ESTIMATION OF RICE YIELD FROM MODIS DATA IN WEST JAVA, INDONESIA

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ABSTRACT

Evaluation of rice production using the remotely sensed data is highly required in Indonesia, because they have been suffering in their crucial conditions such as shortage of rice production in the last 5 years due to many unsuccessful program and disaster. In this study, we analyzed relationship between LAI remotely sensed by MODIS and rice production to estimate rice production in Cianjur, Indonesia. It was possible to estimate the annual rice production of 2008 using the cumulative LAI of January, May and September from 2003 to 2007. The result indicates that the cumulative LAI of remotely sensed data is applicable to the estimation of rice production amount in wide areas, and the creation of each estimation equation for the irrigated paddy fields and the rain fed paddy fields will contribute to improvement of the estimation accuracy of the annual rice production.

Keywords: Estimation of rice production, Satellite data, LAI, Food security

INTRODUCTION

The environmental conservation and food production is one of the most critical issues that we have to make best efforts to solve from now on in every country. The remote sensing agricultural research, especially related to rice production and rice field management is very important for Asian countries, because rice is the staple food for the people and, on the other side, Asian agriculture frequently suffers from heavy losses

caused by meteorological events. Considering these matters, it is a good idea to develop an efficient rice cultivation support system based on a concept of the precision agriculture which can effectively increase the rice production and also realize the environmental conservation.

In this study, to assess the feasibility of the estimating rice yield using remotely sensed data, the investigation of the relation between annual rice production from the agricultural statistical data and cumulative LAI derived from MODIS LAI 8days composite data was carried out in west Jawa, Indonesia.

METHODOLOGY

Study site: The study was conducted in 5 sub-districts (Kecamatan Bojongpicung, Ciranjang, Karangtengah, Sukaluyu and Mande) located in the north east of Kabupaten Cinajur, west Jawa, Indonesia (longitude 106°21'E-107° 22'E, latitude 6°42S-7°25'S).

Data for analysis: (1) MODIS/Terra+Aqua Leaf Area Index 8-day L4 Global 1km SIN Grid V005 was collected from October,2001 to September,2008 (276 composite data), (2) SPOT5 satellite (HRG-X) data was acquired on February 20 and July 10, 2011, (3) TERRA satellite (ASTER) data was acquired on May 29, (4) Administrative boundary GIS data, (5) Agricultural statistics data from 1996 to 2008 which was published by BPS.

Procedure: First, the leaf area index composite data (LAI), the SPOT data and the ASTER data were rectified using the administrative boundary GIS data by the nearest neighbor resampling algorithm using the selected ground control points. Secondly, a supervised classification was applied to these rectified images to distinguish the paddy fields, and the mask file of paddy fields was created. Data on cumulative LAI value of paddy fields from October, 2001 to September, 2008 were calculated, and the data was added to the GIS of administrative boundary. Finally, the tabulate area analysis was executed using the LAI data and the agricultural statistic data to analyze the seasonal trend of LAI and the relationship between the annual rice production and LAI.

RESULTS AND DISCUSSION

The seasonal trend of averaged LAI in all sub-districts (Kecamatan) is shown in Figure 1. There are three minimum values in a year, which are in March, July and December. These seasons correspond to the harvesting season of rice crop around the test site. Table 1 shows the relationship between cumulative LAI of each month and the annual rice production. The result shows significant positive correlation between the annual rice production and the cumulative LAI of each month except for February and December. The correlation coefficients in January, May and September, a couple of months before the harvesting season respectively, are relatively high against other months.

Figure 2 shows the relationship between the cumulative LAI of January, May and September and the annual rice production. There is positive correlation between the cumulative LAI of all sub-districts and the annual rice production ($r=0.664$, $p<0.01$). Moreover, the correlation coefficient gets higher when limited to three sub-districts where the irrigation ratio is more than 80% ($r=0.866$, $p<0.01$).

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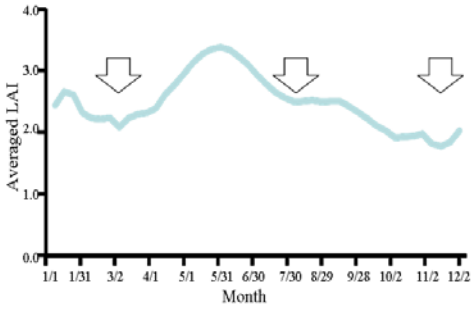

Fig. 1 Seasonal trend of averaged LAI around the test site

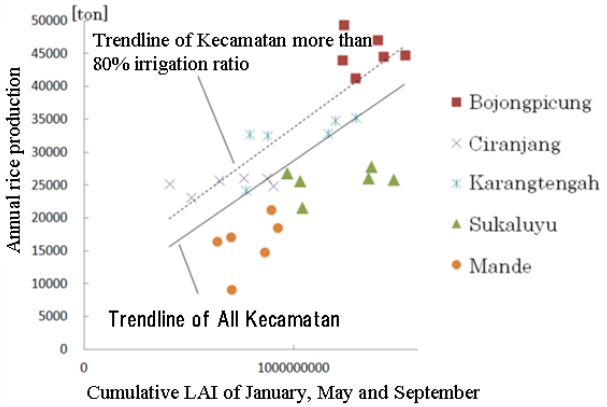

Fig. 2 Relationship between the cumulative LAI of January, May and September and the annual rice production

Table 1 Relationship between cumulative LAI of each month and the annual rice production

sub-district	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All	0.558 **	0.353	0.372 *	0.459 *	0.603**	0.657 **	0.529 **	0.671 **	0.668 **	0.604 **	0.569 **	0.217
Bojongpicung	-0.578	0.106	-0.831 *	-0.074	0.380	0.516	-0.266	0.040	0.192	-0.683	0.201	-0.570
Ciranjang	0.120	0.115	-0.648	-0.616	0.542	0.396	-0.398	-0.164	0.488	-0.232	-0.625	-0.740
Karangtengah	0.396	0.023	-0.916 *	-0.141	0.755	-0.031	-0.444	0.261	0.587	0.648	-0.485	-0.878 *
Sukaluyu	0.133	-0.196	-0.887 *	-0.114	0.533	-0.135	-0.378	-0.141	0.268	0.237	-0.758	-0.737
Mande	-0.178	0.169	-0.660	-0.015	0.580	-0.412	-0.027	0.578	0.778	0.294	0.048	-0.805