Jurnal Kebijakan Ekonomi dan Keuangan
Available at https://journal.uii.ac.id/jkek

The determinant of agriculture development in Indonesia

Aminuddin Anwar

Department of Economics, Universitas Islam Indonesia, Daerah Istimewa Yogyakarta, Indonesia
Corresponding author: aminuddin.anwar@uii.ac.id

JEL Classification Code:
Q10, Q18, O13

Kata kunci:
Agriculture; Error Correction Model; Cointegration; Climate Change

DOI:
10.20885/JKEK.vol1.iss2.art2

Abstract

Purpose – *This study aims to analyze the determinants of agriculture in Indonesia, represented by the variables of labor, land, fertilizer, and rainfall for 1991 to 2018.*

Methods – *This study uses the time series method by utilizing aggregate data at the national level in Indonesia. The method used in this research is the cointegration and error correction model (ECM).*

Findings – *The results of this study indicate that in the short term, the factors that determine agricultural conditions in Indonesia are the amount of land and the use of fertilizers which show a positive impact. Meanwhile, the long-term results show that all variables, namely labor, land, fertilizer, and rainfall, impact agricultural conditions in Indonesia. The adjustment in the short-term to long-term process is shown that there is an adjustment for agricultural conditions in Indonesia.*

Implication – *This study indicates that the policies carried out by the government in the agricultural sector are important for internal aspects, namely labor, land, and fertilizer, and on external effects such as climate change so that appropriate policy interventions can increase agricultural production in Indonesia.*

Originality – *This research contributes to modeling the determinants of the agricultural sector in Indonesia with the error correction model (ECM).*

Abstrak

Tujuan – Penelitian ini bertujuan untuk menganalisis determinan pertanian di Indonesia yang diwakili oleh variabel tenaga kerja, tanah, pupuk, dan curah hujan tahun 1991 sampai dengan tahun 2018.

Metode – Penelitian ini menggunakan metode time series dengan memanfaatkan data agregat tingkat nasional di Indonesia. Metode yang digunakan dalam penelitian ini adalah kointegrasi dan *error correction model* (ECM).

Temuan – Hasil penelitian ini menunjukkan bahwa dalam jangka pendek faktor yang menentukan kondisi pertanian di Indonesia adalah jumlah lahan dan penggunaan pupuk yang menunjukkan dampak positif. Sementara itu, hasil jangka panjang menunjukkan bahwa semua variabel yaitu tenaga kerja, tanah, pupuk, dan curah hujan mempengaruhi kondisi pertanian di Indonesia. Penyesuaian dalam proses jangka pendek ke jangka panjang menunjukkan adanya penyesuaian kondisi pertanian di Indonesia.

Implikasi – Penelitian ini menunjukkan bahwa kebijakan yang dilakukan pemerintah di bidang pertanian penting untuk aspek internal yaitu tenaga kerja, lahan, dan pupuk, serta terhadap dampak eksternal seperti perubahan iklim sehingga intervensi kebijakan yang tepat dapat meningkatkan produksi pertanian di Indonesia.

Orisinalitas – Penelitian ini berkontribusi dalam memodelkan determinan sektor pertanian di Indonesia dengan model *error correction model* (ECM).

Introduction

The agricultural sector is one of the important sectors in developing countries because most people in developing countries tend to be dominated by traditional people whose main economic activity is working in the agricultural sector. This agriculture issue is crucial because first, the fulfillment of domestic food ingredients is one of the crucial things that the government must do by implementing various appropriate policies; second, the sector of land availability which is relatively wide enough to allow the community to use it based on agricultural development; third, the population in developing countries tends to be significant, and the majority have low-income conditions and have minimal expertise. This condition is why most of the economic activities people in developing countries are in the agricultural sector. This condition certainly has significant implications for policies that the government must carry out related to these matters to improve the agricultural sector. A further implication of the government's ability to develop the agricultural sector is the implications for economic development (McArthur & McCord, 2017) which are reflected in food security (Ben et al., 2015), urbanization (Raihan et al., 2022; Raihan & Tuspekova, 2022), the energy sector (Ali et al., 2020), poverty (Maisonnave & Mamboundou, 2022), and the degradation of environmental conditions (Bai et al., 2021; Wang, 2022).

Another aspect that is an essential issue in the agricultural sector is problems related to policies carried out by the government as expressed (Barichello & Patunru, 2009) that there are several problems encountered with agricultural conditions in Indonesia, including policies related to rice, protection against trade agriculture, agricultural productivity inequality, and poverty. These problems indicate that agricultural conditions cannot be separated from government intervention to develop various programs and policies oriented toward the agricultural sector. Another important thing is that agricultural needs between developing and developed countries have very different requirements, as evidenced by (Gollin et al., 2017), who analyze the differences in productivity between countries and conclude that agricultural productivity in developing countries is lower than in developing countries. This is undoubtedly an essential concern for various parties, especially the government, to conduct studies related to the issue of agricultural conditions in developing countries.

The condition of agricultural development and the determinant factors is shown in Figure 1, which shows the relationship between agricultural production and labor in the agricultural sector and agricultural production and the amount of agricultural land. The relationship between agricultural production and labor conditions in the agricultural sector shows that the two have an inverse relationship, where from 1991 to 2018, agricultural production increased yearly. However, the workforce in the agricultural sector has decreased from year to year. This condition shows that one of the crucial aspects of agricultural production, namely labor, has been reduced yearly. Another condition shown in Figure 1 is the relationship between agricultural production and agricultural land, which shows a unidirectional relationship because there was an increase between agricultural production and the amount of agricultural land during that period.

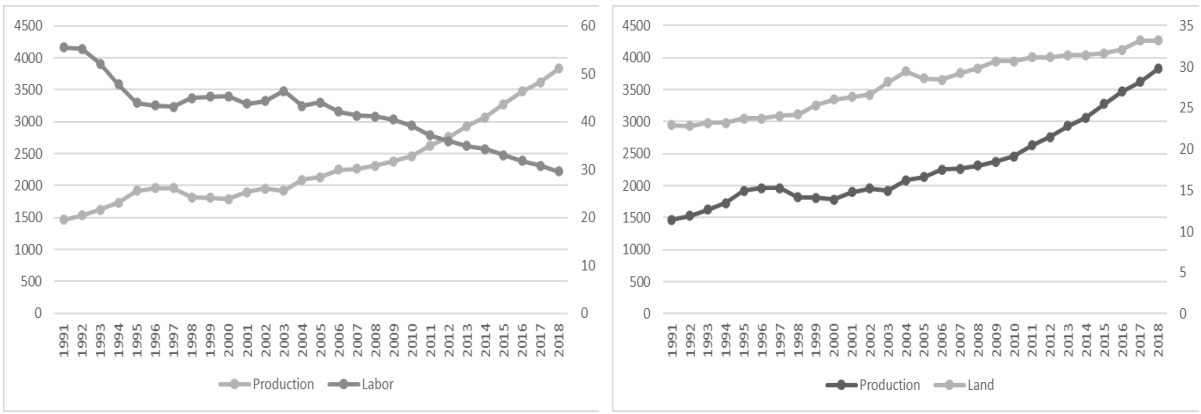

Figure 1. Development of Agricultural Production, Labor, and Total Land

The initial study, which is an essential part of the development of the agricultural sector, is to analyze the influence of the agricultural sector on economic growth and development. A study conducted by (Brückner, 2012) explains the agricultural sector and urbanization on economic growth in countries in Africa and concludes that the agricultural sector makes a significant contribution to a country's economy. Another study (Dethier & Effenberger, 2012) shows that, in general, agricultural growth impacts economic growth and economic development by reducing poverty. The impact of developing the agricultural sector for developing countries is that it can improve people's income conditions and will have implications for the country's economic conditions. A study of the relationship between the agricultural sector and economic growth and human capital in Indonesia was carried out (Bashir & Susetyo, 2018), and the relationship between agriculture, industry, and economic development in Indonesia (Bashir et al., 2019). Indonesia, which has people primarily in rural areas and the majority work in the agricultural sector, is an essential part of identifying the agricultural sector's role in economic development in Indonesia.

The diversity of determinants in the agricultural sector analysis shows that the role and impact of the agricultural sector is an important part. This condition is indicated by the existence of several particular implications of the presence of the agricultural sector. One crucial aspect is the change in land use shown by (Yamamoto et al., 2019) about the shift from forest to agriculture in Indonesia. Another condition is shown in Vietnam by (Le, 2020) due to land use restrictions and misallocation of the agricultural sector, and by (Abman & Carney, 2020), which analyzes land ownership rights that have implications for agricultural productivity and deforestation. In line with the above issues, land use consolidation and labor allocation are essential factors in agricultural productivity (Tran et al., 2022) and the existence of communal land use that often occurs in developing countries in agricultural productivity (Gottlieb & Grobovšek, 2019).

Another aspect that is the focus of research related to agriculture is the issue of agricultural productivity. The issue of productivity becomes essential because the development of shared research is carried out to analyze the main determinants of agricultural productivity. One of the studies (Headey et al., 2010), analyzing productivity conditions between countries in the world, concludes that institutions, policy changes in prices, and government spending on the agricultural sector have essential effects on agricultural productivity. Another study related to agricultural productivity was shown by (Anik et al., 2017) in South Asia, while another survey on agricultural productivity in Indonesia was conducted by (Rada et al., 2011), which examined the impact of government policies on agricultural productivity. In addition, another study conducted by (Mamba & Ali, 2022) in Africa examined the effect of exports on the agricultural sector. An analysis of the impact of labor productivity on the agricultural industry and the agricultural system in Europe was carried out (Giannakis & Bruggeman, 2018).

Another study of the agricultural sector is indicated by its determinant, which is an external factor of changing climatic conditions. Some of these studies by (Iglesias et al., 2011) analyze adaptation strategies of the agricultural sector in the Mediterranean region due to climate change. Meanwhile, research from (Adams et al., 1999) which investigated the impact of climate change on agriculture, concluded that the adaptation of agricultural conditions due to climate change in the farming system impacted food production and prices. Another study (Barrios et al., 2008) analyzed the effects of climate change on agricultural production in African countries, which showed different effects between several African countries due to climate change. In addition, a study in South Asia by (Zakaria, Jun, & Khan, 2019) concludes that in the initial conditions, financial development tends to increase agricultural productivity but will decrease agricultural productivity in the next period. Several follow-up studies on climate change have focused on the effects of CO2 development which have implications for agricultural productivity in China by (Luo et al., 2017), an analysis in ASEAN conducted by (Chopra et al., 2022) which analyzes the sustainability of the agricultural sector in the presence of energy. renewable energy and carbon emissions, and an analysis in Bhutan by (Rehman et al., 2022) focusing on the effects of carbon emissions. Based on these initial conditions and the development of previous studies to analyze the factors that determine agricultural development, this study develops a model for the agricultural sector in Indonesia by including climate change variables.

Research Methods

This empirical research was conducted to analyze the determinants of the Agricultural Sector in Indonesia in a study using time series data for the period 1991 to 2018. The analysis carried out used an econometric approach that focused on using time series methods. This study analyzes the factors that determine the improvement of the agricultural sector in Indonesia in the long and short term and analyzes the adjustment of the conditions of the agricultural sector in Indonesia using the Cointegration and Error Correction Model (ECM) approach. The variables used in this study are aggregate variables for the agricultural industry, and their determinants can be shown in the table.

Table 1. Definition of Variable

Variables	Symbol	Units	Definition
Agriculture	$Agric_t$	US Dollar	Agriculture value added is the net output of the agriculture sector after adding up all outputs and subtracting intermediate inputs.
Labor	$Labor_t$	Percent	People of working age were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not, due to temporary absence from a job or working-time arrangement in the agriculture sector.
Land	$Land_t$	Percent	Agricultural land refers to the share of arable land under permanent crops and pastures.
Fertilizer	$Fertilizer_t$	Kg per Hectare	Fertilizer consumption measures the number of plant nutrients used per unit of arable land
Rainfall	$Rainfall_t$	Millimeters	Average rainfall for one year

The basic concept of cointegration which was initiated by (Granger, 1981), is that the cointegration condition of two series occurs when the two series move under the same conditions without the influence of the variable lag value and trend, and these conditions in the short term will tend to be different but will be tied together in the long run. Further explained by (Granger, 1986) and (Engle & Granger, 1987) that non-stationary time-series data at the level I(0) after I(1) is differentiated into stationary, then there is a linear combination so that to be cointegrated, it must have a level of integration the same one. Based on these conditions, this study will analyze the adjustment process that occurs in the conditions of agricultural development in Indonesia and the factors that influence it. The economic model used in this study is that the condition of agriculture in aggregate in Indonesia is determined by Agricultural Sector Labor, Total Agricultural Land, Fertilizer Use, and Rainfall Rates. Specifically, the economic model of this research is shown in the following equation:

$$\text{Agriculture} = f(\text{Labor}, \text{Land}, \text{Fertilizer}, \text{Rainfall})$$

Based on the economic model, the derivation of the economic model as the basis for estimating in this study was formed into several model equations by distinguishing between the Short-Term Model and the Long-Term Model. Equation 1 shows a long-term model that shows the relationship between factors influencing agricultural development in Indonesia.

$$Agric_t = \beta_0 + \beta_1 Labor_t + \beta_2 Land_t + \beta_3 Fertilizer_t + \beta_4 Rainfall_t + \varepsilon_t \quad (1)$$

Meanwhile, to be able to analyze the balancing process as indicated by the adjustment process in the model, the model for agricultural development in Indonesia is shown by equation 2, which is a model for the short term with Error Correction (EC) or the adjustment value in the components of the model equation.

$$\Delta Agric_t = \delta_0 + \delta_1 \Delta Labor_t + \delta_2 \Delta Land_t + \delta_3 \Delta Fertilizer_t + \delta_4 \Delta Rainfall_t + \gamma\, EC_t + \varepsilon_t \quad (2)$$

Where is the value

$$EC_t = (Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) \quad (3)$$

Based on equations 1 and 2 above, the value of $Agric_t$ is the value of agricultural production, $Labor_t$ is the number of workers in the agricultural sector, $Fertilizer_t$ is the value of

the amount of fertilizer used, $Rainfall_t$ is the value of rainfall, and EC is the error correction which represents the adjustment value in the model. The coefficient values $\beta_1, \beta_2, \beta_3,$ and β_4 are long-term estimation coefficient values that represent the magnitude of the influence of agricultural determinants in Indonesia. Meanwhile, in the short term, the coefficient values $\delta_1, \delta_2, \delta_3$ and δ_4 are short-term estimation coefficient values that represent the magnitude of the influence of agricultural determinants in Indonesia. In addition, the value of γ, which is the coefficient value of the error correction, represents the model's adjustment value.

The estimation procedure carried out in this study begins with testing the model specifications, including testing the stationarity of the data, testing the classical assumptions on the data, and testing cointegration. This process is carried out to analyze the initial conditions of the data before the estimation process is carried out because before carrying out the model estimation process, the data conditions must have conditions that do not have unit roots and other problems in the model, such as autocorrelation. The stationarity test of the data was carried out using the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981) to test the stationarity of the data following the autoregressive (AR) pattern, namely AR (1) and higher AR. The procedure carried out in this ADF test is to compare the ADF statistical value with the critical value of the Mackinnon statistical distribution, where the decision on the ADF value can be concluded if the absolute value of the ADF statistic is greater than the critical value, then the data is stationary. If the absolute value of the ADF statistic is less than the critical value, then the data is not stationary.

Further testing carried out in this study is to prove the existence of an equilibrium condition indicated by the model's long-term adjustment process. This test is carried out using the Engle-Granger Cointegration approach (Engle & Granger, 1987), namely by using the residual value of the model, which shows that if the residual value is stationary at level or I(0), then the data has a linear combination so it can be concluded that the data cointegrated. After passing the model specification testing process, the following process can be done to carry out a model estimation process to prove the influence of factors on agricultural development in Indonesia and the adjustment conditions in the model by estimating the long-term model in equation one and the short-term model in equation two.

Results and Discussion

The results of the initial analysis of the condition of the research data shown in table 2 show the descriptive conditions of the data on each variable. The condition of the data for production shows that the average value of the data is at a value of 25,226 with a standard deviation of 0.256, while for labor, it is 41,785 with a standard deviation of 6,680, for the land variable, it is indicated by an average of 508630.4 with an average of 67050.2, for fertilizer has an average of 167,253 with a standard deviation of 39,901. The value for rainfall has an average of 238,119, with a standard deviation of 18,066. These results indicate that the condition of the data from this study has good initial data conditions with distributions on each variable, and there are no outlier values in the data.

Table 2. Descriptive Analysis

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
Production	25.22598	25.18281	25.69182	24.84181	0.255815
Labor	41.78536	43.21	55.51	29.63	6.680384
Land	508630.4	516730	623000	413510	67050.2
Fertilizer	167.2533	148.6229	236.4423	120.4108	39.90086
Rainfall	238.119	243.725	281.1	194.0333	18.06602

The time series analysis requires a structured procedure to provide the proper model specifications before estimating the model. The procedure implementation is carried out in stages, including testing the stationarity of the data, which prevents spurious regression. The next step is to find out whether there is an adjustment or term condition on the model, then a cointegration test analysis is carried out on the model. The data and model specification process results are carried out to conclude the best model that can be implemented in the data estimation procedure. The

subsequent analysis in the initial specifications on the time series data is to test the stationarity of the data, the results of which are shown in table 3. The results of the data stationarity test using the Augmented Dickey-Fuller (ADF) Test show that at the level for all variables, a probability value of 0.9694 is obtained for production, 0.1803 for Labor, 0.3151 for Land, 0.9558 for fertilizer, and 0.4447 for rainfall so based on this it shows that the data is not stationary at the level. Meanwhile, the results of stationarity at the First Difference level show that for production of 0.0004, the labor of 0.0327, land of 0.0043, fertilizer of 0.0000, and rainfall of 0.0000 so that it can be concluded that for all variables at the First Difference level, the data shows stationary conditions.

Table 3. Stationarity Test

Variables	Augmented Dickey-Fuller Test			
	Level		Fist Difference	
	t-Statistic	Probability	t-Statistic	Probability
Agriculture	-0.618486	0.9694	-5.819890	0.0004
Labor	-2.893974	0.1803	-3.803436	0.0327
Land	-2.523771	0.3151	-4.761061	0.0043
Fertilizer	1.400427	0.9558	-5.958992	0.0000
Rainfall	0.8029	0.4447	-7.881945	0.0000

The following process in the model specification is to carry out cointegration testing where this test is one of the essential stages to carry out the proper modeling process in the data to be able to provide the correct conclusions on the condition of the data in the process to analyze the adjustment conditions in the data for long-term conditions. In this study, cointegration testing was carried out using Engle-Granger cointegration (Engle & Granger, 1987), where the testing process was carried out by testing the residual value of the regression estimate with stationarity testing, which would later obtain the value of the stationary testing process at the level for the residual which would conclude cointegration conditions on the data. The results of cointegration using Engel-Granger are shown in table 4, which shows that the residual value at the level using the ADF obtained a probability value of 0.0022, so it can be concluded that cointegration in the model can be analyzed for any adjustments to conditions in the long run. These results indicate that based on agricultural conditions in Indonesia, the adjustment process to agricultural production in Indonesia is actual and proven to occur.

Table 4. Cointegration Test using Engel-Granger

Variables	Augmented Dickey-Fuller Test	
	Level	
	t-Statistic	Probability
Residual	-4.996828	0.0022

Further specification analysis on the model carried out in this study tests the classical assumptions on the model because the data analysis base used is ordinary Least Square. Testing the normality of the data and classical assumptions in this model is shown in Table 5, which tests the normality of the data, Testing Heteroscedasticity, Multicollinearity, and Autocorrelation. The first test was carried out by testing the normality of the data, which showed that the test results using Jarque Bera obtained a value of 0.57033 with a probability of 0.750875 so that it could be concluded that the data had conditions that were normally distributed. The following result was carried out to test the heteroscedasticity of the model using the Breusch-Pagan Godfrey obtained an Obs*R-squared value of 6.612179 with a probability of 0.1579, so it can be concluded that there is no heteroscedasticity in the model.

The follow-up result from table 5 is to perform serial autocorrelation and multicollinearity testing on the data. The next test for serial autocorrelation in the model with the Breusch-Godfrey LM Test shows that the Obs*R-squared value is 2.209471 with a probability value of 0.3313 can be concluded that there is no serial autocorrelation in the model. The results for testing multicollinearity on the model using the Variance Inflation Factor (VIF) show that for the labor,

the value is 6.1075, the land is 5.8757, fertilizer is 4.1479, and rainfall is 1.1895 compared to the value required for VIF, which is 10, so for the entire dependent variable has a value less than 10 so it can be concluded that there are no symptoms of multicollinearity conditions. The results of the classical assumption test on this model indicate that this model does not have problems that cause the estimated value to be biased and not follow the model specifications.

Table 5. Classical Assumption Test

Normality Test			
	Value	Probability	
Jarque-Bera	0.573033	0.750875	
Heteroskedasticity Test			
	Obs*R-squared	Prob. Chi-Square (4)	
Breusch-Pagan-Godfrey	6.612179	0.1579	
Serial Correlation			
	Obs*R-squared	Prob. Chi-Square (2)	
Breusch-Godfrey LM Test	2.209471	0.3313	
Multicollinearity			
Variables	VIF	Variables	VIF
Labor	6.1076	Fertilizer	4.1479
Land	5.8757	Rainfall	1.1895

Based on the initial process of determining the best estimation model in the time-series model, it is shown that in the determinant model of agricultural development in Indonesia, it is found that the results of the data stationarity test show results that are not stationary at the level and stationary at the first difference. The next stage of analysis is to perform a cointegration test on the model, which shows that there is cointegration in the model. The last model specification analysis is a classical assumption test which concludes that the overall analysis procedure obtained good data conditions. Based on this, the appropriate time series method to analyze agricultural development in Indonesia is the Error Correction Model (ECM).

The estimation results in this study are shown in table 6, which shows the long-term and short-term models' results. Each column for the long-term and short-term estimation results for the effect of labor, land, fertilizer, and rainfall variables on agricultural conditions in Indonesia is shown by dividing the estimation results partially for each group of variables. In each group shown in column 1, the partial analysis results are the effects of the Land and Labor variables on agricultural conditions. In contrast, for column 2, the results of the partial analysis are the effects of the Fertilizer and Rainfall variables on agricultural conditions. The estimation results in the long term show some partial and overall impact of labor, land, fertility, and rainfall on agriculture in Indonesia, and the analysis results for the short term on the model are shown in column 3, which shows the estimation results for all variables and the value of Error Correction Term. (EC) which is the adjustment value in the ECM model.

The general results shown in table 6 for the long-term and short-term model of the determinants of agricultural development in Indonesia in this study indicate that in the long term, agricultural conditions in Indonesia are determined by all factors included in the model, namely labor, land area, fertilizer use, and rainfall. This result indicates that the internal and external impacts of the agricultural production process in Indonesia have an essential role. Meanwhile, the short-term results show conditions that are not much different because the dominant factors shown by land and fertilizer aspects on agricultural production in Indonesia show significant results. However, the results for labor and labor variables show the opposite condition. In addition, the results of the adjustment values that occur in this model indicate an adjustment from the short-term to the long-term balance for agricultural development in Indonesia.

The estimation results for table 6 and column 3 show that the influence of each variable on agricultural conditions in Indonesia shows various conditions. The long-term results for labor show that the coefficient value is -0.0080 with a probability value of 0.0000, which can be concluded that there is a negative effect of the level of labor on the level of agriculture in Indonesia. The estimation results for the variable agricultural land in the long term obtained a coefficient value

of 2.20E-06 with a probability of 0.0000, so it can be concluded that the influence of agricultural land area on agricultural conditions in Indonesia is positive and significant. The following result of the variable range of fertilizer use in Indonesia shows that in the long-term model, a value of 0.0017 is obtained with a probability value of 0.0000, which indicates a positive and significant effect on agricultural conditions in Indonesia. The condition of the climate change variable represented by the rainfall variable in the long term shows that a value of -0.0006 is obtained with a probability of 0.0451, which means that the influence of the level of rainfall and agriculture in Indonesia is negative and significant. The Error Correction Term (EC) results on agricultural conditions in Indonesia indicate that this value has a coefficient value of -0.525776 with a probability value of 0.0028, so it can be concluded that the EC value is negative and significant. The long-term results for labor show that the coefficient value is -0.0080 with a probability value of 0.0000, which can be concluded that there is a negative effect of the level of labor on the level of agriculture in Indonesia. Meanwhile, for the labor variable in the short term, the coefficient value is -0.002217 but not significant. This condition indicates that if there is a change in the level of labor in the agricultural sector, which tends to rise, it will have implications for the decline in agricultural conditions in Indonesia. This result is undoubtedly contrary to the basic theory, which shows that labor productivity will increase agricultural production, as revealed by a study conducted (Headey et al., 2010), which concluded that labor in agriculture positively impacts agricultural productivity in developing country's productivity. In addition, another thing that becomes important (Giannakis & Bruggeman, 2018) is that labor productivity is also influenced by the form and agricultural system implemented by a country. Another implication shown by (Tran et al., 2022) is the change from machinery in agricultural production to production inputs.

Table 6. Estimation Results

Long Run Estimation Result						
Variables	Dependent Variable: Agriculture					
	1		2		3	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
Constant	24.5103	0.0000	23.9912	0.0000	24.2867	0.0000
Labor	-0.0135	0.0001			-0.0080	0.0000
Land	2.52E-06	0.0000			2.20E-06	0.0000
Fertilizer			0.0058	0.0000	0.0017	0.0000
Rainfall			0.0011	0.3224	-0.0006	0.0451
F-statistic	464.4733		72.05993		860.2119	
Prob(F-statistic)	0.0000		0.0000		0.0000	
R-squared	0.9738		0.8522		0.9934	
Observation	28		28		28	
Short Run Estimation Result						
Variables	Dependent Variable: ∆(Agriculture)					
	1		2		3	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
C	0.025879	0.0000	0.030846	0.0000	0.021593	0.0001
∆(Labor)	-0.002238	0.2682			-0.002217	0.2548
∆(Land)	4.50E-07	0.1562			8.12E-07	0.0256
∆(Fertilizer)			0.000194	0.3858	0.000448	0.0636
∆(Rainfall)			-9.43E-05	0.4513	-0.000180	0.1554
EC	-0.419906	0.0124	-0.291249	0.0424	-0.525776	0.0028
F-statistic	2.484530		1.792547		2.545253	
Prob(F-statistic)	0.086145		0.176708		0.059615	
R-squared	0.244752		0.189503		0.377340	
Observation	27		27		27	

The estimation results for Indonesia's variable land of agriculture in the long term are positive and significant. Meanwhile, the short-term estimation results have a positive and significant effect. This result shows that the role of agricultural land in the development of the agricultural

sector in Indonesia is essential because when there is an increase in the amount of agricultural land, it will have implications for increasing agriculture in Indonesia. The results, which show that the influence of land area has a positive impact on agricultural production, are in line with those (Ghatak & Madheswaran, 2013) who concluded that this influence is part of the government's policy to improve the agricultural sector. This condition shows that land use has an essential role in improving agriculture in Indonesia, so it is necessary to carry out structured policies to increase productivity and land efficiency through various government policies. Land use change in Indonesia is indicated by (Yamamoto et al., 2019) about the shift from forest to agriculture in Indonesia. Another aspect that needs to be done by the government is the existence of restrictions as indicated (Le, 2020) and land ownership (Abman & Carney, 2020).

The following result of the variable range of fertilizer use in Indonesia shows that the long-term model indicates a positive and significant effect on agricultural conditions in Indonesia, and the short-term model has a positive and significant influence on agricultural conditions in Indonesia. The result of this study is in line with research by (Ghatak & Madheswaran, 2013) in Nepal, which also concluded that chemical fertilizers are a critical issue in the sustainability of increasing agricultural production. In addition, according to (Gollin et al., 2017), agriculture in developing countries tends to prevent the use of fertilizers because it will increase the risk of consumption.

The condition of the climate change variable represented by the rainfall variable in the long term shows that the influence of the level of rainfall and agriculture in Indonesia is negative and significant. Meanwhile, in the short term, results are not significant. This difference indicates that the effect of rainfall tends to impact the long term compared to the short term. It also shows that the effect of climate change, which is represented by rainfall, affects agricultural conditions in Indonesia, which shows a negative effect. This result is in line with research (Adams et al., 1999), which shows that the impact of climate change is shown in changes in agricultural productivity and product demand, which is indicated by changes in various preferences. In addition, research from (Barrios et al., 2008) shows that the impact of climate change on the differences in the level of agricultural productivity between countries in the analysis between countries in Africa

The Error Correction Term (EC) results on agricultural conditions in Indonesia are negative and significant. This result means that the ECM model is valid in showing the conditions of agricultural adjustment in Indonesia. This result implies that the adjustment value of agricultural conditions in Indonesia towards equilibrium conditions is 0.525776, so it can be analyzed that the equilibrium conditions that occur in agriculture in Indonesia can be indicated by a variation of 0.525776 in the values of Labor, Land, Fertilizer, and Rainfall towards equilibrium conditions. This condition is certainly evidence that the process of long-term equilibrium conditions that arise in agriculture in Indonesia is determined by several things, such as market policies and the agricultural industry (Rada et al., 2011), other policies related to externalities from the environment affect agricultural conditions (Yamamoto et al., 2019). This result is also in line with (Bashir & Susetyo, 2018), which concludes that the long-term adjustment process to agricultural conditions in Indonesia is influenced by economic growth and human capital in the long-term adjustment process.

Conclusion and Implications

Analysis of the agricultural sector becomes essential for Indonesia because the geographical and demographic conditions support the conditions for developing the agricultural sector. Based on the results of the analysis carried out to identify the determinants of agriculture in Indonesia by modeling it in the long-term and short-term using the cointegration method and error correction model, several conclusions can be obtained that can be used as material for the development of studies and policies in the agricultural sector in Indonesia. The results and conclusions obtained in this study are that the dominant factors in increasing agricultural production are land and using fertilizers in the short term. Meanwhile, long-term factors that influence agricultural development in Indonesia tend to depend more on labor, land area, fertilizer, and rainfall.

The conclusion that can be drawn from the study results for long-term conditions is that there is an essential role for all factors included in the model. These results indicate the position of

labor, land area, fertilizer, and rainfall in Indonesia's agriculture development. The role of labor in agricultural development is negative, which means that labor tends to have a negative impact on agriculture in Indonesia because the development of agricultural production today tends to be influenced by the quality of labor compared to its quantity, so it tends to create negative values. Another thing that is found in the long term is the positive impact of land area and the use of fertilizers, which means that the increase in agricultural production in Indonesia is still dominated by agricultural land development factors and the use of fertilizers to increase agricultural production through various programs for opening new agricultural lands and proper use of fertilizers.

The results in the short-term show relatively similar conditions where land and fertilizer are two crucial aspects in increasing agricultural development in Indonesia. Meanwhile, labor and rainfall have no impact on agricultural development in the short term. This study result shows that the dominant factor in the short term is agricultural land and fertilizer, which can be a solution for agricultural development in the short term, but labor and rainfall conditions cannot be pursued in the short term. This condition has implications for policies that will have to be carried out by the government to increase agricultural production by focusing on increasing the amount of land and supplying fertilizers for the short term. In the long term, it can be done by focusing more on developing the quality of human resources through various development programs.

Based on the findings of this study, the government has a central role in developing the agricultural sector by implementing appropriate policies to increase agricultural production in the short and long term. Several things that can be essential for the government to do through its policies are to improve the quality of the agricultural sector workforce through various integrated and tiered agricultural model development programs in all regions in Indonesia. Another policy that the government can take in terms of land development and the use of fertilizers is to increase the number of new agricultural lands through more structured programs and improve the quality of agricultural lands using various methods, one of which is the use of appropriate fertilizers. Another policy as a solution for agriculture conditions in Indonesia is by the government is to overcome external problems as indicated by the existence of climate change that has an impact on agricultural production, and this condition is part of global policies related to climate change which must be one of the policy focuses in overcoming world climate change. The results of the adjustments shown in the results of this study indicate that the adjustment conditions in the short-term to long-term process are an inseparable part of the policies carried out by the government so the process requires appropriate policy interventions to increase agricultural production in Indonesia towards balance in the long run.

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