FACTORS AFFECTING CORN FARMING PRODUCTION IN LASALEPA SUB-DISTRICT MUNA DISTRICT

Vebby Surya Atika¹, Muhammad Aswar Limi¹*, Mukhtar¹

¹Department of Agribusiness Faculty of Agriculture Halu Oleo University, Kendari 93232

*Corresponding author : aswar_agribusiness@yahoo.com

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ABSTRACT

The objective of this research was to analyze the factors that affect the corn production in Lasalepa Sub-District, Muna District. This research was conducted in January - March 2020 in Lasalepa Sub-District, Muna District where the majority of farmers were engaged in corn farming. The primary and secondary data were collected through interview and literature study. The data analysis in this research employed regression equation using Cobb-Douglas production function model and a storage test against the classical assumptions which included multicollinearity and heteroscedasticity tests. Based on the results of regression analysis in this research, it can be concluded that the factors that significantly affected farmers' production were land area (X₁) and seed (X₄). According to the results of the research, it is necessary to add and reduce the factors of corn farming production in order to obtain profitable and optimal farming results. Furthermore, the role of government is also needed in terms of providing input subsidies so that farmers can use more inputs to increase their production.

Keywords: corn farming; factors affecting; Lasalepa Sub-District; Muna District; production

INTRODUCTION

Indonesia has fertile natural resources and is an agrarian country where the majority of its population work as farmers (Erviyana, 2014). The agricultural sector plays an important role in Indonesian economy in terms of its contribution to gross domestic product (GDP), providing employment, reducing the number of poor people in rural areas and its role in foreign exchange value generated from export (Soekartawi, 2016). In Indonesia, corn is the second most important food crop after rice. Corn is widely used as raw material for food, animal feed, industry, and energy source. The need for corn will continue to increase from year to year in line with the improvement of the economic standard of living of the community. Corn is one of the most important agricultural commodities and is related to large industries (Atman, 2015).

Southeast Sulawesi is one of the provinces which has corn harvest area of 54,635.1 ha of which its production reached 221,498.5 tons. Its productivity reached 40.5 tons/ha (Indonesian Statistics (BPS) of Southeast Sulawesi, 2019). One of the districts in Southeast Sulawesi that produces corn is Muna District. The state of corn productivity in Muna District in 2014-2016 continued to decrease from 2.94 Tons/ha in 2014 to 2.20 Tons/ha in 2016. The decrease of corn productivity was caused by a decrease in corn production from 35,786 Tons in 2014 to 19,352 tons in 2016 and reduced harvested area from 14,365 ha in 2014 to 8,791 ha in 2016. However, corn productivity in 2017 increased again to 2.32 tons/ha with an increase in production of 35,157 tons and harvested area to 15,138 ha. In 2018, the corn productivity has increased again to 3.27 tons/ha with a production of 32,602.8 tons and harvested area of 9,984ha (BPS of Muna District, 2019). One of the sub-districts in Muna District that produces corn is Lasalepa Sub-District, which has been developing local corn farming to utilize land owned without the thought of maximizing the yields. Kaliba et al (2000) stated that farmers prefer varieties which minimize the land use rather than maximizing the yields.
The fluctuated corn production in Muna District is a serious concern for the government and extension workers. Justin (2015); Hussain et al (2018) explained that the government adaptive actions in agricultural extension activities is by introducing new crop seeds and changing the agricultural practices so that it can increase production. Through extension activities, the government introduced a new variety of corn for corn farming that has never been planted by farmers so far but has similarities with the usual local corn planted by farmers. Kaliba et al (2000); Justin (2015); Upadhyay et al (2018) stated that the availability of extension services and varieties characteristics are factors that affect the rate of corn seeds adoption thus, it inhibits the corn productivity.

In addition to increase the production, the government introduced new corn varieties to farmers to improve the technical efficiency of corn farming as well so that the farmers who have been only using local corn seeds begin to switch to hybrid corn seeds. Sicelo et al (2012) conveyed that the use of hybrid seeds can improve the technical efficiency of corn farming. Corn farmers use production factors to increase the production in the form of land, labor, capital, as well as seeds, fertilizers, and pesticides. Sicelo et al (2012) claimed that the most important contributor in the process of corn production is the number of seeds, fertilizers, pesticides, and labor used per hectare. Furthermore, Rahman & Rahman (2013) stated that seeds, fertilizers and organic fertilizer significantly increase the corn productivity. Increasing the corn production requires knowledge of the use of production factors so as to increase the corn production because according to Justin (2015), factors that inhibit corn productivity include access to fertilizer, seed and other chemical inputs needed for higher production. Based on this, the objective of the study was to analyze the production factors used by farmers in hybrid corn farming that can affect corn production in Lasalepa Sub-District, Muna District.

MATERIALS AND METHODS

This research was conducted in January - March 2020 in Lasalepa Sub-District, Muna District, where the majority of farmers engaged in corn farming. The primary and secondary data were collected through interview and literature study. The data analysis of this research employed regression equation using Cobb-Douglas production function model and a storage test against classical assumptions which included multicollinearity and heteroscedasticity tests.

The analysis of Cobb Douglas Production Function mathematically can be written as the following equation (Soekartawi, 1989):

$$Y = a \cdot X_1^{b_1} \cdot X_2^{b_2} \cdot X_3^{b_3} \cdot X_4^{b_4} \cdot X_5^{b_5} \cdot X_6^{b_6} \cdot e^u$$

Information:
- $Y$ = Production (Kg)
- $X_1$ = Land area (Ha)
- $X_2$ = Labor (Working Day)
- $X_3$ = Capital (IDR)
- $X_4$ = Seed (Kg)
- $X_5$ = Fertilizer (Kg)
- $X_6$ = Pesticides (Lt)
- $a, b = $ The amount to be expected
- $u = $ Error (disturbance term)
- $e = $ natural logarithm, $e = 2.718$.

RESULTS AND DISCUSSION

Characteristics of Respondents

The characteristics of respondents in Lasalepa Sub-District, Muna District were grouped based on age, level of formal education, number of family dependents, and farming experience which are presented in Table 1 as follows:

Table 1. Identity of respondents

| No. | Characteristics of Respondents | Number (Person) | Percentage (%) |
|-----|--------------------------------|-----------------|----------------|
| 1.  | Age (years old)                |                 |                |
|     | Productive (15 – 54)           | 59              | 89.39          |
|     | Non-productive (> 55)          | 7               | 10.61          |

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Based on Table 1, it is known that 83.39% of corn farmers in Lasalepa Sub-District, Muna was categorized in the productive age category and only 10.61% of them was categorized in the non-productive age category. Farmers’ age greatly affects the ability of farmers because generally older farmers have limited physical abilities compared to young farmers and are influential in adopting production technology to improve the technical efficiency of their farming. Sicelo et al (2012); Wongnaa et al (2018); Upadhyay et al (2018) said that the adoption of production technology (adoption of corn varieties) and the ability to improve technical efficiency are affected by the age of the farmer. Furthermore, Mulungo (2013) stated that the non-productive age can significantly cause technical inefficiency.

Tuwo (2011) stated that education in general greatly affects farmers’ way of thinking. Higher education at a relatively young age will cause farmers to be more dynamic. Older farmers who receive formal education are more likely to accept new things and changes in terms of how to do business. The results showed that the farmers respondent with the highest level of formal education were 42.42% junior high school graduates, while the lowest were undergraduate graduates by 1.52%. The education level of corn farmers who were respondents in this study was relatively low and their knowledge regarding corn farming was only obtained from their parents. Mulungo (2013); Justin (2015); Wongnaa et al (2018); Akhtar et al (2019) claimed education as an important factor in increasing production yield because education significantly encourages the adoption of agricultural production/diversification technology so that if the farmer education level is low it can cause technical inefficiency.

Family dependents are all family members both who live in one house and not, whose living costs depends on the farmer. The greater the number of family dependents, the greater the effort that must be done by farmers to meet their needs. However, if the family dependents are at productive age, it can be the source of labor in the family. The results showed that 73.00% of the total dependents of corn farming families were small families.

Experience is the best teacher for farmers. Experience can be a reference in preparing steps in the future. Experienced farmers will be more courageous in taking risks (risk takers) because they are able to overcome the things that will happen in their businesses (Tuwo, 2011). The results showed that 53.03% of the corn farmers had more than 10 years experience. Farmers are expected to have capability and skill in managing their farms by adopting new production technology which is technically more efficient to increase the corn production (Sicelo et al., 2012; Wongnaa et al., 2018; Akhtar et al., 2019).

Classic Assumption Test

The classic assumption tests used in this study were multicollinearity and heteroscedasticity tests as shown in Table 1 as follows:

Table 2. Classic assumption test

| No | Production Factors | Collinearity Statistics |
|----|-------------------|------------------------|
|    |                   | Tolerance | VIF |
| 1. | Land area (Ha)    | 0.134      | 7.482 |
| 2. | Labor (Working Day)| 0.847      | 1.180 |
| 3. | Capital (IDR)     | 0.140      | 7.128 |
Table 2. Classic assumption test

| No | Production Factors | Collinearity Statistics |
|----|--------------------|-------------------------|
|    |                    | Tolerance  | VIF  |
| 4. | Seed (Kg)          | 0.205      | 4.872   |
| 5. | Fertilizer (Kg)    | 0.159      | 6.280   |
| 6. | Pesticides (Liters)| 0.154      | 6.495   |

Source: Primary Processed Data, 2020

Multicollinearity test aims to test whether the regression model find a correlation between independent variables (Ghozali, 2018). The results of the multicollinearity test revealed that the data did not experience multicollinearity symptom because all variables' VIF were less than 10. VIF values of X1 to X6 were 7.482, 1.180, 7.128, 4.872, 6.280, and 6.495. Heteroscedasticity test aims to test whether the regression model find that there is an unequal variance from the residuals of one observation to another (Ghozali, 2018). Based on Figure 1, the points spread and do not form certain clear patterns. So, it can be concluded that there was no heteroscedasticity.

Factors Affecting Corn Farming Production

Factors affecting corn farming in Lasalepa Sub-District of Muna District were grouped by land area, labor, capital, seeds, fertilizer, and pesticides, presented in Table 3 as follows:

Table 3. The average production and the use of production factors of corn farming

| No | Production Factor | Amount |
|----|-------------------|--------|
| 1. | Production (Kg)   | 704.55 |
| 2. | Land area (ha)    | 0.86   |
| 3. | Labor (Working Day)| 15.05 |
| 4. | Capital (IDR)     | 658.030|
| 5. | Seed (Kg)         | 12     |
| 6. | Fertilizer (Kg)   | 42.12  |
| 7. | Pesticides (Liters)| 4.7   |

Source: Primary Processed Data, 2020

The effect of the use of production factors in corn farming in Lasalepa Sub-District, Muna District can be known through the analysis of the Cobb-Douglas production function. By looking at the significance value of the F-count, it can be seen how much the factor of production affect the amount of production. The test results can be seen in Table 4 as follows:

Table 4. The analysis result of factors affecting the production of corn farming in Lasalepa Sub-District, Muna District in 2020

| Model          | Regression Coefficient | Sig | Ket   |
|----------------|------------------------|-----|-------|
| Constant       | 5.046                  | 0.000 | **   |
| Land Size (X1) | 0.293                  | 0.000 | **   |
| Labor (X2)     | 0.270                  | 0.187 | ns   |
| Capital (X3)   | 0.123                  | 0.123 | ns   |
| Seed (X4)      | 0.238                  | 0.001 | **   |
| Fertilizer (X5)| -0.159                 | 0.130 | ns   |
| Pesticides (X6)| 0.025                  | 0.730 | ns   |

The coefficient of determination ($R^2$) = 0.817

$\text{Sig F-count} = 0.000$

Source: Primary Processed Data, 2020

Note: **: significant effect; ns: no significant effect
The equation was made after the natural anti logarithmic transformation was carried out so that Cobb-Douglas production function of the corn farming was obtained as follows:

\[ Y = 0.703 \cdot X_1^{0.293} \cdot X_2^{0.370} \cdot X_3^{0.123} \cdot X_4^{0.238} \cdot X_5^{0.159} \cdot X_6^{0.025} \]

Based on the analysis result of the coefficient of determination test (R²), the coefficient of determination (Adjusted R Square) was 0.817. The coefficient of determination was 0.817 or equal to 81.7%. This means that as much as 81.7% of the independent variables used in the corn farming can be determined by land area (X₁), labor (X₂), capital (X₃), seeds (X₄), fertilizer (X₅), and pesticides (X₆) which affect the production variable (Y) by 81.7%, while the remaining 18.3% is affected by other variables not included in the model.

Based on the analysis result of the F test, it was obtained that the Sig value of Fcount = 0.000. Sig value of Fcount was less than 0.05 indicating that there was an effect of land area (X₁), labor (X₂), capital (X₃), seeds (X₄), fertilizer (X₅), and pesticides (X₆) together on production (Y). Limi (2014); Purwanto et al (2015) stated that soil, seeds, fertilizer, and labor significantly affect the production of hybrid corn farming.

**Land Size (X₁)**

The partial test analysis that has been done obtained the regression coefficient of land area variable by 0.293 with a significant level of 0.000 which is smaller than α = 0.1, so it can be considered that land area variable affected the corn production in Lasalepa Sub-District, Muna District. The result of the estimated land area regression coefficient was 0.293, which means that for every 1% increase in land area value, the corn production will increase by 29.3%. So, land area had a positive and real effect. This is because the larger the area planted, the greater the production of corn will be produced. Lalu (2017), an increase in corn production can be done by increasing the land area.

Based on Table 3, the agricultural land area is very important in the process of production or farming. The agricultural land area will affect the scale and ultimately affect the efficiency of an agricultural business. According to (Suratiyah, 2015), in terms of efficiency, the wider the business land area, the higher the production and income per unit area. The results of the study explained that the average land area was 0.86 ha. The land area is very influential on the production of a farm because the larger the land area planted by a farmer, the greater the opportunity for corn farmers to obtain higher production. Seen from the ownership status of the land used by the farmers who became the respondent, all respondents use their own land so that it can affect the level of productivity of the respondents' agriculture compared to farmers who work on other people's land.

**Labor (X₂)**

The partial test analysis that has been done obtained that the coefficient of labor variable was 0.270 with a significant level of 0.187 which is greater than α = 0.1, so it can be considered that labor had no significant effect on corn production in Lasalepa Sub-District, Muna District. The estimation result of the labor regression coefficient was 0.270 which means that for every increase of 1 labor, the corn production will increase by 27%. So, labor had a positive but not a real effect. This shows that the labor factor does not affect the corn production due to the use of labor in corn farming in the study area is more widely used during land management, planting and harvesting activities.

**Capital (X₃)**

The results of the partial test analysis that has been done obtained that the regression coefficient of capital variable was 0.123 with a significance level of 0.123 which is greater than α =
0.1, so it can be considered that capital had no significant effect on corn production in Lasalepa Sub-District, Muna District. The estimated result of the capital regression coefficient was 0.123, which means that for every increase in capital value by 1, the corn production will increase by 12.3%. So, capital had a positive but not real effect. This shows that capital production did not affect the corn production because the capital owned by the farmers was still relatively low compared to the recommended capital, causing a lack of production facilities. Wongnaa et al (2018) stated that adoption of production technology affects the initial capital expenditure.

Soekartawi (1989) stated that capital in farming is defined as a form of wealth, either in the form of money or goods used to produce something either directly or indirectly in a production process. The results showed that the average capital usage was IDR 658,030 in one planting season. The average capital spent by the farmers was still relatively small compared to the capital recommended by Agromedia (2007), which is IDR 6,199,600. Based on the research, the average corn farmer uses his own capital and there is no access to credit institutions. Mulinga (2013); Wongnaa et al (2018) stated that access to credit to overcome the availability of funds in an optimal time is needed by farmers.

Seed (X4)

The results of the partial test analysis that has been done obtained that the regression coefficient of the seed variable was 0.238 with a significance level of 0.001 which is smaller than \( \alpha = 0.1 \), so that it can be considered that seed had a significant effect on corn production in Lasalepa Sub-District, Muna District. The estimation result of seed regression coefficient was 0.238, which means that for each increase in seed value by 1, the corn production will increase by 23.8%. So, seeds had a positive and real effect. This shows that the effect of seed production on corn production was because the quality of the seeds used by farmers is superior and maintained well.

Seed is a plant or plant part that is used to reproduce plants. The use of quality seeds is the initial stage for success. The results showed that the average use of seeds by respondents of corn farmers in Lasalepa Sub-District was 12 kg/ha. The use of seeds by the farmers was still relatively low. This is compared with the use of seeds recommended by Agromedia (2007), which is at the average of 20 kg/ha. According to Christoporus & Sulaeman (2009), the recommended use of seeds for corn commodities is 30-40 kg/ha. Tamba (2018) stated that the need for corn seeds per land area unit can be affected by the factors of spacing, number of seeds per planting hole, land conditions, seed weight, and seed germination. The number of corn seeds needed for the farmers in the study Tamba (2018) ranged from 15-20 kg/ha or at the average of 16.95 kg/ha. The high and low use of seeds depends on the amount of land area and capital owned by farmers.

Fertilizer (X5)

The results of the partial test analysis showed that the fertilizer variable regression coefficient was -0.159 with a significance level of 0.130 which is greater than \( \alpha = 0.1 \), so that it can be considered that fertilizer had no significant effect on corn production in Lasalepa Sub-District, Muna District. The estimated regression coefficient of fertilizer was -0.159 which means that every increase in the fertilizer value by 1 will decrease the corn production by 15.9%. So, fertilizer has a negative and not significant effect at a 90% confidence level. This shows that fertilizer did not affect the corn production because the fertilizer used by the respondent farmers was still relatively low compared to that recommended. The lack of the use of fertilizer was due to the very limited availability of fertilizers and the price of fertilizer which is quite expensive for farmers.

Snapp, et al (2014) stated that crop diversification and soil management practices to improve soil fertility help farmers to improve the efficiency of fertilizer use. Furthermore, Kaliba et al (2000) stated that the use of inorganic fertilizers for corn production was affected by the characteristic factors of corn seed varieties. Fertilization is one of the important factors to increase the yield obtained. Generally, fertilizer is given in solid and liquid form through the planting medium and then absorbed by the roots of plants. The results showed that the average fertilizer use was 42.12 kg/ha. The use of fertilizer in the study area was still relatively low with an average of 42.12 kg/ha. According to Syafruddin (2016), the recommended corn fertilization use was 190-210 kg N per hectare to increase the production by 3.3 tons/ha, while according to Isnuriyadi (2019), the highest use of fertilizer on corn farming is 300-350 kg/ha. The use of fertilizers in the study area generally was not in accordance with the recommended dosage. Most corn farmers used fertilizer according to their experience in farming, so the use of fertilizer varies greatly in each hectare.
Pesticides ($X_0$)

The results of the partial test analysis that has been done obtained the regression coefficient of pesticide variables by 0.025 with a significance level of 0.730 which is greater than $\alpha = 0.1$, so that it can be considered that pesticides had no significant effect on corn production in Lasalepa Sub-District, Muna District. The result of the estimated pesticide regression coefficient was 0.025, which means that for each increase in the value of pesticides, corn production will increase by 2.5%. So, pesticides had positive and unreal effects. This shows that pesticides production factor did not affect the corn production because the use of pesticides done by the farmers did not match the recommended measurements but according to the experience of farmers in farming. Pesticide controls the pests and diseases that attack plants and can cause crop failure. Pesticides are widely used by farmers in controlling pests and diseases that attack plants because they are easily applied to large areas by using sprayer. The results showed that the use of pesticides was at the average of 4.7 L/ha. This means that the use of pesticides in the study area varies depending on the level of pest and plant disease. In the use of pesticides, dosage and size must be considered because pesticides are poisons which if used excessively will cause harm. Riyadi (2007) explained that to be able to obtain maximum results, plants must be protected from various weeds or other plant pests. The first weeding is done when the pests have started to grow, usually 15 days after the planting. Weeding must be maintained so as not to disturb or damage the plants. The second weeding is done at the same time as piling. This piling is done to strengthen the stem from strong wind attacks. In addition, it is also to improve drainage and facilitate irrigation.

CONCLUSION AND RECOMMENDATIONS

Based on the results of the research that has been done, the conclusion is drawn from the results of the regression analysis obtained that the factors that significantly affected the farmers' production were land area ($X_1$) and seed ($X_4$). Based on the results of the research, it is necessary to add and reduce the production factors in corn farming in order to obtain farming results that can benefit optimally and the role of the government in providing input subsidies so that farmers can use more inputs to increase production.

REFERENCES

Agromedia, R. (2007). Budidaya Jagung Hibrida. Agromedia Pustaka. Jakarta.

Akhtar, S., Li, G. cheng, Nazir, A., Razzaq, A., Ullah, R., Faisal, M. Raza, M. H. (2019). Maize production under risk: The simultaneous adoption of off-farm income diversification and agricultural credit to manage risk. Journal of Integrative Agriculture, 18(2), 460–470. https://doi.org/10.1016/S2095-3191(18)61968-9

Atman. (2015). Produksi Jagung: Strategi Meningkatkan Produksi Jagung. Plantaxia. Yogyakarta.

BPS Kabupaten Muna. (2019). Kabupaten Muna Dalam Angka 2019. BPS Kabupaten Muna. Muna.

BPS Provinsi Sulawesi Tenggara. (2019). Sulawesi Tenggara Dalam Angka 2019. BPS Provinsi Sulawesi Tenggara. Kendari.

Christoporus & Sulaeman. (2009). Analisis Produksi Dan Pemasaran Jagung Di Desa Labuan Toposo Kecamatan Tawaeti Kabupaten Donggala. J Agroland. 16(2): 141-147.

Erviyana, P. (2014). Faktor-Faktor Yang Mempengaruhi Produksi Tanaman Pangan Jagung di Indonesia. JEJAK Journal of Economics and Policy. 7(2): 194-202.

Ghozali, I. (2018). Aplikasi Analisis Multivariate dengan program IBM SPSS 25. Universitas Diponegoro. Semarang.

Hussain, A., Rasul, G., Mahapatra, B., Wahid, S., & Tuladhar, S. (2018). Climate change-induced hazards and local adaptations in agriculture: a study from Koshi River Basin, Nepal. Natural Hazards, 91(3), 1365–1383. https://doi.org/10.1007/s11069-018-3187-1

Imsuriyadi, P.D. (2019). Analisis Faktor-Faktor Yang Mempengaruhi Produksi dan Pendapatan Petani Jagung (Studi Kasus: Desa Saentis, Kecamatan Percut Sei Tuan, Kabupaten Deli Serdang). Skripsi. Universitas Medan Area. Medan.

Justin, K. U. (2015). Factors influencing maize crop production at household levels: A case of Rukwa Region in the southern highlands of Tanzania. African Journal of Agricultural Research, 10(10), 1097–1106. https://doi.org/10.5897/ajar2014.9262

Kaliba, A., Verkuilj, H., & Mwangi, W. (2000). Factors Affecting Adoption of Improved Maize Seeds and Use of Inorganic Fertilizer for Maize Production in the Intermediate and Lowland Zones of Tanzania. Journal of Agricultural and Applied Economics, 32(1), 35-47. doi:10.1017/S1074070800027802
Lalu, M. (2017). Faktor-Faktor yang Mempengaruhi Usahatani Jagung di Lahan Sawah dan Lahan Kering. *Jurnal Pengkajian Dan Pengembangan Teknologi Pertanian*, 20(1), 81-90. doi:http://dx.doi.org/10.21082/jpptp.v20n1.2017.p81-90

Lim, M.A. (2014) Pengaruh Faktor Produksi Terhadap Produksi Usahatani Jagung Melalui Pendekatan Analisis Jalur. *Agriplus* 24(1), 90 - 97

Mulinga, N. (2013). Economic Analysis of Factors Affecting Technical Efficiency of Smallholders Maize Production on Rwanda. *Rwanda Journal*, 1(1). https://doi.org/10.4314/rj.v1i1.4h

Purwanto, A., Hadayati., & Muis, A. (2015). Analisis Produksi dan Pendapatan Usahatani Jagung Hibrida di Desa Modo Kecamatan Bukal Kabupaten Buol. *Jurnal Agroland*, 22(3): 205-215

Rahman, S., & Rahman, M. S. (2013). Energy productivity and efficiency of maize accounting for the choice of growing season and environmental factors: An empirical analysis from Bangladesh. *Energy*, 49(1), 329–336. https://doi.org/10.1016/j.energy.2012.10.042

Riyadi. (2007). Analisis Faktor-Faktor Yang Mempengaruhi Produksi Jagung Di Kecamatan Wirosari Kabupaten Grobogan. *Tesis*. Program Pasca Sarjana. Universitas Diponegoro. Semarang.

Sicelo, I. D., Micah, B. M., & J, I. R. (2012). Technical efficiency of maize production in Swaziland: A stochastic frontier approach. *African Journal of Agricultural Research*, 7(42), 5628–5636. https://doi.org/10.5897/ajar12.1204

Snapp, S., Jayne, T. S., Mhango, W., Benson, T., & Ricker-Gilbert, J. (2014). Maize yield response to nitrogen in Malawi’s smallholder production systems. *National Symposium on Eight Years of FISP—Impact and What Next*, (October), 13. Retrieved from http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/128436/filename/128647.pdf. https://ageconsearch.umn.edu/record/188570

Soekartawi. (1989). *Prinsip Dasar Ekonomi Pertanian; Teori dan Aplikasi*. Rajawali. Jakarta.

Soekartawi. (2016). Agribisnis; Teori dan Aplikasinya, Ed-1. Cet-11. Rajawali Pers. Jakarta.

Suratiyah K. (2015). *Ilmu Usahatani; Edisi Revisi*. Penebar Swadaya. Jakarta Timur.

Syafuddin, N. (2016). Pemupukan N, P, dan K Spesifik Lokasi pada Tanaman Jagung. *Jurnal Pengkajian Dan Pengembangan Teknologi Pertanian*, 19(2), 119-133. doi:http://dx.doi.org/10.21082/jpptp.v19n2.2016.p119-133

Tamba, M. (2018 _ Analisis Faktor Yang Mempengaruhi Produksi Jagung di Kecamatan Tigalingga Kabupaten Dairi Provinsi Sumatera Utara. *Jurnal Bisnis Net*. 1(2): 7-20.

Tuwo, M.A. (2011). *Ilmu Usahatani; Teori dan Aplikasi Menuju Sukses*. Unhalu Press. Kendari.

Upadhyay, N., Ghimire, Y. N., Sharma, B., Acharya, Y., Gairhe, S., & Sapkota, S. (2018). Factors Affecting Adoption of Maize Varieties in Nepal. *Journal of the Institute of Agriculture and Animal Science*, 35(1), 39–45. https://doi.org/10.3126/jiaas.v35i1.22512

Wongnaa, C. A., Awunyo-Vitor, D., & Andivi Bakang, J. E. (2018). Factors affecting adoption of Maize production technologies: A study in Ghana. *Journal of Agricultural Sciences - Sri Lanka*, 13(1), 81–99. https://doi.org/10.4038/jas.v13i1.8303.