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Economic efficiency and risk of cassava farming in Lampung province

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Abstract

Purpose: This study aimed to analyze the effect of the use of production factors on cassava production, to analyze cassava income, to analyze the level of economic efficiency in the use of cassava production factors, and to analyze the risk of cassava farming in Lampung Province.

Research methodology: The population consisted of 473 farmers from TerusanNunyai, Central Lampung regency. Interviews, observation, documentation, and questionnaires were all used to collect data.

Results: The performance of cassava farming which is measured based on the income analysis, the average income value is Rp. 7.351.369,66 with an R/C ratio of 1,46. Then, production factors for NPK-Phonska, TSP/SP-36, KCL, manure, labor, pesticide, and land are not economically efficient in cassava farming, while seed production factors are not economically efficient yet. Income and production in cassava farming have a high risk.

Limitations: There is unavoidable transaction cost; therefore, it is necessary to involve transaction costs to get the maximum profit to reach economic efficiency.

Contribution: The contribution of this research is to provide input for cassava farmers to get maximum income by avoiding the slightest possible risk.

Keywords: *Cassava, Economic, Efficiency, Income, Risk*

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1. Introduction

Cassava is the main food crop sub-sector commodity in Indonesia after rice, corn, soybeans, beans (Zulkarnain et al., 2010; Ekaria & Muhammad, 2018). Cassava has great potential for increased production (Karyanto & Suwasono, 2008). At this time, cassava is not used as a food ingredient or industrial raw material but for the renewable energy development industry in the form of bioenergy such as bioethanol or biofuel (Anggraini et al., 2016). Indonesia is one of the main producers of cassava in the world, with production reaching 19.046.000 tons with a market share of 7,19 %, which is fourth after Nigeria, Congo, and Thailand (Pusat Data dan Sistem Informasi Pertanian, 2016). The cassava commodity has the opportunity to compete in the international market with the support of good quality and quality in Indonesia so that it has an impact on international trade (Pramesti et al., 2017). Cassava production in each province in Indonesia is uneven (BPS Statistics Indonesia, 2017). Therefore, the cassava plant has great potential to continue to be developed, considering that the demand for the tapioca industry for cassava raw materials continues to increase.

Lampung Province production ranks first with 5.056 tonnes (BPS Provinsi Lampung, 2019). Therefore, Lampung Province is the center of cassava production in Indonesia. Lampung Province is the main cassava producer in Indonesia, which is the mainstay as a national and export supplier of cassava. This can be seen from the area and the largest cassava production among other provinces. As a national center for cassava production, cassava production in Lampung Province contributes 34,56% to national production (BPS Provinsi Lampung, 2019). Where the center of cassava production in Lampung Province in Central Lampung Regency with a total of 1,244,958 tons or 28.36% of the total cassava production in Lampung Province (BPS Provinsi Lampung, 2019), this is due to the development of cassava farming management technology such as cultivation techniques (planting, fertilizing, and controlling pests). The existence of technology has enabled a paradigm shift in product manufacturing (Nagarajan et al., 2018).

Central Lampung Regency has the largest area and production of cassava among districts/cities in Lampung Province (BPS Provinsi Lampung, 2019). Therefore, Central Lampung Regency has the competitiveness of cassava production in Lampung Province (Rosanti, 2018). High productivity has not been used properly by farmers as an opportunity to improve farm performance or income. The performance of cassava farming is constrained by the climate and uncertainty of the selling price at the farmer level. The average purchase price by large traders is Rp. 700 /kg - Rp. 1.100 /kg. In addition, the area of land owned by farmers is not sufficient to be said to be suitable for cultivation because the average is below one hectare.

Unstable or fluctuating production is influenced by the use of inaccurate and efficient production factors (Mufrianti and Anton, 2014). Production factors owned by farmers generally have a limited amount. This makes farmers use their own production factors efficiently in farming management so that they get maximum income. The allocation of effective and efficient production factors can result in optimal production, so that farm income will increase and is closely related to farming efficiency (Efrizal et al., 2011).In the rainy season, the quality of cassava decreases due to the harvest of cassava carried out prematurely, and there is bacterial wilt disease, so the selling price is low (Prabowo et al., 2015). According to Ekaria & Muhammad (2018), production risk happens due to crop failure with a decrease in the amount of production and income risk due to fluctuations in the selling price and purchase price of production inputs. The uncertainty in the agricultural sector arises from fluctuations in the amount of production and prices. Uncertainty in agricultural production is due to climate, pests, disease, and drought.

Failed production can affect farmers' decisions to do further farming (Yansah et al., 2020). Low production and high production costs can result in low income earned by farmers. This is due to the limited knowledge of farmers in managing efficient farming. The efficient use of production factors is related to the quantity and quality of the harvest, which has an impact on income (Suciaty & Hidayat, 2019). In addition, farmers in farming can control the cost of production, which is used to help determine the selling price of the commodities produced so that farmers get maximum profit. Farmers plant cassava because it provides income for cassava farmers by knowing the risks so that they can minimize losses in farming. Based on the description above, The purpose of this study was to analyze the effect of the use of production factors consisting of seeds, urea, NPK-Phonska fertilizer, TSP / SP36 fertilizer, KCL fertilizer, manure, labor, pesticides, and land area on the yield of cassava farming, analyzing the level of economic efficiency in the use of cassava farming production factors and analyzing the risks of cassava farming in Lampung Province

2. Literature review and hypothesis development

Production function

Sukirno (2000) states that the production function is related to the factors of production (input) and the level of the amount of production (output) produced. The production function is a function that shows the relationship between production results and input production factors (Mubyarto, 1995). The production function is mathematically analyzed as follows:

$Y = f(X_1, X_2, X_3 ...... X_n)$ ……………………………………………………… (1)

Information:

Y	= The level of the production amount is influenced by production factors
f	= Production Function
X_1 ….. X_n	= Inputs affecting Y.

The Cobb Douglas Production Function uses a multiple linear form production function with the Cobb Douglas production function equation as follows:

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + ... + b_n \ln X_n + e \qquad (2)$$

Information:

ln	= Naturallogarithm
Y	= The level of the production amount
b_0	= Intercept
$b_1, b_2, ..., b_n$	= Coefficient X
X_1 …… X_n	= Inputs affecting Y
e	= Error terms

The Cobb Douglas function shows the elasticity of X against Y, and the total elasticity is a return to scale (Soekartawi, 2003).

Income

Farming costs are classified into two, namely fixed costs and variable costs. Fixed costs are costs that are relatively fixed in number and continue to be incurred even though the product obtained is large or small, while variable costs are costs whose size is influenced by the production obtained so that these costs vary depending on the size of the desired production (Soekartawi, 1995). The total costs are systematically analyzed as follows :

$$TC = FC + VC \qquad (3)$$

Information:

TC	=	Total Cost ………………………………..	(Rp.)
FC	=	Fix Cost ……………..…………….…………..	(Rp.)
VC	=	Variable Cost…………………....……….	(Rp.)

Farming revenue is the multiplication of the product obtained by the selling price. Acceptance is systematic as follows (Soekartawi, 1995)

$$TR = Y \cdot Py \qquad (4)$$

Information:

TR	=	Total Revenue ………………….……….	(Rp.)
Y	=	Production result…………....……………	(Rp.)
Py	=	Price Y…………………....……………..	(Rp.)

Revenue is the amount earned at the time of sale. Revenue is obtained from the multiplication of production output and selling price (Soekartawi, 2016). Farming income is obtained from the difference in revenue and total costs incurred by farmers in one production process (Fauziah & Soejono, 2019). The farm's gross income is the value of the product over a certain period of time. Farming receipts are the multiplication of the production of commodities with the selling price of commodities (Rahim & Hastuti, 2007). Revenue is obtained from the reduction between the revenue and the total cost of production. Gross income is the value of agricultural production before deducting total production costs (Rahim & Hastuti, 2007).

Farming income is the difference between revenue and total costs. Acceptance is systematic as follows (Soekartawi, 1995)

$$\Pi = TR - TC \quad \ldots\ldots (5)$$

Information:

Π	=	Farm Income………………………...…..	(Rp.)
TR	=	Total Receipts……….………..….……...	(Rp.)
TC	=	Total Cost…………………...……....…..	(Rp.)

Farming income is divided into cash cost income, and total cost income. Income on cash costs is income earned on costs that are incurred by farmers, while income on total costs is income after deducting cash costs and expenses.

Economic efficiency

Sugianto (1982) states that economic efficiency is measured using maximum profit and minimum cost criteria. In addition, economic efficiency is a measure that shows the ratio between actual profit and maximum profit (Soekartawi, 2003), where economic efficiency occurs when the marginal product value of each additional unit of input equals the price of each unit of input, mathematically written as the following :

$$NPMx = Px \quad \ldots\ldots (6)$$

Information:

NPMx	=	The Marginal Product Value of the input X
Px	=	Input price X

- NPMxi / Pxi> 1, meaning that the use of input X is not economically efficient, so input X can still be added.
- NPMxi / Pxi<1, meaning that the use of input X is not economically efficient, so input X needs to be reduced (Soekartawi, 2003).

According to Soekartawi (1994), economic efficiency can occur if farmers are able to make an effort so that the Marginal Product Value (NPMx) for a production factor is equal to the price of the production factor (Px). The use of resources (factors of production) can be said to be efficient if (1) all available resources are fully used; (2) the style of its use is to provide additional prosperity for the community. (Sukirno, 2000)

In farming activities, farmers will allocate production factors as efficiently as possible to get maximum production so that farmers can get maximum profit. This condition can be achieved by two approaches

1) The maximum profit approach is to allocate the production factors that are owned as efficiently as possible to get maximum production.
2) The minimal cost approach is to obtain greater profits by reducing production costs as small as possible

Productivity is low due to inefficient farming and risks (Nafisah & Fauziyah, 2020). According to Asnah et al. (2015), there is a close relationship between productivity and efficiency. Inefficient production is caused by inappropriate use of production factors. The use of appropriate production inputs can minimize inefficiency (Simanjuntak et al., 2019; Anggraini et al., 2016; Gultom et al., 2014). Production factors/inputs such as capital, land, labor, and good management, if managed properly, can produce maximum output (Darwanto, 2010). The amount of production is influenced by independent variables such as business capital, land status, land area, farming experience, seeds/seedlings, manure/organic, urea, NPK-Phonska, medicines, labor, and climate (Fauziyah, 2010; Masithoh & Nahraeni. , 2013; Kune et al., 2016)

Farming risks

Low productivity is caused by risk (Kurniati, 2015). Risk is uncertainty, and this occurs due to a loss event that has an impact on survival (Tjahjadi, 2011). Uncertainty is caused by situations such as limited information, long intervals of activities, limited experience in decision making (Darmawi, 2005). The success in farming depends on the risks experienced in using the input. Agricultural business risks can reduce farmers' income, namely, (1) production risk, (2) price risk, (3) institutional risk, (4) financial risk, (5) human risk (Harwood et al., 1999).

Darmawi (2005) defines risk into several things, namely

1) Risk is the possibility of loss
2) Risk is uncertainty
3) Risk is the spread of actual results
4) Risk is the probability that something results will differ from the expected results

According to Kasidi (2010), the sources of risk can be classified into 3 (three), namely 1) social risk, meaning that people's actions create events that result in deviations that are ultimately detrimental. 2) physical risk, meaning that it occurs as a result of natural phenomena and human behavior that is not normal. 3) economic risk, meaning the risk that occurs due to economic impacts such as inflation, recession, and price fluctuations.

3. Research methodology

The research was conducted at TerusanNunyai, Central Lampung Regency, with a focus on one of the province's cassava production centers (BPS Provinsi Lampung, 2019). The descriptive quantitative technique was utilized. Primary and secondary data were collected. Primary data were gathered through in-depth interviews with cassava farmers. Secondary data were collected from documents owned by research-related institutions. Interviews, observation, documentation, and questionnaires were all used to collect data. The study population consisted of 473 farmers from TerusanNunyai. The sampling methodology was determined using Sugiarto et al. (2003)'s formula and 66 samples were taken using a purposive sampling method. There were two data analyzes, namely (1) analysis of cassava production factors (2) analysis of cassava farming income, (3) economic efficiency analysis of cassava farming and (4) risk analysis of cassava farming.

Analysis of cassava production factors

Analysis of the Cobb-Douglas production function

Analysis of the factors affecting cassava production is using the Cobb-Douglas production function (Sinabariba, 2014). Multiple linear regression analysis is used to measure the effect of more than one independent variable on the dependent variable (Algifari, 1997; Ghozali, 2005; Sugiyono, 2017). The Cobb-Douglas production function is mathematically analyzed as follows (Soekartawi, 2003):

$$Y = boX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}X_8^{b8}\ X_9^{b9} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ Xn^{bn}e^{u} \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

Information:

Y	=	Cassava production...	kg	X_5	=	KCL fertilizer …………...	kg
bo	=	Intersep		X_6	=	Manure …….. …………...	kg
$b_1 \ldots b_8$	=	Regression coefficient X		X_7	=	Labor……………………..	HOK
X_1	=	Seeds……..................	bunch	X_8	=	Pesticide……………………	liter
X_2	=	Urea fertilizer…….....	kg	X_9	=	Land area ……………….	ha
X_3	=	NPK-Phonska fertilizer	kg	U	=	Mistake (disturbance term)	
X_4	=	TSP fertilizer……...	kg	E	=	Natural logarithm (2,718)	

The functional relationship between the factors of production and production results is analyzed using Multiple Linear Regression by means of the Cobb-Douglas production function equation, which is logged so that it becomes:

$$Ln\ Y = Ln\ bo + b_1LnX_1 + b_2LnX_2 + b_3LnX_3 + b_4LnX_4 + b_5LnX_5 + b_6LnX_6 + b_7LnX_7$$

$+ b_8 LnX_8 + b_9 LnX_9$ ………………………………………………………………... (8)

Classic Test

Heteroscedasticity Test. The heteroscedasticity test aims to test the regression model whether there is an inequality of variance from the residuals of one observation to another. Heteroscedasticity can be detected using the white test.

Multicollinearity Test. The multicollinearity test was conducted to test the regression model to have a correlation on the independent variables. The way to detect multicollinearity is to look at the tolerance and Variance Inflation Factor (VIF) values. The cut-off value that is commonly used to indicate multicollinearity is a tolerance value <0.10 or the same as the VIF value> 10.

Model Fit Test (Goodness of Fit)

The coefficient of determination R. The coefficient of determination (R2) is used to measure how far a model is in explaining the dependent variable. The value of the coefficient of determination is between 0 - 1. The value getting closer to 1 means that the independent variable provides almost all the information needed to predict the dependent variable. The coefficient of determination can be the number of independent variables in the regression model, so many researchers recommend using the adjusted R Square.

T-test (partial test). The partial test is used to determine whether the independent variable has an influence on the dependent variable.

F-test (together test). The **s**imultaneous test (F statistical test) basically shows whether all the independent variables included in the model have a joint influence on the dependent variable.

Analysis of cassava farming income

Analysis of cassava farming income according to Pindyck & Rubinfield (2001) and Soekartawi (2016) to formulate mathematically to calculate income is as follows:

Π	=	TR – TC
Π	=	Py. Y – Pxi.Xi – TFC ………………………………………………. (9)

Information:

Π	=	income	(Rp.)
Y	=	output	(Kg.)
Py	=	output price	(Rp.)
Xi	=	production factors.…... (i = 1,2,3, ..., n)	
Pxi	=	price of production factors i...	(Rp.)
TFC	=	Total Fixed Cost.…………………..	(Rp.)

According to Soekartawi (2016), farm income is measured by the Analysis of revenue and costs (R / C Ratio), which means the amount of farm revenue obtained by producers for every rupiah cost incurred on farming. Mathematically the R/C ratio is as follows:

R/C = TR/TC ……………………………………………………………………. (10)

Information:

R/C	=	The ratio between revenue and fees	
TR	=	Total Revenue ……………..……………..	(Rp.)
TC	=	Total Cost ………………..…………..	(Rp.)

R/C ratio criteria:

R/C > 1	=	farming is profitable and deserves to be continued
R/C < 1	=	farming suffered losses and was not feasible to continue

Analysis of the economic efficiency of cassava farming

To find out whether the use of production factors reaches optimal conditions, it is done by looking at the comparison between the marginal physical product of the production factors and the prices of the factors of production, so that it can be written as follows:

$$\frac{NPM\,x_i}{Px_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(11)}$$

From the formula above, it can be explained that the optimal conditions will be achieved if:

$$\frac{NPM\,x_1}{Px_1} = \frac{NPM\,x_2}{Px_2} = \frac{NPM\,x_3}{Px_3} = \frac{NPM\,x_4}{Px_4}$$

NPM is obtained from :bi $.\frac{Y}{X1}$. Py

Information: :

Bi	=	elasticity of input production i	
Py	=	cassava price ………………………………	(Rp.)
Y	=	production result…………………...…..	(Kg.)
$X_{1,2,3\ldots,n}$	=	factors of production………………..…….	(Kg/Ltr)

NPM/Pxi Criteria

NPMx/Pxi> 1	=	the use of cassava farming production factors is not efficient
NPMx/Pxi = 1	=	efficient use of cassava farming production factors
NPMx/Pxi< 1	=	Inefficient use of cassava farming production factors

Analysis of the risk of cassava farming

The coefficient of variation (CV) is a measure of relative risk obtained by dividing the standard deviation by the expected value (Kadarsan, 1995). Mathematically, farm risk (price, production, income) and the lower profit limit can be written as follows:

The farm risk formula (price, production, income) is as follows

Price Risk	:	CV = σ/P ……………………………………………….. (12)
Production Risk	:	CV = σ/Q ………………………………………………. (13)
Income Risk	:	CV = σ/Y ………………………………………………. (14)

Information:

CV	=	coefficient of variation	
Σ	=	standard deviation	
P	=	average price ………………………...…..	(Rp.)
Q	=	production average………………………..	(Kg.)
Y	=	average income …………………………..	(Rp.)

The formula for the lower profit limit is as follows

L = E - 2V ……………………………………………………………………………. (15)

Descriptions:

L	=	Lower limit	
E	=	Average price/income/production ……………...............	(Rp./Kg.)
V	=	Standard deviation of price/income/production	

Risk criteria:

CV > 0,5 then the value of L < 0 = cassava farming is at risk

CV < 0,5 then the value of L > 0 = cassava farming is not at risk

4. Results and discussions

Factors affecting cassava production

The factors that are thought to affect the production of cassava are seeds (X_1), urea fertilizer(X_2), NPK-Phonska fertilizer (X_3), TSP/SP36 fertilizer(X_4), KCL fertilizer(X_5), manure (X_6), labor (X_7), pesticide (X_8), and land (X_9).

Heteroscedasticity Test. Heteroscedasticity test using White's test. White's test is the same as both Park's test and Glejser's test. From the calculation of the white test regress equation, the R^2 value is obtained to find the chi-square value in the Summary model as in Table 1.

Table 1. Heteroscedasticity test with white test

Model	R	R Square	Adjusted R Square	Std. ErroroftheEstimate
1	.440[a]	.194	.060	.04127

Source: SPSS processed data, 2020

Table 1 shows that the calculation results of the white test regression equation produce an R^2 value of 0.194. The results of the calculated chi-square value of 12.804 and the chi-squared value of the table with 8 degrees of freedom at the 95% confidence level obtained a value of 15.507. So that the value of c^2 count (12,804) <c^2 table (15,507) then the value of c^2 count<c^2 table which means the heteroscedasticity in the regression model.

Multicollinearity Test. Multicollinearity test on a good regression model should not experience any correlation between the independent variables seen from the Tolerance value<0.10 and VIF> 10. The results of the study show that the Tolerance and VIF values are in Table 2.

Table 2. Multicollinearity test

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	7.434	.790		9.413	.000		
LnX_1 (Seed)	.148	.078	.135	1.908	.062	.209	4.779
LnX_2 (Urea fertilizer)	.412	.150	.386	2.745	.008	.053	19.020
LnX_3(NPK-Phonska fertilizer)	-.008	.012	-.032	-.576	.567	.628	1.593
LnX_4 (TSP/SP36 fertilizer)	.002	.014	.007	.154	.879	.477	2.095
LnX_5 (KCL fertilizer)	-.021	.037	-.023	-.576	.567	.628	1.593
LnX_6 (Manure)	-.005	.008	-.021	-.608	.546	.848	1.180
LnX_7 (Labor)	-.014	.061	-.011	-.306	.761	.779	1.284
LnX_8 (Pesticide)	-.013	.036	-.015	-.364	.717	.604	1.657
LnX_9(Land)	.486	0.13	.501	3.637	.001	.055	18.194

Source: SPSS processed data, 2020

Table 2 shows that the multicollinearity test for the independent variables obtained Tolerance<1 and VIF> 10 values, only variables X_1 (seed), X_3 (NPK-Phonska fertilizer), X_4 (TSP/SP36 fertilizer), X_5 (KCL fertilizer), X_6 (manure), X_7 (labor), and X_8 (pesticide) which stated that there was no multicollinearity, while the variables X_2 (urea fertilizer) and X_9 (land) contained multicollinearity. Therefore, one of the variables X_2 (urea fertilizer) and X_9 (land) must be removed to obtain a result that is free from multicollinearity. The urea fertilizer variable (X_2) is excluded from the equation, the results are in Table 3.

Table 3. Multicollinearity test without variable urea fertilizer (X_2)

Model	Unstandardized Coefficients		Standardized Coefficients	T	Siq	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	9.381	.367		25.551	.000		
LnX_1 (Seed)	.201	.080	.183	2.526	.014	.223	4.485
LnX_3 (NPK-Phonska fertilizer)	-.004	.012	-.017	-.364	.717	.538	1.857
LnX_4 (TSP/SP36 fertilizer)	-.005	.015	-.016	-.319	.751	.493	2.029
LnX_5 (KCL fertilizer)	-.020	.039	-.022	-.505	.616	.628	1.593
LnX_6 (Manure)	-.005	.009	-.022	-.592	.556	.848	1.180
LnX_7 (Labor)	-.007	.047	-.006	-.151	.880	.781	1.280
LnX_8 (Pesticide)	-.008	.038	-.009	-.209	.835	.605	1.652
LnX_9(Land)	.808	.067	.833	12.026	.000	.243	4.118

Source: SPSS processed data, 2020

Table 3 shows that the multicollinearity test after the urea fertilizer variable (X_2) is released, the independent variables are obtained such as X_1 (seed), X_3 (NPK-Phonskafertilizer), X_4 (TSP/SP36 fertilizer), X_5 (KCL fertilizer), X_6 (manure), X_7 (labor), X_8 (pesticide) and X_9 (land) which affect the production of cassava no multicollinearity.

Multiple Linear regression analysis. Multiple linear regression analysis was used to analyze the factors that influence cassava production. The results of this study are the factors that influence cassava production in Table 4.

Table 4. Results of the regression analysis for cassava in Rumbia district, Central Lampung regency

Model	Unstandardized Coefficients		Standardized Coefficients	T	P-values
	B	Std. Error	Beta		
(Constant)	9.381	.367		25.551	.000***
LnX_1 (Seed)	. 201	.080	.183	2.526	.014**
LnX_3 (NPK-Phonska fertilizer)	-.004	.012	-.017	-.364	.717[ns]
LnX_4 (TSP/SP36 fertilizer)	-.005	.015	-.016	-.319	.751[ns]
LnX_5 (KCL fertilizer)	-.020	.039	-.022	-.505	.616[ns]
LnX_6 (Manure)	-.005	.009	-.022	-.592	.556[ns]
LnX_7 (Labor)	-.007	.047	-.006	-.151	.880[ns]
LnX_8 (Pesticide)	-.008	.038	-.009	-.209	.835[ns]
LnX_9(Land)	.808	.067	.833	12.026	.000***
R-squqred	.936				
Adjusted R-squared	.927				
F-statistic	100.351				
Prob (F-statistic)	.000[a]				
Information					
(*)	= Significantatthe 90% Confidence Level				
(**)	= Significantatthe 95% Confidence Level				
(***)	= Significantatthe 99% Confidence Level				
([ns])	= Not significant				

Source: SPSS processed data, 2020

Determination Coefficient (R). The equation of the effect of transaction costs on cassava farming income is as follows:

$$\text{Ln Y} = 9.381+0,201\text{Ln}X_1 - 0,004\text{Ln}X_3 - 0,005\text{Ln}X_4 - 0,020\text{Ln}X_5 - 0,005\text{Ln}X_6 - 0,007\text{Ln}X_7 - 0,008\text{Ln}X_8 + 0,808\text{Ln}X_9 \quad (16)$$

The accuracy of the model from the above equation can be seen from the value of the coefficient of determination (R^2). It is known that the R-squared value in the table is 0,936 or 93,60%, meaning that 93,60% of the cassava production variable can be explained by the variable seed (X_1), NPK-Phonska fertilizer (X_3), TSP/SP36 fertilizer (X_4), KCL fertilizer (X_5), manure (X_6), labor (X_7), pesticide (X_8) and (X_9), while the remaining 6,4% is explained by other variables not included in the model.

F test. The F-counted test on cassava production is 197.828 with a probability of 0,000[a], meaning that independent variables such as seed (X_1), urea fertilizer (X_2), NPK-Phonskafertilizer (X_3), TSP/SP36 fertilizer (X_4), KCL fertilizer (X_5), manure (X_6), labor (X_7), pesticide (X_8) and land (X_9), together have a significant effect on cassava production.

T test. To determine the effect of the independent variable (X) on the dependent variable (Y) in the regression model, it is explained as follows:

Seed (X_1). The number of seeds had a significant effect on cassava production at the 99% level of confidence. This is in line with research by Raphael (2008); Luthfiah et al. (2017); Girei et al. (2013); Nkang and Ele (2014); and Ogunniyi et al. (2013) stated that the seeds had a positive and significant effect on increasing cassava production because the varieties used were superior varieties of cassava, namely Cassesart variety and Thai variety. The coefficient value obtained is 0,201, which means that every one percent addition of the number of seeds will increase cassava production by 0,201%. Constraints in the development of cassava high-quality seeds are not available at the time of planting (Effendi, 2002) so that cassava farmers have to look for local seeds that have good quality. According to Lingga etal. (1989) increasing the productivity of cassava is influenced by the variety used.

NPK-Phonska fertilizer (X_3). The amount of NPK-Phonska fertilizer had no significant effect on cassava production. The coefficient value obtained is -0.004, which means that every one percent addition of the NPK-Phonska fertilizer will reduce cassava production by 0.004%. Farmers are supposed to provide fertilizer by planting it so that it is effective for absorption, but farmers do it by spreading it so that the fertilizer cannot be absorbed properly. The use of NPK fertilizer in the study was 181.24 kg/ha; this amount exceeds the recommended use of 100 kg/ha NPK fertilizer (BPTP Lampung 2008). The use of fertilizers must be in accordance with the right dose and time; excessive application of fertilizers will have a negative impact on plant growth (Habib, 2013)

TSP/SP36 fertilizer (X_4). The amount of TSP/SP36 fertilizer had no significant effect on cassava production. The coefficient value obtained is -0.005, which means that every one percent addition of the TSP / SP36 fertilizer will reduce cassava production by 0.001%. These results are in line with the research of Anggraesi et al. (2020), TSP/SP36 fertilizer has no significant effect with a coefficient value of - 0.143. The use of TSP / SP36 fertilizer at the time of the study was 128.71 kg/ha, but this amount was still less than their commended use of TSP / SP36 150 kg/ha (BPTP Lampung 2008) so that the product obtained was not optimal.

KCL fertilizer (X_5). The amount of KCL fertilizer had no significant effect on cassava production. The coefficient value obtained is -0.020, meaning that every one percent addition of the KCL fertilizer will reduce cassava production by 0.020%. The use of KCL fertilizer at the time of the study was 129.23 kg/ha, but this amount exceeds their commended use of 100 kg/ha of KCL fertilizer (BPTP Lampung 2008). The use of KCL fertilizer is essential for tuber growth and a source of nutrition or tubers (Anggraini et al., 2016) so that it has an impact on increasing production. However, the amount used for KCL fertilizer needs to be reduced because the amount used exceeds the government's recommendation.

Manure (X_6). The amount of manure has no significant effect on cassava production. The coefficient value obtained is -0.005, which means that every one percent addition of the number of seeds will reduce cassava production by -0.005%. The use of manure at the time of the study was 2,340.20 kg/ha, but this number is still less than the recommended use of manure 5 - 10 tonnes/ha (BPTP Lampung 2008).

Labor (X_7). The number of workers has no significant effect on cassava production. The coefficient value obtained is -0.007, which means that every one percent addition of the number of seeds will reduce cassava production by 0.007%. Production requires a lot of labor due to bulky plants, but excess labor makes the workforce not focus on work so that it is ineffective and has an impact on decreasing cassava production. Labor that is not suitable for use, the resulting production results are reduced (Luthfiah et al., 2017). In addition, Kuswono et al. (2012) emphasize that the use of more labor is due to farmers requiring a lot of labor at harvest time. Sholeh (2007) states that increasing the ability of workers in a business is not limited to increasing the quantity of labor but must be emphasized on improving the quality of workforce skills.

Pesticide (X_8). The amount of pesticides did not significantly affect cassava production. The coefficient value obtained is -0.008, which means that every one percent addition of the number of seeds will increase cassava production by 0.008%. The use of pesticides in cassava farming does not require a large amount of money. This is because farmers clean more in a competitive way without using pesticides.

Land (X_9). The land area has a significant effect on the income of cassava farming farmers, with a confidence level of 99%. In line with the research of Supriyatno et al. (2008), land area has an effect on cassava production. The coefficient value of the land area is 0,808, which means that each additional one percent of the land area will increase the production of cassava by 0,808%. The addition of land area increases cassava production, which has an impact on increasing farmers' income. In line with the research of Rahayu & Riptanti (2010), Kristian (2013), Saragih & Saleh (2016), Alitawan& Sutrisna (2017), Pratiwi andHardyastuti (2018), Iskandar et al. (2018), increasing land area can increase production yields, which has an impact on increasing the amount of income.

Analysis of cassava farming income

The performance analysis of cassava farming is carried out to see how much value the income generated by the farmers is. The calculation of the performance of cassava farming is presented in Table 5.

Table 5. Calculation of farming performance on cassava farmers

Description	**Unit**	**Price (Rp.) / unit**	**Farming (ha.)**	
			Physical	**Value (Rp)**
Revenue				
Production	Kg	1.003,24	23.111,58	23.186.447,44
Production cost				
I. Cash costs				
Seed	Ikat	7.880,28	102,23	805.613,64
Urea fertilizer	Kg	2.026,76	206,95	419.432,77
NPK-Phonska fertilizer	Kg	3.113,33	181,24	564.250,70
TSP/SP-36 fertilizer	Kg	2.851,85	128,71	367.071,69
Kclfertilizer	Kg	5.312,50	129,23	686.547,42
Manure	Kg	526,17	2.340,20	1.231.350,91
Pesticide	Kg			301.578,95
Laborers outside family	HOK	60.070,42	34,52	2.073.417,78
Plow	Rp.			639.233,55
Tax	Rp			83.789,47
Transportation costs	Rp			1.613.284,21

Description	Unit	Price (Rp.) / unit	Farming (ha.)	
			Physical	Value (Rp)
Total Cash Costs				8.785.571,10
II. Calculated Costs				
Laborer inside family	HOK	60.070,42	6,53	392.271,74
Shrinkage of tools	Rp			148.901,60
Land lease	Rp			6.508.333,33
Total Calculated Costs	Rp			7.049.506,68
III. Total Costs	Rp			15.835.077,78
Profit				
I. Profits Over Cash Costs	Rp			14.400.876,34
II. Profits Over Total Costs	Rp			7.351.369,66
R/C Ratio				
I. R/C Ratio of Cash Costs	Rp			**2,64**
II. R/C Ratio to Total Costs	Rp			**1,46**

Source: Primary data (processed), 2020

Table 5 shows that the average venue of cassava farming is Rp. 23.186.447,44/ha, with an average price of cassava per kilogram of Rp. 1.003,24. The amount of cassava production produced by farmers was 23.111,58 kg (23,1tons), the amount of production is still not optimal when compared to the national productivity standard of 41 tons/ha (Kementerian Pertanian, 2017), 23,87 tons/ha (BPS Provinsi Lampung, 2019) and several studies by Igbal et al. (2014) amounted to 36,11 tonnes/ha, and Anggraini et al. (2016) of 23,06 tonnes/ha. The low productivity of cassava is thought to occur due to inefficient production factors (Fitriana et al., 2019).

The cash cost component in cassava farming consists of transportation costs (18,16%), tax costs (0,85%), low costs (8,44%), laborers outside family (26,45%), medicine costs. (3,36%), fertilizer costs (33,70%) and seed costs (9,04%). Based on these 7 (seven) cash cost components, the cost of fertilizer is the largest cost incurred by cassava farmers in the production process. In cassava farming, fertilizer is needed to restore soil fertility. Soil fertility is a source of success for a plant, especially cassava, which absorbs many nutrients. Most cassava farmers have started applying the use of organic fertilizers/manure to reduce the use of chemical fertilizers that damage the soil structure.

The use of fertilizers in cassava farming per hectare, namely urea fertilizer (206,95 kg), NPK-Phonskafertilizer (181,24 kg), TSP/SP36 fertilizer (128,71 kg), KCL fertilizer (129,23 kg) and manure (2.340,50 kg). Good soil conditions require organic matter in the top layer of at least 2% (Young, 1997). Organic material that has carried out decomposition supplies nutrients to plants Afandi et al. (2015) and Leksono et al. (2018) argued that the provision of organic matter as a treatment could increase production yields. Organic material is a natural material used for soil fertility, affecting production and quality of production (Munir & Swasono, 2012). Inorganic fertilizers for cassava plants in the form of urea fertilizer, TSP fertilizer, KCL fertilizer and NPK-Phonska fertilizer.

The biggest cost component after fertilizer costs is the cost of laborers outside the family. The components of labor costs in farming consist of land processing (2,53%), planting (12,39%), fertilization (25,11%), eradicating HPT (5,44%), weeding (8,62%), harvest (41,08%) and post-harvest (4,83%). The largest component of labor costs is the harvesting cost of Rp. 1.359.836,13 with a percentage of 41,08%. The amount of this cost is because the harvesting of cassava must be done in a fast time, considering that the cassava plant is bulky (a product that breaks quickly), so it requires a lot of labor. Tubers are still good 1-3 days after harvest depending on storage. Then, the HCN content is high if the tubers are bluish, affecting the quality of the flour. In addition, there are transportation costs that cassava farmers use to pay for trucks carrying the harvest at a cost of Rp. 1.613.284,21.

Pesticides used by cassava farmers are in the form of herbicides and insecticides. In cassava farming, herbicides are used to eradicate weeds, and insecticides are used to eradicate pests and plant diseases.

Judging from the use of this type of pesticide, the most common pests that attack cassava plants are red mites. Based on the research that has been done, the cost of the pesticide used is Rp. 301.578,95 /ha.

The next component of cassava farming is seeds. 102,23bunches of cassava seeds are used at a price of Rp. 7.880,28 /bunch. The number of costs incurred by the cassava farmers is Rp. 805.613,64/ha. The seeds used in the research area have several varieties. The selection of superior varieties is the beginning of the success in increasing the productivity of cassava plants by increasing the potential for plenty of fields. In general, the seeds used by cassava farmers are Cassesa and Thai varieties. Types of varieties are considered by cassava farmers to be selected by cassava farmers. The types of cassava varieties determined by the cassava farmer depend on market demand, in this case, the factory. In addition to cash costs, the structure of production costs in cassava farming has costs taken into account.

The cost components calculated in cassava farming consist of land rental costs (86,92%), equipment depreciation costs (3,33%), and the cost of a laborer inside a family (9,76%). In the income analysis, land rental costs, equipment depreciation, and kindergarten in the family are costs incurred but considered. Land rental costs are the largest costs calculated in cassava farming. The land is an important farmer set in doing business. Based on the research results, it is known that the average area of land for cassava farmers is 0.95 ha. Increasing the area of planted land and management using good technology will increase production and will be followed by increasing income (Normansyah et al., 2014). Most of the land ownership status of cassava farmers is their own land. This situation is because most of the owned land is obtained from inheritance or grants from parents, so the cultivated land is self-owned land (Zulkarnain et al., 2010).

Farming carried out by cassava farmers consists of costs in cash, and costs are calculated. These cash costs include seed, urea fertilizer, TSP/SP36 fertilizer, NPK-Phonska fertilizer, KCL fertilizer, manure, pesticide, low costs, taxes, transportation costs, and laborers outside the family Rp. 8.785.571,10. Costs calculated include depreciation of equipment, cost of kindergarten in the family, and land rent of Rp. 7.049.506,68. The sum of the cash costs and the calculated costs will get a total cost of Rp. 15.835.077,78/ha. In cassava farming, cassava farmers earn an average income per hectare from a cash cost of Rp. 14.400.876,34 and a total cost of Rp. 7.351.369,66.

Based on the income analysis that has been done, it is found that the ratio of farmer revenue to cash costs is 2,64. This ratio can be interpreted as every Rp. 1.000,00 cash costs incurred will get an acceptance of Rp. 2.640,00. The calculation of the revenue to cash costs ratio shows that it is greater than one (R/C> 1). This means that the farming carried out by cassava farmers is profitable where the revenue earned is greater than the costs incurred—the R / C value is in line with several previous studies such as Thamrin et al. (2013) of 7,5; Iqbal et al. (2014) of 4,71; Mardika et al. (2017) of 3,00.

Cassava economic efficiency

The results of the economic efficiency analysis of cassava farming are shown in Table 6.

Table 6. Results of the economic efficiency analysis of MT I

Variable	Regression Coefficient (Bi)	NPMxi	Pxi	NPMxi/Pxi	Information
Seed (X_1)	.201	61864.74	9022.73	6.8565457	Not yet Efficient
NPK-Phonska Fertilizer (X_3)	-.004	-691.43	3159.26	-0.2188584	Not Efficient
TSP/SP-36 Fertilizer (X_4)	-.005	-1105.34	2887.50	-0.3828002	Not Efficient
KCL Fertilizer (X_5)	-.020	-6566.57	5965.08	-1.1008347	Not Efficient
Manure(X_6)	-.005	-82.73	328.79	-0.2516073	Not Efficient
Laborers (X_7)	-.007	-0.06	3423398.19	0.0000000	Not Efficient
Pesticide (X_8)	-.008	-0.64	372227.29	-0.0000017	Not Efficient
Land (X_9)	.808	3.68	6519696.97	0.0000006	Not Efficient

Source: Primary Data (processed) 2020

Table 6 shows that the use of production factors for NPK-Phonska fertilizer, TSP/SP-36 fertilizer, KCL fertilizer, manure, labor, pesticides, and land have an efficiency value <1, which means that these production factors are inefficient. In comparison, the seed production factor has an efficiency value of> 1. This shows that the production factor is not efficient. Based on the results of the calculation of economic efficiency analysis, it can be concluded that:

Seeds (X_1), the value of economic efficiency obtained from the seed production factor is 6.856. The value of economic efficiency is more than one, which means that the use of seed production factors is not economically efficient, so there is a need for additional seed input to achieve economic efficiency. This is in line with the research of (Maharani et al., 2019), which states that the use of seeds is not efficient with an efficiency value of -8,813.

NPK Phonskafertilizer (X_3), the value of economic efficiency obtained from the NPK-Phonska fertilizer production factor is -0,218. The value of economic efficiency is less than one, which means that the use of the NPK-Phonska fertilizer production factor is not economically efficient, so it is necessary to reduce the NPK-Phonska fertilizer input to achieve economic efficiency. In addition, in line with research, Budiawati et al. (2012) stated that the use of NPK-Phonska fertilizer is inefficient with an efficiency value of -4,51.

TSP/SP36 fertilizer (X_4), the value of economic efficiency obtained from the TSP/SP36 fertilizer production factor is -0,383. The value of economic efficiency is less than one, which means that the use of TSP/SP36 fertilizer production factors is not economically efficient, so it is necessary to reduce the input of TSP/SP36 fertilizer to achieve economic efficiency.

KCL fertilizer (X_5), the value of economic efficiency obtained from the KCL fertilizer production factor is -1,101. The value of economic efficiency is less than one, which means that KCL fertilizer production factors are not economically efficient, so it is necessary to reduce KCL fertilizer input to achieve economic efficiency.

Manure (X_6), the efficiency value obtained from the manure production factor is -0,252. The value of economic efficiency is less than one, which means that the use of manure production factors is not economically efficient, so it is necessary to reduce labor input to achieve economic efficiency. This is in line with the research of Seru et al. (2017), which states that organic fertilizers are inefficient with an efficiency value of 10,714. In addition, it is in line with the research of Budiawati et al. (2012), which states that the use of manure is not efficient with an efficiency value of 0,53.

Labor (X_7), the efficiency value obtained from the labor production factor is 0,000. The value of economic efficiency is less than one, which means that the use of manure production factors is not economically efficient, so it is necessary to reduce labor input to achieve economic efficiency. In line with the research of Supriyatno et al. (2008), the use of labor factors in cassava production is not efficient. In addition, according to Luthfiah et al. (2017), the use of labor is inefficient with a value of -0,1404. This is because the use of tractors can increase productivity and speed up land processing time and be more economical.

Pesticide (X_8), the value of economic efficiency obtained from the production factor of drugs is -0,0000017. The value of economic efficiency is less than one, which means that drug production factors are not economically efficient, so it is necessary to reduce the input of drugs to achieve economic efficiency. The use of drug production factors is excessive use not according to the needs needed. This is because the level of knowledge of farmers on the use of drugs is less. This is in line with the research of Luthfiah et al. (2017) stated that the use of pesticides is inefficient with a value of 0,2917 because farmers do not use pesticides correctly, farmers do base on experience and do not read packaging labels, thus causing environmental pollution and environmental, ecological damage.

Land (X_9), the efficiency value obtained from the land area is 0,0000006. The value of economic efficiency is more than one, which means that the use of production factors for the land area is not economically efficient, so it is necessary to reduce the input of land area to achieve economic efficiency. This is in line with the research of Fadlli & Bowo (2018), which states that land area is inefficient with a value of 0,0906. Land area is a production input that has a major role in increasing production because it affects the scale of farming (Suharyanto et al., 2015)

Cassava farming risks

The results of the risk analysis of cassava farming are shown in Table 7.

Table 7. Risk analysis of cassava farming in TerusanNunyai, Central Lampung regency

Types of Risk	Average	Standard Deviation (SDV)	Coeff Variation (CV)	Lower limit (L)
Price risk	1.003,24	238,57	0,23	526,10
Production risk	23.111,58	19.680,95	0,70	-16.250,32
Income risk	14.400.876,34	12.659.266,06	0,93	-10.917.655,78

Source: Primary data processed, 2020

Table 7 shows that the price risk in cassava farming is obtained by an average Coefficient of Variation (CV) value of 0,23, which means that the CV value is 0,23 <0,5 and L 526,10> 0,5, so cassava farming has no price risk. . This is because the selling price of farmers at the time of the study is the ideal selling price of Rp. 1.003,24. The ideal selling price occurs during the dry season, where cassava production is low, while the demand for tapioca factories tends to be high so that the tapioca factories bid the cassava at a higher price than the previous prices. In line with the research of Pratiwi et al. (2020) have a low risk for cassava with a CV value of 0,135 <0,5.

The risk of production in cassava farming obtained an average Coefficient of Variation (CV) value of 0.70 which means that the CV value is 0,70> 0,5 and L -16.250,32 <0,5, and then cassava farming has a high production risk. This is due to the low production of cassava farmers at the time of the study, namely 23,1 tonnes/ha when compared to the national productivity standard of 41 tonnes /ha (Kementerian Pertanian, 2017) and research by Iqbal et al. (2014) amounting to 36,11 tonnes/ha. The low productivity of cassava is thought to have occurred due to inefficient use of production factors (Fitriana et al., 2019). Cassava farmers do not use quality seeds, which affects production. In addition, the use of fertilizers is not in accordance with government recommendations, and cassava farmers only use fertilizers according to their farming capital capacity. In line with research Ekaria& Muhammad (2018) have a production risk level value of CV 2,61> 0,5.

The income risk in cassava farming obtained an average Coefficient of Variation (CV) value of 0,93 which means that the CV value is 0,93> 0,5 and L -10.917.655,78 <0,5, and then cassava farming has a high risk of income. This is due to unstable production, which tends to decline, which is indicated by a high level of production risk, in line with Lawalata's research (2017); Ekaria & Muhammad (2018). Therefore, farmers must apply GAP (*Good Agriculture Practices*) in running their farms so that the risk of income can be reduced so that farming can produce high production and high income. The income that farmers get has an impact on farmers' decisions to do business. Farmers who are brave enough to face risks have high hopes of getting profits.

5. Conclusion

This research concludes that the performance of cassava farming is measured based on the income analysis. The average income value is Rp. 7.351.369,66 with an R/C ratio of 1,46 so that the performance of cassava farming is feasible to continue developing. Then, the use of NPK-Phonska fertilizer production factors, TSP/SP-36 fertilizer, KCL fertilizer, manure, labor, pesticide, and land are not economically efficient in cassava farming, while the seed production factors are not economically efficient yet in farming. Income and production in cassava farming have a high risk, while the price does not include price risk because the price is ideal at the time of the study. The policy implication is in the form of input subsidies so that cassava farmers can use the production factor to its full potential. In addition, the regional minimum price policy for cassava can increase the income and sustainability of cassava farming. To ensure the sustainability of the cassava commodity in the future, it is necessary to have a modern institutional model by utilizing modern technology. To get profit with optimum economic efficiency, it is necessary to hold advanced research by involving transaction cost in the production fee component.

References

Afandi, F. N., Siswanto. B., & Nuraini, Y. (2015). Pengaruh pemberian berbagai jenis bahan organik terhadap sifat kimia tanah pada pertumbuhan dan produksi tanaman ubijalar di entisolngrangkahpawon kediri. *Jurnal Tanah dan Sumberdaya Lahan*, 2(2), 237-244.https://jtsl.ub.ac.id/index.php/jtsl/article/view/134

Algifari. (1997). *Analisis regresi, teori, kasus dan solusi, edisipertama*. Yogyakarta : BPFE Universitas Gajah Mada.

Alitawan, A.A.I., & Sutrisna, K. (2017). Faktor-faktor yang mempengaruhi pendapatan petani jeruk pada desa gunung bau kecamatan kintamani kabupaten Bangli. *E-Jurnal EP Unud*, 6(5), 796-826. file:///C:/Users/User/AppData/Local/Temp/28588-1-59290-1-10-20170508-1.pdf

Anggraesi, J., Ismono, R.H., & Situmorang, S. (2020). Pendapatan dan faktor-faktor yang mempengaruhi produksi ubikayu manis dan ubikayu pahit di kecamatan seputih banyak kabupaten lampung tengah. *JIIA*, 8(2), 226-233. DOI: http://dx.doi.org/10.23960/jiia.v8i2.226-233

Anggraini, N., Harianto, H., &Anggraeni, L. (2016). Efisiensi teknis, alokatif dan ekonomi pada usaha tani ubi kayu di kabupaten Lampung tengah provinsi Lampung. *Jurnal Agribisnis Indonesia (Journal of Indonesian Agribusiness)*, 4(1), 43-56. https://doi.org/10.29244/jai.2016.4.1.43-56

Apriadji. (1989). *Bertanam umbi-umbian*. Jakarta, Indonesia : PenebarSwadaya.

Asnah, Masyhuri, Mulyo, J. H., & Hartono, S. (2015). Tinjauan teoritis dan empiris efisiensi, risiko, dan perilakurisiko usaha tani serta implikasinya dalam upaya pencapaian swasembada pangan. *Forum Penelitian Agro Ekonomi*, 33(2), 81–94. http://ejurnal.litbang.pertanian.go.id/index.php/fae/article/view/3790/3139

BPS Provinsi Lampung. (2019). *Provinsi lampung dalam angka*. BPS Provinsi Lampung. Lampung. https://lampung.bps.go.id/publication/2019/08/16/801f3b93e755a417d7e80da5/provinsi-lampung-dalam-angka-2019.html

BPS Statistics Indonesia. (2017). *Statistik indonesia, statistical yearbook of indonesia*. Indonesia. https://www.bps.go.id/publication/2017/07/26/b598fa587f5112432533a656/statistik-indonesia-2017.html

BPTP [Balai Pengkajian Teknologi Pertanian] Lampung. (2008). *Teknologi budidaya ubi kayu*. BPTP Lampung. file:///C:/Users/User/AppData/Local/Temp/ubikayu.pdf

Budiawati, Y., Perdana T., &Natawidjaya, R. (2016). Analisis efisiensi pengunaan faktor-faktor produksi ubikayu di kabupaten garut. *Jurnal Agribisnis Terpadu*, 9(2),1-13. DOI: http://dx.doi.org/10.33512/jat.v9i2.2498

Darmawi, H. (2005). *Manajemen resiko*. Jakarta : Penerbit PT. BumiAksara.

Darwanto. (2010). Analisis efisiensi usaha tani padi di jawa tengah (penerapan analisis frontier). *Jurnal Organisasi Dan Manajemen*, 6(1), 46–57. http://jurnal.ut.ac.id/index.php/jom/article/view/282

Effendi, S. (2002). Teknik perbanyakan bibit ubi kayu secara mudah dan murah. *Buletin Teknik Pertanian*, 7(2), 66-68. file:///C:/Users/User/AppData/Local/Temp/bt072028-1.pdf

Efrizal, Y., Nurung, M., &Mulyasari, G. (2011). Analisis pendapatan, efisiensi dan pemasaran semangka (citrulus vulgaris) di kampung Tempuran kecamatan Trimurjo kabupaten Lampung Tengah. *J. Agrisep*. 10 (2) , 273-286. DOI: https://doi.org/10.31186/agrisep.10.2.273-286

Ekaria., & Muhammad, M. (2018). Analisis risiko usahatani ubikayu di desa Gorua kecamatan Tobelo Utara (risk analysis of cassava farming in gorua village, north tobelo district). *Jurnal Agribisnis Perikanan*, 11(2), 9-14. DOI: 10.29239/j.agrikan.11.2.9-14.

Fadlli, A., & Bowo, P. A. (2018). Efisiensi faktor-faktor produksi usaha tani ubi kayu di kabupaten Pati. *EFFICIENT Indonesia Journal of Development Economics*, 1(3), 191-199. DOI: https://doi.org/10.15294/efficient.v1i3.27879

Fauziah, F. R., &Soejono, D. (2019). Analisis pendapatan usahatani jamur merang dan kontribusinya terhadap pendapatan rumah tangga petani di kelurahan Sempusari kecamatan Kaliwates kabupaten Jember. *SEPA*, 15 (2), 172 –179. DOI: https://doi.org/10.20961/sepa.v15i2.26492

Fauziyah, E. (2010). Analisis efisiensi teknis usahatani tembakau (suatu kajian dengan menggunakan fungsi produksi frontier stokhastik). *Jurnal EMBRYO*, 7(1), 1–7. file:///C:/Users/User/AppData/Local/Temp/1jurnal-Elys_juni2010.pdf

Fitriana, M. D., Zakaria, W. A., & Kasymir, E. (2019). Analsis efisiensi produksi usahatani ubikayu di kecamatan natar kabupaten Lampung Selatan. *Jurnal Ilmu-Ilmu Agribisnis*,7(1), 22-27.DOI: http://dx.doi.org/10.23960/jiia.v7i1.22-27

Ghozali, I. (2005). *Aplikasi analisis multivariate dengan program SPSS*. Semarang : Badan Penerbit Universitas Diponegoro.

Girei A.A., Dire, B., Yuguda, R.M., &Salihu, M. (2014). Analysis of productivity and technical efficiency of cassava production in ardo-kola and gassol local government areas of Taraba State, Nigeria. *Agriculture, Forestry and Fisheries*. 3(1), 1-5. Doi: 10.11648/j.aff.20140301.11

Gultom, L., Winandi, R., & Jahroh, S. (2014). Analisis efisiensi teknis usahatani padi semi organik di kecamatan Cigombong, Bogor. *Informatika Pertanian*, 23(1), 7–18. https://doi.org/10.21082/ip.v23n1.2014.p7-18.

Habib, A. (2013). Analisis faktor-faktor yang mempengaruhi produksi jagung . *Agrium*, 18(1), 79-87. DOI : https://doi.org/10.30596/agrium.v18i1.347

Harwood, J., Heifner, R., Coble, K.H., Perry, J., &Somwaru, A. (1999). *Managing risk in farming: concepts, researchand analysis*. Agricultural Economic Report No. 774. Marketand Trade Economic Divisionand Resource Economics Division, Economic Research Service U.S. Department ofAgriculture.https://www.ers.usda.gov/publications/pub-details/?pubid=40971

Iqbal, A. M., Lestari, D. A. H., & Soelaiman, A. (2014). Pendapatan dan kesejahteraan rumah tangga petani ubikayu di kecamatan sukadana kabupaten Lampung Timur. *Jurnal Ilmu-Ilmu Agribisnis*, 2(3), 246-252. DOI: http://dx.doi.org/10.23960/jiia.v2i3.246-252

Iskandar, R., Nainggolan, S., &Kernalis, E. (2018). Analisis faktor-faktor yang mempengaruhi keuntungan usahatani kelapa sawit (swadaya murni) kecamatan Jambi luar kota kabupaten Muaro Jambi. *Jurnal Ilmiah Sosio Ekonomika Bisnis*, 21(1),1-13. DOI: https://doi.org/10.22437/jiseb.v21i1.5096

Kadarsan, H. W. (1995). *Keuangan Pertanian danpembiayaan perusahaan Agribisnis*. Gramedia Pustaka Utama. Jakarta.

Karyanto, T., & Suwasono, S. (2008). Analisis potensi ubikayu dalam rangka ketahanan pangan di kabupaten wonogiri, *Jurnal Buana Sains*, 8(1),5-14.file:///C:/Users/User/AppData/Local/Temp/255-423-1-SM.pdf

Kasidi. (2010). *Manajemen risiko*. Penerbit Ghalia Indonesia. Bogor.

Kementerian Pertanian. (2017). *Statistik pertanian 2017*. Kementan RI. Jakarta.

Kristian. (2013). Determinan produksi, konsumsi, dan harga ubikayu indonesia. *Jurnal Kelitbangan*, 3(1),1-23.https://journalbalitbangdalampung.org/index.php/jip/issue/archive

Kune, S., Muhaimin, A., & Setiawan, B. (2016). Analisis efisiensi teknis dan alokatif usahatani jagung (studi kasus di desa Bitefa kecamatan Miomafo Timur kabupaten Timor Tengah Utara). *AGRIMOR*, 1(01), 3-6. https://doi.org/https://doi.org/10.32938/ag.v1i01.23

Kurniati, D. (2015). Perilaku petani terhadap risiko usahatani kedelai di kecamatan Jawai selatan kabupaten sambas. *Jurnal Social Economic of Agriculture*, 4(1), 32–36. DOI: http://dx.doi.org/10.26418/j.sea.v4i1.10130

Kuswono, Slamet, & Suratiningsih, S. (2012). Analisis perbandingan pendapatan usaha tani ubi kayu daplang dan jenis markonah di desa metaraman kecamatan Margorejo kabupaten Pati. *j. Agromedia*, 30 (2), 70-84.DOI: https://doi.org/10.47728/ag.v30i2.28

Lawalata, M, Darwanto, D.H, &Hartono, S. (2017). Risiko usahatani bawang merah diKabupaten Bantul. *Agrica*,10 (2), 56-73.http://ojs.uma.ac.id/index.php/agrica/article/view/924/1133.

Leksono, T. B., Supriyadi, & Zulkarnain. (2018). Analisis perbandingan pendapatan usahatani padi organik dan anorganik di kecamatan Seputih banyak kabupaten Lampung Tengah. *Jurnal Wacana Pertanian*, 14(2),69-79. DOI: http://dx.doi.org/10.37694/jwp.v14i2.45

Lingga, P., B. Sarwono, F. Rahardi, P. C. Rahardja, J. J. Afriastini, R. Wudianto, W. H. Apriadji. 1989. *Bertanam umbi-umbian*. Jakarta : PenebarSwadaya.

Luthfiah, A., Mukson, & Setiadi, A. (2017). Analisis efisiensi ekonomi penggunaan faktor-faktor produksi pada usahatani ketela pohon di kecamatant logowungu kabupaten pati (economic efficiency analysis of the use of production factors on cassava farming in district tlogowungupati regency). *AGRISOCIONOMICS Jurnal Sosial Ekonomi Pertanian*, 1(2), 146-154. DOI: https://doi.org/10.14710/agrisocionomics.v1i2.1876

Maharani, A. D., Prasetyo, E., & Setiawan, B. M. (2019). Analisis ekonomi penggunaan faktor-faktor produksi pada usahatani padi di kelompok tani sidomakmur kecamatan pati kabupaten Pati. *Jurnal Ilmu-Ilmu Pertanian,* 3(1), 18-30. DOI: https://doi.org/10.32585/ags.v3i1.553

Mardika, I. N., Rantau, I. K., &Wijayanti, P.U. (2017). Analisis usahatani ubikayu varietas gajah (studi kasus di kelompok tani-ternak kerti winangun, desa bukti, kecamatan kubu tambahan, kabupaten buleleng). *E-Jurnal Agribisnis dan Agrowisata*, 6(2),231-239.DOI: https://doi.org/10.24843/JAA.2017.v06.i02.p06

Masithoh, S., & Nahraeni, W. (2013). Analisis efisiensi penggunaan faktor-faktor produksi usaha tani kubis (brassica oleracea) di kertasari, Bandung, jawa barat. *JurnalPertanian*, 4(2), 100–108. https://core.ac.uk/reader/228439910

Mubyarto. (1995). *Pengantar ekonomi pertanian*. LP3ES. Jakarta

Mufrianti, F., & Anton, F. (2014). Analisis faktor produksi dan efisiensi alokatif usahatani bayam (amarathussp) di Kota Bengkulu. *J.Agrisep*, 15 (1), 31-37. http://jurnal.unsyiah.ac.id/agrisep/article/view/2090

Munir, M., &Swasono, M.A.H. (2012). Potensi pupuk hijau organik (daun trembesi, daun paitan, daun lantoro) sebagai unsur kestabilan kesuburan tanah. *Agromix*, 3(2), 1-17. DOI : https://doi.org/10.35891/agx.v.3i2.750

Nafisah, D. &Fauzyah, E. (2020). Efisiensi teknis dan perilaku resiko petani padi berdasarkan penggunaan input (studi kasus di desa Langkap kecamatan Burneh). *SEPA*, 17(1), 55-64. DOI: https://doi.org/10.20961/sepa.v17i1.42228

Nagarajan, H.P.N., Raman, A. S., &Haapala, K. R. (2018). A sustainability assessment framework for dynamic cloud-based distributed manufacturing. *Procedia CIRP*, 69, 136–141.Doi:10.1016/j.procir.2017.11.120

Nkang, M. O., & Ele. I. E. (2014). Technical efficiency of cassava producers in ikom agricultural zone of cross river state, Nigeria. *Journal of Research in Agricultural and Animal Science*. 2(10), 09-15. file:///C:/Users/User/AppData/Local/Temp/B2100915-1.pdf

Normansyah, D., Rochaeni, S., &Humaerah, A.D. (2014). Analisis pendapatan usahatani sayuran di kelompok tani jaya, desa Ciaruteun Ilir, kecamatan Cibungbulang, kabupaten Bogor. *Jurnal Agribisnis*, 8(1), 29 – 44. DOI: https://doi.org/10.15408/aj.v8i1.5127

Ogunniyi, L. T., Ajetomobi, J. O., & Fabiyi, Y. L. (2013). Technical efficiency of cassava -based cropping in oyo state of nigeria. *Agris on-line Papers in Economics and Informatics*, 5(1), 51-59. https://online.agris.cz/archive/2013/01/06

Pindyck R. S., & Rubinfeld, D. L. (2001). *Microeconomics*. New Jersey (US): PrenticeHall.

Prabowo, I. W. H.B., Haryono, D., & Affandi, M.I. (2015). Strategi pengembangan usahatani ubi kayu (manihotutilissina) di kecamatan Menggala kabupaten Tulang Bawang. *Jurnal Ilmu-Ilmu Agribisnis.* 3(1), 48-56. DOI: http://dx.doi.org/10.23960/jiia.v3i1.%25p

Pramesti, F.S., Rahayu, E.S., &Agustono. (2017). Analisis daya saing ubikayu indonesia di pasar internasional. *SEPA*, 14(1),1-7. DOI: https://doi.org/10.20961/sepa.v14i1.21034

Pratiwi, L. F. L., & Hardyastuti, S. (2018). Analisis faktor-faktor yang mempengaruhi pendapatan usahatani kentang pada lahan marginal di kecamatan Kejajar kabupaten Wonosobo. *AGRIDEVINA*, 7(1), 14-26.DOI https://doi.org/10.33005/adv.v7i1.1127

Pratiwi, O., Haryono, D., &Abidin, Z. (2020). Pendapatan dan risiko usahatani ubikayu (manihot utilisima) di desa bumi agung marga kecamatan Abung Timur kabupaten Lampung utara, *Jurnal Ilmu-IlmuPertanian*, 8(1), 9-14. DOI: http://dx.doi.org/10.23960/jiia.v8i1.9-14

Pusat Data dan Sistem Informasi Pertanian (Pusdatin). 2016. *Outlook komoditas pertanian sub sektor tanaman pangan: ubi kayu*. Kementerian pertanian. http://epublikasi.pertanian.go.id/arsip-outlook/81-outlook-tanaman-pangan/429-outlook-ubikayu-2016

Rahayu, W., & Rintanti, E. W. (2010). Analisis efisiensi ekonomi penggunaan faktor-faktor produksi pada usahatani kedelai di kabupaten Sukoharjo. *Caraka Tani*, 25(1), 119-125. DOI: https://doi.org/10.20961/carakatani.v25i1.15758

Rahim, A. B. D., & Hastuti, D. W. R. (2007). *Pengantar teori dan kasus ekonomika pertanian.* Jakarta: Penebar Swadaya.

Raphael, I. O. (2008). Technical efficiency of cassava farmers in south easterm, Nigeria: stochastic frontier approach. *Agricultural Journal.* 3(2), 152-156. DOI : https://medwelljournals.com/abstract/?doi=aj.2008.152.156

Rosanti, N., Zakaria, W. A., Hasyim, A. I., &Kasymir E. (2018). Analisis daya saing ubi kayu di propinsi lampung. *Sosial dan Ekonomi Pertanian*, 12(1), 62-74. DOI :https://jurnalfp.uisu.ac.id/index.php/sep/article/view/20

Saragih, F. H. (2016). Faktor-faktor yang mempengaruhi pendaatan rumah tangga tani padi. *Jurnal Agrica,* 9(2),101 -106.DOI: https://doi.org/10.31289/agrica.v9i2.486

Seru, G., Kardi, C., &Yudiarini, N. (2017). Efisiensi penggunaan faktor produksi pada usahatani jagung manis (studi kasus di kelurahan Kesiman kecamatan Denpasar Timur). *Agrimeta: Jurnal Pertanian Berbasis Keseimbangan Ekosistem*, 7(14), 15-19. Retrieved from https://e-journal.unmas.ac.id/index.php/agrimeta/article/view/53

Sholeh, M. (2007). Permintaaan dan penawaran tenaga kerja serta upah: teori serta beberapa potretnya di Indonesia. *Jurnal Ekonomi dan Pendidikan*, 4(1), 62-75.DOI: https://doi.org/10.21831/jep.v4i1.618

Simanjuntak, B., Sukiyono, K., & Sriyoto. (2019). Analisis fungsi produksi dan efisiensi alokatif usahatani ubi jalar di kecamatan Hulu palik kabupaten Bengkulu Utara. *Jurnal AGRISEP*, 18(1),187–202. DOI: https://doi.org/10.31186/jagrisep.18.1.187-202

Sinabariba, F. M., Prasmatiwi, F. E., & Situmorang, S. (2014). Analisis efisiensi produksi dan pendapatan usaha tani kacang tanah di kecamatan Terbanggi besar kabupaten Lampung tengah. *Jurnal Ilmu-Ilmu Agribisnis*, 2(4), 316-322. DOI: http://dx.doi.org/10.23960/jiia.v2i4.316-322

Soekartawi. (1990). *Teori ekonomi produksi dengan pokok bahasan analisis fungsicob- douglas*, Jakarta: Rajawali Press.

Soekartawi. (1995). *Analisis usaha tani*.Penerbit Universitas Indonesia. Jakarta

Soekartawi. (2003). *Teori ekonomi produksi dengan pokok bahasan analisis fungsi cobb douglas, cetakan ke-3*. Jakarta: Rajawali Pers.

Soekartawi. (2003). *Teori ekonomi produksi dengan pokok bahasan analisis fungsi cobb-douglass*. PT. Raja Grafindo Persada. Jakarta.

Soekartawi. (2016). *Analisis usaha tani*. Jakarta: Universitas Indonesia PRESS

Suciaty, T., & Hidayat, Y. R. (2019). Analisis efisiensi ekonomi penggunaan faktor-faktor produksi pada usahatani kedelai (GLYCINE MAX L. MERRILL) (Studi Kasus di Desa Bantarwaru Kecamatan Gantar Kabupaten Indramayu). *Jurnal Ekonomi Pertanian dan Agribisnis (JEPA),* 3(4), 663-670. DOI: https://doi.org/10.21776/ub.jepa.2019.003.04.1

Sugianto, T. (1982). *The relative economic efficiency of irragated rice farm, west java, Indonesia*. Ph.D. Dissertation. Departemen of Agricultural Economics, University of illionis, Urbana

Sugiarto, D. Siagian, L.S., Sunarto, & Oetomo D.S. (2003). *Teknik sampling*. Jakarta: Gramedia Pustaka Utama

Sugiyono. (2017). *Metode penelitian kuantitatif, kualitatif dan r&d*. Bandung : Alfabeta.

Suharyanto, Rinaldy, M., & Ngurah Arya, N. (2015). Analisis risiko produksi usaha tani padi sawah di propinsi Bali. *Jurnal Agraris*. 1 (2), 70 - 77. DOI: https://doi.org/10.18196/agr.1210

Sukirno, S. (2000). *Pengantar teori mikro ekonomi*. PT Raja GrafindoPersada. Jakarta.

Supriyatno, S., Pujiharto, P., & Budiningsih, S. (2008). Analisis efisiensi alokatif penggunaan faktor produksi usahatani ubikayu (manihot esculenta) di Desa Punggelan Kecamatan Punggelan Kabupaten Banjarnegara. *Agritech: Jurnal Fakultas Pertanian Universitas Muhammadiyah Purwokerto*, 10(1)..DOI: 10.30595/agritech.v10i1.963.

Thamrin, M., Mardhiyah, A., & Marpaung, S. E. (2013). Analisis usahatani ubikayu (manihotutilissima). *Agrium*. 18(1), 57-64. file:///C:/Users/User/AppData/Local/Temp/343-409-1-PB.pdf

Tjahjadi, B. (2011). Hubungan manajemen risiko dengan ketidakpastian lingkungan dan strategi serta dampaknya terhadap kinerja organisasi. *Jurnal Ekonomi dan Bisnis Airlangga*, 21(2), 142-154. DOI: http://dx.doi.org/10.20473/jeba.V21I22011.%25p

Yansah, Y., Setiawan, I., & Pranoto, Y. (2020). Analysis of farm cassava partnership in the village of Great Pudding Besar district of Bangka. *Journal of integrated agribusiness*, 2(2), 91-104. doi: 10.33019/jia.v2i2.1516.

Young, (1997). *Agroforestry for soil management*. Second edition. CABI International. ISBN 0 85199 1890, 320 pp

Zulkarnain., Haryono, D., & Kasmyr, E. (2010). Keunggulan komparatif dan kompetitif dalam produksi padi di kabupaten Lampung Tengah propinsi Lampung. *Jurnal Pertanian Terapan*, 10(3), 185 – 199. DOI: https://doi.org/10.25181/jppt.v10i3.262