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Factors Affecting the Production of the Food Crop Subsector in East Java Province

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ABSTRACT

This study aims to analyze the factors that influence the food crop subsector production. This research paper used the panel regression analysis method to analyze the secondary data. The findings indicated that agricultural lands, laborers, fertilizer subsidies, rainfall, and irrigation infrastructure partially increase the production of the food crop subsector.

Keywords: *Agriculture Land; Fertilizer Subsidy; Irrigation Infrastructure; Laborers; Rainfall*

1. Introduction

Development policies of a region relate to the planning quality. Different conditions of each region significantly impact the characteristics of the development. Thus, determining the base sector is necessary (Sjahrizal, 1997). Policies of regional development in Indonesia are more emphasized in the agricultural sector since lands are mostly used for agriculture, and 50% of the agricultural laborers satisfy their daily needs from the agricultural sector. This sector has a very important role in the economy in Indonesia (Winoto & Siregar, 2016), and it affects the sustainability of other sectors, such as small industries highly relying on the raw materials it produces (Kimbal, 2020).

To foster the development of the agricultural sector, it is essential to find and exploit its potential (Tomaney, 2010). The agricultural sector covers five main subsectors, namely, plantation, food crops, animal husbandry, forestry, and waters. Among the five subsectors, food crop makes the biggest contribution to the nation's Gross Regional Domestic Product (GRDP). It plays a significant role in Indonesia's development, and expanding the subsector is to increase the domestic food crop commodity production.

East Java Province is one of the national food barns that greatly contribute to national needs. Hence, the province could increase the production of food crop subsector commodities. On this basis, this study investigates what factors affect the production of the food crop subsector (Badan Pusat Statistik, 2018).

2. Literature Review

2.1. Production Theory

Production is the relationship between existing natural resources and outputs. Production refers to the activity of adding value to an item. According to Soekartawi (1990), the production function shows the relationship between the level of output and input. The Cobb-Douglas production function model is widely used in the production sector, the formula of which is:

$$Q = K^{\alpha} L^{\beta} \quad (1)$$

where,
Q = Output
K = Income
σ = Capital Input Elasticity
β = Labor Input Elasticity (Sukirno, 2013).

2.2. Agricultural Development

Agriculture's contribution to food security, employment, and national income establishes its crucial role as its development aims to increase economic growth, reduce poverty, and reduce unemployment (Njoku & Ihugba, 2011).

In general, agricultural development emphasizes farmers' income and living standards. Todaro & Smith (2012) proposed three steps to increase food production: expanding agricultural land, increasing productivity, and appropriate pricing policies.

2.3. The Relationship between Land Area and Production

The land is a vital production factor in the agricultural sector. It is a place for farmers to produce the crop. It has differences with other production factors, as indicated by the fixed land area and increasing land demand, creating land scarcity and food insecurity (Mubyarto, 1989).

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However, land conversion poses serious problems for paddy fields that are crucial in producing food crops such as rice, corn, soybeans, and peanuts. As it breaks the irrigation network (Prajanti, 2014) and lessens land to produce food crop commodities, it instantly reduces food availability.

The conversion of agricultural land to non-agricultural land creates insoluble problems for some cities with high economic growth, for it multiplies the demand for land resources. The constant availability of agricultural land leads to high competition for agriculture, industries, trade, and inhabitants. This ownership also raises problems of food availability (Lanz et al., 2017).

2.4. The Relationship between Laborers and Production

Laborers are the production input factor in agriculture. Intensive laborers provide optimal food availability and work on their own agricultural land. Therefore, they should be effectively used by the scale of the agricultural business (Soekartawi, 1990).

In agriculture, the laborers (workers) are assigned to (1) plant preparation, (2) provision of production facilities for seeds, fertilizers, pests/diseases, (3) planting, (4) maintenance such as weeding, fertilization, treatment, and irrigation, (e) harvesting and distribution, and (f) sales.

According to Soekartawi (1990), one important aspect is laborers in agricultural production management. However, the current trend is that the older generation of farmers makes up most of the farming community. In comparison, the younger generation prefers working in the industrial sector or moving to urban areas.

2.5. The Relationship between Fertilizer Subsidy and Production

From 1978 to 1998, the Indonesian government had a directly-controlled system for subsidized fertilizer distribution to support its food self-sufficiency program. In the 1998 reform era, the fertilizer distribution system was handed over to the free market, where the government withdrew the subsidies from 1998 to 2002. The provision and distribution of subsidized fertilizers were carried out based on the Regulation of the Minister of Trade Number 15 of 2015 concerning the supply and distribution of subsidized fertilizer for the agricultural sector.

PT Pupuk Indonesia (Persero) will allocate the supply and distribution of subsidized fertilizers according to production capacity for efficiency, effectiveness, and flexibility. For farmers/farmer groups, the subsidized fertilizers are distributed by authorized representative retailers. As stipulated in the Regulation of the Minister of Agriculture regarding the allocation and HET of subsidized fertilizers, it is carried out in a closed system through a Group Needs Definitive Plan with the maximum retail price.

The production shortage in the agricultural sector is caused not only by fewer subsidies from the government. The distribution irregularities also pinpoint the weaknesses of its distribution system. The modes frequently used for fertilizer fraud are smuggling, non-subsidized fertilizer counterfeiting, and higher retail price than HET. This calls for effective supervision on each line to misuse subsidized fertilizers (Ricker-Gilbert & Jayne, 2011).

2.6. The Relationship between Rainfall and Production

Rainfall greatly affects crop production since the amount of which determines the yield of the crop. Extreme climate affects rainfall. Several studies contended that rainfall and rainy days affect agricultural production. This ultimately affects not only the plantation commodities but also agricultural commodities in urban areas (Tampubolon & Sihombing, 2017).

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2.7. The Relationship between Irrigation Infrastructure and Production

Water is another determinant factor of the agricultural production process. Therefore, irrigation is vital to supply water for agriculture with the right amount, time, and outstanding quality. It will decrease agricultural production if it does not meet these standards (Knox et al., 2012).

Irrigation infrastructure comprises dams, primary and secondary channels, and dividing boxes. The disruption of this infrastructure will affect the existing system's performance, resulting in decreased efficiency and effectiveness of irrigation. If this keeps up, it could decrease agricultural production and negatively impact farmers' income and the surrounding economic conditions (Edwards & Smith, 2018).

This concludes irrigation is one of the major components in agriculture as it also occupies strategic roles in farming technology, especially in lowland rice fields. However, it depends on supporting other technologies, such as using superior seeds, soil management, balanced fertilization, and pest and disease control (Hendayana, 2003).

2.8. Regional Development Strategy

Development strategies are necessary to reduce inequality and accelerate economic development (Kim, 2008). The strategies should concern increasing the economy among regions to create harmonious relationships emphasizing harmonic growth, sectoral development programs, and harmony among business actors (Sumarsono, 2004).

Munibah et al. (2009) proposed supply-side and demand-side strategies for regional development programs. The supply-side strategy is a strategy of increasing investment for production activities. The demand-side strategy is to increase the production of goods and services through local production activities. This implies the importance of determining the local potential to discern the development priorities for realizing community welfare. It will do if linkages among regions and sectors are also considered. The sectoral approach is solely ineffective in recognizing the changes in the spatial structure. In contrast, the regional approach is equally insufficient since the macroeconomic analysis cannot explain sectors by sector and per commodity (Taringan, 2004).

3. Research Methodology

This research was conducted in East Java Province, deliberately selected since its production food crop subsector had increased from 2012 to 2016. The variables used are the production of the food crop subsector (dependent variable), land area, laborers, fertilizer subsidy, rainfall, and irrigation infrastructure. The data were obtained from the BPS - Statistics Indonesia and the Ministry of Finance. The method used in this research is panel data regression.

The unification of data time series and cross-section is called panel data. In general, the panel regression analysis model is:

$$Y = \beta 0 + \beta 1LNLL + \beta 2LNTK + \beta 3LNI + \beta 4LNCH + \beta 5LNII + e \quad (2)$$

where,

Y	=	Production of the food crop subsector
β0	=	Intercept
β1, β2, β3, β4, β5, dan β6	=	Constant
LNLL	=	The area of land for the food crop subsector

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LNTK = Labor of subsector food crop
LNI = Fertilizer subsidy of subsector food crop
LNCH = Rainfall
LNII = Irrigation Infrastructure

The panel data analysis used three estimation models, namely common effect, fixed effect, and random effect. The common effect model is a technique to estimate panel data and regression models. It ignores the heterogeneity between cross-section units and time series. The fixed effect model considers the unit cross-section's heterogeneity in the panel regression model. The random effect model assumes that each unit in the cross-section has a different intercept.

Before the estimation, a model specification test must be carried out to determine the model used. In addition, Chow Test was used to select the common effect or fixed-effect models with the formula:

$$F = \frac{(RRSS-URSS)/(N-1)}{URSS/NT-N-K} \quad (3)$$

where,
RRSS = Restricted Residual Sum Square (Sum Square Residual of the panel estimation using the common effect or PLS method)
URSS = Unrestricted Residual Sum Square (Sum Square Residual from the panel estimation using the fixed-effect method)
N = Number of cross-section samples
T = The number of time series samples
K = Total number of regression variables

Suppose F-Value is higher than F-Table at a certain confidence level (α). In that case, we reject the H0 hypothesis and accept the H1 hypothesis, implying that we must use the Fixed Effect Model (FEM) for the estimation technique in this study.

In addition to Chow Test, Hausman Test can determine whether the Fixed Effect or Random Effect is the most suitable for the research. If the Hausman test results in a value of $Chi - Square_{value} > Chi - Square_{tabel}$ and the p-value is significant, the hypothesis H_0 is rejected and H_1 is accepted so that the Fixed Effect Model (FEM) model approach is more suitable as a model in this research.

As for the assumption test, we conducted multicollinearity, heteroscedasticity, and normality tests. The multicollinearity test was conducted to analyze whether the regression model finds a correlation between the independent variables. If the correlation exists, a multicollinearity problem exists. A good regression model should not correlate with the independent variables.

Also, in the regression model, one of the assumptions must be fulfilled so that the parameter estimates in the model are BLUE (Best Linear UnPure Estimator), which is the error term or residual with a constant variant called homoscedasticity (Var U_i = σ_u ^ 2). It is called heteroscedasticity if the variants are not the same or changing.

The normality test aims to determine the regression model's normal distribution of residual variables. The t-test and F-test assume that the residual value follows a normal distribution. If this assumption is violated, the statistical test will be invalid for a small sample.

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As to the Parameter Significance Test, a simultaneous statistical test is used to determine the simultaneous effect of the independent variable on the dependent variable. The statistics are formulated as:

$$F = \frac{R^2/K}{1-R^2/(n-k-1)} \quad (4)$$

The hypothesis testing used p-value to compare the p-value of F with the F table (critical value). Suppose the calculation results show the probability value of F<F table (critical value). In that case, H_0 is rejected, and H_1 is accepted, concluding that the independent variables simultaneously significantly affect the dependent variable in the research model. If the probability value of F > F table (critical value), H_0 is accepted and H_1 is rejected, leading to a conclusion that the independent variables do not simultaneously have a significant effect on the dependent variable in the research model.

As for the t-test, the partial test needs to explain the significance level of the independent variables in influencing the dependent variable. The t-test is to determine the significance of an independent variable individually in influencing the dependent variable. Its formula is:

$$t = r\frac{n-2}{1-r} \quad (5)$$

The hypothesis testing was based on the p-value concept, comparing the critical value (α) with the p-value. If the p-value is less than the critical value (α), H_0 is rejected and H_1 is accepted. Accepting H_1 means the independent variable has a significant effect on the dependent variable.

In the Coefficient of Determination, a model has advantages and disadvantages when applied to different problems. To measure the goodness of a model (goodness of fit), a coefficient of determination (R^2) is used. It is a measure that shows the contribution of the independent variable to the dependent variable, the value of which is between 0 and 1. If it is close to 0 (zero), the ability of all independent variables to explain the dependent variable is highly limited. If it is close to 1 (one), the independent variables provide nearly the information explained to predict the variation in the dependent variable (Sutikno et al., 2017).

4. Results and Discussion

To determine the estimation model, this study applied the Chow Test to select the Common Effect and Fixed Effect, the probability of which is 0.05. **Table 1** below provides the results.

Table 1. Chow Test Results

Probability F	Test Indicators	Result	Note
0.00	Prob F < Sig (0.00 < 0.05)	H_0 Rejected	Method: Fixed Effect

Source: Eviews

Table 1 indicates that the Chow Test results show the probability value of cross-section F is 0.00, smaller than 0.05. With the results, H_0 is rejected, and Ha is accepted. This implies that the Fixed-Effect method is better for this study than the Common-Effect. Consequently, the Hausman-Test is used.

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The Hausman Test was also used to select Fixed Effect or Random Effect models. The probability value for the Hausman test is 0.05.

Table 2. Hausman Test Results

Probability F	Test Indicators	Result	Note
0.03	Prob.Chi^2 < Sig (0.03 < 0.05)	H_0 reject	Method: Fixed Effect

Source: Eviews

As **Table 2** shows that the value of Prob. Chi^2 is 0.03, H0 is rejected. This signifies that in this study, it is suitable to use the Fixed Effects instead of the Random Effect. Thus, the Chow Test and the Hausman Test highlight the suitability of using the Fix Effect method.

Besides, we conducted a multicollinearity test for the classic assumption test to determine the correlation between the independent variables. **Table 3** below presents the results.

Table 3. Multicollinearity Test Results

	LnLL	LnCH	LnI	LnII	lnTK
LnLL	1	0.13	0.33	0.68	0.40
LnCH	0.13	1	0.21	0.10	0.14
LnI	0.33	0.21	1	0.31	0.01
LnII	0.68	0.10	0.31	1	0.26
LnTK	0.40	0.14	0.01	0.26	1

Source: Eviews

Table 3 shows that the correlation value between the dependent variables is small (less than 0.08). This implies no multicollinearity problem.

Table 4. Multicollinearity Test Results

Jarque–Bera Value	P-value
8,58	0,28

Source: Eviews

Table 4 shows that the Jarque-Bera value is 8,58, and the probability value is 0,28. Since the probability value is smaller than α = 5%, H_0 is accepted, and the residuals are normally distributed.

As for the hypothesis test, a t-test was conducted to determine the relationship between the independent and dependent variables partially. **Table 5** below shows the results.

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Table 5. T-Test Results

Variable	Coef.	Std. Error	t-Statistic	Prob.
LNLL	0.82	0.08	9.81	0.00
LNTK	0.03	0.17	1.74	0.08
LNI	-0.05	0.02	-2.14	0.03
LNCH	-0.005	0.006	-0.85	0.39
LNII	0.004	0.002	1.79	0.07
C	4.36	0.90	4.79	0.00

Source: Eviews

Table 5 signifies that partial lands, laborers, fertilizer subsidies, and irrigation infrastructure are significant for food crop production, while rainfall does not affect food crop production in East Java Province. The subsidy and rainfall variables have a negative coefficient value, indicating that the greater the fertilizer subsidy and rainfall, the lower the food crop production.

In addition, F-test was conducted to determine the effect of the independent variable on the dependent variable as a whole. **Table 6** below delivers the results.

Table 6. F-Test Results

R-square	0.998	Mean dependent var	26.76
Adjusted R-square	0.997	S.D dependent var	20.54
Standart error	0.097	Sum squared resid	1.39
F-statistic	2.028	Durbin-Watson Stat	2.01
Prob (F-statistic)	0.00		

Source: Eviews

As the estimation results in **Table 6** show that the probability value (F-statistic) is 0.00, the independent variable influences the dependent variable as a whole. Based on the existing hypothesis, H_0 is rejected, meaning that the independent variable affects the dependent variable.

Table 7. Determinant Coefficient (R-square) Test Results

R-Squared	0.99	Mean dependent var	12.65
Sum square resid	1.77	Durbin-Watson stat	12.58

Source: Eviews

Table 7 shows the coefficient of determination is 0.99. This indicates that the ability of the independent variable to the dependent variable is 99%, while other variables explain the remaining 1%.

5. Conclusion

The evidence from this study suggests that partially, lands, laborers, fertilizer subsidies, and irrigation infrastructures are significant for the production of the food crop subsector in East Java Province. Simultaneously, the variables of land area, laborers, fertilizer subsidy,

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rainfall, and irrigation infrastructures affect the production of the food crop subsector. Thus, East Java Provincial Government should provide farmers with knowledge regarding the food crop's growing season to realize its maximum production.

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7. Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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