Water productivity analysis at Sumani watershed, Indonesia
インドネシア国スマニ川流域における水生産性に関する分析

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1. Introduction

Variation of water productivity is influenced by climatological and hydrological condition that directly influence water demand and supply for irrigation. As water demand projection, agriculture sector which withdrawal around 70 % of freshwater will increase by 10 % in 2050 (FAO, 2011) and total amount of water evaporated in crop production would almost doubling of today in 2050 (Molden, 2007). On the other hand, climate change increase uncertainty of water availability for agriculture.

The improvement in water productivity (WP) or more crop per drop is necessary for sustainability rice production. WP defined as above varies from region to region and from field to field, depending on many factors, such as crop patterns, climate patterns (if rainfall fits crop growth), irrigation technology and field water management, land and infrastructure, and input, including labor, fertilizer and machinery. Water productivity is calculated by formula (Cai and Rosegard, 2003). Mitigation action such as development adequate irrigation system and adaptation action such as adjusting cropping schedule are several solution to increase water use efficiency. Hence, the objective of the study is to analyze the water productivity based on the current cropping schedule and the existing irrigation system as a base for future investment in order to sustain rice production.

2. Materials and methods

Water productivity is generally defined as crop yield per cubic meter of water consumption, including ‘green’ water (effective rainfall) for rain-fed areas and both ‘green’ water and ‘blue’ water (diverted water from water systems) for irrigated areas (Cai and Rosegard, 2003). Water consumption is divided into two classification. Beneficial water consumption is crop water demand, and non-beneficial water consumption is water losses to evaporation and irrigation distribution. In this study, total water consumption is equal to the irrigation water requirement that depends on several factors including cropping patterns, crop growths periods, crop coefficient (Kc), potential evaporation, effective rainfall and percolation rice field.

Sumani watershed is a primary rice-producing region which has an area of around 57,089 ha. Approximately 30% of this area is paddy fields, which depend on the existence of water resources in the watershed. In this study area, rice cropping intensity varies from once a year to three times a year. Approximately 67 % of rice field area are cultivated three times a year. In general, cropping rice planting schedule is divided into three periods; the main planting

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season (wet season), "Gadu" planting season (planting in the end of wet season and harvesting in the dry season) and dry planting season. In the study area, planting schedules are not uniform. However, to simplify the analysis, we assume the cropping schedule is uniform by using majority cropping schedule in the study area. The main planting, Gadu planting and dry planting are started on December, April and July, respectively, and planting period of each season is 110 days. To assure of water availability in the dry season, there are four groups of irrigation system based on the type of irrigation: technical irrigation (TI), semi-technical irrigation (STI), simple irrigation (SI), and non-government irrigation (NGI).

3. Results and Discussions

Fig.1 shows that WP from 2009 to 2014 in the study area ranged from 0.45 kg/m3 to 0.66 kg/m3. Among developing countries, China and some South-East Asian countries have a higher WP of rice, ranging from 0.4 to 0.6 kg m3, where the average WP in the developing country was 0.39 kg.m3 (Cai and Rosegard, 2003). The result shows that WP is influenced by yield and irrigated area. However, the increase in water productivity mainly results from the increase in crop yield (Cai and Rosegard, 2003). The water productivity increased from 0.45 kg/m3 to 0.66 kg/m3 in 2009 to 2011. The increase of water productivity clearly due to the increase of yield. While, the water productivity decrease in 2013 to 2014 from 0.66 kg/m3 to 0.52 kg/m3 due to the decrease of irrigated area and stagnant of yield. This work was supported by JSPS KAKENHI Grant Number 18H02295.

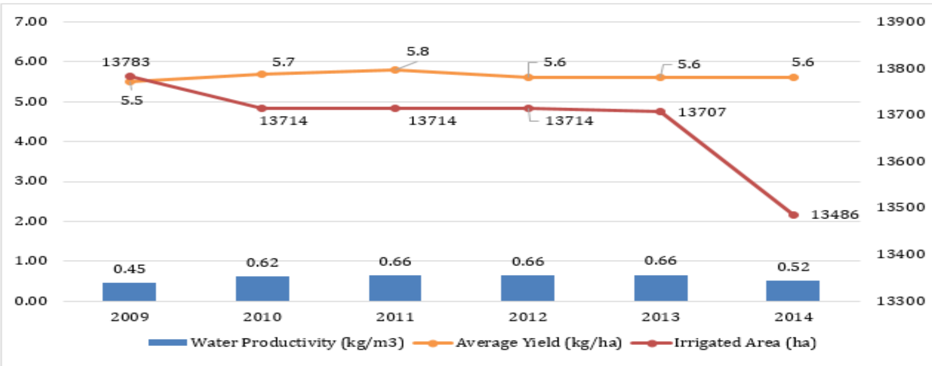

Fig.1 Water productivity of the Sumani watershed

References

Cai, X and Rosegard, M.W. 2003. World Water Productivity: Current Situation and Future Options. https://ageconsearch.umn.edu/bitstream/158145/2/H032641.pdf.

Molden (ed). 2007. Water for food, water for life: A comprehensive assessment of water management in agriculture. London: Earthscan.

FAO.2011. The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk. Rome: Food and Agriculture Organization of the United Nations and London, Earthscan.