Remote Sensing and GIS Based Assessment of Water Scarcity – A Case Study from Hambantota District, Sri Lanka

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Abstract: The average annual rainfall of Sri Lanka varies from 900mm to 6000mm. Yet, the rainfall is not distributed evenly over the island. Consequently, the country has been divided into 3 climatic zones namely, wet zone, dry zone and intermediate zone on the basis of average annual rainfall. Two thirds of the island is occupied by the dry zone, which receives less than 1750 mm of average annual rainfall. The dry zone has periodically faced drought conditions from the past. Hambantota district in the dry zone can be identified as a severely drought affected area, on the basis of surface water availability. With the ongoing massive development projects in the district, the demand for water will increase significantly in the next few years. Therefore, implementation of a proper water management system is a pre-requisite in facilitating this requirement.

Spatial analysis of water scarcity over the district can provide valuable results in designing an effective water management system. In this endeavour, remote sensing and GIS technologies provide a time and cost effective methodology with a higher accuracy.

The objective of this study was to analyse the drought severity of Hambantota, meteorologically (rainfall), hydrologically and physically, in order to categorize the spatial distribution of water stress conditions over the district.

In order to analyse the meteorological drought, the average annual rainfall map of the district was interpolated by using the rainfall data of 15 years over 17 stations in Hambantota. Subsequently, the rainfall map was classified into 4 rainfall severity classes on the basis of decile rainfall.

Hydrological drought was analysed based on 3 factors; i.e. drainage density, distance from water bodies and irrigated area. Catchments and drainage lines of Hambantota were demarcated by using ASTER Global DEM. Subsequently, drainage density of each

catchment was calculated and classified into 4 drought severity classes using quantile classification.

In order to analyse the drought risk based on distance from water sources, water bodies in the district were classified in to 3 groups based on their surface area. Thereafter, multiple buffers were created around these 3 groups by defining 4 drought severity classes for each group.

Irrigated areas were assigned with lowest drought severity class.

Afterwards, physical drought was analysed based on land use and slope. Weights were assigned to each land use class to define the drought severity. The slope map was created using ASTER Global DEM and classified into 4 drought severity classes.

Finally, the above drought components were analysed using a matrix overlay operation to spatially identify the water shortage over Hambantota area. Drought severity measured through the above knowledge based factor analysis was classified into 4 classes to generate the final drought risk map layer. The results illustrate that 20% of Hambantota faces severe water stress conditions, while 11% of the district faces moderate water stress conditions.

The resultant drought severity map can be used as a reference in a future water management endeavour to enhance the effectiveness of the project.

Keywords: Annual rainfall, drought severity, GIS, matrix overlay, water scarcity