Predicting Spatial and Temporal Soil Moisture Distribution in an Agricultural Field of Gumara-Maksegnit Watershed, North Gondar, Ethiopia

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Abstract

A Soil Moisture study was conducted within Gumara-Maksegnit watershed found in the Northern part of Lake Tana, Ethiopia. This was aimed to predict moisture contained in 1meter soil profile spatially and temporally in the drying process of the 2013 from wet to dry period in small rainfed agricultural field mainly covered with cereal and legume crops. A Weekly soil moisture content (v/v) with calibrated PR2/6 profile probe, topographic information with a spatial resolution of 5 by 5 meter measured using GPS and water level, a soil texture in two soil depth ranges, crop growth information and representative soil bulk density were measured in the study period i.e. 30July 2013 to 9November 2013. Physically based hydrological model called Soil-Plant-Atmosphere-Water (SPAW), developed by E. Saxon, 2006; was used to predict the temporal change of soil moisture considering the basic soil properties and agro-climatologic information together with crop data. Co-kriging, in ArcGIS 10.2 (ESRI), was applied to predict the spatial distribution of soil moisture considering slope as a secondary variable and the temporally predicted soil moisture as the main variable. Consistency of the models was checked using coefficient of determination (R^2), root mean squared error (RMSE) and Nash Suitcliff Efficiency (NSE) with values 0.74, 0.71 and 9.5mm/m respectively.

Keywords: Soil moisture, SPAW, co-kriging, spatial and temporal, drying process, soil water storage, slope