

## **Simulation of horizontal and vertical drainage systems to combat waterlogging problem along the Rohri canal in Khairpur district, Pakistan.**

### **ABSTRACT**

Continuous seepage from earthen canals creates a serious water-management problem in Pakistan. Efficient water management through a properly designed drainage system is therefore indispensable and imperative not only for the control of waterlogging, but also to provide a favorable environment for crop root development that ultimately enhances crop growth and increases yield potential. This paper discusses the effectiveness of different remedial measures adopted to intercept seepage from the Rohri canal and control the rising water table on 1,000 ha of agricultural land near the Gambat railway station in the district of Khairpur in the Sindh Province of Pakistan. A three-dimensional (3D) finite-element model for groundwater flow and solute transport (FEMGWST), developed at Universiti Putra Malaysia, has been used to evaluate the performance of horizontal and vertical drainage systems, operating either independently or simultaneously, for different flow levels in the Rohri canal. Simulation results have revealed that an increase in tube-well discharge from 20 to 24 L/s can result in about 5.02% more reclaimed area, and an 8.68% additional reclaimed area can be achieved when the well discharge was increased from 20 to 28 L/s; however, waterlogging still prevailed along the canal embankment. About 196.35 ha of agricultural land had water-table depth below 0.5 m when the well was discharging at 20 L/s, followed by 146.14 ha and 109.59 ha of land for the well discharges of 24 and 28 L/s, respectively. Thus it was obvious that the vertical drainage system alone cannot maintain the water table below the root zone adjacent to the canal embankments. Results revealed that managing waterlogging with the horizontal tile drainage system is only effective up to a distance of 300 m away from the canal, beyond which the effectiveness of this system gradually diminishes. A combined drainage system (tube wells plus a horizontal drainage system) is more effective and beneficial in maintaining the water table within desirable depths, and more land could be cultivated. Under the combined drainage system only 91.98 ha of land was still considered waterlogged as compared to 236.38 ha when only the vertical drainage system was operating.

**Keyword:** canal seepage; finite element method; drainage, Pakistan; simulation