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Identifying an appropriate and sustainable irrigation method using some remotely sensed parameters for the crop cultivation in Vavuniya district

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Abstract

Over consumption of water resources due to unplanned and inappropriate irrigation methods would be a threat to the ecosystem health and to the sustainable agriculture in Vavuniya District. The objective of this study was to identify the most appropriate irrigation method using remotely sensed or derived hydro geological and meteorological information. The impact of different types of irrigation methods on water use efficiency, water consumption, socio economic aspects of irrigation and soil condition were considered to fulfil the objective of this study. Evaporative fraction, soil moisture content, hydrological parameters and the meteorological parameters were derived using satellite imageries namely the products of Moderate Resolution Imaging Spectro-radiameter (MODIS), MOD 09 A1 (Solar Zenith Angle), MOD 11 A1 (Land Surface Temperature), MOD 13 A1 (Normalized Different Vegetation Index) and MOD 43 B3 (Surface Albedo) and the Shuttle Radar Topography Mission (SRTM) DEM (90m resolution) associated with field reference data during January 2014 to June 2014. Estimation of evaporative fraction and soil moisture content were collectively done with the aid of Surface Energy Balance Algorithm (SEBAL) methodin Ilwis 3.7 environment. Appropriate geometric corrections and image processing operations were applied. Parameterization of hydrological and meteorological parameters was done using automated operations associated with auxiliary information of respective imageries. Information on socio economic aspects of irrigation methods were gathered from semi structured interviews and secondary data sources. This study revealed that integral of hydrological, topographical, meteorological and socio economic factors signifying the importance of micro irrigation methods as viable and effective irrigation method in agriculture. Encouraging the farmers to use micro irrigation methods by providing the credit facilities and the subsidy to install micro irrigation systems is vital for the water resource conservation and thereby the sustainable agriculture.

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*Keywords:*Hydrological; Irrigation; Meteorological; Socio economic aspects; Water use efficiency

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1. Introduction

The Vavuniya District is in the Northern Low Lands of Sri Lanka covering an area of about 1966.90 Sq km (Fig. 1). This district falls within the agro climatic zone of Low Country Dry zone. The average rainfall in this district is 1310 mm. The water resources mainly depend on rainfall as there are no perennial rivers. There is one major, 23 medium and 674 minor irrigation tanks found in this district store water during rainfall and supply water for irrigation during crop cultivation. Major livelihood activity in the study area is cultivation of paddy, vegetables and some other cash crops. Cultivation activities associate with seasonal rain fall and with major and minor tanks[1].

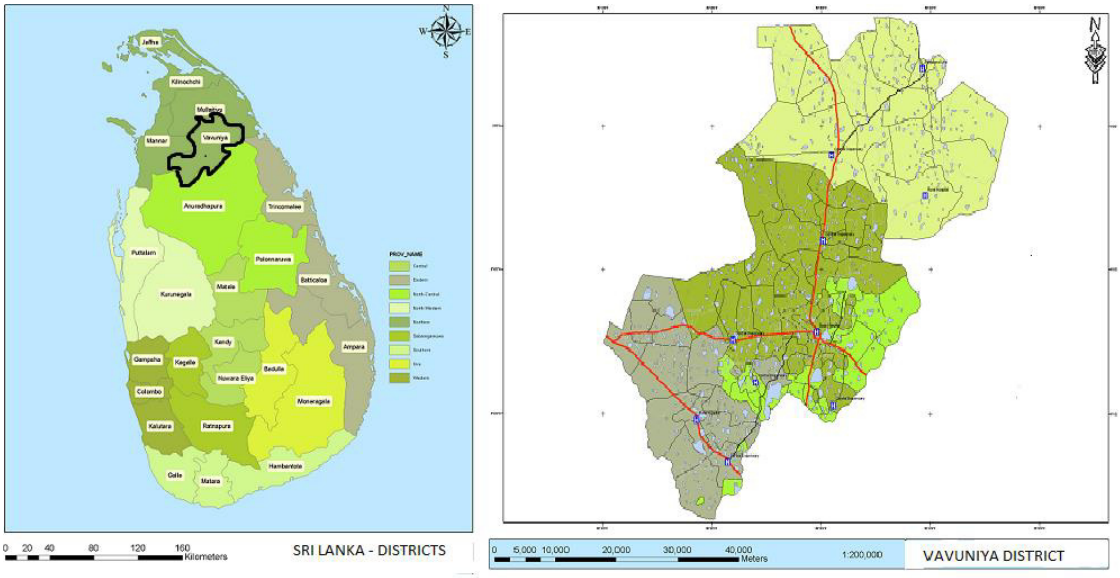

Fig.1. District Map of Vavuniya (Source: Survey Department, Government of Sri Lanka, 2005)

The general landscape of study area with 3% to 4% of slopes contains minor and medium water sheds and catchment basins. Reddish brown earth, Low humicgley and Alluvial soil which occupy the concave valleys and bottom lands are the main soil groups. The cultivation of subsidiary food crops obtains water mostly from seasonal rainfall and supplementary irrigation from shallow dug wells of unconfined aquifer. At present, total population in Vavuniya District is 241,659, out of which there are 53,237 of urban population located in the Vavuniya Division. If an average of 120 liters/person is required for daily use, then the total water demand is 1,687,646 gallons/day.

However, at present the maximum extraction (from groundwater) is around 700 cum/day or 184920 gallons/day which is only 11% of the requirement. It is abstracted by eight wells in which four shallow with large diameter and four relatively steeper with small diameter[2]. Hence, there is a strong management implication for the surface and underground water resources. This study aimed to suggest sustainable irrigation method for the effective management of water resources by minimizing the quantity of water required for irrigation purposes.

2. Methodology

The following steps were carried out in order to identify the most appropriate irrigation method (Fig. 2):