Volume 1 Nomor 2 July 2024
E-ISSN: 3047-4337

https://journal.antispublisher.com/index.php/IPTEKS/index

GREEN PRODUCTIVITY TO INCREASE THE PRODUCTIVITY OF SUGARCANE FARMERS WITH COBB-DOUGLASS METHOD

Inggit Marodiyah
Industrial Engineering Study Program, Muhammadiyah University of Sidoarjo

Article Info

Article history:
Received Jun 11, 2024
Revised Jul 16, 2024
Accepted Jul 21, 2024

Keywords:
Cobb Douglass;
Green Productivity;
Sugar Cane

ABSTRACT

Sugarcane is a crop that requires a number of processing steps from planting to harvesting. Green productivity is a viable option to increase the productivity and sustainability of sugarcane. Various planting methods, management strategies (fertilisation), insect/pest and disease management options as well as management of adverse climatic conditions and waste management that not only improve soil fertility and sugarcane productivity are environmentally friendly and safe for the environment. Productivity in the sugarcane farming environment requires improvement so that the sugarcane management process does not adversely affect the environment. The purpose of this study is to determine the factors that affect productivity and recommendations for improving green productivity. Cobb Douglass method to determine the factors in sugarcane farming that affect the sugarcane management process and green productivity is a strategy used to increase productivity and reduce the environmental impact of sugarcane fields. The results of this study found that the output elasticity value of sugarcane farm labour input symbolized (β) in the 2021-2022 period was smaller than the input of raw materials (α), which was 0.39 in units of million rupiah. Based on this, it can be concluded that the input that has the greatest influence on the productivity of sugarcane farmers is labour, as evidenced by the smallest elasticity value, which means that it has a large influence on productivity. So that to increase green productivity is to reduce the cost of expenditure on labour by maximising working time

Corresponding Author:
Inggit Marodiyah
Industrial Engineering Study Program, Muhammadiyah University of Sidoarjo
E-mail address: inggit@umsida.ac.id
DOI : https://doi.org/10.61796/ipteks.v1i2.190

INTRODUCTION

Sugarcane is one of the main crops used worldwide as a raw material for sugar production. Sugarcane is the number one crop cultivated globally in terms of production quantity. To achieve the maximum quantity of sugarcane production, sugarcane farming efficiency is needed. Efficiency is the extent to which the observed use of a resource to produce an output of a quality that is appropriate for optimal use of the resource to

produce a particular quality output[1]. The sugarcane farming conditions needed to meet the production target are conditions that are in accordance with the standards that have been set by each sugarcane producer or farmer, where these conditions are influenced by resources and environmental factors. This condition allows for variation in the goals of each manufacturer. Sugarcane plants are the only raw material for making granulated sugar or white sugar in Indonesia whose quantity needs to be increased to meet production needs in Indonesia[2]. The sugarcane plant itself, in addition to being a source of sugarcane-producing glucose, also has a carbohydrate content whose needs will always be important in line with the increase in humans, but unfortunately this is not balanced by the increase in sugarcane farming in Indonesia because many factors cause sugarcane farming to decrease productivity[3].

Farmers play an important role in increasing the productivity of sugarcane plants. Farmers can obtain higher sugarcane yields by providing adequate irrigation depending on the needs during different stages of crop growth and the application of chemical fertilizers based on soil analysis. These practices can be better managed under small farms where farmers have greater control. The quality of sugarcane can be improved by harvesting at the optimum ripeness period and minimizing the time it takes to deliver the harvest from the orchard to the sugar mill. The farmers receive input support, production services, credit support, appropriate technology, skill transfer and guaranteed and fixed prices from the Agriculture, Plantation and Livestock Office of Sidoarjo Regency. Agricultural production is strongly conditioned by the fact that inputs are converted into outputs with a considerable time gap[4]. Farmers can obtain higher sugarcane yields by providing adequate irrigation depending on the needs during different stages of crop growth and the application of chemical fertilizers based on soil analysis. These practices can be better managed under small farms where farmers have greater control. The quality of sugarcane can be improved by harvesting at the optimum ripeness period and minimizing the time it takes to deliver the harvest from the orchard to the sugar mill. Sugarcane farmers have many external factors that are challenges in increasing sugarcane productivity, so farmers must be able to adapt to the environment to maintain their agricultural products[5]. External factors that affect sugarcane agricultural products other than inputs such as raw materials, tools, and labor are pest factors, where the factor of decreasing sugarcane productivity because pests are difficult for sugarcane farmers to control[6].

In activities to develop the productivity level of the sugar industry, it must be in line with the increase in the productivity of sugarcane plants in accordance with the quality standards applied. The level of productivity of sugarcane farmers is influenced by the selection of buying types of seedlings, sugarcane plant care processes such as fertilization, weeding, pest and disease control. The improvement of plant quality, the improvement of planting efficiency, and the increase in farmer productivity are intended to improve the quality of sugarcane because with this improvement in quality, the yield or output can be accepted by consumers and partners[7]. The use of bud chip seeds in fulfilling the increase in sugarcane yield and its management to meet superior seeds. In an effort to increase sugarcane planting yield or output, it is necessary to measure productivity[8]. In achieving the national sugar self-sufficiency program, bud chip type sugarcane planting raw materials are needed in the application of sugarcane agricultural technology[9]. The level of sugarcane maturity in the unit of planting area can increase the yield so that from the beginning the growing plant must be managed properly. The

increase in the productivity of the sugar industry also plays a role in improving the economic, political, and social dimensions. Sugar is a strategic food commodity that is indispensable to the community, therefore the availability of sufficient stock is very welcome. In improving the sugar industry, it is necessary to start by increasing the productivity of pre-sugarcane farmers[10]

Therefore, this research is aimed at increasing the productivity of sugarcane farmers in Kajartengguli Prambon Sidoarjo village. The purpose of increasing sugarcane productivity is based on a drastic decrease in sugarcane agricultural productivity, resulting in not maximizing the profits of sugarcane farmers. In 2021, sugarcane farmers in Kajartengguli Prambon Sidoarjo earned a profit of IDR 252,040,000 while in 2022 the profit decreased by 10%. Green productivity is a product or service that results from the application of engineering, technology and the right management system and is not bad for the environment. Green Productivity identifies two needs that are always in the problem, namely the need for effort to make a profit and the need for people to protect their environment[11]. Minimization is carried out on capital expenditure in the field of environmental care, for example the use of natural resources that are maximized. Minimizing production waste, reducing pollution and increasing production is better so that from the implementation of green productivity, it is expected to increase productivity. In the implementation of green Productivity Likelihood of Occurrence eco-eficiency higher results that will affect the sustainable industrial system[12]. Green productivity is a method that has a function in helping businesses in increasing productivity and reducing environmental damage[13]. Growth green productivity It is used as an indicator to measure the performance of green growth or natural growth, reflecting economic growth, energy and pollution emissions. Growth green productivity is currently a more focused topic than Total Productivity Factor (TFP) or a term that refers to production inputs that affect productivity[14]. Green Productivity itself is a branch of a process design to increase production capacity that is environmentally and environmentally friendly in answering the framework of the sustainable development model for the next generation[15]. This research aims to increase the productivity of sugarcane farmers while preserving the environment without exploiting the environment around Kajartengguli Prambon Sidoarjo village. This research is updated from the previous research by applying an influence analysis Input against Output sugarcane plants are able to provide information on aspects Input What affects the productivity of sugarcane plants decreases. By providing information on the aspects that make the decrease in sugarcane productivity in Kajartengguli village, Prambon Sidoarjo, it can help sugarcane farmers in the area to increase their income and improve the welfare of farmers. Where in previous research, the approach to the productivity of sugarcane farmers in Kajartengguli Prambon Sidoarjo village has not been shown.

This research was conducted to increase the productivity of sugarcane farmers in Kajartengguli village, which had never been studied before. The area was chosen based on the needs of the community who felt a decrease in production. This research was carried out qualitatively using the cobb douglas method as a tool for data analysis.

METHODS

Research Design

This study uses the cobb douglass method with a quaitative approach. Where data is obtained from factors that affect the sugarcane processing process such as material/raw material inputs, labor inputs and machinery inputs as well as outputs obtained during a certain period.

Data collection and analysis methods

The data collection in this study was carried out by conducting interviews with experts as resource persons. The selected resource persons are sugarcane farmers in the Kajartengguli area who are directly related to sugarcane planting activities. Meanwhile, data analysis uses the cobb douglass method.

The stages and data analysis carried out in this study are as follows:

1. Identification of input and output aspects of sugarcane farming in Kajartengguli Prambon Sidoarjo village.
2. Calculation of sugarcane agricultural productivity.
3. Data analysis uses the cobb douglas function.

Cobb Douglas

The Cobb Douglas function is used to determine the production function in stochastic ftontier analysis. In addition, the linearity in parameters and the ease of estimation using the smallest square of the ordinary, can easily accommodate the estimated number of inputs. The irony is that the regression coefficient provides production elasticity, which is defined as the percentage change in the output level resulting from inputs. The Cobb-Douglas production function is a method in its solution that requires more than one variable, where the first variable is the dependent variable (Y) and the second variable is the independent variable (X). Regression is a way to solve the connectivity between X and Y, where the dependent variable will be affected by the variable X. Thus the constants on the regression line also apply in the completion of the Cobb-Douglas function[16]. The Cobb-Douglas function is often used to analyze the hypothesized factors that affect the production output of an activity, the factors that affect production are analyzed to determine the measure of productivity[17].

The cobb-douglas function in this study is used because it has an easy solution method. Another reason for the widespread use of the Cobb-Douglas production function is that calculations using empirical investigations of elasticity values have yielded many accurate estimates[18]. The Cobb-Douglas function model can be used to estimate future productivity levels, which can prevent future productivity declines[19]. Cobb Douglas's production function is also very flexible because it can be used to estimate productivity in the world of services, which is a real calculation in converting initial capital and labor into something that produces products or services. Cobb Douglas production function analysis is an approach method that has a solution model in the form of equations based on relationships and their effects on dependent and independent variables[20]. The cobb-douglas function technique can also be used in testing the contribution of capital value

(Input) an investment in productivity levels. The cobb-douglas function usually uses two variables, namely capital (K) and labor (L) which can substitute for each other[21].

Stages of calculating the cobb douglas function[22] :

a. Determines the input and output data.
b. Naturalize the actual data of inputs and outputs into logarithmic form.

$$\text{LnY} = L_n\beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 \qquad (1)$$

Where:
And = output sugarcane or total sales of sugarcane plants
X1 = input raw materials or sugarcane seeds
X2 = input labor or farm labor
X3 = input sugarcane farming machinery or tools
= constantβ_0
= regression coefficient$\beta_{1,2,3}$
e = error term

c. Finding productivity equations.

$\sum X_1 \bar{Y} = b_1 \sum (X_1)^2 + b_2 \sum X_1 \overline{X_2} + b_3 \sum X_1 \overline{X_3}$ (1)
$\sum X_2 \bar{Y} = b_1 \sum X_1 \overline{X_2} + b_2 \sum (X_2)^2 + b_3 \sum X_2 \overline{X_3}$ (2)
$\sum X_3 \bar{Y} = b_1 \sum X_1 \overline{X_3} + b_2 \sum X_2 \overline{X_3} + b_3 \sum (X_3)^2$ (3)
$a = Y - b_1 X_1 - b_2 X_2 - b_3 X_3$
$Y = a + + + b_1 X_1 b_2 X_2 b_3 X_3$

d. Look for the determination coefficient (R2).

$$Ry\ (1,2,3) = \frac{b_1 \sum X_1 \bar{Y} + b_2 \sum X_2 \bar{Y} + b_3 \sum X_3 \bar{Y}}{\sum Y^2}$$

$$R2 = Ry(1,2,3)^2$$

e. Test F.

$$F = \frac{R^2(N-m-1)}{m\,(1-R^2)}$$

Where:
N = number of data periods
M = many aspects input

f. Data analysis.

RESULT AND DISSCUSION

The following are the results of the calculation in this study where the stages of the research are as follows:

1. Identification of input and output aspects of sugarcane farming in Kajartengguli Prambon Sidoarjo village

   Sugarcane Farmer Production Data in 2021-2022

   Production data is also called output or production output is noted with the letter Q, which is the total amount of sales of sugarcane agricultural products. Meanwhile, the input data in this study is divided into three, namely the input on the use of raw materials or sugarcane seeds is noted with the letter M, the input on the use of labor/farm labor is noted with the letter L, and the input on the use of machinery or farm tools is marked with the letter T. The following is a recap of the data in 2021-2022 agricultural products shown in table 1.

Table 1. Output Data (Ouput) and Input (Input) for 2021-2022

No	Year	Output	Input Type		
		Q (Rp. Million)	M (Rp. Million)	L (Rp. Million)	T (Rp. Million)
1		973.23	295.00	486.50	11.00
2	2021	125.00	35.25	40.00	36.00
3		205.26	66.65	75.00	6.05
4		1016.08	301.25	526.00	18.20
5	2022	126.00	27.05	42.70	12.00
6		190.80	66.00	82.35	7.20
	Total	2636.37	791.20	1252.55	90.45

The table above illustrates the sales results of sugarcane farming in the 2021-2022 period, it is known that in one year there are 3 sales of sugarcane products. The data was used to analyze whether the productivity of sugarcane farming in Kajartengguli village was good or not.

2. Calculation of sugarcane agricultural productivity.

   Productivity Calculation for Each Input

   Below are the stages of calculating sugarcane agricultural productivity in 2021-2022 for each input. The method of calculating sugarcane agricultural productivity is carried out by dividing the input value of each category by the output value of sugarcane agriculture.

Table 2. Raw Material Input Productivity in 2021-2022

No	Year	Q (Rp. Million)	M (Rp. Million)	P
1		973.23	295.00	3.30
2	2021	125.00	35.25	3.55
3		205.26	66.65	3.08
4		1016.08	301.25	3.37
5	2022	126.00	27.05	4.66
6		190.80	66.00	2.89

Table 2. Describes the amount of raw material input productivity to sugarcane sales output.

Based on table 2 above, it can be seen that the productivity of raw materials at the end of the 2022 period has decreased. This shows the need to improve the production process so that the company does not experience a decrease in productivity.

Table 3. Labor Input Productivity 2021-2022

No	Year	Q (Rp. Million)	L (Rp. Million)	P
1		973.23	486.50	2.00
2	2021	125.00	40.00	3.13
3		205.26	75.00	2.74
4		1016.08	526.00	1.93
5	2022	126.00	42.70	2.95
6		190.80	82.35	2.32

Table 3. Describe the amount of labor input productivity to sugarcane sales output.

Based on table 3 above, it can be seen that labor productivity in 2022 is unstable because it has decreased in the first and last period. This shows the need to improve the production process so that the company does not experience a decrease in productivity.

Table 4. Input Productivity of Machinery/Farming Equipment in 2021-2022

No	Year	Q (Rp. Million)	T (Rp. Million)	P
1		973.23	11.00	88.48
2	2021	125.00	36.00	3.47
3		205.26	6.05	33.93
4		1016.08	18.20	55.83
5	2022	126.00	12.00	10.50
6		190.80	7.20	26.50

Table 4. Describes the amount of input productivity of agricultural machinery/tools to the output of sugarcane sales. Based on table 4 above, it can be seen that the productivity of agricultural machinery/tools every year experiences a drastic decrease every second period. This shows the need to improve the production process so that the company does not experience a decrease in productivity.

3. Data analysis uses the cobb douglas function.

Natural Logarithm Data (ln) from Sugarcane Agricultural Output and Inputs in 2021-2022

Table 5 will present the actual data of outputs and inputs that have been naturalized into logarithmic form.

a. Naturalize the actual data of inputs and outputs into logarithmic form.

Table 5. Logarithm Data on Natural Output and Logarithm Natural Input in 2021-2022

No	Year	Output Type		Input Type					
		Q (Rp. Juta) (Y)	(Y^2)	M (Rp. Million) (X1)	(X1^2)	L (Rp. Million) (x2)	(X2^2)	T (Rp. Million) (x3)	(X3^2)
1		6.88	47.34	5.69	32.34	6.19	38.28	2.40	5.75
2	2021	4.83	23.31	3.56	12.69	3.69	13.61	3.58	12.84
3		5.32	28.35	4.20	17.64	4.32	18.64	1.80	3.24
4		6.92	47.94	5.71	32.58	6.27	39.25	2.90	8.42
5	2022	4.84	23.39	3.30	10.87	3.75	14.09	2.48	6.17
6		5.25	27.58	4.19	17.55	4.41	19.46	1.97	3.90
(∑)	Total	34.04	197.91	26.64	123.68	28.62	143.34	15.14	40.32
	Average	5.67		4.44		4.77		2.52	

Table 5. It is a form of original data that has been naturalized into logarithms. The natural logarithmic function itself is useful for solving problems with high variable values, so that with natural logarithms, the function can be simplified. Based on table 5 above, it is known that the total value of each variable X1, X2, and X3 will be used in the calculation of determination to find out which factors affect the most decrease in sugarcane agricultural productivity. So, these factors can be evaluated and eliminated.

b. Finding productivity equations.
From the calculations in this study, the results of the sugarcane farmer productivity equation are obtained as follows, namely:
Y = 0.11 + 0.46X1 + 0.39X2 + 0.66X3

c. Look for the determination coefficient (R2).
Then, we searched for a double correlation equation of 3 predictors on the productivity of sugarcane farmers based on the double correlation formula of 3 original predictors and obtained the following results:
Ry (1,2,3) = 0.86
Coefficient of determination (R2) = (0.862) = 0.74

d. Test F.
So, after that, the calculation of the F test was carried out and the significance test value of the double correlation coefficient was obtained as follows, namely:
F = 1,15
After the data processing calculation is carried out in obtaining the value of the regression coefficient in the existing period, new values will be obtained for the equation of the production function of sugarcane farmers with Cobb Douglas which is presented in the following table.

Table 6. Comparison of Coefficient of Production Value with Cobb-Douglas

Coefficient	Year 2021-2022
Y = a = τ	0.11
X1 = b1 = α	0.46
X2 = b2 = β	0.39
X3 = b3 = γ	0.66
Production Efficiency Index (δ)	1.11
Production Elasticity from Inputs ($\alpha + \beta + \gamma$)	1.51

From table 6, it can be seen that the final result of the calculation of sugarcane agricultural productivity shows the lowest value of the productivity inhibiting function is found in the symbol X2 which means that the labor input has the lowest productivity value which causes the level

of productivity of sugarcane farming not to be optimal. Good productivity is a value that is close to the number 1.

CONCLUSION

Analysis of the productivity of sugarcane agricultural raw materials, based on the results of the productivity calculation in this study after making calculations using the Cobb-Douglas production function, it can be concluded that the input that has the greatest influence on the productivity of sugarcane farmers, namely labor, is evidenced by the smallest elasticity value, which means that it has a large influence on productivity. Thus, the conclusion for the 2021-2022 period is that the level of productivity of sugarcane farmers is still small due to the huge costs incurred for labor. Therefore, it is necessary to increase farmers' productivity by minimizing cost expenditure on labor. Another alternative to reduce labor costs is by working effectively and efficiently, meaning maximizing time as best as possible. The implication of this study is to increase plant productivity by using advanced technology and optimizing labor and production costs. Environmental sustainability by managing water efficiently. And the welfare of the workforce with the implementation of k3 and the compensation obtained. The development of further research has created a sensor-based monitoring system and automation that can improve efficiency and productivity..

REFERENCES

[1] M. A. Orinda, R. O. Mosi, M. A. Ayieko, F. A. Amimo, and H. Y. Nchimbi, "Technical Efficiency of Cricket (A. domesticus and G. bimaculatus) Production: A Cobb-Douglas Stochastic Frontier Approach".

[2] N. Andeva, W. Indrawati, and A. Kusumastuti, "Produktivitas Tebu (Saccharum officinarum L.) Asal Bibit Bud Chips (Ujung, Tengah, Pangkal) Akibat Aplikasi Mulsa Bagasse," *J. Agro Ind. Perkeb.*, vol. 6, no. 2, p. 99, Oct. 2018, doi: 10.25181/jaip.v6i2.815.

[3] H. F. Aditya and F. D. Permatasari, "Effect of Different Doses of Liquid Organic Fertilizer on the Growth of Lettuce Plants (Lactuca sativa L.): Pengaruh Perbedaan Dosis Pupuk Organik Cair Terhadap Pertumbuhan Tanaman Selada (Lactuca sativa L.)," *J. Appl. Plant Technol.*, vol. 2, no. 2, pp. 128–135, Nov. 2023, doi: 10.30742/japt.v2i2.109.

[4] S. Matsvai, A. Mushunje, and S. Tatsvarei, "Technical efficiency impact of microfinance on small scale resettled sugar cane farmers in Zimbabwe," *Cogent Econ. Finance*, vol. 10, no. 1, p. 2017599, Dec. 2022, doi: 10.1080/23322039.2021.2017599.

[5] I. M. Maharani, N. Hanani, and S. Syafrial, "Bagaimana Petani dalam Pengelolaan Risiko? Persepsi dan Perilaku Petani Tebu di Jawa Timur," *JSEP J. Soc. Agric. Econ.*, vol. 16, no. 1, p. 25, May 2023, doi: 10.19184/jsep.v16i1.38094.

[6] I. Marodiyah, A. S. Cahyana, and I. R. Nurmalasari, "INTEGRASI METODE QRM DAN FMEA DALAM MANAJEMEN RISIKO PETANI TEBU," vol. 02, no. 03, 2022.

[7] R. Trizudha, S. Rahayuningsih, and A. Komari, "Studi Kualitas Puding Melalui Pendekatan Six Sigma Studi Kasus Di Pt. Keong Nusantara Abadi," *JURMATIS J. Ilm. Mhs. Tek. Ind.*, vol. 1, no. 1, p. 44, Mar. 2019, doi: 10.30737/jurmatis.v1i1.1009.
[8] M. B. Anthony, "Pengukuruan Produktivitas Dengan Menggunakan Metode Objective Matrix di PT.ABC," *JATI UNIK J. Ilm. Tek. Dan Manaj. Ind.*, vol. 3, no. 1, pp. 13–30, Oct. 2019, doi: 10.30737/jatiunik.v3i1.494.
[9] S. Irianti, W. Indrawati, and A. Kususmastuti, "Respons Bibit Bud Chips Batang Atas, Tengah, dan Bawah Tebu (Saccharum officinarum L.) terhadap Aplikasi Dosis Mulsa Bagasse," *J. Agro Ind. Perkeb.*, vol. 5, no. 1, p. 15, Dec. 2017, doi: 10.25181/aip.v5i1.648.
[10] Juli Panglima Saragih, "PRODUCTION SYSTEM DINAMIC AND POLICY PERSPECTIVE OF REVITALIZATION OF INDUSTRY FOR SELF-SUFFICIENCY OF SUGAR SUPPLY," *Kajian*, vol. 22, no. 4, pp. 281–300, Desember 2017.
[11] H. Santoso and P. Nugrahaeni, "PENERAPAN 'GREEN PRODUCTIVITY' UNTUK PENINGKATAN PRODUKTIVITAS DAN KINERJA LINGKUNGAN DI PABRIK GULA SRAGI," 2015.
[12] D. Zhang, "Green credit regulation, induced R&D and green productivity: Revisiting the Porter Hypothesis," *Int. Rev. Financ. Anal.*, vol. 75, p. 101723, May 2021, doi: 10.1016/j.irfa.2021.101723.
[13] Y. Wang, X. Sun, and X. Guo, "Environmental regulation and green productivity growth: Empirical evidence on the Porter Hypothesis from OECD industrial sectors," *Energy Policy*, vol. 132, pp. 611–619, Sep. 2019, doi: 10.1016/j.enpol.2019.06.016.
[14] A. J. Nugroho and D. Sentoso, "Analisis Risiko Limbah di Lingkungan Pekerja dengan Metode Enviromental Risk Analysis Untuk Mendukung Pelaksanaan Green Productivity," 2022.
[15] M. Fatikhin and N. Sudjoni, "ANALISIS EFISIENSI USAHATANI SERTA FAKTOR-FAKTOR YANG MEMPENGARUHI PRODUKSI TEBU DI DESA BADANG KECAMATAN NGORO KABUPATEN JOMBANG".
[16] D. Hastuti, H. Wibowo, E. Subekti, and P. Aditama, "(STUDI KASUS DESA SIDOMUKTI KECAMATAN BANDUNGAN KABUPATEN SEMARANG)".
[17] S. Gechert, T. Havránek, Z. Havránková, and D. Kolcunova, "Death to the Cobb-Douglas production function".
[18] B. Mahaboob, K. A. Ajmath, B. Venkateswarlu, C. Narayana, and J. P. Praveen, "On Cobb-Douglas production function model," presented at the RECENT TRENDS IN PURE AND APPLIED MATHEMATICS, Vellore, India, 2019, p. 020040. doi: 10.1063/1.5135215.
[19] M. N. Purwanto, L. Abdurrahman, and A. F. Santoso, "ANALISIS INVESTASI TEKNOLOGI INFORMASI PADA PT BANK MANDIRI DENGAN MENGGUNAKAN FUNGSI PRODUKSI COBB-DOUGLAS," *JIPI J. Ilm. Penelit. Dan Pembelajaran Inform.*, vol. 8, no. 1, pp. 94–105, Feb. 2023, doi: 10.29100/jipi.v8i1.3294.
[20] D. P. Ningrum, L. Abdurrahman, and A. F. Santoso, "Analisis Performansi Biaya Teknologi Informasi Menggunakan Fungsi Produksi Cobb Douglas Pada PT. Telkom Indonesia".

[21] R. Noelsa and E. Kurniati, "Analisis Marginal Rate of Technical Substitution (MRTS) Pada Fungsi Produksi Cobb-Douglas," *Bdg. Conf. Ser. Math.*, vol. 2, no. 2, Aug. 2022, doi: 10.29313/bcsm.v2i2.4812.
[22] M. Y. Fonisasi and A. N. Hutapea, "Faktor-Faktor yang Mempengaruhi Produksi Kacang Tanah di Desa Fafinesu Kecamatan Insana Fafinesu Kabupaten Timor Tengah Utara," *AGRIMOR*, vol. 4, no. 1, pp. 4–6, Sep. 2019, doi: 10.32938/ag.v4i1.565.