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Understanding rice price formation in Central Java: Interactions between market forces, food security, and climate anomalies

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Abstract
This study analyzes the complex factors influencing rice prices in Central Java, Indonesia, during 2018-2024 using panel data analysis. The findings reveal that while cooking oil and sugar prices generally exhibit a positive influence on rice prices via consumption spillovers, the effect of cooking oil became negative in 2021-2024. Domestic rice production significantly depresses prices, whereas food consumption expenditure shows a positive correlation. The Regional Food Security Index (FSI) negatively correlates with rice prices, and the disparity related to the government's Maximum/Highest Retail Price (HET) ratio is positively correlated. Notably, El Niño 3.4 index anomalies consistently drive rice prices upward, highlighting climate vulnerability. Policy implications emphasize integrated interventions encompassing inflation control, production stabilization, food security enhancement, HET evaluation, and climate change mitigation. Additionally, it recommends stronger institutional coordination in rice price and supply chain management.

Keyword: Rice Price, Central Java, Panel Data, Food security

Abstrak
Penelitian ini menginvestigasi dinamika kompleks yang memengaruhi harga beras di Jawa Tengah, Indonesia, selama periode 2018-2024 menggunakan analisis data panel. Temuan menunjukkan bahwa harga minyak goreng dan gula umumnya memiliki pengaruh positif terhadap harga beras melalui mekanisme efek limpahan konsumsi, meskipun dampak harga minyak goreng bergeser negatif pada periode 2021-2024. Produksi beras domestik memberikan tekanan signifikan ke bawah pada harga, sementara pengeluaran konsumsi makanan secara keseluruhan berkorelasi positif. Indeks Ketahanan Pangan (IKP) regional berkorelasi negatif dengan harga beras, dan disparitas terkait Harga Eceran Tertinggi (HET) pemerintah berkorelasi positif. Terutama, anomali indeks El Niño 3.4 secara konsisten mendorong harga beras ke atas, menyoroti kerentanan sektor pertanian terhadap iklim. Implikasi kebijakan menekankan intervensi terintegrasi yang mencakup pengendalian inflasi komoditas terkait, stabilisasi produksi, peningkatan ketahanan pangan regional, evaluasi HET, dan mitigasi dampak perubahan iklim, lebih lanjut merekomendasikan penguatan koordinasi kelembagaan dalam pengelolaan harga dan rantai pasok beras.

Kata kunci: Harga Beras, Jawa Tengah, Data Panel, Ketahanan pangan

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1. Introduction

Food security is a crucial issue that garners serious attention from both the government and society, as the SDGs propose to eliminate all forms of poverty, hunger, and malnutrition by 2030. Food security is a shared responsibility enshrined in Law No. 12 of 2012 concerning Food, to realize the availability, affordability, and fulfillment of sufficient, safe, quality, and nutritionally balanced food consumption, both at the national and regional levels 1 down to the individual level in an equitable manner. The government places food security as a top priority in its efforts to achieve national food self-sufficiency. This strategic policy reflects a commitment to strengthening the economic and social foundations through sustainable and independent food availability.

Rice plays a crucial role in supporting human life as a primary food commodity. The government is obligated to ensure the availability, affordability, and adequate and nutritious consumption of rice for all segments of society across all regions (Bondansari et al., 2024). Unexpected price increases can affect household food security differently, depending on the level of community welfare; unexpected increases in the prices of essential goods will lead to a sharper increase in the food portion of household budgets (Amolegbe et al., 2021; Barboza et al., 2020). Surges in food costs, combined with various shocks such as natural disasters and economic crises, have the potential to threaten community food and nutritional security. This condition makes poor communities increasingly vulnerable to hunger and the availability of sufficient nutrition (Gustafson, 2013).

From a production-side perspective, rice prices are influenced by various fundamental factors such as the base paddy price, production levels, harvested area, and stock management. Seasonality also plays a role, with the dry season typically yielding better harvests. The persistently dominant level of rice consumption as the primary carbohydrate source in the community's dietary patterns also influences the determination of government purchasing prices (Anggraeni et al., 2019). An efficient rice price transmission mechanism forms the foundation for creating a balance between the interests of producers and consumers. Effective price transmission ensures that price movements at the producer level are reflected in prices at the consumer level, and vice versa, indicating a symmetrical flow of information (Kusumaningsih et al., 2017).

Economic institutions, embodied through government policies, play a crucial role in shaping rice prices. Government intervention in stabilizing paddy/rice prices is considered necessary for distribution efficiency, production enhancement, food security, and the rural economy (Hermanto, 2017; Suryana et al., 2014). The Government Procurement Base Price (HPP) policy functions as a price protection instrument at the farmer level, limiting excessive price declines during the main harvest season. On the other hand, rice import and export policies directly affect the availability of supply in the domestic market, affect price fluctuations significantly. Agricultural input subsidies, such as fertilizers and seeds, have the potential to lower production costs and indirectly influence paddy selling prices. Finally, price stabilization programs

through market operations and buffer stocks represent institutional intervention efforts to mitigate price volatility that is detrimental to both consumers and producers.

Several empirical studies have examined the impact on rice prices. Grant et al., (1979) investigated the interplay of economic, institutional, and physical factors affecting the supply, demand, and price of US rice, finding that yields are influenced by climate, technology, and acreage, while acreage is affected by real prices, government programs, and previous acreage, with production elasticity to price varying across regions, and demand primarily influenced by income and population with a small impact from retail price changes, and world exports being more elastic than US exports, leading to differentiated markets. Islam & Chowdhury (2014) analyzed the factors causing rice price increases in Bangladesh using primary data and factor analysis, identifying political crises, natural disasters, lack of government support, input and international rice price inflation, seed and fertilizer scarcity, and a lack of strong inventory and supply chain management as key determinants, and recommending increased storage capacity for price stabilization. Hermawan et al., (2017) found that domestic rice prices in Indonesia are negatively influenced by production and exchange rates, and significantly positively by international prices and per capita income, with per capita income having a dominant influence. Sembiring et al. (2018) found that per capita consumption, imports, and Bulog's stock have a negative effect on rice prices in North Sumatra, while international prices and production have a significant positive effect, with rice production having the largest impact. Wang et al. (2015) investigated the long-term and short-term causal relationships between the prices of rice, crude oil, wheat, corn, and soybeans in China using the Autoregressive Distributed Lag method, finding that crude oil prices, along with wheat, corn, and soybean prices, influence rice prices, with significant long-term and short-term price transmission elasticities and an error correction mechanism maintaining long-term price relationships.

Central Java Province is recognized as a significant national food granary in Indonesia, with substantial production of rice, corn, and various other agricultural commodities. Notably, the province holds the second-largest agricultural land area in Indonesia, with a paddy production land area of 1,642,761.23 hectares and a production volume of 9,084,107.53 tons in 2023 (Statistics Jawa Tengah Province, 2024d). The government's commitment to supporting food security is outlined in the Regional Medium-Term Development Plan (RPJMD) of Central Java Province, specifically in the third objective: Enhancing a Resilient, Competitive, and Sustainable Economy, through programs aimed at increasing diversification and community food security, as well as stabilizing the prices of essential and important goods.

In early 2024, Central Java Province faced an inflation rate of 2.98% (year-on-year) and 0.57% (month-to-month), with rice commodities contributing the largest share of inflation at 0.87 percent. The El Niño phenomenon, which caused drought, uneven harvests, and flooding that disrupted rice production and distribution in several regions, significantly drove up rice prices. In October 2023, food commodities also contributed to the inflation component, with price increases in gasoline, red chili, rice, cayenne

pepper, and sugar. The main drivers mitigating inflation were price decreases in broiler eggs, broiler meat, shallots, watermelon, and cooking oil (Statistics Jawa Tengah Province, 2024b). The price fluctuations of medium-quality rice and sugar; notably, the price of medium-quality rice experienced a price surge in September 2023 to IDR 12,472 compared to IDR 11,298 in the previous month, while sugar prices also increased from IDR 13,763 in August 2023 to IDR 14,196 in September 2023.

Despite the comprehensive understanding provided by existing literature regarding various factors driving rice prices from global and regional perspectives, there remain limitations in comprehending the complex interactions among macroeconomic factors, consumer preferences, and specific climate anomalies that influence rice prices at the sub-national scale. This is particularly true for Central Java province, which holds the position as Indonesia's second-largest rice producer. This study aims to comprehensively analyze the factors influencing the price dynamics of rice commodities in 35 districts/cities of Central Java Province during the period 2018-2024. Employing a panel data approach, this research will examine the impact of (1) cooking oil and sugar prices as indicators of consumption spillover, (2) rice production and average food consumption as representations of supply-demand aspects, (3) the Food Security Index and the difference between the Maximum/Higest Retail Price (HET) and the actual rice price as reflections of government policy, and (4) El Niño/La Niña climate conditions. A thorough understanding of the interaction of these various factors is expected to provide more accurate insights into the formation of rice prices at the regional level, which can subsequently contribute to the formulation of more effective policies in maintaining price stability and food security.

2. Research Method

This study employs panel data analysis to investigate the determinants of rice price across 35 districts/cities in Central Java, Indonesia, during the period 2018-2024. The utilization of panel data facilitates a comprehensive examination of the dynamic relationships between variables in both the cross-sectional (inter-regional) and time-series (inter-temporal) dimensions. Consequently, this approach enables the identification of inter-regional heterogeneity effects and temporal variations in variable behavior. The panel data model constructed for this analysis incorporates rice price as the dependent variable, alongside a suite of independent variables encompassing: cooking oil price and sugar price (to capture consumption spillover effects), rice production and average food consumption (representing supply-demand dynamics), the Food Security Index and the disparity between the government-established Maximum/Higest Retail Price (HET) and the actual rice price (reflecting governmental policy aspects), and El Niño/La Niña climate conditions (detailed variable definitions and calculation methods are presented in Table 1). The empirical model for this research is specified as follows:

$$\begin{aligned} Ln\ Rice\ Price_{it} = {} & \alpha + \beta_1 LnCooking\ oil\ price_{it} + \beta_2 LnSugar\ Price_{it} + \\ & \beta_3 LnRice\ Production_{it} + \beta_4 Food\ Consumption_{it} + \beta_5 FSI_{it} + \\ & \beta_6 Rice\ Price\ Floor\ Ratio_{it} + \beta_7 Climate_{it} + \varepsilon \end{aligned} \quad (1)$$

Where $Rice\ Price$ is the Price of Premium Rice per kg; $Cooking\ Oil\ Price$ is the price of cooking oil per liter; $Price\ Sugar$ is the price of sugar per kg; $Rice\ Production$ is the result of rice production in toms; $Food\ Consumption$ is the average monthly expenditure for food (in %); FSI is the Food Security Index; $Rice\ Price\ Floor\ Ratio$ is the disparity between the price of medium rice and the Highest Retail Price (HET) determined by the government; $Climate$ is the anomalous value of the el-nino index 3.4. α is a constant, $\beta_1, \beta_2, \ldots, \beta_n$ are coefficients, i is the cross section districts/cities and t is the observation period and ε is the error term. All variables, initially expressed in their original units, will be transformed using the natural logarithm (Ln). Panel data regression techniques will be applied using the Common Model (CM), Fixed Effects (FE), and Random Effects (RE) models as estimation methods. The choice between the FE and RE models will be determined through the Hausman test, which evaluates the correlation between the error term and the predictor variables. In addition, the Chow test will be used to detect any structural changes in the regression model.

Tabel 1. Description of research variables

Variable Abbreviation	Definition	Measurement	Source
Rice Price	Price of IR64 Premium Rice per kg (IDR)	Ln	Sihati
Cooking Oil Price	Price of Bimoli Cooking Oil per liter (IDR)	Ln	Sihati
Sugar Price	Price of White Crystal Sugar (medium kw) per kg (IDR)	Ln	Sihati
Rice Production	Annual Rice Production (Tons)	Ln	Statistics Jawa Tengah Province
Food Consumption	Percentage of Monthly Per Capita Expenditure on Food in Urban and Rural Areas (%)	%	Statistics Jawa Tengah Province
FSI	Food Security Index	Index	Indonesia National Food Agency
Rice Price Floor Ratio	Disparity against Highest Retail Price (HET) (%) (available only from 2021)	%	Indonesia National Food Agency
Climate	Monthly average anomaly in El-Nino Index 3.4 from January – December.	Index	National Centers for Environmental Information

The calculation of price data on rice, cooking oil and sugar was taken from the Sihati website with monthly data then calculated based on the calculation:

$$Price = \frac{High + Low + Price_{January} + Price_{December}}{4} \quad (2)$$

where $High$ is the highest price in the current year and Low is the lowest price in the current year. Sihati is the Commodity Price and Product Information System is stipulated in the Decree of the Governor of Central Java No. 500/37 of 2013.

3. Results and Discussion

3.1. Results

This section presents the findings from the data analysis. To ensure a comprehensive understanding, we will first provide a narrative explanation and interpretation of the results, followed by the relevant descriptive statistics tables or estimation results tables. This structure aims to give readers initial context and insights before they review the tabular data in detail, thereby facilitating a clearer understanding of the complex dynamics influencing rice prices in Central Java.

Figure 1 illustrates the dynamics of rice prices (IR64 Premium Rice per kg) in Central Java Province from January 2018 to December 2024, revealing significant fluctuations with a general upward trend over the last decade. Starting at IDR 11,399 in January 2018, the price exhibited moderate fluctuations in the initial years. From 2022 onwards, a more pronounced and accelerated increase is evident. The price steadily climbed from IDR 11,090 in January 2022 to IDR 12,086 by September 2022. This upward momentum continued into 2023, with prices reaching IDR 12,987 in January 2023 and surpassing IDR 14,000 by January 2024, reaching IDR 14,416. The highest recorded price in this dataset is IDR 15,649 in March 2024, representing a significant increase of approximately 37.3% from the January 2018 price. Although there was a slight correction in the latter part of 2024, with the price settling at IDR 14,582 in December 2024, the overall trend clearly indicates a sustained escalation in rice prices within the analyzed period. Accroding to Statistics Jawa Tengah Province (2024a, 2024b), the most substantial increase in rice prices in Central Java was observed during the February to April 2024 period. This surge aligns with the year-on-year (y-on-y) inflation data for the food, beverages, and tobacco group in Central Java, which ranged from 8% to 9% during the same period. Rice emerged as the largest contributor to inflation during these months, driven by a confluence of factors including depleted stock due to the impacts of El Niño, uneven harvests, and widespread flooding that led to both production declines and disruptions in rice distribution within the surrounding areas.

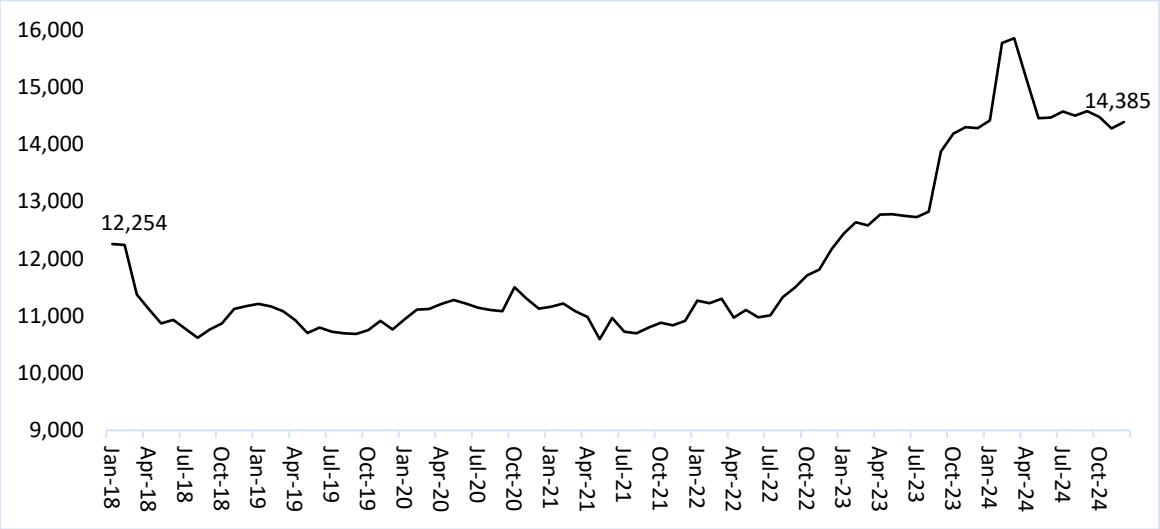

Figure 1. Monthly rice prices (IDR/kg) in Central Java 2018-2024 (Sihati, 2025)

Table 2. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	N
Rice Price	12,040.68	11,630.5	15,594.25	9,466.5	1,459.053	245
Cooking Oil Price	16,949.79	16,612	34,057.75	12,618.5	3,472.613	245
Sugar Price	13,524.36	13,435	17,441.25	10,802.25	1,851.542	245
Rice Production	15,5956.7	12,3994.4	46,1188.9	77.68	125,259.6	245
Food Consumption	47.97502	48.16	58.37	35.85	4.40005	245
FSI	82.50469	82.98	94.2	62.42	5.06665	245
Rice Price Floor Ratio	-6.65249	0.00	6.76	-32.89	9.59975	140
Climate	0.019405	0.075	0.815	-0.855	0.566152	245
Ln Rice Price	9.389023	9.361386	9.654658	9.155515	0.117641	245
Ln Cooking Oil Price	9.718247	9.717881	10.43581	9.442919	0.197175	245
Ln Sugar Price	9.503164	9.505619	9.766593	9.28751	0.134236	245
Ln Rice Production	11.14501	11.72799	13.04156	4.352598	1.963775	245

Tabel 3. Panel data regression estimation results

Variable Dependent	2018 - 2024				2021 - 2024			
Ln Rice Price	RE		FE		RE		FE	
Ln Cooking Oil Price	0.166	***			0.044		-0.021	***
Ln Sugar Price	0.480	***			0.624	***	0.802	
Ln Rice Production	-0.010	***	-0.127	**			0.012	
Food Consumption	-0.001		0.008	***			-0.001	
FSI	-0.003	***	0.012	***			-0.006	***
Rice Price Floor Ratio							0.003	***
Climate	0.078	***	0.092	***			0.018	**
C	3.705	***	9.415	***	3.029	***	2.442	***
Chow Test			1.956	***			3.717	***
Hausman Test			38.891	***			19.948	***
BP LM Test	35.410	***			24.862	***		
R-squared	0.791		0.535		0.628		0.959	
Adj R-squared	0.786		0.449		0.625		0.942	
Durbin-Watson stat	1.501		1.670		1.057		1.262	
F-statistic	150.501		6.239		204.539		110.324	
Prob(F-statistic)	0.000		0.000		0.000		0.000	

Note: *, ** and *** indicate significance levels at 0.10, 0.05 and 0.01; FE indicates that the selected model is Fixed Effect and RE is Random Effect.

The descriptive statistics table (Table 2) summarizes the central tendency and range of the variables under investigation. The mean rice price was 12,040.68 IDR/kg, with a minimum of 9,466.5 IDR/kg (Cilacap 2021) and a maximum of 15,594.25 IDR/kg (Tegal City 2024). Cooking oil price averaged 16,949.79 IDR/liter, ranging from a minimum of 12618.5 IDR/liter (Pekalongan City in 2020) to a maximum of 34,057.75 IDR/liter (Pati 2023). The mean sugar price was 13,524.36 IDR/kg, with a minimum of 10,802.25 IDR/kg (Jepara 2018) and a maximum of 17,441.25 IDR/kg (Semarang City 2024). Rice production had a mean of 155,956.7 tonnes, a minimum of 77.68 tonnes (Surakarta City 2022), and a maximum of 461,188.9 tonnes (Grobogan 2020). Food

consumption averaged 47.98%, with a minimum of 35.85% (Salatiga City 2022) and a maximum of 58.37% (Grobogan 2019). The Food Security Index (FSI) had a mean of 82.50, a minimum of 62.42 (Pekalongan City 2018), and a maximum of 94.2 (Kota Salatiga 2023). The Rice Price Floor Ratio showed a mean of -6.65, a minimum of -32.89 (Purworejo, Rembang and Pati in 2021), and a maximum of 6.76 (Surakarta City 2024). The Climate variable had a mean of 0.019, a minimum of -0.855 in 2020, and a maximum of 0.815 in 2021.

Table 3. presents the estimation results of panel data regression models, comparing Random Effects (RE) and Fixed Effects (FE) in explaining the natural logarithm of rice price (Ln Rice Price) as the dependent variable, using data from 35 districts/cities in Central Java, Indonesia, over the periods 2018-2024 and the sub-period 2021-2024. For the 2018-2024 period, the Chow test (4.883, $p<0.001$) and the Hausman test (0.000, $p<0.001$) are statistically significant, suggesting that the Fixed Effects (FE) model is more appropriate for this data compared to the Common Effects (CE) and Random Effects (RE) models. However, the BP LM test is also significant (35.410, $p<0.001$), independently supporting the use of the RE model over CE due to significant individual effects. In the RE model for 2018-2024, several independent variables significantly influence Ln Rice Price, including Ln Cooking Oil Price (coefficient 0.166, $p<0.001$), Ln Sugar Price (coefficient 0.480, $p<0.001$), Ln Rice Production (coefficient -0.010, $p<0.001$), FSI (coefficient -0.003, $p<0.001$), and Climate (coefficient 0.078, $p<0.001$). The FE model for the same period shows significance for Ln Rice Production (coefficient -0.127, $p<0.05$), Food Consumption (coefficient 0.008, $p<0.001$), FSI (coefficient 0.012, $p<0.001$), and Climate (coefficient 0.092, $p<0.001$).

For the sub-period 2021-2024, the Chow test (2.673, $p<0.01$) and the Hausman test (5.927, $p<0.1$) again indicate significance, although the significance of the Hausman test is slightly reduced, still favoring the FE model over RE. The BP LM test remains significant (24.862, $p<0.001$), supporting RE over CE. In the RE model for 2021-2024, Ln Sugar Price (coefficient 0.624, $p<0.001$) and Climate (coefficient 0.018, $p<0.01$) are significant. The FE model for this period demonstrates strong significance for Ln Cooking Oil Price (coefficient -0.021, $p<0.001$), FSI (coefficient -0.006, $p<0.001$), and Rice Price Floor Ratio (coefficient 0.003, $p<0.001$), as well as Climate (coefficient 0.018, $p<0.05$). The R-squared and Adjusted R-squared values tend to be higher in the RE model for 2018-2024 (0.791 and 0.786) and in the FE model for 2021-2024 (0.959 and 0.942), indicating the proportion of the dependent variable's variance explained by the model.

3.2. Discussion

The estimation results from the panel data regression model indicate the influence of cooking oil and sugar prices on the dynamics of rice prices in Central Java. During the analysis period of 2018-2024, the statistically significant positive coefficients in the Random Effects (RE) model suggest that increases in the prices of cooking oil and sugar are correlated with increases in rice prices. This phenomenon can be explained through the mechanism of consumption spillover, where price changes in substitute or

complementary commodities can affect the demand and price of other commodities, including rice. The rise in the prices of cooking oil and sugar, as essential goods, can reduce consumers purchasing power for other commodities or reflect general inflation that also affects rice prices. The increase in food commodity prices during the COVID-19 pandemic, caused by global supply chain disruptions, including food, due to labor shortages and factory closures, which subsequently triggered a 32.4 percent increase in global food prices by the end of 2021 driven by strong post-lockdown demand and government economic stimulus (AMRO, 2022), and has confirmed the impact of rising primary commodity prices on rice prices the impact of rising primary commodity prices on rice prices, as supported by Jati & Premaratne (2017), and Balcilar & Bekun (2020). However, an intriguing finding emerges in the sub-period analysis of 2021-2024, where the Fixed Effects (FE) model shows a statistically significant negative coefficient for cooking oil prices on rice prices. This change in the direction of influence indicates a potential shift in market dynamics or consumer behavior during this shorter time frame.

From the production side, rice production has a negative impact on rice prices, a finding consistent with the principle of supply and demand, where an increase in the quantity supplied of a good, in this case rice production, tends to depress its selling price. Assuming relatively constant or not fully elastic demand, an increase in regional rice production will increase market availability, potentially lowering the retail price of rice. This significant negative effect underscores the fundamental role of domestic supply in determining the level of rice prices at the district/city level. During harvest periods, the abundance of rice commodities in the market leads to a decrease in rice prices, while during off-harvest periods, there is a tendency for rice prices to increase in Central Java (Statistics Jawa Tengah Province, 2024c). This finding corroborates the findings of Yanti et al. (2021) in North Sumatra, Qodri et al. (2023) in East Java, and Fitrawaty et al. (2023) in Indonesia.

From the consumption side, a positive correlation exists between the average monthly expenditure on food in general and the level ofrice prices in Central Java. An increase in food consumption expenditure, acting as an indicator of heightened aggregate demand or inflationary pressures within the broader food sector, has the potential to drive up the prices of essential food commodities such as rice. This mechanism can manifest through increased consumer purchasing power leading to higher demand for various food types, including rice, or via the transmission of inflation from other food sectors to rice prices. Consequently, the overall dynamics of food consumption at the regional level can serve as a contributing factor to fluctuations in rice prices.

Regions exhibiting higher Food Security Index (FSI) scores, which reflect better conditions of food availability and affordability, tend to experience lower levels of rice prices. This phenomenon can be elucidated through market mechanisms where an adequate supply of food and consumer purchasing power that supports food accessibility can alleviate inflationary pressures on staple commodities like rice. Thus, the level of food security in a region becomes a significant factor in moderating rice price fluctuations at the regional level. Furthermore, a positive correlation is observed

between the price disparity of medium-quality rice relative to the government-established Maximum Retail Price (HET) and the level ofrice prices in Central Java. Regions displaying a larger price difference between medium-quality rice and the HET tend to have higherrice prices as well. This relationship may indicate market inefficiencies, variations in rice quality across regions not fully captured by HET regulations, or market practices allowingrice prices to respond more freely to local supply and demand conditions compared to the more regulated medium-quality rice segment.

Climate anomalies, as measured by the El Niño 3.4 index, show a positive correlation with the level ofrice prices. Higher anomaly values of the El Niño 3.4 index above the 0.5 threshold (indicating stronger El Niño conditions) tend to be followed by an increase in rice prices. This is likely due to the association of El Niño conditions with extreme weather patterns such as droughts, which can disrupt paddy production, thereby reducing supply and pushing prices upward in the market. Consequently, the intensity of the El Niño phenomenon becomes a significant climatic factor contributing to rice price fluctuations at the regional level. Consistent with the findings of Barrios-Perez, et al. (2021) in Central Colombia and Mulyaqin (2020) in Banten Province, El Niño events are observed to lead to a reduction in rice production. This decline is primarily attributable to a decrease in total precipitation, an increase in the number of dry days and extended dry spells, compounded by a rise in the frequency of both diurnal and nocturnal heatwave episodes.

Policy implications point towards the necessity of comprehensive and adaptive interventions to stabilize rice prices in Central Java. Given the influence of cooking oil and sugar prices as related commodities, general inflation control policies and the stabilization of other essential commodity prices are crucial to mitigate price pressures on rice. Additionally, sustained efforts to enhance and maintain the stability of regional rice production, particularly through effective management of harvest and post-harvest periods, as well as mitigating the impacts of extreme climate anomalies like El Niño, need to be prioritized to ensure adequate supply and avoid price spikes. Furthermore, strengthening food security at the regional level by improving food accessibility and affordability can act as a rice price stabilizer. Finally, the evaluation and adjustment of HET policies for rice, considering market dynamics and quality differences across regions, are necessary to reduce price disparities that can potentially affectrice prices.

4. Conclusion

The conclusion of this study highlights the intricate dynamics influencingrice prices in Central Java during the 2018-2024 period. Panel data analysis results indicate that cooking oil and sugar prices generally exert a positive influence on rice prices, suggesting a consumption spillover mechanism. However, an intriguing finding in the 2021-2024 sub-period reveals a shift in the impact of cooking oil prices to negative, implying potential changes in market behavior or consumer responses. From the production perspective, domestic rice supply demonstrates a significant price-depressing effect, consistent with basic economic principles. Meanwhile, overall food

consumption expenditure exhibits a positive correlation with rice prices, likely reflecting aggregate demand pressures.

Furthermore, the regional Food Security Index (FSI) shows a negative correlation with rice prices, underscoring the role of food availability and affordability in stabilizing prices. The price disparity of medium-quality rice relative to the government-established Maximum Retail Price (HET) displays a positive correlation withrice prices, indicating potential market inefficiencies or quality differences. Lastly, climate anomalies measured by the El Niño 3.4 index consistently correlate positively with rice prices, affirming the agricultural sector's vulnerability to climate change. The policy implications of these findings emphasize the need for integrated interventions encompassing the control of related commodity inflation, stabilization of rice production, strengthening regional food security, evaluation of HET policies, and mitigation of climate change impacts to achieve sustainable rice price stability in Central Java. From an institutional economics perspective, this study recommends strengthening coordination among government agencies in the implementation of rice price and supply chain policies, as well as evaluating the effectiveness of the HET in responding to regional market dynamics and the diverse quality of rice.

References

Amolegbe, K. B., Upton, J., Bageant, E., & Blom, S. (2021). Food price volatility and household food security: Evidence from Nigeria. *Food Policy*, *102*, 102061. https://doi.org/10.1016/j.foodpol.2021.102061

AMRO. (2022). *Feeding Inflation in ASEAN+3: The Rising Price of Food*. https://www.amro-asia.org/wp-content/uploads/2022/09/AMRO-Analytical-Note_Feeding-Inflation-in-ASEAN3_The-Rising-Price-of-Food_14-September-2022_.pdf

Anggraeni, W., Mahananto, F., Sari, A. Q., Zaini, Z., Andri, K. B., & Sumaryanto. (2019). Forecasting the Price of Indonesia's Rice Using Hybrid Artificial Neural Network and Autoregressive Integrated Moving Average (Hybrid NNs-ARIMAX) with Exogenous Variables. *Procedia Computer Science*, *161*, 677–686. https://doi.org/10.1016/j.procs.2019.11.171

Balcilar, M., & Bekun, F. V. (2020). Spillover dynamics across price inflation and selected agricultural commodity prices. *Journal of Economic Structures*, *9*(1), 2. https://doi.org/10.1186/s40008-020-0180-0

Barboza, G., Gavinelli, L., Pede, V., Mazzucchelli, A., & Di Gregorio, A. (2020). A contribution to the empirics of food price behavior: the case of rice price dynamics in Italy. *British Food Journal*, *123*(1), 419–440. https://doi.org/10.1108/BFJ-12-2019-0937

Barrios-Perez, C., Okada, K., Varón, G. G., Ramirez-Villegas, J., Rebolledo, M. C., & Prager, S. D. (2021). How does El Niño Southern Oscillation affect rice-producing environments in central Colombia? *Agricultural and Forest Meteorology*, *306*, 108443. https://doi.org/10.1016/j.agrformet.2021.108443

Bondansari, B., Widiatmaka, W., Machfud, M., Munibah, K., & Ambarwulan, W. (2024). Kebijakan menuju kemandirian beras, kasus di kabupaten banyumas jawa tengah.

Risalah kebijakan pertanian dan lingkungan Rumusan Kajian Strategis Bidang Pertanian Dan Lingkungan, *11*(1), 33–45. https://doi.org/10.29244/jkebijakan.v11i1.53470

Fitrawaty, Hermawan, W., Yusuf, M., & Maipita, I. (2023). A simulation of increasing rice price toward the disparity of income distribution: An evidence from Indonesia. *Heliyon*, *9*(3), e13785. https://doi.org/10.1016/j.heliyon.2023.e13785

Grant, W. R., Leath, M. N., & States., U. (1979). *Factors affecting supply, demand, and prices of U.S. rice*. U.S. Dept. of Agriculture, Economics Statistics, and Cooperatives Service, for sale by the National Technical Information Service. https://catalog.hathitrust.org/Record/102911086

Gustafson, D. J. (2013). Rising food costs & global food security: key issues & relevance for India. *The Indian Journal of Medical Research*, *138*(3), 398–410.

Hermanto, S. (2017). Kebijakan Harga Beras Ditinjau Dari Dimensi Penentu Harga. *Forum Penelitian Agro Ekonomi*, *35*(1), 31–43.

Hermawan, W., Fitrawaty, F., & Maipita, I. (2017). Factors Affecting the Domestic Price of Rice in Indonesia. *JEJAK*, *10*(1), 155–171. https://doi.org/10.15294/jejak.v10i1.9133

Islam, M., & Chowdhury, F. (2014). Factors Affecting the Prices of Rice in Bangladesh from the Perspective of Growers and Sellers. *UITS Journal*, *3*(2).

Jati, K., & Premaratne, G. (2017). Analysis of Staple Food Price Behaviour: Multivariate BEKK-GARCH Model. *The Journal of Asian Finance, Economics and Business*, *4*(4), 27–37. https://doi.org/10.13106/jafeb.2017.vol4.no4.27

Kusumaningsih, A., Jamhari, J., & Darwanto, D. H. (2017). Analysis of Rice Price Trend and Vertical Integration of Rice Market in Indonesia. *Ilmu Pertanian (Agricultural Science)*, *1*(2), 074. https://doi.org/10.22146/ipas.10783

Mulyaqin, T. (2020). The Impact of El Niño and La Nina on Fluctuation of Rice Production in Banten Province. *Agromet*, *34*(1), 34–41. https://doi.org/10.29244/j.agromet.34.1.34-41

Qodri, L. A., Ismail, M., Ekawaty, M., & Wahyudi, S. T. (2023). *The Dynamic Impact of Rice Production and Harvested Area on Agricultural Product Prices During COVID-19* (pp. 275–285). https://doi.org/10.2991/978-2-38476-064-0_30

Sembiring, S. A., Saragi, P. H. C., Sitorus, J. A., Tamba, A., & Simatupang, M. U. (2018). Analysis of factors affecting retail prices of rice in North Sumatera. *IOP Conference Series: Earth and Environmental Science*, *205*, 012010. https://doi.org/10.1088/1755-1315/205/1/012010

Statistics Jawa Tengah Province. (2024a). *Perkembangan Indeks Harga Konsumen Provinsi Jawa Tengah April 2024*.

Statistics Jawa Tengah Province. (2024b). *Perkembangan Indeks Harga Konsumen Provinsi Jawa Tengah Februari 2024*.

Statistics Jawa Tengah Province. (2024c). *Statistik harga Produsen Beras di Penggilingan Provinsi Jawa Tengah 2023*.

Statistics Jawa Tengah Province. (2024d). *Statistik Tanaman Pangan*.

Suryana, A., Rachman, B., & Hartono, M. D. (2014). Dinamika Kebijakan Harga Gabah Dan Beras Dalam Mendukung Ketahanan Pangan Nasional. *Pengembangan Inovasi Pertanian*, *7*(4), 155–168.

Wang, Y., Zhao, S., Yang, Z., & Liu, D. J. (2015). Food versus crude oil: what do prices tell us? Evidence from China. *China Agricultural Economic Review*, *7*(3), 435–447. https://doi.org/10.1108/CAER-09-2014-0091

Yanti, M. E., As'ad, O. A., & Sibuea, F. A. (2021). Economic Factors Affecting Rice Price Fluctuation in North Sumatera. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *4*(2), 2277–2285. https://doi.org/10.33258/birci.v4i2.1925