



The Analysis of Factors Influencing Corn Yield in Kupang Regency

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Abstract

Agriculture sector is the main sector in Indonesia that can be made as one of economic growth sources. One of the commodities that can be utilized is corn. Corn (*Zea mays*) is the staple and substitutive food sources of the people of Nusa Tenggara Timur (NTT) however, the corn cultivation in NTT is not optimal because the corns are still planted traditionally. Many kinds of effort have been done in order to raise the corn yield in NTT. The aim of this research is to see the influence of the input variable and which input variable is the most dominant toward the corn yield. This research was held in six villages on three subdistricts in Kupang regency which was selected purposively, they were Fatuleu subdistrict, Taebenu subdistrict, and North Amfoang subdistrict. The number of farmers chosen as sample members from each subdistricts was 30. The data were collected through interview, observation, and questionnaire. In order to know the factors influencing the corn yield, the researcher used Cobb Douglas production function model. The result of the regression analysis showed that there were influence of the input variable toward the corn yield and the most dominant factors were the number of plants, pesticide, and nitrogen. The Cobb Douglas production function that was obtained was $Y = (-576.723) - 301,801 X_1 + 77,297 X_2 + 0,036 X_3 + 5,437 X_4 + 47,170 X_5 + 31,095 X_6 - 17,760 X_7 + 412,998 X_8 + e$.

Keywords: *Corn yield; Kupang regency; Cobb Douglas.*

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1. Introduction

Agricultural sector is one of the main livelihood sector for most of Indonesian people, so that this sector is expected to be the economic growth basis in the near future. This can be achieved by utilizing the human resources and natural resources that are possessed by Indonesia. One of the natural resources that becomes the main commodity in the agricultural sector is corn. In Indonesia, the need of corns will be always increasing from year to year because corn is the second food commodity after paddy and the substitutive calorie sources or rice food supplementary and also as the livestock's feed. So in line with the increasing of people's economic living standard and industrial advancement the increase of production through natural resources, land availability, as well as the yield and technology potency [3].

Sola in Matanews.com said that Indonesia succeeded in becoming a corn self-supporting country in 2008 with 16.3 million tons of yield. The corn yield in 2014 was estimated around 32 – 34 million tons (increased 80% compared to the yield in 2008). If the yield target can be achieved, the corn export potency in 2014 will reach 50% from the domestic need of corn which is 16.3 million tons. For the people of NTT, corn is the main food crops that is always cultivated in the field or yard together with other plants such as field paddy, tubers, and nuts in the mixed-cropping system, even this commodity is also cultivated in the citizens' garden and a small part of it is cultivated in the rain reservoir field by using the drill well [4].

Besides being a staple food, corn also becomes the supplementary food stuff for most villagers in NTT. The corn variant which is mostly consumed by citizens is wet corn (boiled unripe corn), while in the village, shelled corns are processed into bosc corn, titi/ketamak corn, corn rice, and corn chips. However, the corn cultivation is not optimal even if from time to time it will always be developed. The yield increasing efforts are done continuously through several strategies that is being developed which are the expanding the cultivating field, increasing the cultivating frequency (from once a year to twice a year), and post-harvest manufacturing.

Nusa Tenggara Timur province is one of the Indonesian central corn yield region that is supported by the role of corn in Nusa Tenggara Timur as the supplementary food stuff for rice as the corn consuming culture. Generally, there are three region zones in Nusa Tenggara Timur province as the corn yield central region, they are Flores zone, Sumba zone, and Timor zone. Kupang is the region that becomes the fourth biggest corn yield because in 2014, its corn yield was 46,878 tons (based on Agriculture and Plantation Department of Nusa Tenggara Timur Province 2015) while in Kupang, Fatuleu subdistrict is the greatest corn producer. However, during 2010-2014 the production and area of corn field underwent inclining trend [6].

The low corn yield was caused by several factors, they were no extended use of superior variety, field shrinkage every year, minimum farmers' capital, ineffective usage and cultivation manner, and also no maximum development system. The inclining corn yield was also caused by several external factors such as: uncertain rainfall, low quality of the seed planted, frequent pest attacks, ineffective cultivation system where there were still many farmers who still applied traditional system in corn plants cultivation, and some other factors that caused the incline of corn yield. Besides the continuous incline of corn yield, the shrinkage of corn field is also happening every year. That is why Kupang district as one of the corn producer central area for Timor zone and

to fulfill the demand that keeps increasing, the effort to raise the corn yield in Kupang district needs to have a bigger attention from the government so that self-supporting corn program can be achieved.

The problem statements in this research are as follows: How do the input variables which are: area of the field, labour, number of plants, seed, nitrogen fertilizer, phosphate fertilizer, potassium fertilizer, and pesticide influence the corn yield in Kupang regency and which variable has the most influence toward the corn yield in Kupang regency. The aim of this research is to analyze and determine which input variable is the most influential to the corn yield. The benefits of this research are: In academical benefit, the results of this research can contribute in the treasury of agricultural economic social development, in the practical benefit, the results of this research can be advice and information for the corn farmers in order to improve their ability and corn yield improvement technique by knowing the production factors.

2. Materials and Methods

The basic method used in this research is the descriptive analysis method. In this research the factors influencing the corn yield and the usage of corn yield input in six villages and one subdistrict in Kupang regency can be assumed as follows: function of the field area (X1), labour (X2), number of plants (X3), seeds (X4), nitrogen fertilizer (X5), phosphate fertilizer (X6), potassium fertilizer (X7), pesticide (X8), and corn yield (Y)

Some variables that can influence the yield are ignored, they are: rainfall, field condition, plants' age, and season. Even though those factors are influential toward the yield but because this research was done in three subdistrict and they had the same season, it can be assumed that rainfall, field condition, pest attacks, and season are homogen for all respondents.

2.1. Time and Place of Research

This research was held in six villages and three subdistricts in the Kupang regency and was held in April to June 2016. The reason why this research was held in that region is because Kupang regency is the one of corn yield central regions for Timor zone.

Three sample subdistricts chosen to represent the 24 subdistricts in Kupang regency are based on the highest, average, and lowest corn yield. Those subdistricts are Fatuleu subdistrict, Taebenu subdistrict, and North Amfoang subdistrict respectively.

2.2. Kinds and Source of Data

The kind of data that is used was quantitative data, it was chosen based on the sources and divided into primary data and secondary data. The secondary data were obtained from Badan Pusat Statistik Kabupaten Kupang 2015, Dinas Pertanian Kabupaten Kupang 2015, Dinas Pertanian dan Perkebunan Provinsi Nusa Tenggara Timur 2015, and several issues / publications that are related to the writing of this research. While the primary data were obtained through direct observation and direct interview to the farmers by using the questionnaires.

2.3. Population and Sample

The population in this research is the corn farmers in Kupang regency, the sample taking method was purposive sampling which is the sample taking technique that chooses the sample specifically / intentionally based on the aim of the research. First, it was chosen from the district level then a sample was chosen in the subdistrict level purposively with the criteria that the chosen subdistrict was the highest, average and lowest corn yield central with the ideal area and represent the whole Kupang district. Then the criteria of the chosen villages were also the highest and lowest corn producers in the three subdistricts.

The number of sample members chosen from each subdistrict was 30 farmers based on the consideration of the practicality, cost, time, accuracy, and data analysis. Respondent farmer samples were decided randomly by using proportional sampling technique which is deciding by the researcher 30 farmers for each subdistrict so that the total number of the whole sample is 90 farmers for three subdistricts. The next step is choosing the sample farmers from each village by using the proportional sampling technique, which uses the formula as follows:

$$N_k$$

$$N_i = \frac{N_k}{N} \times 30$$

Legends :

N_i = The number of respondent
in each village

N_k = The number of farmers in
each village

N = The total farmers in a subdistrict

30 = The number of total
farmers in a subdistrict that
will be observed

2.4. Data Collecting Technique

In this research the methods of collecting data were done in 3 ways, they were:

- a. Interview, the interview technique was done directly with the respondents who were the corn farmers chosen as the sample by using the questionnaire that had been prepared previously.
- b. Direct observation, this technique was done by holding a direct survey to the research objects in the chosen subdistrict in the Kupang regency to understand the corn agribusiness activities.
- c. Questionnaire, it is the data collecting technique which was done by asking a set of written questions to the respondents.

2.5. Data Analysis Method

In order to determine the factors influencing the corn yield, the researcher used the Cobb Douglas production function model. This model was then used to determine the factors influencing the corn yield in Kupang regency. In this research, there were eight production factors which were relevant to be estimated, they were: area of the field, labour, number of plants, seeds, nitrogen fertilizer, phosphate fertilizer, potassium fertilizer, and pesticide with the equation as follows:

$$Y_1 = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} e^{\mu}$$

Legends:

Y1 = Corn Yield (kg)

a = Constant

b1 – b9 = Regression Coefficient of each variables

X1 = Area of the Field (Ha)

X2 = Labour (JOK)

X3 = Number of Plants (Btg/Ha)

X4 = Seeds (kg)

X5 = Nitrogen Fertilizer (kg)

X6 = Phosphate Fertilizer (kg)

X7 = Potassium Fertilizer (kg)

X8 = Pesticide (Ltr)

e = Natural Logarithm

u = Error

The relation between the production factors such as area of the field, labour, number of plants, seeds, nitrogen fertilizer, phosphate fertilizer, potassium fertilizer, and pesticide applied to the corn plants can be determined by doing the multiple linear regression.

3. Results

3.1. General Description of the Research Location

Astronomically, Kupang regency is located between -9015' 11,78" -, -10022 14,25" south longitude and between 123016' 10,66" - 124013' 42,15" east longitude. This regency also has borders as follows: northern border is abuted on the Sawu sea and Ombai strait, western border is abuted on Kupang city, Rote Ndao regency, Sabu Raijua regency and Sawu sea, southern border is abuted on the Indian ocean, and eastern border is abuten on Southern Middle Timor regency and Timor Leste.

3.2. The Condition of the Kupang Regency's Citizen

Based on the citizen survey held by the government, there are 334,189 citizens of Kupang regency in 2015, whereas there are 170,823 men and 163,366 women.

3.3. Agricultural Condition in Kupang Regency

Agricultural sector is the main superior sector in Kupang regency and the kind of plants which is frequently cultivated by the people there is corn plants. For the citizen of Kupang regency, corn is the main food crops that is always cultivated in the field or yard together with other plants such as field paddy, tubers, and nuts in the mixed-cropping system.

3.4. Area of the Field

Approximately the area of the field used by the farmers in Kupang regency to cultivate corn plants is 1.3 Ha with the smallest field is only 0.1 Ha and the largest one is 7 Ha. This condition shows that in cultivating corn crops, there are still many people who utilized their garden, but there are also some farmers who utilized a special field intended to cultivate the corn plants. The area of the field factor in this research is an uninfluential factor toward the corn yield. This result gives a description that a larger area for cultivating corn plants does not guarantee to give more corn yield. This is in line with the previous assumption that is being the problem of the research. The absence of significant influence of this factor is caused by the not optimal utilization of the field area by the farmers. Some farmers are still not having the same distance of corn plants from one to another of those, so that some farmers seem to have not utilized the field optimally. Even though it is not significant, simultaneously or collectively this variable does influence the corn yield. This in in line with the theory that field as one of the production factors which is also a yield factory has a quite big contribution toward the agricultural business. The number of the production from agricultural business is affected by the area of the field

used [2].

3.5. Labour

Based on the research result, the approximate number of labour hired by the land owners in managing the corn agribusiness in Kupang regency is about 4 people per hectare, most of them come from the owners' household. The highest number of labour hired is 10 people with each person working for 5 – 7 hectares while the lowest one is 2 people with each person working for 0.1 – 0.5 hectare.

The labour variable in this research does not give significant influence toward the corn yield. Even though it is not significant, the relation between those two variables is positive. This is in line with the theory of production resource management, one of the important aspects in agricultural resources classification is labour aspect [3].

From this research result, it is found that the labour data may also be the owner of the land (traditional agriculture) or general laborer (commercial agriculture). In this case, the corn yield agribusiness does not rely on the number of labour.

The most dominant factors were the number of plants, pesticide, and nitrogen

a. Number of Plants

The number of corn plants available or cultivated in the field which is possessed by the respondent farmers showed the smallest number is 1,000 plants and the highest one is 101,000 plants. Based on the research results, it is known that the number of corn plants owned by 35 respondent farmers is around 1,000 – 10,000, while the number of respondent farmers who have the number of plants around 10,000 – 101,000 is 55 with the cultivation spacing 80 cm x 60 cm dan 80 cm x 80 cm.

The number of plants variable is the significant influential factor toward the corn yield positively. This explains that the locations of corn cultivation in the research site tend to have identical characteristics in terms of the soil fertility so that the more plants cultivated, the more corn yield will be harvested.

Based on the result of the research, the cultivation spacing used by the respondent farmers is 80 cm x 60 cm dan 80 cm x 80 cm with the approximate plant population 18.739,7 per hectare. While the cultivation spacing suggested based on the theory for plant population around 66.000 - 75.000 per hectare is 75 cm x 20 cm dan 75 cm x 40 cm. It can be concluded if the corn farmers in the respondents region want to increase their corn yield, they will have to apply the suggested cultivation spacing [1].

b. Nitrogen Fertilizer

Approximately the amount of nitrogen fertilizer used by the respondent farmers to cultivate the corn crops is 21.55 kilograms per hectare with the price of Rp 2.000 per kilogram. Nitrogen fertilizer is used by the respondent farmers because they assumed by applying nitrogen fertilizer to their crops, it will make the corn

crops grow faster and guarantee the optimum presence of nutrients which then will increase the corn yield. Based on the result of the research, it is determined that the lowest usage of nitrogen fertilizer by the respondent is 10 kilograms for 0,1 hectare dan the highest one is 80 kilogram for 7 hectare in a cultivating season or for 3 months. Nitrogen fertilizer variable in this research is also a significant influential variable toward the corn yield positively.

This is in line with the theory that nitrogen is the main fertilizer used to foster the tissue growth of corn crops [7]. The application of the fertilizer must be appropriate to the fertility of the soil and the need of the plant, it means that the fertilizer should be applied in a specific location, differently in a certain location, cultivating pattern, kinds of corn crops cultivated, and crops management. Based on the result of the research, the respondent farmers used nitrogen fertilizer approximately 21.55 kilograms per hectare. While the suggested dosage for optimal corn yield is 150 kilograms per hectare. So, in order to improve the corn yield, the respondent farmers are expected to apply the suggested dosage of nitrogen fertilizer appropriate to the role of field agricultural informer [1].

c. Pesticide

Based on the data acquired from the farmers' questionnaire, the kinds of pesticide used by the respondent farmers are curacron and dursban which is used approximately 2 litres per hectare. Those two kinds of pesticide is used by the respondent farmers because they give benefits in hampering the growth of pests and eradicating all kinds of pests attacking the corn crops.

Pesticide variable in this research has significant influence and positive relation toward the corn yield. This result shows that the increased use of pesticide will be in line with the increase of corn yield. However, according to the Law of Diminishing Return, the overuse of production resources will just cause contraproductivity toward the production. This result also explains that the use of pesticide is also one of the ways to improve the quality or quantity of the corn yield that can be obtained. By using a better pesticide, the pests' attacks will be minimalized so that the crops will give a better yield.

The result shows there is a significance, so that there is a positive relation between those two variables. This is in line with the theory that pesticide as one of the production factors has a contribution toward the agribusiness. In the research site, the respondent farmers used the curacron and dursban pesticide because both of them give a lot of benefits in hampering the growth of pests, eradicate the pests, and work quickly and effectively [5].

4. Discussion

4.1. Discussion of Theoretical

The Estimation of Cobb-Douglas Production Function Parameter

The production function used to explain Y and X was Cobb-Douglas production function:

$$Y = A X_1^{b_1} X_2^{b_2} \dots X_n^{b_n}$$

Cobb-Douglas production form that is decided to be the model which needs to be estimated are: area of the field, labour, number of plants, seeds, nitrogen fertilizer, phosphate fertilizer, potassium fertilizer, and pesticide are then treated as X, and Y as the yield is as follows:

$$Y = (-576.723) - 301,801 X_1 + 77,297 X_2 + 0,036 X_3 + 5,437 X_4 + 47,170 X_5 + 31,095 X_6 - 17,760 X_7 + 412,998 X_8 + e$$

4.2. Discussion of Verification

But when verified the factors that not dominant in this research is the corn farmers in Kupang regency is seeds, phosphate fertilizer, and potassium fertilizer.

a. Seeds

Based on the result of the research done, it is determined that the seeds used by the respondent farmers are the type of BISI 21 and BISI 22 which are obtained from the government's subsidy or bought from the Village Unit Cooperation (KUD) with the approximate price per kilogram is 16,000 – 20,000 rupiahs. The lowest seeds usage by 29 respondent farmers based on the research result is 10 – 15 kilograms while the highest one by 61 farmers is 20 – 50 kilograms. Based on this research, seeds do not have significant influence toward the corn yield.

Even though it is not significant, those two variables are related positively. This is in line with the theory that in managing the production resources one of the important aspects in agricultural (Soekartawi, 1990). In this research, the types of seeds used by the farmers are BISI 21 and BISI 22 with the yield around 2200.44 kilograms.

b. Phosphate Fertilizer

Approximately the amount of phosphate fertilizer used by the respondent farmers to cultivate the corn crops is 17.33 kilograms per hectare with the price of Rp 2.500 per kilogram. Phosphate fertilizer is used by the respondent farmers because they assumed by applying phosphate fertilizer to their crops, it will not only raise the fertility of the soil and give real effect to the number of humps of the corn crops and the weight of the hump, but also guarantee the optimum presence of nutrients which will finally increase the corn yield. Based on the result of the research, it is determined that the lowest usage of nitrogen fertilizer by the respondent is 10 kilograms for 0,1 hectare dan the highest one is 70 kilogram for 7 hectare in a cultivating season or for 3 months.

Phosphate fertilizer variable in this research is not significantly influential toward the corn yield. This is in line with the theory that phosphate fertilizer is used to foster the production of flowers and seeds, quicken the fruit ripening, and stimulate the formation of roots in the early growth of corn crops (Syukur.M dan Azis R 2014).

c. Potassium Fertilizer

Based on the data acquired from the farmers' questionnaire, approximately the amount of potassium fertilizer used by the respondent corn farmers is 17.05 kilograms per hectare. Potassium fertilizer is used by the respondent farmers because they assumed by applying potassium fertilizer to their crops, it will affect the corn yield, strengthen the stem and roots of the corn crops, and also improve its resistance against pest attacks. Based on the result of the research, it is determined that the lowest usage of nitrogen fertilizer by the respondent is 10 kilograms for 0,1 hectare dan the highest one is 60 kilogram for 7 hectare in a cultivating season or for 3 months.

Potassium fertilizer variable in this research does not significantly influence the corn yield. This result explains that the increased use of potassium fertilizer in a production process of agribusiness does not directly raise the corn yield.

d. Production

The amount corn yield for every respondent farmers is not the same which is the number of highest yield is 10,000 kilograms with the area of 7 hectares. However, the ability of each farmers will be different in managing or cultivating the corn crops. From this research it is determined that the amount of corn yield obtained is approximately 2200.44 kilograms for each harvest. The lowest corn yield is 200 kilograms with the area of 0.10 hectares.

Based on the information obtained from the respondent farmers, it is determined that generally, the corn farmers in the respondents' region sell their yield by using the wholesale system and the location of the sale is directly in the same place or the yield is brought to the location of the wholesalers where the sale region includes Kupang regency and Kupang city.

5. Conclusion

Generally, production factor variables in Kupang regency that influence the corn yield are number of plants (X3), nitrogen fertilizer (X5), and pesticide (X8) while the most dominant variable in influencing the corn yield in Kupang regency is the number of the plant and followed by the pesticide variable (X8) and nitrogen fertilizer variable (X5).

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