DESIGN CRITERIA AND DRAINAGE EFFICIENCY OF ON-FARM DRAINS

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ABSTRACT

Intense monsoon rains produce surface runoff from the cropped areas. Evacuation of this surface runoff from the area within a safe time is essential to protect the crops from damage due to inundation, scalding, scorching, restricted root respiration and rise of ground water table into the root zone due to infiltration of rain water. On-farm surface drains (Moraba and Chak drains) need to be provided to ensure the evacuation of the surface runoff from the area in time. This study was conducted to evaluate the performance of on farm drains on hydraulic principles with varying drainage coefficients vis-à-vis the evacuation time and the capacity of the main drainage system.

The on-farm drainage system was evaluated for a sample area of 13 moraba (225 acres) and consisted of 2 branch chak drains (7,700 and 5,500 ft long) and a 1100 ft long outfall section of chak drain. The runoff likely to be generated from each moraba was determined for a rainfall depth of 4 inches by using HEC-1 computer program and SCS curve number method (CN = 70). Only 30% of cropped area was considered to produce any runoff. The peak runoff rate was estimated as 0.58 cusecs with time to peak as 8.5 hrs, base time of 86 hrs and total outflow volume of 2.77 acre feet. Outflow from each moraba enters to the adjacent drain section. The flow from the outfall section enters the main drain through a drainage inlet under free flow condition. The flow in outfall section was considered to be as normal and the normal flow depth was computed by using Newton Raphson Iterative method. The flow in the other sections of the chak drain was considered to be as gradually varied flow and flow depth was determined by Euler's method. Near peak flow rates the high flow depths in d/s sections affected the flow depth

in u/s sections of the drain. Under small flow conditions the flow remains as uniform and flow depth as normal depth. At higher flows, the flow depth becomes larger than the normal depth due to backwater affect of the higher flow depth in the d/s section.

The flow depth in the drain section affects the inflow from any moraba into the adjacent drain. A rise in the flow depth in the drain section above the ground level restricts the inflow to the drain and completely blocking the inflow when water level in the drain reaches the bank level. This results in temporarily ponding of water in the area. Whenever capacity becomes available in the drain section, the ponded water from the area is drained out from the area. The hydraulics of flow was analyzed in a spreadsheet model. Each section of the drain was modeled separately in a spreadsheet. The outflow from u/s section was linked as inflow for the d/s section. The d/s and u/s water depths in different sections of the drain were also linked. Thus change in any section of the drain would affect flow processes in all other sections. The unsteady flow process was analyzed as pseudo-steady state over five minute interval.

Drain design were evaluated for different drainage co-efficient of 0.2, 0.4, 0.6, 0.8, and 1.0 lps/ha to find out that how efficiently a design can provide evacuation of the ponded water from the area. It was found that evacuation of the ponded water require 75, 49, 28, 18 and 16 hrs when the drainage system is designed at drainage co-efficient of 0.2, 0.4, 0.6, 0.8 and 1.0 lps/ha, respectively. The ponded volume corresponding to these design coefficients was as 12945, 7695, 3500, 1325 and 741 ft^3, respectively. It was concluded that the drainage system designed at drainage co-efficient of 0.2 lps/ha or less would provided adequate drainage to most crops.