A STUDY ON SURFACE WATER - GROUNDWATER INTERACTION IN JAFFNA PENINSULA

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Groundwater depletion is defined as long-term water table declination in a region. Groundwater depletion during low rainfall periods and flash floods during monsoonal periods are the predominant water issues identified in the Jaffna Peninsula, the Northern part of Sri Lanka. In order to solve the above issues, an approach based on enhanced groundwater recharge is proposed and Analytical Hierarchy Process (AHP) analysis was initially performed to develop Groundwater Potential Zone Mapping (GWPZM) based on seven different groundwater behavioural influencing factors such as geomorphology, soil distribution, drainage density, lineament density, land use and land cover, lithology, and slope to recognize recharge potential. The most suitable, moderately suitable, suitable, less suitable, and unsuitable were the zonation criteria derived by plotting the GWPZM of the Jaffna Peninsula using AHP and GIS analyses.

A water resource action plan was developed to propose suitable stormwater quality and quantity controlling structures according to the hydrogeological behaviour of the Jaffna Peninsula. Storage impoundments, infiltration basins, swales, vegetated filter strips, bio-retention systems, exfiltration trenches and subsurface exfiltration galleries were proposed for the urbanized region of the Jaffna Peninsula. Check dams, Nala bunds, Gabion structures, Groundwater dams, Gully plugs, Percolation tanks and Contour bunds were proposed for the agricultural and populated woodland areas of the Jaffna Peninsula.

The major artificial recharging units were proposed for the areas with adequate suitability of groundwater infiltration potential according to GWPZM. Recharging reservoirs were assigned for the lagoon region with silt sedimentation. Drywells were proposed for the regions adjacent to the floodplains along with storm-water quality control structures. Paleo channel footprints were not found in the preliminary studies.

Flood analysis was carried out using Rainfall-Runoff-Inundation Model (RRI model) and the model was calibrated based on the inundation area of the year 2017 extreme flood event. Water flow obstacles cannot be modelled using the RRI model and therefore, the predicted value exceeded the actual value by about 30%. The flood analysis was performed for the hypothetical situation after the establishment of the aforementioned artificial recharging techniques. The inundation area is found to be reduced by 41.47% as compared to the previous condition while the inundation depth is 20% lower than the previous situation as a result of enhanced groundwater recharge. Moreover, model uncertainty and parameter sensitivity analyses were conducted to determine the accuracy and reliability of the modelling performance.

An initial plan for real-time monitoring of water table depletion and flash flood conditions were developed targeting the long-term sustainability of groundwater systems. Sensor locations and the rule-based system of Web GIS were considerably discussed, and further recommendations are derived to enhance the groundwater resources availability in Jaffna Peninsula.

Keywords: AHP analysis, GWPZM, artificial recharging, RRI model

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