The Relative Contribution of Parameters of the Water Balance Equation to the Rising Water Table Phenomenon in the Inland Alluvium Basin of Haryana, India

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Guchie Gulie Sulla

Water Technology Institute, Arba Minch University, P.O. Box 21, Arba Minch, Ethiopia, guchie4@yahoo.com

Haryana State is located in north-western India between latitudes 24°35' and 31°55' north and longitudes 74°23' and 77°36' east covering an area of 44,212 sq. km. The state has been sub-divided into eight ground water sub-basins and the Inland Alluvium basin (22.4% area of the state) is the largest ground water basin in the state and covers the middle east, central and south-western saucer shaped depression of the state. It is underlain with saline and brackish ground waters and lacks adequate natural surface drainage outlets, while its geohydrological conditions do neither permit natural subsurface drainage.

Canal irrigation in this basin has resulted in a rising water table that has lead to seasonal waterlogging, flooding of the land surface after rainfall and secondary salinisation problems. These problems have resulted in reduction of crop yield and rendered a considerable area unfit for cultivation. To tackle these problems for sustainable agriculture, an integrated approach is required. In view of these interlinked problems, this study aims at identifying the most important factor to which the the rising water table and related problems can be attributed. Thus, inflow and outflow parameters of the water balance equation for the area were considered to be precipitation (Pr), irrigation (Irr), surface runoff (R.off), actual evapotranspiration (ET_a), lateral subsurface inflow (Q_{lsi}) and lateral subsurface outflow (Q_{lso}). It is obvious that annual water losses through evapotranspiration and surface runoff are highly dependent on the annual depth of irrigation and/or rainfall. But it is more complicated to study the relative contribution of the parameters that depend on each other to other parameters that depend on them. Therefore, in this study, only irrigation, precipitation and net lateral subsurface flow were considered to be relatively independent and their relative contribution to the overall average change in water table from June to May (Δh) was studied. The relative contribution of each of these parameters was evaluated from the functional relationship of overall average change in water table from June to May (Δh) with inputs from irrigation, rainfall and lateral subsurface flow. The study shows that the squared multiple correlation coefficient value for regression of Δh on Irr, Pr and Q_{lsn} was quite high. It indicated that about 98.9% of variance of Δh was due to variation in inflows of Irr, Pr and $Q_{lsn\ and}$ the consideration of only these three parameters can be assumed to be correct.

The squared correlation coefficient values of restricted models indicated that about 13.6%, 83.5% and 0.9% of variance of Δh was due to the variations in Irr, Pr and Qlsn, respectively. The squared multiple partial correlation coefficient values indicate that controlling any two of the three independent variables resulted in an increase in the proportion of the variance that the remaining independent variable account for the overall average change in the water table (Δh). This may be due to some correlation among the independent variables. However, the squared multiple partial correlation coefficient of Δh with Pr with controlled effects of Irr and

Qlsn was highest. About 98.73% of the variance of Δh would have been accounted for by Pr if the effects of the variations in Irr and Qlsn could be controlled. This and the higher squared multiple correlation coefficient values of other restricted models, in which Pr was included as independent variable indicate that the variance of Δh was accounted for more by precipitation than other variables. That is, the relative contribution of precipitation to rising water table condition is higher than that of other parameters.