The observation of soil characteristics and water balance at rain-fed paddy field in Northeastern Thailand

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1. Introduction

Rice productivity at rain-fed paddy field in Mekong River basin mostly depends on spatial and seasonal variability of rainfall. Rain-fed paddy fields comprise more than 90% of the total area of paddies in Northeastern Thailand, and annual rainfall in this area varies between 900 and 2000 mm/year. Thus, rice productivity in this area is influenced by spatial and seasonal variability of water balance. Clarifying of movement of water at rain-fed paddy field is important. Soil texture—particularly clay content—is the primary factor in determining downward water loss, and it could determine the water productivity of rain-fed paddy fields (Tsubo et al., 2007). Quantifying the change in amount of soil water in the dry season can help clarify the beginning of flooding period in the rainy season. The purpose of this study is to clarify the characteristics of the yearly water balance in a rain-fed paddy field by examining soil physical properties and seasonal changes in amount of soil water.

2. Materials and Methods

Hydro-meteorological observation was conducted at typical rain-fed paddy field located in a suburb of Khon Kaen city (16°27' N, 102°32' E), Northeastern Thailand. Paddy field is flat plane (slope angle ~0.5%–1.5%) and area of paddy field is about 10,000 m² and bund height is about 50 cm. Texture of surface soil was sandy loam by using soil classification method of FAO. Two observation points has been set at low and high altitude field (lower paddy and upper paddy). Difference of altitude between both points is about 2.0 m. Meteorological data were obtained by the Automatic Weather Station (MAWS201, Vaisala Inc.). PVC tube (6 cm in diameter and 460 cm in length) was installed to measure groundwater levels. These levels were measured manually with a ruler in the middle of each month. Profile ADR soil moisture sensors (Profile Probe, Delta-T Devices Ltd.) were installed at each observation points and observed vertical profile of soil water content of 6 points below soil surface on the depth of 10, 20, 30, 40, 60, 100 cm. Soil samples were collected at same depths for observation of soil water content in the dry season. Soil texture, porosity and saturated hydraulic conductivity were evaluated by particle-size analysis and the falling head permeability test. Water balance was calculated by using vertical profile of soil water content and measured groundwater level. Durations of analysis is from January 2005 to September 2007.

3. Results and Discussions

The layer of 40-60 cm depth at lower paddy was high clay content and very low conductivity. Conductivity of lower paddy is lower about 2-4 in order than that of upper paddy, this layer should be impermeable layer.

Fig. 1 shows relationship between soil clay content and saturated hydraulic conductivity at lower and upper paddies. Correlation coefficient between soil clay content and saturated hydraulic conductivity at the depth of 20-60 cm in lower paddy has high value. Thus, high clay content layer like hard pan might contribute to flooding of paddy surface in the rainy season.

According to seasonal variations of water balance, changes in amount of soil water were about 6-24% to total amount of rainfall in the rainy season. Amount of soil water change mainly in the surface layer (0-100cm).