Improvement of Cassava Production in Central Java: a Production Function Approach

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ABSTRACT

The aims of this research were (1) effects of TSP manure to cassava production, (2) elasticity of cassava production, (3) the risk of cassava production, and (4) impacts of production increase to cost, revenue, and income Furthermore,data analysis that used to determine the effect of TSP and others' input to cassava production was a regression model that combines with the dummy variable.This model was intended to emphasize the need to separate groups of farmers who applied TSP and groups of farmers who did not use TSP.Conclusions of this research were (1) the use of TSP would increase cassava production, on the group of farmers who applied TSP, urea was input that effect to cassava production, while on the group of farmers who did not apply TSP, urea and seed were input that effect to cassava production. (2) The elasticity of urea was by 0.87 on the group of farmers who applied TSP, and the elasticity of urea was by 0.35 and the elasticity of seed was by 0.44 on the group of farmers who did not apply. (4) Additional production by increasing the use of inputs could still provide additional income and additional income for farmers who applied TSP greater than those farmers who did not apply TSP.

Keywords: *Improvement, Production, Function, and TSP*

I. INTRODUCTION

Indonesia was the fourth largest cassava producer in the world after Nigeria, Thailand, and Brazil [8]. In 2013, Indonesia produced 23,936,20 tons of cassava and it made Indonesia become the third largest cassava producer in the world [1]. Millions of people in Africa, Asia, and Latin America depend on cassava as their food because it more adaptable in the marginal soil than other commodities and it could resolve food insecurity in that area.

In Indonesia, cassava is the third main food after rice and corn. Cassava spread in all provinces of Indonesia. At this time, cassava is a commodity of agroindustry such as tapioca flour products, fermentation industries, and many more food industries. The potential markets of tapioca flour are Japan and The United States of America [17].

Cassava until the middle of 1980s mostly used for household consumption (67%), 11% for export, and only 22% for industrial raw materials. That condition changed in the early 1990s, however 41% for household consumption, 13% for export, and 46% for industrial raw materials [10]. Furthermore, the export of cassava increased every year. The average of the growing export volume of cassava in 2000-2015 increased 109,18% every year, as well as the value export of cassava that increased 132,07% every year. Indonesian cassava export was in fresh and processed form those are cassava flour, cassava shredded, and cassava pellets. The main countries of destination Indonesian cassava export are Taiwan, Philippines, Australia, Malaysia, England, and Brunei Darussalam [6]

Based on [6], the balance of Indonesian cassava in 2015 was expected to reach surplus 298,33 tons, and that was estimated to increase in the future. Indonesia is estimated to have a cassava surplus of 1.42 million tons in 2016, 1,75 million tons in 2017, 2.44 million tons in 2018, and 3.12 million tons in 2019.

Central Java Province was one of the provinces that has a large area of agricultural land, that condition makes agricultural be one of the main sectors. Pati Regency is central of cassava production with the highest productivity; 43.55 tons/Ha. The question about that condition was how to increase cassava production in Pati Regency. One of the important things for increasing production was input productions. [2]said that a physical connection between inputs and outputswas called production. Researched in Nigeria by [13] about determinant inputs and technical efficiency of cassava production. The conclusion of its research was a large land area, labor force, herbicides, and manure are determinant inputs of cassava production.

Farm business of cassava in Pati Regency couldbe divided become 2 groups, those are farmers who applied Triple Super Phosphates (TSP) manure and farmers who did not use TSP. The question about that is whether application of TSP affects to cassava production. The aims of this research are (1) effects of TSP manure to cassava production, (2) elasticity of cassava production, (3) the risk of cassava production, and (4) impacts of production increase to cost, revenue, and income.

II. METHODS

The research was located in Pati City, Central Java Province and was completed in 2018. Sample of farmers in this research were 120 farmers with the

details; 87 farmers that apply TSP on their cassava production, and 33 farmers that don't apply TSP on their cassava production.

Data analysis that used to determine effect of TSP and others input to cassava production wasa regression model which combine with dummy variable. This model was intended to emphasize the need to separate a group of farmers who applied TSP and a group of farmers who did not use TSP. Model formulation refers to opinions [7],[16],as:

$$Q=\alpha + \beta_1 X + \beta_2 Y + \beta_3 Z + D + u$$

Q : Amount of production (Kg)
X : Land area (Ha)
Y : Amount of seeds (Bundle)
Z : Urea (Kg)
D : 1:Farmers who Applied TSP; 0:Farmers who did not apply TSP

The result of that test uses to know whether it needs to separate between the group that applied TSP and the group that did not apply TSP. If the result of the regression analysis shows that the use of the TSP effect to cassava production means that it needs to did separate between the group that applied TSP and the group that did not apply TSP. After that, the analysis continued to determine the effect of inputs to cassava production on each group with the regression dummy model. Formulation of model refers to [7], as:

$$Q=\alpha + \beta_{11}D_1X_1 + \beta 10D1X0 + \beta_{21}D_1Y_1 + \beta_{20}D_1Y_0 + \beta_{31}D_1Z_1 + \beta_{30}D_1Z_0 + u$$

Q : Amount of production (Kg)
X_1 : Land area of farmers who apply TSP(Ha)
X_0 : Land area of farmers who did notapply TSP(Ha)
Y_1 : Amount of seeds of farmers who apply TSP(Bundle)
Y_0 : Amount of seeds of farmers who did not apply TSP(Bundle)
Z_1 : Amount of urea of farmers who apply TSP(Kg)
Z_0 : Amount of urea of farmers who did not apply TSP(Kg)

The regression coefficient from the result of regression analysis from this model could not be used directly as efficiency value. Formulation to find efficiency value refers to [7], [16], [18], as:

$$\text{The value of efficiency} = \text{regression coefficient} \times {}^{\text{average variable}}/_{\text{average product}}$$

Calculation of risk refers to the value of Variation Coefficient (CV). Based on [9], mathematic formulation of the risk was CV=SD/E (Q). SD was deviation standard, and E (Q) was the number of expected products, which approximated by the average production. The higher the CV value is the higher the risk.

The relationship of cost with production refer to [5],[16]. The mathematical formulation was Ln C=a+ Ln Q + D_1 + u. C wasthe amount of cost, Qwasthe amount of production, and D,1:Farmers who Applied TSP; 0:Farmers who did not apply TSP.

III. RESULTS AND DISCUSS

Use of Production Inputs

The amount of production would be influenced by the use of production inputs. Functionally, there wasa relationship between production inputs and production. This functional relationship could be form linear, quadratic, or exponential [3],[16].

Table (1).The Average Use of Production Inputs on Cassava Farming in Pati Regency (2018)

Variable	Sum	Group that did not Apply TSP	Group that Applied TSP
Land area (Ha)	0,65	0,66	0,60
Seeds (Bundle)	36,51	33,30	44,97
Urea (Kg)	362,42	375,86	326,97
Herbicides (Liter)	1,10	1,09	1,14
Labor (Man power)	38,20	35,63	44,97
Production (Kg)	21.405,42	19.681,04	25.951,52

Source: Analysis of primary data, 2018

Reference [12] said that the world production of cassava reached 10 ton/ha, India reached 26 ton/ha. Central Bureau of Statistics of Central Java recorded that in 2016 cassava production about 16,62-43,55 ton/ha. The highest production was in Pati Regency and the lowest production was in Wonogiri Regency. In 2018, by converting production in hectares, the group of farmers who did not apply TSP reached production amount 29.70 ton/ha, and the group of farmers who apply TSP reached production amount 42.97 ton/ha. That condition means cassava production in Pati Regency was higher than world production and India. The high of cassava production in Pati Regency was because of the farmers use production inputs as in Table (1), and the farmers applied mechanization, which was when they processing the land. The mechanization could make the soil become more loose than compare when that process uses human labor. The loose of soil makes tubers growth better.

The price of cassava that receives by farmers who apply TSP or not was the same, it is IDR 2,133/Kg. Buyers of cassava did not consider the use of manure on cassava production processes that discriminate of cassava prices.

The Effect of The Use of Production Inputs on Cassava Production

The Effect of Use of TSP on Cassava Production

Regression analysis with dummy used to know the effect of use of TSP on cassava production, where TSP was dummy variable. This condition is caused by not all of the farmers use TSP, meanwhile, all farmers use seeds and urea. Production inputs on Table (1) show that not all of the production inputs were used on this regression. Herbicides and labor did not include on the model, this was caused by decreasing the value of R^2 adjusted. Based on that condition, herbicides and labor did not include in the model.

Analysis results show that inputs that effect on cassava production were TSP, seed, and urea, while land area did not influence on cassava production. The number of seedlings was related to many plants in which there was a land area arrangement. Analysis results show that the more plants the more production. Urea was related to the provision of nutrients for plants, analysis result shows that more nutrients on soil more production products. Analysis result showed that the farmer who applied TSP get higher production that who did not apply TSP. this was indicated by a positive and real coefficient with an error value lower than α=5%. Triple Super Phosphate (TSP) was a fertilizer with phosphate content of 44-46%. Phosphate was one of the nutrients needed by plants to spur growth the roots of the plants so that plant roots be bushier [14]. Farmers in Pati Regency applied TSP fertilizer when the plants ages 3-4 months.

Group Analysis

The first regression result shows that farmers who apply TSP get bigger production than farmers who did not apply TSP. Analysis was continued with put dummy in the input. It aims to determine inputs that effect on each group of farmers. This was used to find inputs that need priority for increasing the production of each group.

Group 1 was a group of farmers who apply TSP, input that effect was urea. Urea has a positive effect while seed and land area did not effect. More urea that was used on cassava production more production results. The reviewed by beta coefficient, urea had the biggest coefficient, so urea needs priority. This result was supported by [11] who said that urea effect to cassava production in Pekanbaru, and the result of the research by [13] that find land area and manure were main input that affects cassava production.

Group 0 is a group of farmers who did not apply TSP, inputs that effect were seed and urea. Seed and urea had a positive effect while land area there did not effect. More use of seed and urea would increase cassava production. This was supported by the research result by [13] that said seed and urea effect to cassava production in Pekanbaru. The result of the coefficient beta analysis, the coefficient of urea was bigger than a coefficient of seed. So it means that urea was the priority input.

Production elasticity

Production elasticity was a concept that was used to measure the change of input use on cassava production. The greater an elasticity value more elastic. Table (2) present the result of elasticity calculation value.

Table (2). The Result of Elasticity Calculation Value

Group	Input	Average Value	Regression coefficient	Elasticity
Farmers who apply TSP	Z1 (Urea)	375,86	60,23	0,87
	Q_1	19.681,03		
Farmers who do not apply TSP	Y_0 (Seed)	44,97	252,50	0,44
	Z_0 (Urea)	326,97	27,37	0,35
	Q_0	25.951,52		

Source: Analysis data result, 2018

Table 2 showed that group 1, if the use of urea was increased by 10% so cassava production would increase by 8.7%. On the group 0, if the use of seed was increased by 10% socassava production would increase by 4.4%, and if the use of urea was increased by 10% so cassava production would increase by 3.5%.

Risk Analysis

Risk analysis was an analysis to know a chance to get expected production or the chance to deviate from expected production. Risk was the opposite of CV. The higher CV the smallest the risk.

Table (3). Risk Analysis Production

Component	Group that did not Apply TSP	Group that Applied TSP
Production	19,681.03	25,951.52
SD	9,975.24	20,127.95
CV	0.51	0.78

Source: Analysis data result, 2018

Table (3) showed that the group of farmers who applied TSP had CV value by 0.78, which means the chance to deviate from getting expected production by 78% or in the chance to get expected production only by 22%. The group of farmers who did not apply TSP had CV value by 0.51, it means the chance to deviate from getting expected production by 51% or in the chance to get expected production only by 49%.

Cost Analysis

Results from analysis of the influence of production quantity (Q) and $D_1$to cost was Ln $\hat{C}$=9.722+0.625 Ln Q + 0.195 D_1, R^2=0.377, Q and D_1significants with level α=0.05. Furthermore, by analyzing each group the equation for farmerswho apply TSPwas Ln $\hat{C}$ = 9.798 + 0.636 Ln Q and for the farmers who did not apply TSP was Ln $\hat{C}$ = 9.798 + 0.617 Ln Q. Both have significant effects, but the elasticity value was greater thanapply TSP was 0.636

while the did not apply TSP group had an elasticity of 0.617.

By using equations from groups that farmers who applied TSP or farmers who did not apply TSP, the estimated value of costs could be obtained. The waywas to replace Q with an average of production. The average of production produced by group farmers who did not apply TSP is 19,681 Kg, so if farmers add 1% of the product, the additional production is 196.81 Kg. Furthermore, by multiplying the price of IDR 2,133/Kg, an additional revenue of IDR 419,795 was obtained. The result of the calculation of the alleged cost was obtained at IDR 8,028,685, by referring to the elasticity value there was an additional cost of 0.617% ie an additional cost of IDR49,537. The Additional income of farmers who do not apply TSP wasIDR 370,259. Additional of production by increasing the application of inputs could still provide additional of income.

The average of production produced by group farmers who apply TSP was 25,951 Kg, so if farmers add 1% of the product, the additional production was 259.61 Kg. Furthermore, by multiplying the price of IDR 2,133/Kg, an additional revenue of IDR 553,748 was obtained. Calculation results obtained alleged costs of IDR 11,832,122. by referring to the elasticity value, an additional cost of 0.617% occurred, namely an additional cost of Rp.75,252. Thus farmers get an additional income of IDR 478,496. Additional production by increasing the application of inputs could still provide additional income and additional income for farmerswho applied TSP greater than those farmers who did not apply TSP.

IV.CONCLUSIONS AND RECOMMENDATIONS

Conclusions of this research were (1) the use of TSP will increase cassava production, on the group of farmers who applied TSP, urea was input that effect to cassava production, while on the group of farmers who did not apply TSP, urea and seed were input that effect to cassava production. (2) The elasticity of urea was by 0.87 on the group of farmers who applied TSP, and the elasticity of urea was by 0.35 and the elasticity of seed was by 0.44 on the group of farmers who did not apply. (3) Production risk the use of TSP was bigger than did not use TSP. (4) Additional production by increasing the use of inputs could still provide additional income and additional income for farmers who applied TSP greater than those farmers who did not apply TSP.

Recommended to (1) farmers who did not apply TSP yet to use TSP and (2) farmers who applied TSP to increase their production were by increasing the use of urea, and special for farmers who did not apply TSP to increase their production were by increasing urea and seed.

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REFERENCES

[1] Anonim. Top Cassava Producing Countries in the World. https://www.worldatlas.com. Access to July 2, 2019.
[2] Barkley, A. and Barkley, P.W.,Principles of Agricultural Economics.Routledge.2013.
[3] Battie, B.R. and Taylor C.R., Production Economic.Gadjahmada.University Press.Yogyakarta, 1996.
[4] Central Bureau of Statisticof Central Java. Statistics of Central Java. Semarang. 2016
[5] Darmawan,D.P,.The Measurement of Productive Efficiency with Use of Stochastic Approach.Elmatera.Yogyakarta. 2016.
[6] Deptan. The Cassava Outlook in 2015.Center Data and Agriculture Information System. Jakarta. 2015
[7] Ekananda, M.,The Principle of Econometric for Research in Economic, Social, and Bussines. MitraWacana Media. 2015
[8] FAO. The Cassava Transformation in Africa".The Food and Agriculture Organization of the United Nations (FAO). 2011
[9] Klemperer, D., Forest Resources Economics and Finance. McGraw-Hill. 1996
[10] Listiyani,.The Analysis of Cassava Supply inGunungkidulRegency.JurnalDinamikaSosialEkonomi.Vol. 2 (2).Page 39-40.2001.
[11] Nizar, R.,Nurwati,NandAmalia. Allocative Efficiency Analysis Production Function of Cassava Farming (*ManihotSp*) in Tenayan Raya Sub-district of PekanBaru City.IOP Conference Series.Earth and Environmental Science.2017
[12] Mwebaze, P.,Socio-Economic Inputs Influencing Productivity of Cassava Farmers in E-Africa. AARES (Australian Agricultural and Resources Economics Society).2016.
[13] Ogunleye, Ayodeji Sunday. R. Adeyamo, A.S. Bamire and S.O Binuiomote Cassava Production and Technical Efficiency. inAyedaade local government area of Osun state Nigeria. Elixir International Journal Agriculture 71 (2014)24465-24468.2014.
[14] PT LautanLuasTbk.,Manure of Triple Super Phosphate (TSP).https://www.lautan-luas. Com. 2019.
[15] Soekartawi, Theory of Production Economic withthe Cobb-Douglas Function Approach.PT RajaGrafindo Jakarta. 1994
[16] Supranto,J.,Econometrica 2. Ghalia Indonesia.2004
[17] Tomohide, S.,TheDeterminants of Cassava Productivity and Price under the Farmers' Collaboration with the Emerging Cassava Processors: A Case Study in East Lampung, Indonesia. Journal of Development and Agricultural Economics Vol. 1(5), pp. 114-120. 2009.
[18] Widajono, A.,The Analysis of Application Multivariate Statistics. STIM YKPN. Yogyakarta. 2010.