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WATER-LOGGING FROM IRRIGATION CANALS IN ALLUVIAL SOIL

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The irrigation of land by means of canals has caused water logging in some of the areas which has made it exceedingly important to combat this hazard. In approaching this problem an investigator is handicapped by the lack of approriate data reflecting the conditions of water table prevailing before the construction of canal. On the other hand a really effective and financially practicable remedy has yet to be evolved to prevent water logging.

The study of water table between confluence of two rivers shows that the spring level was, and in some places still is, below the level of rivers bounding the tract. Evidence indicates that in Punjab water level remained below ground level prior to construction of canals inspite of recharging from the rivers which suggests existence of outlet for subsoil flow in the neighbourhood of confluence point. Recharge from the rivers and rain contribute to the ground water table. During the rainy period spring level rises, but surplus of water will drain off by subsoil flow to restore the water table to the normal level during dry period. In some places where spring level is close to the ground surface, rainfall may cause water-logging temporarily and disappear after a dry period. The surface water is removed by surface drainage or by means of subsoil drainage into the rivers which form the boundaries of the affected area. The above two processes of drainage, assisted by evaporation and transpiration would remove the whole of the water added to the soil from all sources so that water table is kept at a depth not injurious to crops

The direction of flow of subsoil drainage is independent of direction of flow along surface drainage. Permanent surface water in any considerable quantity is likely to influence the direction of subsoil, but even then the direction of subsoil flow may be different from that of the flow in the surface channel. Therefore a canal crossing a surface drainage line has no influence on subsoil flow, provided accumulation of surface water is prevented. The alignment of canal is selected in such a way that it passes along the highest ridge of the central plateau and part of water adds to the subsoil water table. Similarly distributary channels, water courses, and field irrigation also contribute to the water table.

The introduction of canal system disturbs the equilibrium of subsoil water table resulting in rise in water table. Seasonal fluctuations due to rain fall may cause waterlogging in lowlying areas. It may not be overlooked that the canal would cause permanent rise in spring level resulting in waterlogging. The permeability of sub-soil beneath a canal bed vary from place to place and from stratum to stratum. The presence of impermeable stratum below a canal bed would prevent downward percolation resulting in a considerable rise in spring levels to constitute water-logging. In Punjab on Upper Jhelum Canal serious water-logging has occured in lands adjoining some reaches of the canal due to this reason.

In earthen channels water escapes from the wetted perimeter by percolation through minute interstices of the soil. A percolation cone is formed in which water can flow under the action of gravity and capillary attraction. Flow takes place in a horizontal as well as vertical direction so that water fans out. Solid cones are formed beneath large canals and dispersed cones are formed under smaller channels or due to presence of impervious layer. Solid cone will obstruct the subsoil flow since it creates an adverse hydraulic gradient whereas dispersed cone can not do so. Formation of solid or dispersed cone will depend upon the size of canal. The mathematical relationship

$$D = \frac{W\,(V-V')}{2V'\,\tan Q}$$, where D,W,V,V' and Q are depthe of soild cone, width

of channel, percolation velocities and divergence angle respectively, indicates that there is for every soil and for every depth of spring level, a limit to the size of canal which can be constructed without the danger of obstruction of subsoil flow. This limit will depend not only on the spring level which existed before the canal was constructed, but also on that which is likely to prevail after the canal has been in flow for a long period.

The spring level observations are recorded in Punjab at regular basis in the months of June and October. The study of this record for the years 1905 and 1919 in Lower Chenab Canal system shows that generally the spring levels have risen. Waterlogging has appeared between main canal and Kot Nikka Branch, but there has been no complainst in the area situated between the main canal and Gugera Branch. The spring levels between the Rakh and Jhang Branches may rise dangerously to cause water logging. Water logging will inevitably appear between Jhang Branch and the river on the right and between, Burala Branch and the Deg Nala on the left. The spring level lines obsevations are likely to be misleading close to large canals owing to the absence of close observations and the spring level profile would not clearly indicate the presence of well developed percolation cones. Effect of percolation cones on subsoil drainage can be better judged by careful planning of water-table observations through sinking of bore holes or wells especially for this purpose at suitable locations. Generally smaller channels and large distributaries have little effect on obstruction to subsoil flow whereas percolation from large canals have a predominant role in causing waterlogging. Spring level and geological obsevations prior to construction of canal help in analysing the real cause of water-logging. The study of corss-sections of Ground surface cross sections may indicate places liable to waterlogging.

The experience of irrigation in Lower Chenab Canal system shows that volume of water contributed to the soil expressed in feet depth spread over the whole area from two distinct sources, rainfall and canal irrigation system, is estimated as 0.28 ft. and 0.78 ft respectively. After canal irrigation, an increase in the quantity of water added to the subsoil is of the order of 200 to 600 percent based on rainfall and irrigation intensity. Greater part of contribution to the subsoil is by main canals, and also significantly by water courses. Other parts of the canal system have relatively little effect.

The earlier methods of preventing waterlogging were to restrict irrigation in the area or by means of construction of surface drains. Reduction of intensity of irrigation or restriction of irrigaion during Kharif period are to some extent useful checks against waterlogging, but the reduction in quantity of water added to the subsoil would not be sufficient to check waterlogging. It is also difficult to put it into practice due to the existing conventional system of irrigating the fields. The drainage works so far carried out in Punjab have not been found to be effective as a remedy for waterlogging because the surface drainage system drains rainfall runoff only. An extensive network of surface as well as seepage drains, not so for attempted in Punjab. is needed to combat waterlogging. Such a system of drains would be very costly, most troublesome to maintain and even then it may not offer a complete solution to the problem.

The main cause of water logging is the canal irrigation system and can be controlled only by waterproofing the bed and sides of these channels, probably in suitable selected reaches, mainly at and near bifurcations of large canals. This may be the best remedy to check waterlogging on the main line of Lower Chenab Canal. At present various lining material such as clay puddle, cement, bitumen are on trial, but an entirely satisfactory means of lining has yet to be evolved. Further research in this field is essential to find an economical and effective water proof lining. Lining of canals and water courses may also prove to be actually remunerative owing to the revenue and increased agriculture production which will be obtained from the water saved.