Relationship between regional characteristics of rice yield and water management in Indonesia

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◆Introduction

The situation in Indonesia

In Indonesia, the food shortage resulting from rapid increase in population is serious problem, and small rise in temperature caused by global warming affects crop productivity in low latitude area. Considering the fact that large quantity of rice is imported, it is necessary to increase rice yield and its stability.

Governmental plan

1.The effective use and management of the irrigation water.
2.The introduction of high-yield seed varieties.
3.The improvement of fertilization.

Purpose

Grasp of relationship between regional characteristics of rice yield and water management.

Ⅰ. Estimation of rice yield by using satellite data.
Ⅱ. Comparison between two areas having different water management system.

West Java
Advanced facilities of the large scale irrigation.
FAO indicate defect in distribution system of the irrigation.

Bali
Traditional and small scale irrigation system constructed and managed by Subak(water supply union).

◆Data and method

Actual rice yield data

The sampling was made on each individual field. Rice gain were separated from the rice crops, the fresh weight of gain were measures after harvesting.

	West Java	Bali
date	Aug 28 ~ 29	Oct 5 ~ 7
Number of point	35 points	50 points

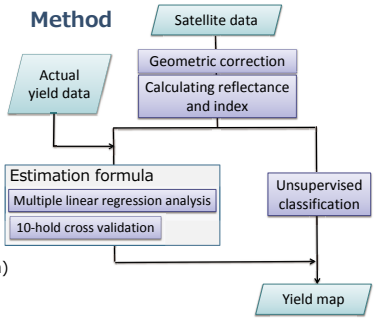
Satellite data

	West Java		Bali	
	Satellite data	Date of acquisition	Satellite data	Date of acquisition
Extraction of paddy field in harvest season	Landsat8 SPOT5	6/9/2014 8/12/2014 8/17/2014	SPOT6	9/20/2014
Estimation of rice yield	SPOT5	8/17/2014	SPOT6	9/20/2014

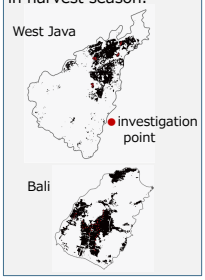
Reflectance
Blue, Green, Red, Near-infrared, Short-wavelength infrared (1570-1650nm, 2110-2290nm)

Index
NDVI=(NIR-red)/(NIR+red)
GNDVI=(NIR-green)/(NIR+green)
NDWI=(red-SWIR)/(red+SWIR)
LSWI=(NIR-SWIR)/(NIR+SWIR)

Method



Extraction of paddy field in harvest season.



◆Results and discussion

Estimation of rice yield by using satellite data.

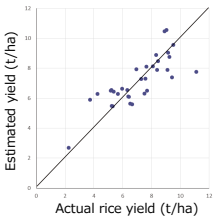
The yield estimation formula was made by multiple linear regression analysis.
RMS error was calculated by 10-hold cross validation.

Grasp of regional characteristics.

The formula was applied to satellite data.
Yield was visualized.

Comparison between regional characteristics of rice yield and water management.

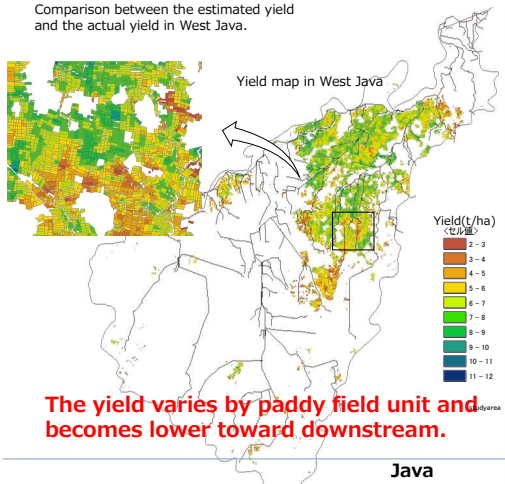
■ Result in West Java



Yield=90.14*NIR +26.49*NDWI-6.69
statistically significant with the 1% level.

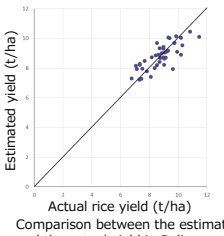
RMS error =1.14t/ha

Comparison between the estimated yield and the actual yield in West Java.



The yield varies by paddy field unit and becomes lower toward downstream.

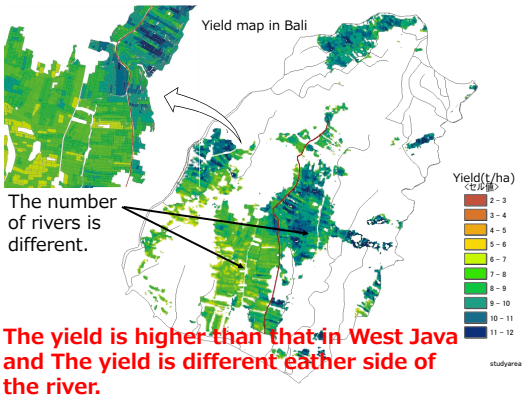
■ Result in Bali



Yield=30.97*GNDVI-6.34
statistically significant with the 1% level.

RMS error =0.59t/ha

Comparison between the estimated yield and the actual yield in Bali.



The yield is higher than that in West Java and The yield is different eather side of the river.

	Java	Bali
Irrigation water	Intake irrigation water from Citarum river. (dependence on precipitation)	Intake irrigation water from several rivers and spring water.
Irrigation facilities	Maintenance of the large scale irrigation by the government.	Traditional and small-scale irrigation.
Management method	A defect in distribution system of the irrigation water.	Thorough water management system controlled by Subak.

Characteristics were caused by a defect in distribution system of the irrigation water.

Characteristics were caused by thorough water management system.

◆Conclusions

Ⅰ. The rice yield was estimated by satellite data. This enabled us to grasp yield tendency by paddy field unit.
Ⅱ. These characteristics suggest that the yield in Indonesia was affected by water management.
West Java : the yield varies by paddy field unit and becomes lower downstream.
Bali : The yield is high and stable in the paddy fields getting irrigation water from the same river.