

## Agricultural product fluctuation in Indonesia and the global teleconnection pattern

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### 1. Introduction

Indonesia is currently the fourth most populous country in the world and continues to grow. Rice is the main agricultural crop and due to the fact that in several years rice had to be imported from other countries due to poor harvests, estimating the annual harvest yield is of great importance. While several studies have shown that rice crops in Indonesia are affected by ENSO phenomenon, they have mostly used data predating the 1990s. Consequently we have used recent grid-point data for analysis of the relationships between rice crop yields and variations in weather for the period from the 2000s onwards.



### 2. Precipitation in Java and the teleconnection pattern

The terrestrial air temperature and precipitation 1900-2006 gridded monthly time series data (Version 1.01) produced by the University of Delaware was used for analysis. The correlation coefficient between the June to August (JJA) precipitation in Java and global surface pressure shows a positive correlation around northern Japan, and implies that precipitation over Java is related to pressure anomalies over northern Japan. This result may arise due to the simultaneous influence of a Rossby wave on both areas (Pacific Japan (PJ) pattern). In Java, rice is usually planted twice a year, the first planting being around December and the second around May. Given that the second planting and growing period corresponds to the dry season, the precipitation in the JJA period could possibly affect rice production in a rainfall fed field.

### 3. Relationships between precipitable water and rice crop yield in Maluku

NCEP/NCAR reanalysis data and data describing the annual yield of the paddy field rice harvest from 1980 to 2006 were used for our analysis. Precipitable water levels are averaged over the period from March to May (MAM) in the area from 123.25E to 135.75E, and from 9.50S to 3.75N. The time series of the precipitable water and annual yield data both indicate ENSO-like characteristic variations from the 1990s onwards. The correlation between two data from 1980 to 2006 is statistically significant ( $r=0.64$ ). The month of May corresponds to the second annual planting period; if rainfall is insufficient to plant rice, farmers will decide to plant other crops such as corn and peanuts. Therefore, the correlation between MAM precipitable water levels and the rice crop yield indicates that the rainfall level in MAM affects the choice of which crop to plant. In the eastern part of Indonesia especially, the rate of dry-land rice field is relatively high and as such

the rain in MAM may strongly influence the choice of which crop to plant.

#### 4. Mixed cropping in Java

Figure 1 shows an example of mixed crop planting in Java, in this case, corn is planted between furrows of rice. In other cases, papaya (with an edible root) and/or cassava are used to protect against poor crops of rice that arise from abnormal weather. If weather fluctuations increase, along with the impact of future global warming, various planting systems adapted to abnormal weather will be necessary for a stable agriculture system.

#### 5. Conclusion

In Indonesia, precipitation strongly influences the rice harvest, and in northern Japan, the temperature is also an important factor for the rice crop. The fact that precipitation in Java and the surface pressure around northern Japan show a simultaneous variation in the JJA period implies that the rice crop yields in both areas may also show simultaneous fluctuations. Therefore, under climatic variations in the future, analysis of the global teleconnection patterns in relation to agricultural products will become important for stable food supplies. Also, the reanalysis data are potentially useful for estimations of rice crop yields. If this estimation method is improved to factor in other dry-land rice areas, estimation for crop yields over a wider area will become possible.

Keywords: Indonesia, Java, Maluku, rice, Precipitable water, teleconnection pattern