EFFICIENCY OF PRODUCTION FACTOR USAGE IN CORN FARMING AT SERANG DISTRICT, BANTEN PROVINCE

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Abstract

Maize (Zea mays) is one of the strategic commodities in Indonesia's economy, because it is a second food-producing carbohydrate after rice. Corn self-sufficiency program (Program Swasembada Jagung) launched by the government, requires good cooperation between the farmers and the government. Corn demand was increased continually, in line with the living standards of the local economy and the progress of the animal feed industry. Human resources, natural resources, land availability and potential yield and technology, have roll in increasing the production number. The aims of this experiment were to analyze the influence of production factors to the corn production and also to analyze the efficiency usage in corn farm enterprises at Serang District, Banten Province. Sampling method was done by stratified random sampling method, with total samples of 61 corn farmers. Results indicated, that simultaneous effect of land area (X-1), seeds (X-2), urea (X-3), pesticides (X-4), NPK – nitrogen, phosphor and potassium (X-5), the use of manure (X-6) and labor (X-7) factors, significantly affected the corn production. Partially, land area (X-1), seeds (X-2), urea (X-3), NPK (X-5), and the use of manure (X-6) factors, significantly affect the corn production. Economically, the land use (X-1), seeds (X-2), and pesticides (X-4) factors, shows inefficient yet, whereas for urea (X-3), NPK (X-5), the use of manure (X-6) and labor (X-7) as the production factor, shows not efficient.

Key words: production factors, Cobb-Douglas, economic efficiency, corn farming

INTRODUCTION

Corn is one of the food crops that have an important role in agricultural development, because in Indonesia, corn is the second food commodity after rice as food substitutes, and also as source of calories; as well as animal feed. Corn and other cereal crop are important commodities which contain carbohydrates, protein, vitamin B and minerals [4]. Corn demand continues to increase from year to year in line as the living standards of the local economy increase and also the progress of the animal feed industry [8]. Thus the need to increase the corn production through human resources and natural resources, land availability, yield potency and technology. Corn demand in Indonesia, over 10M tons of dry seed per year, and the largest corn consumption are for human food and also for animal feed industry, because around 51% of feed raw material are corn. From the market side, the corn marketing potential also increased; because of the development of the livestock industry, which in turn will increase the corn demand as animal feed. On the other side, the development of food products from corn are widely used of corn flour for the food products manufacturing [2].

The availability of the means or production factors, do not always provide product to favor the farmers, because the production factors usage by the farmers no longer fit the farmers needs scale. In order to achieve the maximum profit, the farmers must choose the proper use of production factors, optimally and efficiently, because many farmers didn't understand how to use the production factors efficiently. Therefore it is necessary to do research for analyze the efficiency usage of production factors.

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Based on the explanation, the aims of this study were to explore the influence of production factors of corn production and also (2) the efficiency level of production factors usage on corn farming in Serang District, Banten Province, Indonesia.

LITERATURE REVIEW

Farming is one method to allocate the available resources effectively and efficiently to obtain best profits at a certain time. Farming is effective if the farmer can allocate their resources very well, while to be efficient if the usage of the resources can generate output that exceeds the input [10]. According to Mubyarto (1989), business efficiency is the standard to determine the successfully of the production process of a business, while efficiency is composed of technical, price, and economic efficiency. Price efficiency or allocate efficiency measured the success rate of farmers to achieve maximum profit. Maximum profit is achieved when the value of the marginal product of each input is equal to marginal cost. While economic efficiency is a combination of technical efficiency and the efficiency of the price whose value is relative or not absolute. If a value more than one (>1), that indicates the state is inefficient yet, then the farmers have the opportunity to optimize the usage of inputs to add the desired output. If the value is equal to one (= 1), that indicates relatively efficient situation and farmers to obtain optimal output. If the value is less than one (<1), it means is not efficient usage of inputs, and the farmers do not have the opportunity to add input, because the additional inputs will reduce the output.

The model that can answer the relationship between the production factors and the production it selves, is a model of Cobb-Douglas production function [3]. Cobb-Douglas coefficient generated from the production function; shows the elasticity of production. Cobb-Douglas production function can show the condition gain is decreasing return to scale, constant return to scale, and increasing returns to scale. The requirements that must be met in using the production function: (1) there is no zero for using value, (2) in the production function needs to be assumed that there are no technological differences at each observation, (3) each variable X is the independent variable, (4) the differences in locations such as the climate is already included in the error factor.

The production process is an activity of combining factors of production to produce products. Each production process has a technical basis, which in economic theory called the production function. According to Teken and Asnawi (2002), the production function is the physical connection between some productions' factors used with production quantities produced per unit time. In the agricultural business, the production factors consist of capital, labor and technology used.

Clearly illustrates the production function and analyzing of the role of each production factors of a number of production factors, one of the production factors which are considered variable changes while other production factor is constant. Cobb-Douglas production function (exponential production function) is a function equation involving two or more variables with the provisions of one variable called the independent variable and the other variables are called dependent variable. Mathematically it can be written:

$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_n^{bn} \ldots + U$, provided that:

Y = dependent variable;
X = independent variable;
a, b = estimator parameter;
U = error (disturbance term);
e = natural logarithm (e = 2.718)

Cobb-Douglas production function is not too difficult to use in a research, because all variables can be expressed in terms of logarithms, for getting the estimation, because the above equation can be changed in advance into a linear form that is to be:

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + \ldots\ldots\ldots + b_n \ln X_n + U$

According to Debertin (2012), using of the Cobb-Douglas production function parameters (regression coefficient) is partial production elasticity's for each input. So, these parameters can be used to calculate the marginal production if the average production has been known. There are several advantages of the Cobb-Douglas

namely: (1) Cobb-Douglas is more widely used by nature homogenous and makes it possible to measure the returns to scale, (2) the solution is relatively easy, as it can be transferred into a linear form, (3) the results of estimation of the line will result in the regression coefficient that shows the magnitude of each variable factors of production, and (4) the amount of elasticity obtained indicates the level of magnitude of return to scale (Soekartawi, 2003).

According to Debertin (2012), in addition to the advantages already mentioned encountered are also pitfalls in the use Cobb-Douglas namely: (a) Specifications variable erroneous, because the missteps specification of variable will produce elasticity of production is negative, or the value is too big, or too small, (b) variable measurement error, depending on the validity of the data, because the measurement error will cause the amount of elasticity becomes too high or too low, (c) biased towards management variables, related to the management decision-making process in allocating input and output variables. If the management variable has less attention, then the estimating function will produce biased estimation. Another problem that must be considered in a Cobb-Douglas is a problem of elasticity, because the elasticity can be seen if the addition or subtraction of input that closely influence on production, then with the Cobb-Douglas elasticity can be determined from the parameters generated, namely: (1) increasing returns to scale, the scale of business with the increase in results is growing. That is, if an input coupled to the output will result in the addition. In this condition, the elasticity of production $\xi p > 1$, (2) decreasing returns to scale are increasing the number of inputs is not balanced in proportion to the additional output obtained. In this condition, the elasticity of production is between $0 < \xi p < 1$ and (3) constant return to scale, the scale of business with consistent results. That means, the addition or subtraction of input causes the production remains, then in these conditions the elasticity of production (ξp) = 0 (Soekartawi, 2003).

MATERIAL AND METHOD

The study was conducted in the Serang District, Banten Province, Indonesia on the second planting season in August 2013. The data obtained is the primary data and secondary data. Primary data were obtained by interviewing the corn farmers using questionnaire, and the secondary data were obtained by means of literature study and review the results of previous studies, reports of relevant agencies, as well as other relevant publications. Samples are drawn by multistage cluster random sampling, with three stages. The first stage is to determine the sub-district as a center for corn production. The second stage is to select the villages that serve as secondary sampling unit (SSU), and the third stage, to selecting the farmers as a sample, and in this study, using simple random sampling, with a total of 61 samples of corn farmers.

To determine the effect of the usage of production factors in corn farming using the Cobb-Douglas function. The mathematically function of Cobb-Douglas equation is as follows:

$$Y = b_o X_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.X_7^{b7}.e.$$

To facilitate the estimation, by changing the exponentially, transformed into a double limit of the natural logarithm (ln), so that it will becomes the following equation:

$$\ln Y = \ln b_o + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + e$$

notes: Y = corn (kg)
X1 = land area (ha)
X2 = seed (kg)
X3 = urea (kg)
X4 = pesticides (L)
X5 = NPK (kg)
X6 = manure (kg)
X7 = labor (PWD – production working day)
b_0 = intercept
b_1-b_7 = parameter allegedly well as the elasticity of production
e = error nuisance (error term).

To view the overall independent variables (Xi) to dependent variable (Y), using the F-test at the level of 95% ($\alpha = 0.05$). If the F-count > F-table, then simultaneously independent

variables were observed significant effect on corn production, otherwise if the F-count < F-table, the overall use of independent variables has no effect to corn production. To see the effect of each independent variable (Xi) to the dependent variable (Y), then used the t test at the level of 95% (α = 0.05). If the t count > t-table, then each independent variable (Xi) has no significant effect on corn production, and vice versa.

The efficiency usage of production factors can be calculated by using the price efficiency is Marginal Product Value Input (MPVI Xi) equals the input price (PXi). The price efficiency calculation formula is based on the use of techniques Cobb-Douglas production function with the formulation is as follows:

$$\frac{biY.\ PY}{X} = PX$$

, where

bi = production elasticity
Y = average production
X = average factor
PY = production average price
PX = prices average factor

RESULTS AND DISCUSSIONS

Based on the results of the regression analysis of data, the regression coefficients of each independent variable are presented in Table 1.

Table 1 Elasticity of corn farm production values in Serang District

Independent variables	Production Elasticity Value	Significance
Land (X1)	0.913	0.001
Seeds (X2)	0.754	0.000
Urea (X3)	-0.685	0.000
Pesticides (X4)	0.134	0.117
NPK (X5)	-0.523	-0.523
Manure (X6)	-0.166	-0.166
Labor (X7)	-0.014	-0.014
	R^2 = 0.770	
	The confidence level = 0.05	
	Intercept (bo) = 13.428	

Analysis results of the final estimation factors that affect the corn production in Serang District are as follows:

$$Y = 13.428\ X1^{0.913}\ X2^{0.754}\ X3^{-0.685}\ X4^{0.134}\ X5^{-0.523}\ X6^{-0.166}\ X7^{-0.014}$$

The production function obtained. describe the technical efficiency and elasticity of production. The regression coefficient in the production function shows the elasticity of production. From the resulting models determination coefficient 0.770 indicating that 77% of corn production is influenced by some factors: land, seeds, urea, NPK, pesticides, manure and labor. The rest was influenced by other factors outside the model.

The elasticity of production factors to the land area is 0.913 with a significant value (0.001 < 0.05) is a positive value. This implies that the production factor of land area has a positive relation and significant effect on corn production. If the production factor land added with 1% then the output will increase 0.913 percent. Influential land factors of production to corn production due to land in the research area are suitable for corn cultivation. In accordance to Oyewo (2009) that the land has a positive and significant effect on maize production in South Ogbomoso. Nigeria. This is in-line with Soekartawi (1994) that the land has a positive relationship that means the greater the extent of cultivated farm the higher the resulting production. The area of land means an increase in plant populations thus the production increases as the number of plants Nahriyanti (2008).

The seed production elasticity value of 0.754 with a significance value (0.000 < 0.05) has a positive value. This implies that the seed production factors has positive correlation and significantly affect the corn production. If the use of seeds will add with 1% it will increase the corn production as

much as 0.754 %. Oyewo (2009) stated that in Ogbomoso, Nigeria the use of quality seeds as recommended have a positive and significant effect on corn production, the use of seed per hectare on average 15.9 kg. Meanwhile according to Purwono (2007) the use of corn seed was recommended for one hectare ranges between 20-30 kg. Thus the physical factors of production should be increased of the seed used. Influential seed as production factor because the farmers in the study area are already using hybrids quality of corn seeds. In accordance to Akil (2007) the superior varieties such as composite or hybrid varieties have an important role in increasing the production of corn. Prominent role is the potential yield per unit area pest per disease control conformity to environmental and consumer preferences. Similar disclosed by [9] that one of the efforts to increase the productivity of maize is to develop superior varieties that high yielding and adaptive in certain environmental conditions.

The production elasticity value for pesticide with significance 0.134 (0.117 > 0.05) has a positive value. This implies that the pesticide as a production factors have a positive relationship and no significant effect on corn production. Then if the use of pesticides will add 1%, then the corn production will increase by 0.134 percent. A phenomenon that occurs, respondents paying less attention to preventive aspects in the emergence of pests that attacked corn crops besides the absence of recommendations regarding the application of pesticide in corn farming from the local extension officer. So the production factor increased when the user will have an impact on the increase in corn production.

Different elasticity values were shown by the production factors of urea, NPK, manure and labor. This four elasticity of production factors has negative value means that if the use of urea, NPK, manure plus labor will lead to decline the corn production. Production elasticity for urea (X-3) worth -0.685 with a significance values of 0.000 < 0.05. It implies that urea has a negative relationship and the real impact on corn production. If the production factor of urea will added by 1% will lead to a reduction in corn production to decrease 0.685%. The same disclosed as Oyewo (2009), that the fertilizer has a negative relationship to the corn production in Ogbomoso, South Nigeria. The phenomenon that occurs in the farmer as respondents in urea fertilizer has use more than the specified limits so had an impact of the decline in corn production. This is reflected in the average usage of urea in the study area as much as 239.8 kg per ha. As for the recommended optimal use of urea is only 200 kg per ha, thus the usage of urea must to reduced. The elasticity of production for NPK (X-5) is worth -0.523 with a significance value (0.000 < 0.05). It shows that, the use of NPK as production factor had a negative and significant relationship for corn production. If the production factor of NPK will added by 1% will result a reduction in output of 0.523%. The phenomenon happens that the farmer respondents used of NPK already exceed than the recommended dosage so has an impact on the declining corn production. Evident from the average usage as much as 145.9 kg NPK per ha whereas the use of NPK recommended dose is only 100 kg per ha. Thus to increase the corn production and the NPK usage must be reduced.

Results indicated that the use of manure production elasticity is -0.166 with a significance value (0.049 < 0.05). This implies that the manure has a negative correlation and significantly affects the corn production. The negative effect of manure on maize production is due to the poor quality of the manure. In addition the use of excessive manure will also have impact on production obtained. This is in accordance to Mayadewi (2007), that the use of manure to be considered because manure can lead to the development of weeds; so to avoid this must choose the appropriate manure. The average use of manure in the study area are 408.85 kg per acreage or 817.7 kg per ha although formally there is no standard recommended dosage in the use of manure but the phenomenon indicates also that the condition of the soil in the study area still quite fertile so the use of manure are physically necessary to reduce.

Value of production for labor elasticity (X–7) is -0.014 with a significance value (0.940 > 0.05) shows that the use of labor has a negative relationship and no real effect on corn production. When the use of labor added by 1% it will be followed by a decrease in corn production as much as 0.014 percent. The phenomenon shows that the use of labor in the research area is already too much means no longer effective. It is very logical because for corn farming labor is only necessary in the process of soil preparation to harvesting even in the harvest process carried out by the buyer; so the farmers do not need to provide labor. Employment in the studied area had an average as much as 63.1 WDP per ha. Although formally have no standard for labor but this phenomenon shows that in the research area the usage of labor as production factors must also be reduced.

From the equation model then the value of economic efficiency at each independent variable can be seen in Table 2.

Table 2 Efficiency of use factor in corn farming in Serang District

Input Production	Economic Efficiency	Level of Efficiency
Land (X-1)	14.7	Inefficient yet
Seeds (X-2)	14.5	Inefficient yet
Urea (X-3)	-23	Not efficient
Pesticides (X-4)	14.7	Inefficient yet
NPK (X-5)	-8.8	Not efficient
Manure (X-6)	-6.6	Not efficient
Labor (X-7)	-0.07	Not efficient

From Table 2 can be explained that the economic efficiency of land (X-1) is 14.7>1. Land use in the study area is inefficient yet then to increase the production extensive use of land in corn farming needs to be improved. The economic efficiency of seeds (X-2) is 14.5 > 1. This result shows that the use of seeds in the study area was inefficient yet. The use of seed as production factors in the corn farming should be increased. The economic efficiency the use of urea (X-3) is -23 < 1. This result shows that the use of urea is economically not efficient, it is possible that soil conditions in the area was still fertile. So the use of urea in corn farming needs to be reduced.

Economic efficiency of pesticide use (X-4) is 14.7 > 1. This situation shows that the use of pesticides is inefficient yet. Thus to increase corn production the use of pesticides in corn farming still needs to be improved. This is due at the time of the study the condition of the plants under attacked by pests and diseases. Economic efficiency of NPK (X-5) is -8.8 < 1 this condition shows the level of efficiency is not efficient. Thus to achieve the efficient conditions the usage of NPK needs to be reduced. The economic efficiency of manure (X-6) shows the situation that is not efficient with values of -6.6<1. Thus to achieve the efficient conditions the use of manure on corn farming needs to be reduced. The economic value of labor efficiency (X-7) usage equal to -0.07<1 this situation shows that the situation is not efficient. So to achieve an economic efficient then the use of labor in corn farming needs to be reduced.

CONCLUSIONS

From the discussion above it can be concluded that:

1. Overall the land factor (X-1), seeds (X-2), urea (X-3), pesticides (X-4), NPK (X-5), manure (X-6) and labor (X-7) significantly affected the corn production. Partially the land factor (X-1), seed (X-2), urea (X-3), NPK (X-5) and manure (X6) significantly affect the corn production.

2. The allocation usage of land (X-1), seeds (X-2) and pesticides (X-4) as production factor on the corn farming is economically inefficient yet while the urea (X-3), NPK (X-5), manure (X-6) and labor (X-7) as production factor their use is not efficient economically.

SUGGESTIONS

1. To achieve the efficient conditions the usage of land, seed and pesticides as production factors need to be improved. While the factors of urea, NPK, manure and labor usage as production factor needs to be reduced.

2. The corn farmers must give counseling about the usage of production factors on corn farming in Serang District, Banten Province.

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