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Government expenditures on fertilizer subsidies: The impact on the added value of Indonesian agriculture

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Abstract
This research aims to analyze the effect of government spending on fertilizer subsidies on the added value of agriculture in Indonesia. The data sources from the Ministry of Finance and the World Bank Indicator covering 2005 and 2022. The research method applied is the Autoregressive Distributed Lag (ARDL) Model. Long-term estimation results show that budget use for subsidized fertilizers has a negative and significant impact on agricultural added value, possibly caused by resource allocation distortions and fertilizer use inefficiencies. However, in the short term, increasing the subsidized fertilizer budget can provide positive and significant incentives, increasing agricultural added value. These differences indicate changes in economic behavior, emphasizing the importance of evaluating policies and resource management strategies to achieve growth and efficiency in the farming sector.

Keywords: Fertilizer subsidies, Agricultural value-added, Government expenditure, ARDL model

Introduction

The agricultural sector in Indonesia plays an essential role in the country's economic development. It contributes an average of 13.5% to the Gross Domestic Product (GDP) and serves as a source of food security, poverty reduction, employment, and community income (Andono *et al.*, 2022 [1`]; Gina *et al.*, 2023 [7]; Lubis *et al.*, 2022 [12]; Sasongko *et al.*, 2022) [22]. Agricultural added value is vital for the Indonesian economy because it has a cause-and-effect relationship with investment, infrastructure development, and non-financial investment. When agricultural value declines, the government increases infrastructure spending to offset the decline in agricultural value added. In addition, optimizing agricultural cycles, including land use, harvest cycles, supply and demand, storage, and commodity prices, can improve food security in Indonesia. Developing farmer enterprises and creating value-added agricultural products can contribute to economic growth, business expansion, increased income, and welfare.

Agricultural added value is influenced by various agrarian inputs, one of which is fertilizer. Using fertilizers has increased cereal yields, leading to higher GDP per capita and agricultural labor share (McArthur & McCord, 2017) [14]. In line with the findings of Shouraki *et al.* (2013) [26], agronomic inputs such as fertilizers, modern seeds, and water have been found to increase cereal yields, leading to higher GDP per capita and a lower share of labor in agriculture. However, excessive use of chemical fertilizers can cause environmental pollution and soil degradation (Kim *et al.*, 2018). In the Indian economy, pesticides, electricity, rainfall, and seeds significantly impact agricultural GDP, while fertilizers and net irrigated areas do not (McArthur & McCord, 2017) [14]. Therefore, the correct use of fertilizer is essential to increase agricultural productivity and achieve sustainable food production (Aziz *et al.*, 2019) [2]. This, of course, needs to be supported by the availability of adequate and affordable fertilizer for farmers. One of them is through the subsidized fertilizer program.

The fertilizer subsidy program in Indonesia aims to increase agricultural productivity and support farmers. This program is implemented through various strategies, such as distributing subsidized fertilizer according to farmers' needs and implementing an effective subsidy system (Sarwani *et al.*, 2023) [21]. However, the program faces challenges such as rising fertilizer prices, impacting farmers' affordability and fertilizer availability, and reducing production and productivity (Rachman & Sudaryanto, 2016) [18]. The effectiveness of subsidy policies in increasing farmer incomes varies, with some studies showing positive effects while others show limited impacts (Sundari & Halim, 2020) [27]. In addition, post-harvest handling practices and food losses also influence the effect of subsidy programs on rice production (Poernomo, 2018) [17]. To overcome this problem, the government plans to change the distribution mechanism from indirect subsidies to direct subsidies, aiming to ensure farmers receive immediate benefits, reduce price gaps, and increase the efficiency of government subsidies (Warr & Yusuf, 2014) [31].

On the other hand, the use of the government budget for fertilizer subsidies increases by an average of 8-10% per year. This program will burden the country if it is implemented effectively and efficiently. Governments in various countries, including Egypt, Nigeria, and Togo, have implemented fertilizer subsidies. However, the effectiveness and impact of these subsidies have been questioned. Research has shown that fertilizer subsidy programs in Egypt and Zambia have led to excessive application of nitrogen fertilizer, which can negatively affect soil health and the environment (Holden, 2018 [8]; Zinnbauer *et al.*, 2018) [33]. In Sub-Saharan Africa, the second generation of targeted input subsidy programs, including fertilizer subsidies, has experienced design and implementation failures, resulting in unintended negative impacts

(Takeshima & Nkonya, 2014) [28]. Previous fertilizer subsidy programs in Nigeria reduced demand for commercial fertilizer, indicating a substitution effect (Yovo & Ganiyou, 2022) [32]. In Togo, the impact of fertilizer price subsidies on agricultural growth was limited, with other factors such as expenditure, arable land, and labor playing a more significant role (Mason & Jayne, 2013) [13]. These findings suggest a need for improved targeting, diversification, and alternative options in fertilizer subsidy programs to increase their effectiveness and efficiency. This will have an impact on government budget absorption.

Government spending on fertilizer subsidies in Indonesia is essential for several reasons. First, farmers in Indonesia rely heavily on fertilizer to increase agricultural output, and government support through subsidies helps meet the increasing demand for fertilizer (Conway & Barbier, 1995) [5]. Second, these subsidies have implications for sustainability and environmental degradation, as they can affect incentives for sustainable agricultural development and the use of scarce resources (Rachman & Sudaryanto, 2016) [18]. However, implementing the fertilizer subsidy policy has faced challenges in ensuring adequate fertilizer availability at the farm level. This led to the government's plan to change the distribution mechanism from indirect subsidies to direct subsidies to farmers (Warr & Yusuf, 2014) [31]. In addition, research has shown that fertilizer subsidies can be an effective instrument for achieving the goals of rice self-sufficiency and poverty reduction in Indonesia (Sahim *et al*., 2018) [20]. Lastly, government supervision, distribution reliability, and innovation factors are essential in optimizing Indonesia's subsidized fertilizer supply chain management (Osorio *et al*., 2011) [16]. Therefore, it is necessary to analyze the impact of government spending on fertilizer subsidies on the added value of agriculture in Indonesia.

The research on "Government Expenditures on Fertilizer Subsidies: Its Impact on the Added Value of Indonesian Agriculture" is fundamental because it addresses critical government policy aspects that directly affect the agricultural landscape. Previous studies have explored the relationship between government spending on agricultural subsidies and its impact on the sector. Still, this research differentiates itself with a particular focus on the influence of government spending on fertilizer subsidies and its correlation with value added in Indonesian agriculture. The novelty of this research lies in its emphasis on crucial inputs such as fertilizer, which are critical for crop productivity. Autoregressive Distributed Lag (ARDL) models provide methodological advantages, allowing a more robust analysis of short- and long-term effects. This research aims to uncover complex dynamics, providing valuable insights for policymakers in optimizing budg*et al*locations for maximum agricultural efficiency and growth. The findings from this research are expected to provide practical implications for adjusting policies and resource allocation strategies, emphasizing the significance of this research in supporting informed decision-making for sustainable agricultural development in Indonesia.

Method

Sources of data and information

This research uses annual data for Indonesia from 2005 to 2022. Fertilizer subsidy budget data was obtained from the Ministry of Finance (MoF), and agricultural value-added data was obtained from the World Bank Indicator (WDI). The subsidized fertilizer budget is measured in rupiah (IDR), and agricultural value-added data is a percentage of economic growth (%GDP). Table 1 presents a summary of the time-series data utilized by the model. This research aims to establish a link between the use of the fertilizer subsidy budget and agricultural added value.

Table 1: Data and Data Sources

Variable	Abbreviation	Units of measurement	Source
Agriculture, forestry, and fishing, value added	AVA	% of GDP	WDI (2023)
Government Expenditure to Fertilizer Subsidy	SUBFERT	Rupiah (IDR)	MoF (2023)

Model Specifications

The ARDL model is widely used in economics, environmental studies, and political science policy analysis. It is a flexible model that combines autoregressive and distributed lag terms, allowing analysis of long-run relationships between variables and testing for cointegration. The ARDL model has been applied to analyze the relationship between energy poverty and economic growth in Latin American countries, finding significant long-term effects on economic development (Natsiopoulos & Tzeremes, 2022) [15]. It has also been used to examine the cyclical behavior of fiscal policy practices in Turkey, revealing a counter-cyclical structure (Castro-Cárdenas & Ibarra-Yunez, 2023) [4]. The ARDL model has also been used to measure fundamental exchange rate misalignment in Pakistan's manufacturing industry, providing insights for fiscal policy decisions (Serin & Ünlukaplan, 2022) [23]. In addition, it has been used to evaluate the impact of monetary policy tools on financial stability in Algeria, identifying the effects of variables such as money supply, required reserves, interest rates, and real GDP (Shaukat *et al*., 2022) [25].

This research estimates the relationship between the dependent variable (agricultural added value) and the independent variable (budget for fertilizer subsidies). These variables can be expressed using econometric notation as follows:

$$AVA = f(SUBFERT) \quad (1)$$

$$lnAVA_t = \alpha_0 + \alpha_1 lnSUBFERT_{t-i} + \varepsilon_t \quad (2)$$

All model variables were converted to natural logarithm (ln) form. Parameters in Equation 2: α_0 dan α_1 is the long-term elasticity coefficient of budget used for fertilizer subsidies on agricultural added value, while is the error term. In this context, "Δ" denotes the first difference operator. Parameters α_0 dan α_1 represent the coefficients in the model while indicating the elasticity of the long-run relationship, and $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5 \varepsilon_t$ refers to the remaining terms of the model.

$$\Delta lnAVA_t = \gamma_0 + \sum_{i=1}^{k} \gamma_1 \, lnSUBFERT_{t-i} + \gamma ECM_{t-i} + \varepsilon_t \quad (3)$$

After verifying the existence of a long-term relationship between the variables in the study, the next step is to evaluate the short-term relationship between the variables using an error correction model (ECM) based on the ARDL technique. ECM is used to capture adjustments of short-term variables to long-term imbalances. The following expression is a mathematical representation of ECM, which allows us to understand how these variables interact in the short term, correct imbalances in a long time, and assess their impact on the system as a whole.

Results

Descriptive Statistics and Correlations

Descriptive statistics help provide a comprehensive picture of a data set, support decision-making, and provide a basis for more in-depth statistical analysis. Table 2 includes descriptive statistical results for the AVA and SUBFERT variables. The percentage of standard deviation to the mean (%Std. Dev/mean) provides an idea of the relative level of variation of a variable in the context of that variable's average value (mean). The higher this percentage, the greater the variation or dispersion of the data relative to the mean value. Table 2 displays descriptive statistics of the variables.

Table 2: Descriptive Statistical Analysis for all variables

Variables*	Obs	Mean	Std. Dev.	Std. Dev/mean (%)	Min	Max
AVA	18	13.45141	0.657609	4.89	12.39966	15.29015
SUBFERT	18	2.06E+13	1.01E+13	49.03	1.3E+12	3.43E+13

*Statistics are calculated using numbers before taking logarithms

Table 2 shows that for the AVA variable, the standard deviation percentage from the mean is 4.89%. This indicates that individual values in the AVA variable have relatively small variations compared to the mean value. In other words, the data tends to be closer to the mean value, and the distribution of values is denser around the mean. On the other hand, for the SUBFERT variable, the standard deviation percentage from the mean reaches 49.03%. This high percentage indicates that the data in the SUBFERT variable has significant variations from the mean value. The distribution of individual values tends to be more spread out, and the difference between personal values and the mean is more significant. Standard deviation per mean is used to understand the level of data stability. The AVA variable shows strength with a standard deviation per mean of 26.14%, while the FERT variable has higher fluctuations of 28.85%. This means fertilizer use tends to have more significant variation from the average value, indicating the potential for more substantial changes in the data. Next, correlation analysis was carried out.

Correlation analysis measures the extent of the linear relationship between two variables. By using correlation coefficients, such as the Pearson coefficient, this analysis indicates the direction and strength of the relationship between the variables. The correlation coefficient ranges from -1 to 1, where a positive value indicates a positive relationship, a negative value tells a negative relationship, and a value of 0 shows no connection. Correlation analysis helps understand patterns and trends in data, allowing the researcher or analyst to interpret the relationships between observed variables. Table 3 presents the results of the correlation analysis.

Table 3: Correlation Statistics

Variables	AVA	SUBFERT
AVA	1	
SUBFERT	-0.2057	1

Table 3 shows the correlation coefficient between AVA and SUBFERT, which is -0.2057. A correlation value that is close to zero indicates that there is a weak or insignificant linear relationship between the two variables. In this context, negative values indicate the opposite direction of the relationship. Still, the relatively small coefficient magnitude suggests that changes in one variable do not strongly follow changes in the other. Therefore, based on this correlation matrix, it can be concluded that AVA and SUBFERT have a weak and opposite relationship but not strong enough to be considered statistically significant.

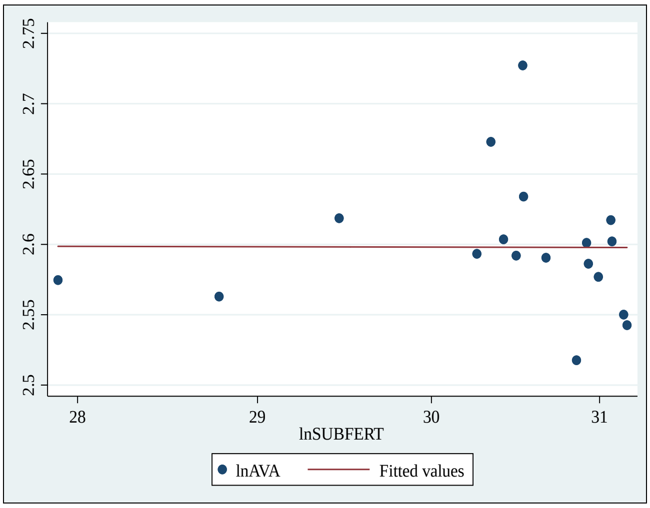

Fig 1: Relationship between Fertilizer Subsidy Budget and Agricultural Value Added in Indonesia, 2005-2022

Over the period 2005 to 2022, the general trend that can be observed is that the AVA value tends to vary throughout the years. Although there is no clear monotonic trend, the AVA value appears to fluctuate from year to year. On the other hand, SUBFERT values also show significant variations over time. Some years have much higher SUBFERT values compared to other years.

Unit Root Test Results

Table 4 shows whether the variable is stationary or not. The model with intercept, lnAVA, and lnSUBFERT is declared not stationary at level but becomes stationary after the first differencing (1st diff). Positive or negative signs on t-statistics indicate the direction of change, while significance determines stationarity.

Table 4: Unit Root test results

Model	ADF at level	ADF at 1st diff	DF-GLS at level	DF-GLS at first diff	P.P. at level	P.P. At first diff
	t-stat	t-stat	t-stat	t-stat	Adj. t-statistics	Adj. t-statistics
Intercept						
lnAVA	-0.279	-3,408***	-2,246*	-3,437***	-0.348	-3,078***
lnSUBFERT	0.304	-2,527**	-1,162	-1,566	1,398	-2,914***
Trend and Intercept						
lnAVA	-4,525**	-3,256*	-4.123***	-3,527**	-2,325	-3,141***
lnSUBFERT	-3,049	-2,071	-2,089	-2,032	-3,651**	-2,507
Note: Critical Value: ***1%, **5%, *10% for intercept						

Selection of criteria for lag orders

Table 5 illustrates that the log-likelihood (L.L.) value increases with increasing lag, indicating an increase in the model's fit to the data. The likelihood ratio (L.R.) test provides information about the significance of adding lags, and the results show that adding lags up to four significantly improves model fit. Information criteria such as FPE, AIC, HQIC, and SBIC provide a comprehensive view of model performance, and lower values at lag 4 indicate a better model. Therefore, the lag order test results support the selection of four lags as the optimal number in the ARDL model to explain the relationship between the observed variables. An asterisk (*) indicates that some results have statistical significance at a certain level of confidence, strengthening the validity of the lag selection.

Table 5: Lag selection criteria

Lag	L.L.	L.R.	df	p	FPE	AIC	HQIC	SBIC
0	22.1078				0.000194	-2.87254	-2.88099	-2.78125
1	33.8013	23,387	4	0	0.000065	-3.97161	-3.99696	-3.69773
2	41.4061	15.21	4	0.004	0.000041	-4.48658	-4.52884	-4.03011
3	47.6129	12,414	4	0.015	0.000034	-4.80184	-4.86099	-4.16278
4	54.2195	13,213*	4	0.01	.000031*	-5.17422*	-5.25028*	-4.35258*

ARDL test method

The ARDL bounds test cointegration analysis aims to assess whether there is a long-term cointegration relationship between the variables in the regression model, especially in the ARDL model. By using constraints on the regression coefficients, this analysis helps identify whether the variables are cointegrated at the I(0) or I(1) level. Positive results indicate a stable long-term relationship between variables, providing a basis for a better understanding of the economic dynamics between variables and improving the accuracy of regression models. Table 6 shows that the F-statistic (6.84) at the 1% significance level exceeds the critical value I(1) (7.84) but does not exceed the critical value I(0) (4.04). This indicates that the null hypothesis cannot be rejected at the 1% significance level, showing a cointegration relationship between these variables at level I(0). In other words, these variables have a stable long-term relationship.

Table 6: ARDL bounds test cointegration (time series model)

Test statistics	Value	Significance (%)	I(0)	I(1)
F-statistic (k)	24,087 (1)	10	4.04	4.78
		5	4.94	5.73
		2.5	5.77	6.68
		1	6.84	7.84

Johansen Cointegration Test

Table 7 shows the cointegration test results using the trace method and the Maximum Eigenvalue method, providing information about the number of long-term cointegration relationships between the observed variables. The trace method's significant eigenvalues are in the first and second order. In order 1, an eigenvalue of 0.74299 produces a trace statistical value of 5.3386, exceeding the 5% critical value of 3.76. This shows at least one long-term cointegration relationship between these variables. Meanwhile, in the second sequence, the eigenvalue of 0.31705 does not reach the critical value, indicating no additional cointegration relationship.

Table 7: Johansen tests for cointegration

Unrestricted cointegration rank test (trace)			
Maximum rank	**Eigenvalues**	**Trace statistics**	**5% critical value**
0	.	24.3598	15.41
1	0.74299	5.3386	3.76
2	0.31705		
Unrestricted cointegration rank test (Maximum Eigenvalue)			
Maximum rank	**eigenvalues**	**Trace statistics**	**5% critical value**
0	.	19.0212	14.07
1	0.74299	5.3386	3.76
2	0.31705		

The max-eigenvalue test indicates 5 cointegrating eqn(s) at 0.05.
***MacKinnon-Haug-Michelis (1999) p-values.*

The results of the Maximum Eigenvalue method are similar to the trace method. The only significant eigenvalue is at number 1, producing a Maximum Eigenvalue statistical value of 5.3386, which again exceeds the 5% critical value of 3.76. Therefore, the results of both methods indicate at least one long-term cointegration relationship between these variables. This result is significant because it shows that these variables have a stable relationship in the long term.

Long-Term and Short-Term Estimates

ARDL (Autoregressive *et al.*) analysis aims to understand the relationship between economic variables in the long and short term. ARDL long-term estimates provide insight into the cumulative impact and long-term balance between variables. In contrast, short-term estimates reveal rapid responses and immediate adjustments to changes in independent variables. Complete details can be seen in Table 8.

Table 8: ARDL Long-run and short-run estimations (selected model: 2, 4)

Long-run estimations				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Prob**
lnSUBFERT	-0.0569	0.0091	-6.28	0.001
C	9.0702	1.4479	6.26	0.001
EC = lnAVA - 0.0569 x lnSUBFERT + 9.0702				
Short-run estimations				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Prob**
D (lnAVA (-1))	0.6495	0.1808	3.59	0.011
D (lnSUBFERT)	0.0676	0.0328	2.06	0.085
D(lnSUBFERT(-1))	0.0456	0.0241	1.89	0.107
D(lnSUBFERT(-2))	0.0960	0.0292	3.29	0.017
D(lnSUBFERT(-3))	0.0772	0.0273	2.82	0.030
ECM (-1)	-2.0920	0.3015	-6.94	0,000
Robustness indicators				
χ^2Normal	3,656	[0.4546]		
χ^2Serial	9,067	[0.0595]		
χ^2ARCH	0.711	[0.3990]		
χ^2Hetero	0.22	[0.6425]		
χ^2Reset	2.04	[0.1580]		

Note: Figures in parentheses [#] are estimated p-values.χ^2 Normal indicates the Jarque-Bera statistics of the test for average residuals,χ^2 Serial is the Breusch-Godfrey LM test statistics for no serial relationship,χ^2 ARCH is the Engle's test statistics for no autoregressive conditional heteroskedasticity,χ^2 Hetero is the heteroskedasticity test based on the regression of squared residuals on squared fitted values, andχ^2 Reset is the test for functional form based on Ramsey's RESET test using the square of the held values.
*Refer to 10% significance level
** Refer to 5% significance level
*** Refer to the 1% significance level

Table 8 shows that in the long term, the lnSUBFERT variable, which is a change in the fertilizer subsidy budget, has a negative and significant impact on the added value of agriculture in Indonesia. The coefficient -0.0569 indicates that each unit change in the lnSUBFERT variable results in a decrease of around 0.0569 in agricultural value added in the long term. This result is significant at the 99% confidence level, indicating that fertilizer subsidies can potentially negatively contribute to the growth of agricultural value added in the longer term. As a complement, the constant (C), which is significant at the 99% confidence level, indicates that this constant also significantly impacts agricultural added value in the long term. Thus, the results of this analysis provide important insights regarding the influence of fertilizer subsidies on agricultural added value, providing a basis for policy considerations to increase the efficiency and sustainability of the farm sector in Indonesia.

Short-term estimation results in the ARDL model provide insight into variables' rapid response to changes over time. In this analysis, the variable change in the logarithm of agricultural added value at lag one D(ln AVA(-1))) shows a significant positive impact on agricultural added value. On the other hand, the variable change in the logarithm of fertilizer subsidies D(ln SUBFERT) does not show a significant effect in the short term, highlighting that changes in fertilizer subsidies do not immediately affect agricultural value added. Short-term analysis also indicates that the influence of the change in fertilizer subsidies on lags 2 and 3 has a positive and significant effect at the 5% significance level. Overall, these results show that the factors that influenced fertilizer subsidies in previous periods significantly encouraged growth in agricultural value added in the short term. A lag effect indicates specific dynamics and patterns in Indonesia's relationship between fertilizer subsidies and agricultural-added value.

In addition, the Error Correction Model (ECM) is used to evaluate the adjustment of errors between variables towards balance in the long term. The ECM coefficient (-1) of -2.0920 indicates that any deviation from the equilibrium in the previous period will decrease by around 2.0920 units in the next period, indicating the existence of a long-term adjustment mechanism. These results are essential in understanding the dynamics of the entire system and how variables interact to achieve a more stable long-term equilibrium. In evaluating the reliability of the model, statistical indicators such asχ2 Normal,χ2 Series,χ2 ARCH,χ2 Hetero, andχ2 Reset are used to test residual normality, serial relationships, conditional autoregressive heteroscedasticity, homoscedasticity, and functional form of the model. The results show that the residuals approach a normal distribution, the model has adequate serial relationships, there is no significant heteroscedasticity, and the model's functional form is acceptable. Overall, these reliability indicators positively contribute to the model's credibility. This is also supported by the results of the Qusum square test, which shows that there is not sufficient evidence to state the existence of structural changes in the model, so the model is considered stable over time. This indicates that the model's regression parameters and relationships between variables are consistent and have not experienced significant changes in the observed period.

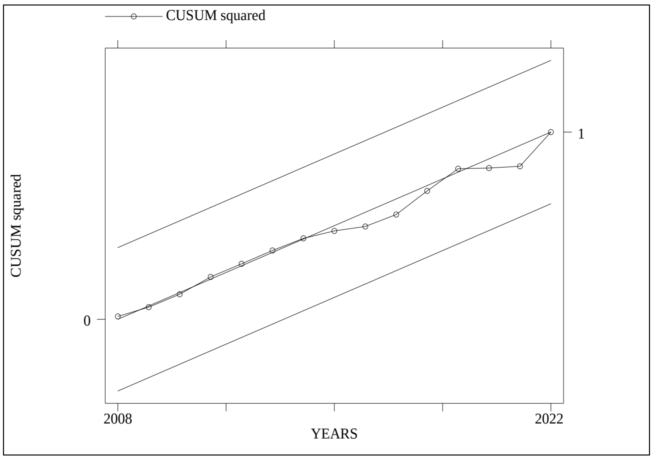

Fig 2: Stability test of the ARDL model

Discussion

The Impact of Using the Fertilizer Subsidy Budget on the Added Value of Agriculture in the Long Term

This research indicates that budget absorption for fertilizer subsidies, which is reflected in the ln SUBFERT variable, has a negative and significant impact on agricultural added value in the long term. The coefficient -0.0569 shows that every unit change in the ln SUBFERT variable can decrease around 0.0569 units of agricultural value added in a long time. These results have significant implications in designing agricultural policy in Indonesia. First, a reduction of agricultural value added could indicate that the budg*et al*located for fertilizer subsidies could be more optimal in supporting the growth of the farm sector. Therefore, it is necessary to evaluate and adjust policy strategies so that the absorption of the fertilizer subsidy budget can be more efficient and support increased agricultural added value.

In addition, a negative impact on agricultural added value can also indicate an imbalance or effectiveness problem in the implementation of the fertilizer subsidy program. Improvement steps and innovation in policy implementation are needed to ensure that the budget issued by the government provides optimal benefits for farmers and the agricultural sector as a whole. This includes increasing efficiency in distributing fertilizer subsidies, increasing quality fertilizer availability, and strict budget use monitoring.

The effectiveness of fertilizer subsidy programs varies across countries. In Sri Lanka, subsidies have a significant positive relationship with average rice yields, contributing to self-sufficiency and food security. However, there are adverse effects, such as excessive use of chemical fertilizers and the burden on the government budget (Dulanjani *et al*., 2022) [6]. In Ghana, the National Fertilizer Subsidy Program (GFSP) has shown positive results, with a 24.5% increase in cereal yields and maize farmers benefiting the most (Tsiboe *et al*., 2021) [29]. In Indonesia, the fertilizer subsidy policy was found to have a positive influence but no real impact on rice farmers' income (Rahmanta *et al*., 2019) [19]. In Ghana, fertilizer subsidy programs have increased agricultural sector productivity, overall economic growth, employment, and welfare, with positive effects on the maize, sorghum, and rice subsectors (Iddrisu *et al*., 2020) [9]. In Nepal, the fertilizer subsidy program must be improved in targeting beneficiaries and understanding public investment preferences (Kyle *et al*., 2017) [11].

The policy implications of these findings involve expanding and refining fertilizer subsidy policies. Strategic steps involve adjusting budg*et al*locations, optimizing distribution mechanisms, and increasing monitoring to ensure that fertilizer subsidies have a maximum positive impact on agricultural added value. This study provides a strong empirical basis to guide the policy decision-making process to improve the competitiveness and sustainability of the farm sector in Indonesia in the long term.

The Impact of Using the Fertilizer Subsidy Budget on Agricultural Added Value in the Short Term

Based on short-term analysis, the findings show that changes in the fertilizer subsidy budget, reflected in the variable D(lnSUBFERT), do not significantly impact agricultural value added in a short period. The coefficient D(lnSUBFERT) with a value of 0.0676 indicates that each unit change in this variable only results in an increase of around 0.0676 units in agricultural added value in the short term. These findings reflect that the effects of changes in fertilizer subsidies take time to manifest in the level of agricultural value added.

The growth of the agricultural sector over a shorter period has varied across countries and regions. In Nigeria, the contribution of agriculture to overall GDP has been declining over the years, with the livestock, forestry, and fisheries subsectors experiencing significant declines in their share of agricultural GDP (Sertoğlu *et al*., 2017) [24]. In Russia, the farm sector has maintained positive growth dynamics, with investments targeted at agribusiness and the development of new jobs, human capital, and labor productivity (Wang *et al*., 2015) [30]. In the United States, the outperformance of the agricultural sector has been driven by increases in total factor productivity, with crop production growing faster than livestock production (Bachewe *et al*., 2019 [3]; Wang *et al*., 2015) [30]. Overall, the growth of the agricultural sector over a shorter period is influenced by various factors such as policy regimes, investment strategies, and changes in input use and output mix.

The policy implications include the need to consider long-standing factors in fertilizer subsidy policies to achieve better results in increasing agricultural value added in the short term. Policy adjustment steps that are more rapid and responsive to changes in external conditions can increase fertilizer subsidy policies' effectiveness in supporting the agricultural sector's immediate growth. Therefore, a quick and appropriate response in managing fertilizer subsidy policies can maximize the positive impact on agricultural added value in the short-term context.

Conclusion

This research reveals that the use of fertilizer subsidy budgets in Indonesia has a significant impact on agricultural added value, with findings showing adverse effects in the long term. The results of the long-term analysis highlight the need for further evaluation of fertilizer subsidy policies to ensure their optimal contribution to agricultural sector growth. On the other hand, in the short term, the findings show that changes in fertilizer subsidies do not directly affect agrarian value-added. Still, long-standing factors such as lag effects need to be considered. The implication is that rapid response in managing fertilizer subsidy policy can increase its effectiveness in supporting agricultural sector growth, and further research is needed to investigate the lagging factors that may influence this impact in more detail.

On the other hand, the research findings provide an essential contribution in the field of education by explaining the impact of the fertilizer subsidy budget on the added value of agriculture in Indonesia. However, this research has limitations, such as the data or methods used. For further investigation, it is necessary to develop more complex models involving more variables to understand broader dynamics. Policy implications involve the need to evaluate and adjust fertilizer subsidy policies to make them more effective and sustainable in supporting the growth of Indonesia's agricultural sector, taking into account environmental and social aspects.

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