

學位論文要旨

Abstract of Thesis

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題目 Title	GIS-based assessment of groundwater quality in tank cascade landscape in Sri Lanka: A study in Ulagalla Cascade

Sri Lanka is divided into three major climatic zones based on the rainfall received; wet zone, intermediate zone, and dry zone. Though the dry zone contributes largely to the agricultural production, the rainfall occurs in the dry zone is confined into two or three months of the year resulting in long dry spells. Hence, the tank cascade system (TCS) in the lowlands within the dry and intermediate zone has evolved, in order to manage the surface water resources in a sustainable manner. Recently, it has been recognized as a globally important agricultural heritage site by the Food and Agriculture Organization of the United Nations (FAO).

As a convenient substitute for insufficient surface water resources in the dry zone of Sri Lanka, groundwater use has dramatically increased during the last three decades, coinciding with changes in agriculture and livelihoods. Accordingly, the TCS is endangered along with overexploitation and quality deterioration. Therefore, we aimed to assess spatial and temporal variations in both irrigation and drinking water quality in the tank cascade landscape.

Interpolation methods are extensively used to map the spatial distribution of water quality parameters. However, the selection of the most appropriate method is a critical issue in environmental studies. We assessed the relative performances of deterministic and geostatistical methods in explaining the spatiotemporal variation of water quality parameters/indices in the Ulagalla tank cascade landscape using root mean square error (RMSE) in a leave-one-out cross-validation. Empirical Bayesian kriging (EBK) performed well for most parameters throughout the study period, and we recommended EBK as the best method to interpolate water quality parameters/indices in the Ulagalla cascade and other tank cascade landscapes in Sri Lanka and similar environments.

We sampled groundwater from 29 wells to give a homogeneous distribution within the Ulagalla cascade, during both Yala (dry) and Maha (wet) seasons, the two main cropping seasons in Sri Lanka. We collected the samples for consecutive 12 months starting from April 2016. We evaluated the suitability of groundwater for irrigation using the

analytic hierarchy process and GIS. Water quality did not vary notably between seasons. However, it deteriorated with the onset of high-intensity heavy rain, especially during the Maha season. A water quality zoning map indicated that groundwater in 4% and 96% of the study area is suitable and moderately suitable for irrigation, respectively.

Since Chronic kidney disease of unknown etiology (CKDu) is a major health concern in north-central province, we tried to assess the suitability of groundwater for drinking by integrating the Sri Lankan standards of drinking water quality parameters and GIS. Based on the overall suitability, we found that the major portion falls under doubtful and unsuitable categories during both seasons. Hence, urgent attention is required to introduce proper long term drinking water treatment technology.

We established new protocols to classify groundwater suitability for both irrigation and drinking for the first time in the tank cascade landscape in Sri Lanka. Hence, irrigation and drinking water quality in tank cascade landscapes and similar environments can be assessed using these methodologies and results.