, the water table is lowered, and salinization due to capillarity is minimized. This situation is ideal where the groundwater is not very brackish or saline, and is therefore suitable for irrigation. In areas where the groundwater is highly saline, the pumped water may be too saline for irrigation, unless mixed with fresher or less saline water. Where the groundwater is too saline for crop production, it must be disposed of. Drainage does not have a direct impact on groundwater quality. It only serves to collect and transport excess

Subsurface drainage (diagram)



Thanks