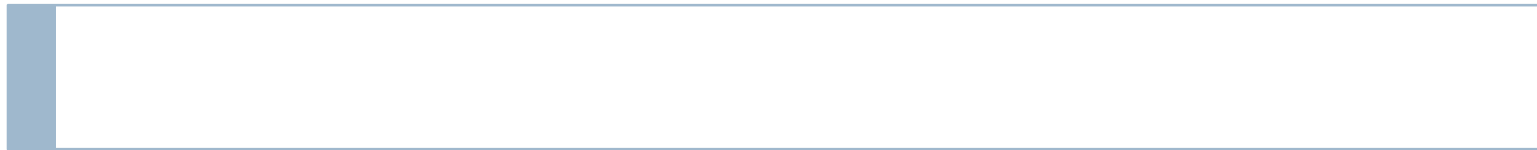


Environmental Impact of Irrigation



Water Logging

- ▶ Water logging prevents oxygen from reaching plant roots, which then suffocates.
- ▶ Also waterlogged solids does not encourage crops to develop their deep roots, so that during drought they are unable to take the deeper moist soil.
- ▶ Water logging occurs either because the water table reaches the surface or because fresh water cannot seeps down beyond the root zone.



Cause

- ▶ **The latter situation can rise in three ways.**
 - ▶ First the openings in the top soil may be too small for water to infiltrate quickly. This can be avoided by proper cultivation of top soil.
 - ▶ Second the sub-soil may be too compact to let water through; this is reclaimed by deep plowing.
 - ▶ Third subsoil may be naturally impermeable, as when it consists of clay, in this case the only solution is to lay under ground drains that discharge surplus water into specially dug ditches.



Cause

- ▶ WAPDA has reclaim 1,80,000 acre water logged agricultural field by installing 14,000 tube wells and 37,000 mile long drains.



WATER LOGGING AND SALINITY

▶ **Water Logging:**

- ▶ An agricultural land is said to be water logged when its productivity or fertility is affected by high water table.
- ▶ Such area where the depth of water table rises at which it tends to the growth of plant doubtful.



WATER LOGGING AND SALINITY

▶ **Water Logging**

- ▶ The height of capillary fringe is more for fine grained soil and less for coarse grained soil.
- ▶ The normal height of the capillary fringe met within agricultural soils various from 0.90 to 1.50 m.
- ▶ The crop yield is adversely affected when the capillary meniscus surface rises to within 0.6. m of ground surface. The land will therefore, water logged when water table is within 1.50 m (i.e. $0.6 + 0.9$) to 2.1 m (i.e. $0.6 + 1.5$) below the ground surface.



WATER LOGGING AND SALINITY

- ▶ The depth of water table which adversely affects the growth of different crops is given below



- ▶ *CROPS*

- ▶ *DEPTH OF WATER TABLE*



- | | |
|-------------------|----------------|
| ▶ 1. Wheat | 0.9m to 1.2 m |
| ▶ 2. Cotton | 1.5 m to 1.8 m |
| ▶ 3. Rice | 0.5 m |
| ▶ 4. Sugar cane | 0.3 m |
| ▶ 5. Foderer crop | 1.2 m |
| ▶ 6. Lucerne | 2.1 to 2.4 m |



EFFECTS OF WATER LOGGING

- ▶ The infertility of the soil when an area becomes water logged is usually due to following reasons.
 - ▶
 - ▶ 1. INHABITING ACTIVITY OF SOIL BACTERIA (nitrifying)
 - ▶ 2. DECREASE IN AVAILABLE CAPILLARY WATER
 - ▶ 3. FALL IN SOIL TEMPERATURE
 - ▶ 4. DEFECTIVE AIR CIRCULATION
 - ▶ 5. RISE OF SALT
 - ▶ 6. DELAY IN CULTIVATION OPERATIONS
 - ▶ 7. GROWTH OF FLORA
 - ▶ 8. ADVERSE EFFECTS ON COMMUNITY HEALTH
-



1. INHABITING ACTIVITY OF SOIL BACTERIA

- ▶ The liberation of plant food depends upon the activity of soil bacteria which requires adequate amount of oxygen in the air for proper functioning.
- ▶ When the soil pores within the root zones of the crop normally grown are so saturated as to effectively cut off the normal circulation of air, the land is said to be water logged.



2. DECREASE IN AVAILABLE CAPILLARY WATER

- ▶ Plant life draws its substance from the soil solution around the soil particles which is drawn into the plant by capillary action and osmosis.
- ▶ If the water table is high the roots of plants are confined to the top layer of the soil above the water table which if the water table is lower, the roots of plants have more for growth.



3. FALL IN SOIL TEMPERATURE

- ▶ If water logged soil warms up slowly and due to lower temperature, action of soil bacterial is sluggish and plant food available is less.



4. DEFECTIVE AIR CIRCULATION

- ▶ When water table is high the drainage become impossible and CO_2 liberated by the plant roots cannot be dissolved and taken away. Consequently fresh air containing oxygen is not drawn in an activity of soil bacteria and plant growth suffers.



5. RISE OF SALT

- ▶ The rise of water table also cause accumulation of Alkali salts in the surface soil by the upwards flow of water which is established in water logged lands.
- ▶ If the water underlying layers contain alkali salts in solution they are brought up with water which evaporates leaving the salts in the surface.
- ▶ The alkaline deposit changes the pH value of the soil. Soils with pH value 7.0 to 8.5 gives normal yields, with pH value 8.5 to 9 the yield decreases, when pH value raised to 11.0 the soil become infertile.



6. DELAY IN CULTIVATION OPERATIONS

- ▶ In water logging areas, cultivation operation i.e. ploughing is impossible or difficult or in any case it is delayed. Sowing of crops and their growth are also delayed.
- ▶ Crops yield is poor and it arrives late in market causing less to cultivator's income.



7. GROWTH OF FLORA

- ▶ In water logged soils, natural flora, such as water hyacinth growth profusely.
- ▶ This reduces the crop yield. A cultivation has to waste money and time both for clearing it out.



8. ADVERSE EFFECTS ON COMMUNITY HEALTH

- ▶ The climate of water logged area becomes damp. Formation of stagnant pools may become breeding places for mosquitoes.
- ▶ The climate thus becomes extremely detrimental to the health of community.



CAUSES OF WATER LOGGING

- ▶ Water logging in a particular area is normally the result of general contributory factors. The main factors causing water logging are given below



INADEQUATE SURFACE DRAINAGE

- ▶ When surface drainage is not adequate, the heavy precipitation in the area is not drained off quickly and rain water remains stagnant over the area for considerable time. This gives rise to heavy percolation and water table rises in the area.



SEEPAGE IN CANAL SYSTEM

- ▶ In nature the water table is in the state of equilibrium.
- ▶ The amount of inflow is practically equal to the amount of out flow. Thus equilibrium is upset by the construction of a new canal system as a new constant source of inflow due to seepage is introduced.
- ▶ The water table to the area, therefore, rises.



OVER IRRIGATION OF FIELDS

- ▶ When the irrigation water applied to the field is in excess of the requirement of the crop, deep percolation takes place which is retained in the intermediate zone augmenting the ground water storage.



OBSTRUCTION OF NATURAL DRAINAGE

- ▶ If a natural drainage is obstructed by irrigation channel, soil or road embankments, it will not be able to pass the rain water of the catchment. There will thus be flooding of land and consequent water logging.



OBLITERATION OF NATURAL DRAINAGE

- ▶ Some times the cultivation plough up and obliteration existing natural drainage. This result in stoppage of storm water flow, consequent flooding and water logged.



INADEQUATE CAPACITY FOR ARTERIAL DRAINAGE

- ▶ The arterial drainage of Nadi may not have adequate capacity to pass the heaviest flood in the entire catchment. As such the functions of all the drains connected to the arterial drains is seriously hampered. The flood water of local drains thus spreads over the country side for days and heavy percolation into the subsoil cause alarming rise in water table.



CONSTRUCTION OF A WATER RESERVOIR

- ▶ Similar to the seepage from a canal, the seepage from the reservoir augments the water table and may cause water logging.



NATURAL OBSTRUCTION TO THE FLOW OF GROUND WATER

- ▶ Some times sub-soil does not permit free flow of subsoil water due to some natural obstruction. This may cause the process of raising the water table.
- ▶ The creation of a high false water table or perched water table also leads to water logging.



REMEDIAL MEASURES

- ▶ In advising anti-water logging measures, and magnitude of various factors, enumerated in previous article should be correctly assessed and allowed for various remedial measures adopted for prevention of water logging are discussed below:-



1. Efficient surface drainage

- ▶ An efficient drainage system which permit quick flow of rain water is short period help to reduce the water logging. They have low initial cost of construction.



2. Under drainage by tile drains

- ▶ The drainage of agricultural land is done more satisfactory by the drains. A suitable tile drain can hold the water table at a predetermined level which will be most beneficial to the crops. It have a large initial cost.



3. Reducing percolation from canal

- ▶ Measures for substantial reduction of percolation losses from canals have to be under taken. This can be achieved in the following ways.
- ▶ (a) **Lining the irrigation channel** so as to make had and sides canal impervious.
- ▶ (b) **Lowering of full supply level of irrigation channels.** If the full supply level of irrigation channel is reduced, there will be lesser seepage loss from enhancement. The effective lead between full supply level and field will also reduce and, therefore, chance of water full use of water is avoided.



3. Reducing percolation from canal

- ▶ (c) Constructing of **interception drains**. These drains are constructed for seepage flow. The distance of seepage and percolation, it is not to near that it may draw water directly from the canal. This distance will depend upon the difference of level between the water surface in the canal and the natural ground water level.



4. Restriction of irrigation

- ▶ (a). The cultivators should be educated for economic use of water and induced to divide his field into “Kiaris” to avoid wastage. He should also be encouraged to supplement his water requirement from open wells and tube wells.
- ▶
- ▶ (b) Areas with high water table may be allowed only for Kharif irrigation and during Rabi the cultivators may irrigate from open wells and tube wells.



5. Lining of Water courses

- ▶ The losses by percolation from cultivators water courses are the order of 20% and above. Their lining, therefore, further, checks the inflow of canal water to sub-soil through water courses.



6. Removing obstruction in natural drainage

- ▶ Drainage crossing with road, rail ways etc canals should be remodeled to make it more efficient.



7. Prevention of seepage from water reservoirs

- ▶ Adequate and suitable designed filters are provided so that seepage ultimately finds its way into the natural stream.



8. Depletion of Ground water storage by pumping

- ▶ The surplus ground water which causes undesirable rise in the water table can be pumped out by:-
- ▶
- ▶ a. **Shallow well pumping:** water is pumped out from top aquifers to depress the water table. This water may be utilized for irrigation in some other areas.



8. Depletion of Ground water storage by pumping

- ▶ **b. Deep well pumping.** The water is pumped out from several water bearing strata by a series of wells, scattered over large and discharge is used for further irrigation.
- ▶
- ▶ In areas where the danger of water logging has become imminent further canal irrigation should not be introduced. Instead, tube wells should be sunk and the area should be irrigated by tube wells. Irrigation from masonry wells also reduces water logging



9. Changes in Crop pattern

- ▶ A change in crop pattern may minimise the damage to plant life.



10. Adoption of sprinkler method for irrigation

- ▶ This reduces the percolation losses from water courses as only predetermined amount of water is applied to the land.



LAND RECLAMATION IN PAKISTAN

- ▶ In Pakistan out of 39 million acres of fertile soil, 23 million are irrigated by an extension system of bore holes and feeder canals.
- ▶ The flat plain of Pakistan has poor natural drainage and irrigation has produced 11 million acres of water logged land.



LAND RECLAMATION IN PAKISTAN

- ▶ At this time WAPDA is working on 16 reclamation projects and will install 1200 tube wells and 2100 miles long drains will dug to reclaim 70 lack land.
- ▶ NOTE (above figures to be updated from internet source or any other reliable means)



Measures to Reclaim Salt Affected Lands

- ▶ (a) Adequate artificial drainage is provided to lower the ground water table below the limit of capillary action so that water can not rise above the ground (by capillary action). This limit, naturally depends on the kind of soil; thus, in clayey soils in sandy soil.



Measures to Reclaim Salt Affected Lands

- ▶ Both the surface drains and under (i.e. sub surface) drains are to be provided for the efficiency of reclamation. Usually, the surface drains are open trapezoidal drains and the under drains are pipe drains; some time, deep open drains are used for under drainage.
- ▶ Surface drains constructed on land and thus will not allow such water table. Under drains will lower the existing high water table to safe limit.



Measures to Reclaim Salt Affected Lands

- ▶ (b) Then, the excess salts are leads from the top 3' to 4' of soil to the ground water table by flooding the land with certain depth of water. This water dept on land dissolves the deposited salts. And the salts in solution percolate down and join the water table.



Measures to Reclaim Salt Affected Lands

- ▶ Washing out of salts from the upper zone of soil by flooding is known as leaching process. This process is continued for some time till the quantity of salts left in the root zone of soil is such as can be tolerated by some salt resisting crops.



Measures to Reclaim Salt Affected Lands

- ▶ (c) When the amount of salts has been reduced to such a safe limit that they can be tolerated by suitable salt resisting crops, such crops are grown on the land. Thus in summer the coarse rice is rice and barceen or even grain may be grow.



Measures to Reclaim Salt Affected Lands

- ▶ Rice and barceen can tolerate the alkali salts to a greeter extent and they also give shade to the land thus reuding evaporating from the surface of land. they are grown for one or two seasons till the alkalinity of soil is reduced to such and extent that the ordinary (i.e. not salt resisting) crops. like wheat, cotton etc. can be grown.



Measures to Reclaim Salt Affected Lands

- ▶ The land is then said to have been reclaimed i.e. on it, the common crops which it is suitable can be grown. The time taken to reclaim a land depends on its degree of alkalinity; greater the alkalinity of land, more the time taken and vice versa. It also depends on the nature of alkali and, the texture and permeability of the soil. Thus NaCl and Na_2SO_4 can be comparatively more easily removed than. Thus coarser the texture of soil more easily can be land be reclaimed.



Measures to Reclaim Salt Affected Lands

- ▶ (d) When Na_2CO_3 is present in the salt affected soil, a chemical treatment is given to the soil before adopting leaching process. Powdered CaSO_4 (Gypsum) at the rate of one tone per acre is mixed intimately with soil in the presence of water. Na_2CO_3 is turned into Na_2SO_4 by chemical reaction Na_2SO_4 is then leached out as before, also the suitable plants are grown as before to complete the land reclamation process.



Measures to Reclaim Salt Affected Lands

- ▶ (e) To reduce evaporation from the surface of land such operation as manure mulching, dry mulching by surface being are used some times, especially it had cases where the water table is very near ground and much evaporation is feared. Mulch is a loose coursing on the surface of soil. It usually consists of organic but it may be of loose soil produced by cultivation.



PREVENTION OF LANDS FROM BECOMING SALT AFFECT

- ▶ Prevention is better than cure hence preventive method should invariably be adopted so that the agricultural land does not become salt affected in the first existence. Such methods are:-
 - ▶
 - ▶ a. Using just the sufficient quantity of irrigations water for raising crops.
 - ▶
 - ▶ b. Provision of adequate surface drainage on irrigation land.
 - ▶
 - ▶ c. Allowable lower intensity of irrigation in the land that is likely to be salt affected.
 - ▶
 - ▶ d. Resorting to such methods of cultivation as help retarding surface evaporation.
 - ▶
 - ▶ e. Not using alkaline water for irrigation purposes.
-

