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THE IMPACT OF CLIMATE CHANGE ON THE PRODUCTION OF FOOD AND VEGETABLE COMMODITIES IN JEMBER REGENCY

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Abstract. The purpose of this study is to find out how climate change is affecting production in Jember Regency, specifically production centers (Sumberbaru District, Bangsalsari District, Wuluhan District, Panti District and Tempurejo District). Climate variables are able to influence the production of rice and eggplant, to reduce the effect of climate change, several controllable variables are used in research panel data, in order to be able to reduce the effects of climate change. From the analysis it can be seen that climate change / uncontrolled variables (temperature, rainfall and humidity) in general and controlled variables (harvested area and subsidized fertilizer) are influential in Jember Regency. Based on climate change data that occur every year per planting season is not too different or tends to be constant. Thus, there is no extreme climate change in Jember Regency.

1. Introduction

Climate change is one of the very serious threats to the agricultural sector. In climate change, season shifts occur, which are marked by the shorter rainy season but with large rainfall, causing cropping patterns to shift. Damage to crops occurs because of the high intensity of rain which has an impact on floods and landslides. Then, fluctuations in temperature and humidity that is increasing can stimulate the growth and development of plant-disturbing organisms. With this explanation, climate change can be detrimental to farmers and the agricultural sector, further shrinking and decreasing agricultural output which has an effect on the decline in farmer income [1].

Indonesia is an area with a wet tropical climate that experiences 2 seasons, including the rainy season and the dry season. Indonesia is a region that is very suitable to be planted by several agricultural commodities, especially rice plants which make rice commodities as a staple food for Indonesian people. According to FAO (2015), based on the impacts of climate change in agriculture it can be explicitly divided into two groups: bio-physical and socio-economic impacts. As reported by the World Bank (2016) the average temperature increase per year is 0.3 degrees celsius. In 2014 an extraordinary rise in temperature reached 1 degree celsius. Indonesia is predicted to experience more rain with changes of 2-3 percent per year. The intensity of rain will increase, but the number of rainy days will get shorter, and increase the risk of flooding.

East Java Province is classified as a tropical climate. The surface height of the land varies greatly, some areas are flat, only a few meters above sea level, the climate is hot enough to reach 33^{o}C, some areas are hilly with gentle slopes, and some are at an altitude area with minimum temperatures reaching 15^{o}C [2].

Food and vegetable commodities are very dependent on natural conditions, for that the availability of water as an important container is a determining factor in this farm. Much or less the amount of water is influenced by the climate in place. food commodity is one of the foodstuffs that

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contains adequate nutrition and reinforcement for the human body, because it contains ingredients that are easily converted into energy. Therefore, rice is also called energy food [3].

Climate change causes the cropping system and planting time in the agricultural sector in Indonesia to change. Unstable changes can cause large losses, especially in the agricultural sector. Then further research is needed to prove the impact of losses experienced due to climate change and other factors. The potential of adaptation actions must be determined for both agriculture and government (Mendelsohn, 2007). Based on the background described, identification problems can be formulated, namely: How does the effect of climate change on the production of food and vegetable commodities in Jember Regency? Based on the background and formulation of the problem above, the objectives of this study in particular are: Analyzing the impact of climate change on the production of food and vegetable commodities in Jember Regency.

2. Method

Research on "The Impact of Climate Change on the Production of Food and Vegetable Commodities in Jember Regency ", is a type of descriptive research, data that has been collected is then compiled, analyzed, and explained so as to provide an overview of the phenomena that occur, explain the relationship, test the hypotheses and draw conclusions from the results of the analysis obtained.

For panel data analysis there are three models namely, Common Effect, Fixed Effect and Random Effect.

Common Effect; The model assumes that the intercept and slope coefficients are constant over time and individually, and the error term explains the differences in the intercept and slope coefficients over time and the individual. Regression is done by combining timeseries and crosssection (pooled) data. Estimates made are by Ordinary Least Square (OLS) regression. This method is called Pooled Regression or Common Effect. Thus, in this model there are no individual effects.

Fixed Effect; The model that assumes the existence of intercept differences for each individual is known as the Fixed Effect regression model. The term Fixed Effect comes from the fact that although intercepts are different in each individual, each individual's intercept does not vary or is fixed all the time (time invariant). In addition, the model also assumes that the slope coefficient is constant over time and individually. Estimation is done by using dummy variable technique for individuals. Furthermore, because of the use of dummy for the estimation of the Fixed Effect, the literature calls it the Least Square Dummy Variables (LSDV) technique.

Random Effect; The panel data method with the Fixed Effect approach above has a problem in terms of degree of freedom if there are many individuals in the regression. In this case, it is said that the individuals in the estimated sample are drawn from a large population of individuals and they have an average value. general for intercept namely $\beta 1$ and individual differences in the value of intercepts for each individual are expressed in terms of error εi.

3. Result and Discussion

This study uses secondary data in the form of controlled and uncontrolled variables. Each variable was obtained from the Jember Regency Agriculture Office, the Central Statistics Office of Jember Regency and the East Java Province Climatology Center. The number of research observations was 100 observations (2009-2018) with five Districts which are centers of rice and eggplant production in Jember Regency.

Effects of Climate Change

The effect of climate change is very determining the results of rice and eggplant production which states that climate has a modifying variable in it, these modifiers have different roles in determining the climate change that occurs. In addition to the climate variables that determine the production of lowland rice, this study also introduces a modifiable variable that can be controlled, namely the harvested area and subsidized fertilizer. This variable is expected to be able to overcome the decline in paddy and eggplant production which is feared due to unstable climate change.

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Data used in the analysis of uncontrolled independent variables (temperature, rainfall, humidity) and free controlled variables (harvested area, subsidized fertilizer). From these independent variables will be seen how much influence on production (dependent variable). The regression model used is Ordinary Least Square (OLS), after several tests, namely, F-Test and t-Test. The following regression results obtained are as follows:

Table 1 Eviews of lowland rice

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
C	-4877687.8	776856.78	-4.877676	0.0000
Temperature	12554.60	2345.022	5.675658	0.0000
Rainfall	49.65746	12.17658	3.416794	0.0022
Humidity	-2465.543	389.2241	-2.897663	0.0156
Harvest Area	4.887676	0.065476	69.59570	0.0007
subsidized fertilizer	0.446573	0.201442	3.0897254	0.0015

Table 2 Eggplant Eviews output

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
C	-51746	753500	-0.686	0.0006
Temperature	1445.2	1151.3	1.0360	0.0064
Rainfall	1680.4	1619.0	0.4888	0.0184
Humidity	-404.89	373.08	-0.8528	0.0464
Harvest Area	3.087	2.318	0.1061	0.0221
subsidized fertilizer	1.74	1.34	1.0768	0.0204

1. Effect of temperature (X1) on the production of lowland rice and eggplant (Y)

Estimation results show the temperature regression coefficient (X1) worth 12554.60 for rice and 1445.2 for eggplant, meaning that every 1^0C increase in temperature, the production of lowland rice and eggplant will increase by 12554.60 / 1445.2 tons. However, seen from the significance value of t-temperature (X1) is 0.0000 <α (0.05), as well as the temperature of the eggplant at 0.0064 This shows that H0 is rejected and H1 is accepted. Which means that the temperature partially significantly affects the production of lowland rice and eggplant in five centers of lowland rice production and eggplant in Jember Regency.

This study contradicts that conducted by Peng et al. (2004) where production will decrease in accordance with the increasing temperature of the effects of global warming. Where production decreased by 10% for an increase of 1^0C. And also contrary to research conducted by Yuliawana et al (2015) where production will decrease by 14.4% due to an increase in temperature of 1^0C.

2. Effect of rainfall (X2) on the production of lowland rice and eggplant (Y)

Estimation results show the regression coefficient of rainfall (X2) is worth 49.65746 for rice and 1680.4 for eggplant, where every 1mm increase in rainfall the production of rice and eggplant will increase by 49.65746 tons of rice / 1680.4 tons of eggplant and seen from the significance value of t-rainfall (X2) is 0.0022 and 0.0184 <α (0.05) This shows that H0 is rejected and H1 is accepted. Which means that the rainfall partially has a significant effect on the production of lowland rice and eggplant in five centers of lowland rice production and eggplant in Jember Regency.

Rainfall variable has a significant effect. Rainfall can affect movement that affect the planting period. The planting index for rice plants is November - February (rainy season), July - October (dry season) and March - June (gadu season). Rice plants require rainfall with an average of 200m / month or 1500-2000 mm / year. Farmers generally plant in the rainy month. In the dry and gadu months, farmers

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also utilize irrigation where irrigation water comes from lakes, swamps or rivers and rainwater. In the rainy season with high rainfall, excess water will be flowed into reservoirs or accommodated for land management and crop consumption during growth in the dry and gadu seasons.

3. Effect of Humidity (X3) on the production of lowland rice and eggplant (Y)

Estimation results show the regression coefficient of Humidity (X3) worth -2465.543 for rice and -404.89 for eggplant, where each 1% increase in the level of humidity the production of rice and eggplant will decrease by 2465.543 tons of rice / 404.89 tons of eggplant and seen from the significance value of t-Moisture (X3) are 0.0156 and 0.0464 <α (0.05) This shows that H0 is rejected and H1 is accepted. Which means partial humidity significantly affects the production of lowland rice and eggplant in five centers of lowland rice production and eggplant in Jember Regency.

According to the Rathnayake Research (2016), the humidity that corresponds to rice plants from the data obtained, can be categorized at the appropriate level until very appropriate. And this is in accordance with research conducted by Sridevi and Chellamuthu (2015) relative humidity is not in accordance with the growth of rice plants, rice production will decrease with increasing humidity.

4. Effect of Harvest Area (X4) on the production of lowland rice and eggplant (Y)

Estimation results show a regression coefficient of Harvest Area (X4) worth 4.887676 for rice and 3.087 for eggplant, where each increase of 1 ha of Harvest Area the production of rice and eggplant will increase by 5.650727 tons of rice / 3.087 tons of eggplant and seen from the significance value of t-Harvest Area (X4) are 0.0007 and 0.0221 <α (0.05) This shows that H0 is rejected and H1 is accepted. Which means that the Harvest Area partially has a significant effect on the production of lowland rice and eggplant in five centers of lowland rice production and eggplant in Jember Regency.

The effort to increase rice production in Jember Regency is to increase the harvested area. One of them is with agricultural extensification. Extensification of agricultural land is an effort to increase the area of crops by taking into account natural resources and the environment.

5. Effect of subsidized fertilizer (X5) on the production of lowland rice and eggplant (Y)

Estimation results show the regression coefficient of subsidized fertilizer (X5) is worth for rice 0.446573 and 1.74 for eggplant, where each increase of 1 ton of subsidized fertilizer the production of rice and eggplant will increase by 0.446573 tons of rice / 1.74 tons of eggplant and seen from the t-significance value of subsidized fertilizer (X5) are 0.0015 and 0.0204 <α (0.05) This shows that H0 is rejected and H1 is accepted. Which means that subsidized fertilizer partially has a significant effect on the production of lowland rice and eggplant in five centers of lowland rice production and eggplant in Jember Regency.

Joko Triyanto (2006) which proves that fertilizer as a production input has a positive influence on rice production. Utilizing government assistance in the provision of subsidized fertilizer for lowland rice farmers is able to provide a positive increase in rice production in Jember District, thus the distribution of subsidized fertilizer should be continued by the government so that it helps farmers in increasing paddy rice production.

4. Conclusion

From the analysis it can be seen that climate change / uncontrolled variables (temperature, rainfall and humidity) in general and controlled variables (harvested area and subsidized fertilizer) are influential in Jember Regency. Based on climate change data that occur every year per planting season is not too different or tends to be constant. Thus, there is no extreme climate change in Jember Regency.

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