Chapter 10
Rainfall Prediction Model Using Exponential Smoothing Seasonal Planting Index (ESSPI) For Determination of Crop Planting Pattern

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ABSTRACT

The traditional crop farmers rely heavily on rain pattern to decide the time for planting crops. The emerging climate change has caused a shift in the rain pattern and consequently affected the crop yield. Therefore, providing a good rainfall prediction models would enable us to recommend best planting pattern (when to plant) in order to give maximum yield. The recent and widely used rainfall prediction model for determining the cropping patterns using exponential smoothing method recommended by the Food and Agriculture Organization (FAO) suffered from short-term forecasting inconsistencies and inaccuracies for long-term forecasting. In this study, the authors developed a new rainfall prediction model which applied exponential smoothing onto seasonal planting index as the basis for determining planting pattern. The results show that the model gives better accuracy than the original exponential smoothing model.

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INTRODUCTION

An accurate rainfall prediction model is needed to overcome the problem of shifting rainfall patterns. Rainfall prediction models for determining cropping patterns recommended by the Food and Agriculture Organization (FAO) is the exponential smoothing to replace the linear models such as regressions which are still widely used. The weakness of this model is the innacuracy in short-term forecasting and inconsistencies for long-term forecasting. This study aims to develop a new model of rainfall prediction using the Exponential Smoothing Seasonal Planting Index (ESSPI) method which has a high degree of accuracy. The next goal is to formulate a new theoretical framework for grouping rainfall data based on the seasonal planting index, a new method of determining smoothing value (α) using the method seasonal planting index, and a new model for predicting rainfall using a seasonal planting index for determining rice cropping patterns.

RELATED WORKS

According to Naylor et al. (2007), some experts find and predict the direction of rainfall pattern changes in the western part of Indonesia, especially in the northern part of Sumatra and Kalimantan, where rainfall intensity tends to be lower, but with a longer period. In contrast, in the southern regions of Java and Bali rainfall intensity tends to increase but with a shorter period. Hartomo et al. (2015) also stated that in certain region such as in Boyolali, Central Java, there had been recorded some shifts in the peak rain pattern during 1969-1979, 1979-1989 and 2000-2010.

Shifting rainfall patterns affect agricultural resources and infrastructure which causes shifts in planting time, seasons, cropping patterns and land degradation. The tendency to shorten the rainy season and increase rainfall in the southern part of Java and Bali resulted in an initial change and duration of the planting season, thus affecting the planting index (PI), planting area, initial planting time and cropping patterns. The retreat of the beginning of the rainy season for 30 days can reduce rice production in West Java and Central Java by 6.5% and in Bali reach 11% of normal conditions. Rice productivity in Brebes Regency is the highest among rice productivity in other districts/cities, which is 65.19 quintals per hectare. The lowest productivity was recorded in Klaten Regency which was 43.19 quintals per hectare.

Rainfall prediction model recommended by the Food and Agriculture Organization (FAO) is the exponential smoothing to replace linear models such as regression which is still widely used for weather prediction in relation to agricultural cultivation. This model is recommended with high accuracy in short-term predictions. According to Ngopya (2009), the first weakness of this model is short-term forecasting

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