DEVELOPMENT OF A COMPREHENSIVE GROUNDWATER MODEL TO ANALYSE THE MANAGEMENT OPTIONS FOR VAVUNIYA REGION

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THIS THESIS IS SUBMITTED
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DECLARATION

I hereby declare that the work included in this thesis, in part or whole has not been submitted for any other academic qualification at any institution.

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ABSTRACT

Due to low porosity and permeability, the recharge and yield are relatively low in the areas that comprise shallow weathered and rarely fractured hard rocks with thin soil mantle. Therefore the problems in sustainable groundwater management are of major and vital importance in these areas. Prevailing Groundwater condition in Vavuniya district is a typical example of this situation.

The records reveal that the groundwater table in Vavuniya did not reach its previous year maximum level during the past 4 years. This may be due to the excessive exploitation of ground water or due to the reduction in recharge of aquifer or the combination of both. The prime intention of this research is to find out an appropriate strategy to ensure sustainability in groundwater management for this region.

The objective of this study is to understand the groundwater systems of Vavuniya region aquifer and hence to improve the evaluation, development, and management of groundwater resources, and the control of groundwater problems in that aquifer.

The specific objectives are,

(1) to achieve an understanding of the basic mechanisms that govern the flow in the aquifer through numerical modeling.

(2) to examine the behavior of the aquifer under various operating conditions.

(3) to prepare a water balance for the territory.

MODFLOW, the three – dimensional, finite difference groundwater flow Computer Model, developed by Waterloo Hydrogeologic Inc was selected for this study.

As no processed reliable data were found for this study area, all basic physical and hydrological data required for this study were collected as raw material and processed to fit the Modflow model.

Since, it is very difficult to attain more reliable results from calibration of a model if large numbers of variables are to be optimized; some of the important variables were optimized separately.

The surface runoff and the recharge due to irrigation storage losses were optimized against reservoir water balance and rainfall recharge was optimized using Penmen – Grindly model. These optimized data were used for the groundwater model simulation to optimize the other variables such as hydraulic conductivity, specific yield, recharge due to river and recharge due to irrigation.

The degrees of influence of river and subsurface dam conditions in groundwater system were examined separately by removing river boundary condition and by introducing Wall boundary condition to the calibrated model.

The overall water balance of the territory was prepared using the cumulative mass balance resulting from the model simulations, available data and the observed hydraulic head data.

The results reveal that the groundwater usage has already reached its optimum level in this region and immediate action is required not only to control further expansion of groundwater exploitation but also to regulate groundwater withdrawal, especially during low rainfall years.

Further, the analysis shows that the non - perennial river a tributary of Parankiaru has less influence in the groundwater system and the subsurface dam conditions certainly have an impact on groundwater system, but this has to be studied further in detail in order to minimize the negative impact and utilize the merits of this condition.

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