Jurnal Ilmiah Sosio-Ekonomika Bisnis
Volume , 29 No. 01, 2026, pp. 70-81
https://doi.org/10.22437/jiseb.56599

ANALYSIS OF RICE SUPPLY AND PRICES IN INDONESIA, 2000-2023

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ARTICLE HISTORY
Recieved: 06 June 2026]
Revised: [09 June 2026]
Accepted: [10 June 2026]

Abstract
Rice is a strategic commodity in Indonesia, serving as the primary staple food. This research aims to describe the trends in rice supply, demand, and prices (2000–2023), analyze the factors influencing price volatility, and predict these conditions for the 2026–2030 period. Using national time-series data, a simultaneous equation system model was estimated using the Two-Stage Least Square (2SLS) technique. The results indicate that while supply is highly volatile, demand has grown more rapidly, triggering an average price increase of Rp496/kg per year. Demand is the most dominant factor positively influencing price. The ex-ante simulation (2026–2030) reveals that a 5% increase in per capita income is predicted to raise price by 13.92%, while a 25% increase in government rice stocks is projected to raise price by 10.53% due to the absorption of supply for reserves. Distinguishing it from previous regional studies, this research provides a comprehensive national-scale analysis over 24 years by integrating imports and government stocks as endogenous variables. Rice price stabilization cannot be achieved abruptly; rather, it requires preventive measures by maintaining the balance between supply and demand, enhancing domestic productivity, and implementing strict distribution oversight to prevent speculative practices in the marketing chain.

Keywords: Demand, Import, Price, Rice, Supply

How to Cite: Author, A.A., & Author, B.B. (2026). Instructions/Template for Preparing Manuscript for JISEB. *Jurnal Sosio-Ekonomika Bisnis*, *29*(01), 46-57. DOI: https://doi.org/10.22437/jiseb.56599

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INTRODUCTION

Indonesia is an agrarian country that positions the agricultural sector as a vital pillar of the national economy through food provision, labor absorption, and contributions to the Gross Domestic Product (GDP). Rice is a strategic commodity that plays a vital role in maintaining national food security as it is the primary staple food for the majority of the population. However, in the last five years (2020–2024), domestic rice production has shown a declining trend triggered by the shrinking of harvested areas. Data indicates that this production decline has implications for a significant reduction in the national rice surplus.

Table 1. Trends in Population, Production, Consumption, and Rice Surplus in Indonesia, 2020–2024

Year	Population (Thousand People)	Rice Production (Tons)	Rice Consumption (Tons)	Surplus/Deficit (Million Tons)
2020	270.203,9	31.334.496	25.404.570,68	+5,92
2021	272.682,5	31.356.017	25.735.774,35	+5,62
2022	275.773,8	31.540.521	25.784.850,30	+5,75
2023	278.696,2	31.101.285	26.138.916,60	+4,96
2024	281.603,8	30.621.248	25.946.974,13	+4,67

Source: Statistics Indonesia (BPS), 2020-2024 (processed by authors).

The condition of a shrinking domestic surplus amidst population growth has forced the government to carry out market interventions to maintain national stock availability. Despite government intervention through the Food Supply and Price Stabilization (SPHP) program and a surge in import volume reaching 4.52 million tons in 2024, retail prices at the consumer level have continued to show a sharp upward trend (Figure 1). The phenomenon of discrepancy between supply-increasing policies and price realities reflects the complexity of the reciprocal (simultaneous) relationships in domestic rice price formation.

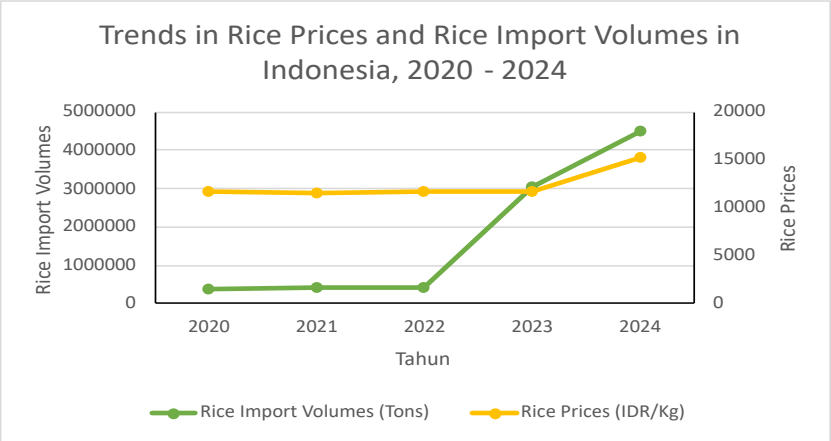

Figure 1. Trends in Rice Prices and Rice Import Volumes in Indonesia, 2020–2024
Source: Statistics Indonesia (BPS), 2026 (processed by authors).

Several literatures have examined these dynamics using various approaches. Nurmadi (2025) analyzed price dynamics at the regional level in Jambi Province using a 2SLS simultaneous model, finding that rice prices are significantly influenced by supply, the price of dry milled grain, and the previous month's rice price. Meanwhile, Hendrawati (2024) examined national rice availability and requirements, with results indicating that rice availability is significantly affected by production, the rice adequacy dummy, and the previous

year's availability. Research by Kasnelly *et al*. (2024) also confirmed that rice demand is inelastic because it is a basic necessity whose fulfillment cannot be delayed.

The discrepancy between the theory of increasing supply through imports and the reality of surging retail prices in the field creates a research gap. This suggests that stock intervention policies have not been fully effective in dampening price volatility, indicating a more complex simultaneous relationship that cannot be explained solely through short-term analysis or simple linear regression. Most previous studies also have limitations regarding their regional scope and the number of structural equations used. The originality of this research lies in the use of a national-scale Two-Stage Least Square (2SLS) simultaneous equation system approach with a historical timeframe of 24 years (2000–2023). The novelty of this study includes the integration of import volume and government stocks as endogenous variables in the price formation mechanism, as well as the application of ex-ante simulations to project market conditions for the 2026–2030 period.

The hypotheses of this research are: (1) rice price volatility is simultaneously influenced by the dynamics of supply (production, imports, and stocks) as well as demand; (2) the increase in per capita income and rice stocks during the 2026–2030 period will impact the rise in rice prices. The objectives of this research are: (1) to describe the trends in national rice supply, demand, and prices for the 2000–2023 period; (2) to analyze the fundamental factors affecting price volatility; and (3) to project rice prices and supply for the 2026–2030 period through ex-ante simulations. This research is expected to serve as a strategic reference for policymakers in efforts to maintain sustainable national food stability.

METHODS

Research Type and Scope

This research employs a quantitative descriptive approach, with the scope of study focused on analyzing the behavior of prices, supply, demand, and imports of rice at the national level. The data used consist of national aggregate data in the form of annual time series over a 24-year period, from 2000 to 2023.

However, the simultaneous equation framework constructed in this research operates under specific structural boundaries. The current model focuses exclusively on national-level macroeconomic aggregates, including aggregate domestic production, official imports, and public buffer reserves held by Perum BULOG. Consequently, it does not incorporate micro-structural variables such as localized farm-level input costs (fertilizer and seed prices), private milling inventories, or regional logistical and distribution margins. While retail price fluctuations in the Indonesian food economy are frequently accelerated by logistical disruptions and marketing inefficiencies along domestic distribution chains rather than absolute production shocks, the integration of these parameters was restricted by the unavailability of continuous, standardized national time-series data over the 24-year observation window (2000-2023). Therefore, the empirical estimations and ex-ante simulations derived from this model should be evaluated specifically within the scope of public buffer-stock interventions and macro-trade policy instruments managed by the central government.

Research Subjects and Data Sources

The primary subjects or objects of this research include four endogenous variables: consumer-level rice prices, rice supply, rice demand, and rice import volumes in Indonesia. The data were obtained through library research from secondary data sources published by credible government and institution agencies. The main data sources include the Indonesia

Central Bureau of Statistics (BPS), the Agricultural Data and Information System Center (Pusdatin) of the Ministry of Agriculture, Perum BULOG, and UN Comtrade.

Data Analysis Method

This research employs two stages of analysis. First, Trend Analysis is used to describe the historical development of research variables through descriptive statistical tables and graphs. Second, a Simultaneous Equation System Model is estimated using the Two-Stage Least Square (2SLS) method to capture the reciprocal relationships between endogenous variables through four equations consisting of three structural equations and one identity equation. The model specifications are as follows:

$QDB = \alpha_0 + \alpha_1 PB + \alpha_2 I + \alpha_3 QDBs + \varepsilon_{1t}$ ……(1)

$IMP = \beta_0 + \beta_1 PIMP + \beta_2 RER + \beta_3 STB + \beta_4 IMPs + \varepsilon_{2t}$ ……(2)

$QSB = QB + IMP - STB - EXP$ ……(3)

$PB = \gamma_0 + \gamma_1 QDB + \gamma_2 QSB + \gamma_3 PW + \gamma_4 PBs + \varepsilon_{3t}$ ……(4)

Variable Descriptions:
PB : Real Rice Price (IDR/Kg)
QDB : Total Domestic Rice Demand (Tons)
IMP : Rice Import Volume (Tons)
QSB : Total Rice Supply (Tons)
Exogenous Variables: Per capita income (I), Import price (PIMP), Real exchange rate (RER), Rice stocks (STB), World rice price (PW), Rice production (QB), Exports (EXP), and lagged variables (previous year).

Data were processed using SAS 9.4. To ensure the model met the Best Linear Unbiased Estimator (BLUE) criteria, classical assumption tests were conducted, including: (i) normality test (Jarque-Bera); (ii) multicollinearity test (VIF); (iii) heteroscedasticity test (Glejser); and (iv) autocorrelation test (Breusch-Godfrey). The model was validated using RMSPE and U-Theil criteria before performing the ex-ante simulation for the 2026–2030 period.

RESULTS AND DISCUSSION

Trends in Rice Demand, Supply, and Prices in Indonesia

Based on the descriptive analysis of the 2000–2023 data, the rice market in Indonesia exhibits complex dynamics between the growth of public consumption and the limitations of domestic supply. In general, the variables of demand, supply, and price show a consistent upward trend, albeit with an unbalanced growth rate.

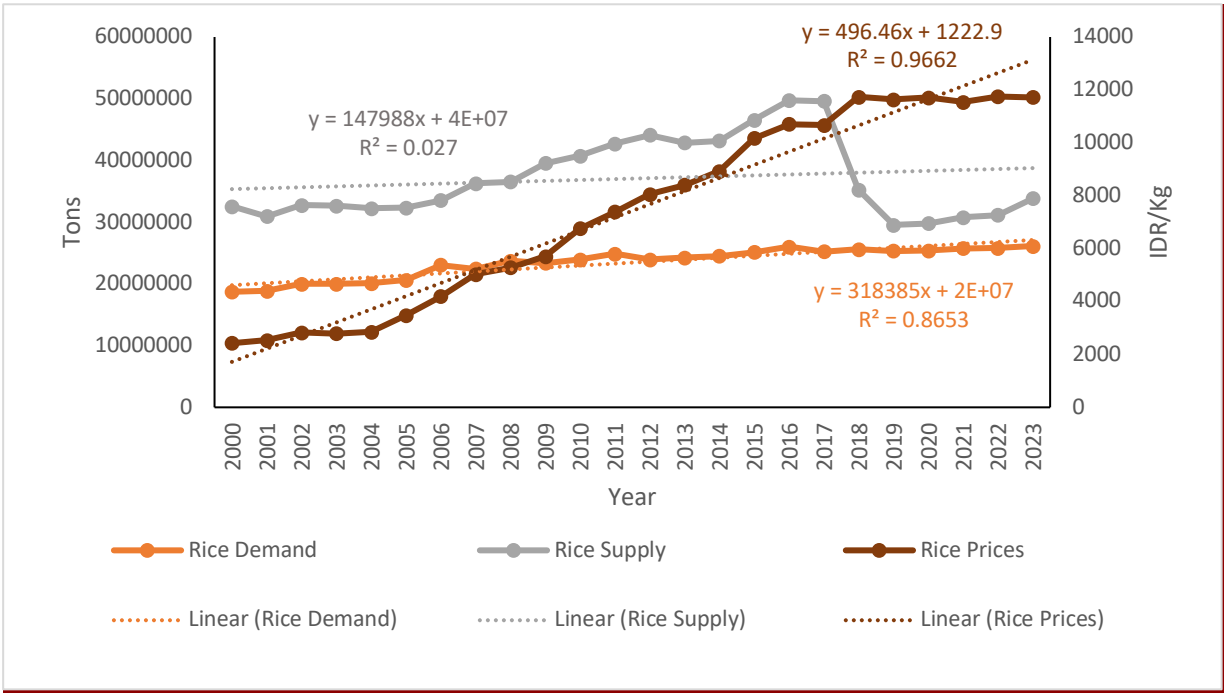

Figure 2. Trends in Rice Demand, Supply, and Prices in Indonesia, 2000–2023
Source: BPS, Pusdatin, UN Comtrade, and BULOG, 2026 (processed by authors).

Rice demand (orange line) shows a steady upward trend (R^2 = 0,8653). The regression coefficient is positive at 318,385.3 which means the total national rice consumption requirement increases by an average of 318 thousand tons every year, in line with population growth. This confirms that population growth is directly proportional to the need for staple food. This finding is consistent with Kasnelly *et al*. (2024), who stated that rice demand is inelastic; the public does not significantly reduce consumption despite price fluctuations because rice has no perfect substitutes.

Rice supply (grey line) shows sharp fluctuations with low linear model capability (R^2 = 0,0272). Mathematically, the national rice supply has only increased by an average of 147.98 thousand tons per year. This is due to a significant structural break in 2018 resulting from a change in BPS data collection methodology from conventional techniques (Eye Estimate) to the Area Sampling Frame (KSA) method. The KSA method produces more accurate estimates that tend to be lower than the 2000–2017 period, which tended to be overestimated (Rusono, 2019). The sharp decline in supply post-2018 is also influenced by non-linear factors such as the shrinking of harvested areas, which reinforces the concerns of Hendrawati (2024) regarding the pressure on national stock availability.

The price variable (brown line) exhibits the strongest and most sustained upward pattern (R^2 = 0,9662) with an average increase of Rp496.46/kg per year. This high level of precision indicates a strong correlation with the price levels of previous periods. This phenomenon reflects that rice prices are highly sensitive to supply disruptions but tend to have a persistent upward pattern. In line with the findings of Nurmadi (2025), rice price dynamics are significantly influenced by the total supply and the price levels in the preceding period. This suggests that the interaction between limited domestic supply and ever-growing demand pressure creates a price increase pattern that is difficult to return to its original level. According to Samuelson (2003), a condition where needs continue to rise while supply remains limited will automatically drive prices to a higher level.

Equation System Model Estimation Results

Before conducting economic interpretation, the simultaneous equation system model underwent a series of diagnostic tests to ensure that the Best Linear Unbiased Estimator (BLUE) criteria were met. The Normality test results showed that the data residuals were normally distributed, while the Autocorrelation test confirmed the absence of time-series correlation in the model's disturbances. The Heteroscedasticity test also yielded favorable results, indicating stable data variance throughout the observation period.

Regarding the multicollinearity test, it was found that the Variance Inflation Factor (VIF) for the Income (I) variable slightly exceeded the threshold of 10. However, this variable was retained in the model based on the consideration that variable I proved to be statistically significant at a 20% significance level with a p-value of 0.1532. In accordance with the arguments of Gujarati (2003), a high VIF value can still be tolerated if the regression coefficient remains statistically significant, as this condition indicates that parameter estimates are still sufficiently precise despite the presence of correlation between variables.

Overall, the model demonstrates an excellent level of accuracy, as shown by the RMSPE values of 2.97% for rice demand and 1.81% for rice supply. The U-Theil values are also relatively small, at 0.0141 for demand, 0.0088 for supply, and 0.1801 for price, indicating the model's ability to follow historical data patterns. Furthermore, there is no bias (UM = 0.00), and most of the errors are random, with UC values ranging between 92% and 98%. Nevertheless, the rice import variable shows a fairly high error rate with an MPE of 58.52%, an RMSPE of 136.8%, and an R^2 of 33,21%, indicating that imports are more heavily influenced by government policy. Meanwhile, the rice price variable has an MPE of 13.78% and an RMSPE of 73.08%, which remains acceptable given the volatile nature of prices.

1. Rice Demand in Indonesia

The estimation results of the rice demand show a coefficient of determination (R^2) of 0,89097, indicating that 89.10% of the variation in rice demand can be explained by the variables of rice price, per capita income, and the previous year's demand. Simultaneously, these variables have a significant effect on national demand ($p < 0,0001$). The estimation results can be seen in Table 2 below.

Table 2. Estimation Results of Factors Affecting Rice Demand in Indonesia

Variable	Parameter Estimate	Standard Error	Pr > |t|	Variable Label
Intercept	3091694	3055593	0.3237	Intercept
PB	-392.162	415.9893	0.3571	'Rice Price in Indonesia (IDR/Kg)'
I	192.1079	129.3921	0.1532****	'Per Capita Income in Indonesia (IDR)'
QDBs	0.648878	0.203401	0.0046*	'Lag of Rice Demand t-1 (Tons)'
Prob > |*F*|			<.0001	Adj R – Sq 0.87461
F Value			54.48	Dw 2.174676
R-Square			0.89097	

Source: Data Processed, 2026

Information: *) Significance Level 1%
**) Significance Level 5%
***) Significance Level 10%
****) Significance Level 20%

Partially, domestic rice prices do not have a significant effect on demand ($p = 0,3571$), which confirms that rice is a highly inelastic staple necessity. This is in line with the findings

of Kasnelly *et al*. (2024) and Gapari (2021) who stated that price fluctuations do not significantly reduce consumption because it is unpostponable, as well as the existence of brand loyalty which, according to Khudori (2025), makes demand "sticky". The per capita income variable shows a positive and significant effect at the 20% significance level, indicating that rice is still classified as a normal good, where an increase in public income will drive an increase in demand. However, the relatively weak response reflects the application of Engel's Law and Bennett's Law, which state that as income increases, consumers will reduce the proportion of starchy staple food consumption and shift to more nutrient-rich food sources (Cirera & Masset, 2010).

This is consistent with research by Windiyarti *et al*. (2018), which explains that as society becomes more prosperous, people tend to diversify their food intake instead of physically increasing their rice consumption volume. Nevertheless, total demand continues to rise due to the massive pressure of population growth (demand-pull). Finally, the previous year's demand variable has a positive and highly significant effect at the 1% level (coefficient of 0.65), proving the phenomenon of strong habit formation. The high level of public dependency creates consumption inertia, meaning that current demand volume is heavily dependent on the consumption patterns of the previous period.

2. Rice Imports in Indonesia

The estimate of the rice import produced a coefficient of determination (R^2) of 0,3322, meaning that 33,22% of the variation in import volume can be explained by import price, real exchange rate, rice stocks, and lagged imports, while the remainder is explained by factors outside the model. An F-statistic probability value of 0.0898 indicates that all independent variables simultaneously have a significant effect on import volume at the 10% significance level. The low R^2 value indicates that import decisions are not entirely based on market efficiency but are instead dominated by government policy. In line with Alam *et al*. (2025), import policy is the result of complex economic-political interactions. Laksmi & Nurdin (2024) also add that in the procurement of public goods such as rice, rent-seeking practices often occur, so pure market logic does not always apply. The estimation results can be seen in Table 3 below.

Table 3. Estimation Results of Factors Affecting Rice Imports in Indonesia

Variable	Parameter Estimate	Standard Error	Pr > |t|	Variable Label
Intercept	2806877	1018870	0.0126*	Intercept
PIMP	-45794.5	127383.8	0.7232	'Import Price (USD/Ton)'
RER	-15.0467	22.06285	0.5035	'Real Exchange Rate (IDR)'
STB	-1.12345	0.382511	0.0085*	'Rice Stocks (Tons)'
IMPs	0.139275	0.159754	0.3942	'Lag of Rice Import Volume (Tons)'
Prob > |*F*|		0.0898	Adj R – Sq	0.19154
F Value		2.36	Dw	1.738078
R-Square		0.33215		

Source: Data Processed, 2026

Information: *) Significance Level 1%

Partially, the rice import price (PIMP) and the real exchange rate (RER) do not have a significant effect on rice import volume. This lack of significance in international prices is supported by Altariq & Saputera (2025), who state that the government continues to procure from abroad when needs are urgent, without excessive consideration of global price

fluctuations. Regarding the exchange rate, Aisyah *et al*. (2025) explain that fulfilling supply becomes the top priority compared to purchase price efficiency resulting from exchange rate fluctuations. This is further reinforced by Setyawati *et al*. (2019), who conclude that the exchange rate variable partially has no significant effect because rice is a strategic and political commodity.

On the other hand, the national rice stock (STB) proved to be the most powerful factor, with a highly significant negative effect at the 1% level (p = 0,0085). The coefficient of -1.12345 indicates that every 1-ton increase in stocks will reduce imports by 1.12 tons. This relationship demonstrates the role of imports as a balancing (residual) variable to maintain the Government Rice Reserve (CBP), as explained by Kurniawan *et al*. (2024). Meanwhile, the lagged import variable has no significant effect, indicating that import activities are situational, depending on the actual production and consumption balance rather than habits from the previous period.

3. Rice Price Volatility in Indonesia

The estimation results of the rice price equation show a coefficient of determination (R^2) of 0,7063, meaning that 70.63% of the variation in rice prices in Indonesia can be explained by the variables of demand, supply, and the previous year's price. The F-statistic value of <.0001 (significant at 1%) proves that this model has a good ability to explain national price volatility. The estimation results can be seen in Table 4 below.

Table 4. Estimation Results of Factors Affecting Rice Price Volatility in Indonesia

Variable	Parameter Estimate	Standard Error	Pr > |t|	Variable Label
Intercept	-8412.81	3073.683	0.0131*	Intercept
QDB	0.000598	0.000199	0.0073*	'Total Domestic Rice Demand (Tons)'
QSB	-0.00009	0.000050	0.0893***	'Total Rice Supply (Tons)'
PW	-0.11197	0.221936	0.6197	'World Rice Price (IDR/Kg)'
PBs	0.251560	0.217411	0.2616	'Lag of Rice Price (IDR/Kg)'
Prob > |*F*|		<.0001	Adj R – Sq	0.64449
F Value		11.42	Dw	2.063981
R-Square		0.70632		

Source: Data Processed, 2026

Information: *) Significance Level 1%
**) Significance Level 5%
***) Significance Level 10%

Partially, rice demand (QDB) is the most dominant determining factor, with a positive and significant effect at the 1% significance level (p = 0,0073). The coefficient of 0.000598 indicates that every 1-ton increase in demand drives a price increase of IDR 0.000598/kg. This relationship is consistent with the concept of demand-pull inflation according to Maggi (2013), a condition where an increase in demand drives upward price pressure. Sugiharto (2024) emphasizes that price pressure strengthens when population growth is not offset by sufficient supply, while Tarigan *et al*. (2011) conclude that the characteristics of rice as an inelastic essential good contribute to keeping market prices high.

The rice supply (QSB) shows a negative and significant relationship at the 10% significance level, in accordance with the law of supply where increased availability exerts downward pressure on market prices. This finding is supported by Kasnelly *et al*. (2024), who

state that supply is the primary instrument for price stability in Indonesia. In line with this, Aulia *et al*. (2025) emphasize that strong food availability guarantees can reduce price volatility at the consumer level. However, the small coefficient value indicates a low price response to changes in supply. Nugrahapsari & Hutagaol (2021) explain this phenomenon as an impact of the Government Purchase Price (HPP) policy, which creates price rigidity, preventing prices from easily falling when supply is abundant in order to protect farmers' welfare.

On the other hand, the world rice price (PW) and the previous year's rice price (PBs) do not have a statistically significant effect on domestic prices. The lack of significance of international prices occurs due to the implementation of import tariff instruments and government stock management, which protect the local market from global fluctuations (Nugrahapsari & Hutagaol, 2021). Regarding the previous year's price, this indicates that price formation in Indonesia is more dynamic within the current year. According to Aulia *et al*. (2025), stability is determined more by fundamental conditions, such as distribution in the current period, rather than following past price inertia, which is also reinforced by active government intervention through continuous market operations.

Ex-Ante Simulation of Rice Prices and Supply in Indonesia (2026–2030)

This projection is prepared under the assumption that the structural relationships between variables based on historical data remain valid (ceteris paribus); however, shocks are applied to specific exogenous variables to observe market adjustment dynamics from 2026 to 2030. This study applies two different policy simulation scenarios. These scenarios will provide an overview of the effectiveness of government policies in mitigating price volatility and import dependency in the future.

1. Simulation Results of the 5% Increase Scenario for Per Capita Income in Indonesia

A 5% annual increase in per capita income is based on the assumption of national economic growth aimed at improving public purchasing power. The results of this scenario simulation can be seen in Figure 3 below.

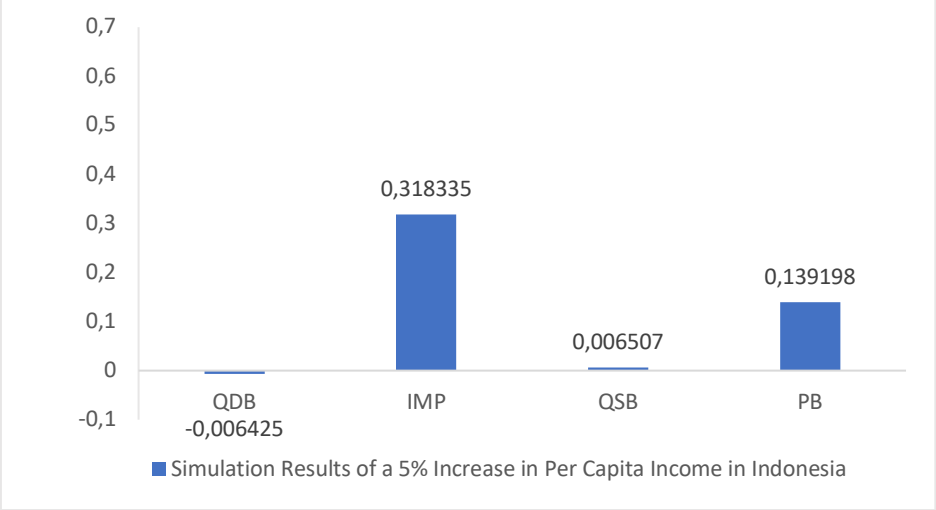

Figure 3. Simulation Results of a 5% Increase in Per Capita Income in Indonesia
Source: Data Processed, 2026

Based on the simulation results, a 5% annual increase in per capita income simultaneously leads to a minor 0.64% reduction in total rice demand (QDB). This structural outcome does not reflect a direct negative impact of the income variable on demand; rather, it is the net result of interlocking feedback loops within the simultaneous equation system. A 5% expansion in public income initially enhances aggregate purchasing power. However, within

an integrated market system, this demand pressure simultaneously drives consumer rice prices (PB) upward by a substantial 13.92% through demand-pull inflation. According to the law of demand, this severe retail price expansion during the current period acts as a major market deterrent for consumers. This negative price effect ultimately overrides the direct positive income effect, reducing the aggregate physical volume of national rice demand by 0.64%.

This interconnected mechanism indirectly reflects the operation of Bennett's Law in Indonesia. Driven by the indirect pressure of the new market equilibrium prices, these findings indicate that as household welfare improves, consumers begin to restrict their physical quantity consumption of medium-grade rice. Instead, they reallocate their surplus purchasing power toward dietary diversification, opting for non-rice food sources that offer higher quality, superior nutritional value, and greater added value.

This increase in income also triggers a highly significant surge in rice import volume (IMP) by 31.83%. This phenomenon indicates a long-term shift in demand driven by the growth of the food processing industry. The need for specific raw materials with stable quality, such as broken rice for the flour and feed industries, is increasingly met through international markets because national production has not been able to consistently meet these technical specifications. On the other hand, the total rice supply (QSB) increased only slightly by 0.65%. The low response of domestic supply to rising prices and income suggests that national production tends to be inelastic. This imbalance indicates that an increase in public welfare without strengthening the domestic production structure will enlarge dependency on global markets and trigger inflationary pressure on staple foods.

2. Simulation Results of the 25% Increase Scenario for Rice Stocks in Indonesia

A 25% increase in national rice stocks (Government Rice Reserves) as a form of intervention policy through the strengthening of the "iron stock" at Perum BULOG to maintain supply stability. The results of this scenario simulation can be seen in Figure 4 below.

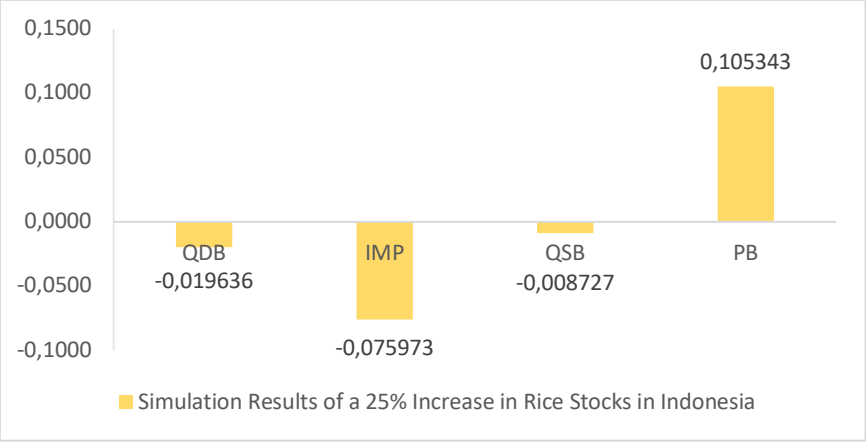

Figure 4. Simulation Results of a 25% Increase in Rice Stocks in Indonesia
Source: Data Processed, 2026

Based on the simulation results, the policy of increasing rice stocks by 25% leads to a 1.96% decrease in rice demand (QDB), indicating an adjustment in consumer behavior towards supply dynamics in the market. On the other hand, strengthening domestic stocks has proven effective in reducing dependence on foreign supply, as shown by a 7.60% decrease in rice import volume (IMP). This confirms that larger domestic reserves are capable of substituting for needs that are typically fulfilled through the international market.

However, this increase in stocks also results in a 0.87% decrease in the rice supply volume (QSB) and a 10.53% increase in rice prices (PB). The decline in supply amidst rising

stocks occurs because an increase in ending stocks mathematically reduces the volume of rice flowing directly into the free market during the current period. This price increase reflects a situation where a large portion of the supply is "withheld" or absorbed from the market to serve as government reserves. Theoretically, although this policy aims to guard against climate uncertainty, stock absorption without proper market operation mechanisms can create a supply reduction effect in the regular market, which ultimately pushes the equilibrium price higher at the consumer level.

CONCLUSION

Based on the research results, it can be concluded that the Indonesian rice market is experiencing a structural imbalance, characterized by steadily increasing demand while domestic supply fluctuates and tends to decline following the BPS methodology change in 2018. Rice demand is significantly influenced by population size and past consumption habits, and it remains inelastic toward price. Meanwhile, imports are determined more by government reserve stock policies rather than market factors. On the other hand, rice prices are influenced by demand pressure, where policies to increase stocks actually reduce market supply and drive price increases.

Ex-ante simulations for the 2026-2030 period indicate that rising public income will increase national import dependency by 31.83%, driven by a shift in preferences toward premium varieties and processing requirements within the food industry. Conversely, a 25% increase in public reserves will successfully reduce foreign trade dependency by 7.60% but will result in a 10.53% rise in retail prices due to the withdrawal of supplies from the open market. Therefore, long-term food stabilization policies must shift away from demographic-based solutions and focus strictly on agribusiness interventions and comprehensive marketing strategies. These measures include accelerating domestic yield capacity through the adoption of location-specific technologies and optimal input distribution to balance consumption; minimizing multi-layered marketing chains and tightening oversight to prevent speculation and systemic information asymmetry; adjusting the timing of Government Rice Reserve (CBP) procurement and release to avoid artificial retail shortages; and utilizing international trade quotas strictly as a data-driven early warning mechanism based on actual production-consumption balances rather than as a reactive instrument during crises.

ACKNOWLEDGMENTS

The author gratefully acknowledges all parties who have guided and supported the preparation of this research to completion. Special thanks are extended to the Statistics Indonesia (BPS) and Perum BULOG for providing the data, as well as family and colleagues for their support.

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