International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 6, 2025
https://theaspd.com/index.php

Do Strategic Food Price Changes Affect The Welfare Of Food Crop Farmers In Bali?

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Abstract
Fluctuations in food commodity prices in Bali affect the stability of food prices which have an impact on people's welfare. This study aims to analyze the effect of the prices of seven main commodities—rice, shallots, garlic, red chilies, cayenne pepper, cooking oil, and granulated sugar—on Famers Term of Trade (FTT) to Crops (Y), which represents overall food prices in Bali during the period from January 2019 to December 2023. The FTT value reflects the welfare of food crop farmers. The method used is multiple regression with secondary data obtained from the Strategic Food Price Information Center (PIHPS) and other market sources. Regression analysis shows that the prices of rice (X1), shallots (X2), and cooking oil (X6) have a significant effect on FTT to Crops (Y), with a coefficient of determination (R^2) of 0.701, which explains 70.1% of the variability in food prices. The simultaneous test (F) confirms that the overall regression model is significant (p-value <0.05), while the partial test (t) shows that the price of rice and shallots has a stronger influence compared to other commodities. This study suggests increasing domestic food production, strengthening food distribution, and responsive import policies to reduce the impact of price fluctuations on people's welfare. These results have important implications for food security policies in Bali.
Keywords: *food price fluctuations, multiple regression, FTT to Crops, Bali, food policy.*

BACKGROUND

Bali Province, as one of the world's leading tourism destinations, faces a major challenge in maintaining stable food prices. Bali is not only home to more than 4 million people, but also welcomes millions of tourists every year. With so many people depending on Bali, both as a place to live and as a tourist destination, food stability is a crucial aspect for social and economic sustainability. The local agricultural sector, although vital, still has to contend with pressures on natural resources, especially in terms of land use change and dependence on imported food commodities that can cause an imbalance between supply and demand.

Globally, food security is a major challenge faced by many countries, especially those that rely on imports to meet their domestic food needs. Countries in Southeast Asia, including Indonesia, are often exposed to the impacts of climate change, fluctuations in world food prices, and geopolitical tensions that can affect food supplies. Bali, as a province that is highly dependent on the tourism sector, also feels the impact, especially in the form of food price fluctuations that are closely related to tourist demand and local household consumption.

As a province rich in agricultural products, Bali has great potential to become independent in terms of food security. However, many food commodities must be supplied from outside Bali, either through imports or inter-provincial distribution, which often causes unstable food prices. Research conducted by Puspaka, Sudarma, and Widhianthini (2022) shows that market operations carried out by BULOG can help stabilize rice prices in Bali, but there are still challenges in increasing the effectiveness of these activities (Puspaka et al., 2022). This indicates that despite government efforts, food price stability in Bali still depends heavily on the policies implemented and the effectiveness of their implementation.

Food prices in Bali are not only influenced by domestic factors, but also by global factors. World food prices, which are influenced by various issues such as climate change, international conflicts, and global economic uncertainty, have a direct impact on food supply in Bali. For example, the prices of staple foods such as cooking oil, rice, and other agricultural products often experience significant increases due to fluctuations in the international market. Research conducted by Akbar and Fahria (2022) on the impact of the COVID-19 pandemic on food prices shows how this global crisis has affected food prices

throughout Indonesia, including Bali. Their research highlights the spike in food prices such as rice, chicken, and eggs due to supply disruptions caused by the pandemic (Akbar & Fahria, 2022).

In addition to external factors, internal factors also play an important role in determining food prices in Bali. Bali's local agricultural potential, which includes commodities such as rice, corn, soybeans, and vegetables, is highly dependent on the availability of limited agricultural land. With the increasing conversion of agricultural land to land for non-agricultural purposes, Bali faces major challenges in meeting local food needs. Research by Antara and Sumarniasih (2020) shows that although Bali has great potential in food commodity production, the imbalance between supply and demand often causes spikes in food prices, which impacts the welfare of the Balinese people (Antara & Sumarniasih, 2020).

Bali's food security is also influenced by the government's policy strategy that focuses on the distribution and regulation of food supplies. In this case, the market operation policy and food price stabilization by the local government, through institutions such as BULOG, are the main instruments in maintaining the stability of rice and other food prices. A study by Agung and Daryanto (2017) on rice market integration in Bali highlights the importance of a well-integrated market network to reduce price fluctuations between regions in Bali (Agung & Daryanto, 2017).

In addition, Bali also needs to adopt modern agricultural technology to increase local food production capacity. The use of agricultural technology 4.0, which includes crop monitoring technology, smart irrigation, and precision farming, can help increase agricultural output without sacrificing environmental sustainability. Widhianthini et al. (2024) emphasize the importance of collaborative strategies between the government, private sector, and communities in maintaining food security in the Bali region. They suggest that agricultural technology be utilized to increase productivity and reduce dependence on food imports (Widhianthini et al., 2024).

However, despite many efforts to increase local food production, climate change and natural disasters still pose a major threat to Bali's food security. Bali, like many other regions, is vulnerable to extreme weather and natural disasters that can damage agricultural output and disrupt food distribution. Therefore, effective climate change mitigation strategies must be part of long-term policies to maintain food security in Bali.

Along with these challenges, it is important to conduct further research to understand the dynamics of food prices and strategies that can be applied to improve Famers Term of Trade (FTT) to crop which has implications for farmer welfare in Bali. One gap in existing research is the limited data and long-term analysis that can describe in more depth the pattern of food price fluctuations and the factors that influence them. Existing research is more often focused on certain commodities or only in a short period of time, while long-term analysis involving various commodities and global economic factors is still limited.

Novelty in this researchis the importance of understanding the influence of tourism factors, climate change, and government policies holistically on food price stability in Bali. More comprehensive research that considers these external, social, and economic factors will provide a deeper understanding of how to maintain food security in Bali, as well as provide recommendations for more effective policies in facing future food security challenges. food security in Bali requires a broader approach that involves natural resource management, strengthening the local agricultural sector, and better regulating food markets. This study aims to fill the existing gap by providing a new perspective on the factors that influence food prices and the welfare of food crop farmers in Bali, as well as providing evidence-based suggestions for more sustainable food policies.

Research methods

This study aims to identify factors that influence food commodity prices that have implications for the Welfare of Food Crop Farmers in Bali through multiple regression analysis. The level of Welfare of Food Crop Farmers is measured by the Famers Term of Trade of Food Crops (FTT to Crop). In this study, we used food commodity price data in Bali for the period January 2019 to December 2023 sourced from the National Strategic Food Price Information Center (PIHPS) for the period January 2019-December 2023 and the Central Statistics Agency (BPS) for 2019-2023. The commodities studied include rice, shallots, garlic, red chilies, cayenne pepper, cooking oil, and granulated sugar, which are considered independent variables in the model. Meanwhile, FTT to Crops is used as the dependent variable.

Types of research

This study uses a quantitative method with a descriptive and inferential approach. We rely on secondary data obtained from PIHPS for the period January 2019-December 2023 and BPS for 2019-2023. According to Sudirman et al. (2021), the use of secondary data in food price analysis can provide a clear picture of market dynamics that occur over a long period of time (Sudirman, 2021).

Data collection technique

The data used in this study include the prices of food commodities traded in the Bali market in the period January 2019 to December 2023. These prices are collected monthly and include commodities such as rice, shallots, garlic, red chilies, cayenne pepper, cooking oil, and granulated sugar. These price data are collected through PIHPS and BPS. Agung et al. (2020) showed that complete and detailed monthly data is essential to understand long-term food price fluctuations and suggested collecting valid secondary data for the accuracy of the research results (Agung et al., 2020).

Analysis Model

To analyze the existing data, this study uses multiple regression analysis with a model that links food commodity prices with FTT to crop in Bali. This multiple regression model can be written in the following mathematical formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \epsilon$$

Where Y is the dependent variable, namely FTT to Crops, and X1,X2,X3,...,X7 are independent variables representing the price of rice, shallots, garlic, red chili, cayenne pepper, cooking oil, and granulated sugar. β0 is the intercept that shows the value of Y when all X = 0, while β1,β2,...,β7 are coefficients that describe the effect of each independent variable on Y. ϵ is the error or residual of the model.

This multiple regression was chosen because of its ability to test the simultaneous influence of several independent variables on one dependent variable, which in this case is food prices in Bali. Widyanthini et al. (2023) stated that the multiple regression model is very effective in economic research to identify relationships between variables in the food economy (Widyanthini, 2023).

Hypothesis Testing

To analyze the influence of independent variables on food commodity prices in Bali, this study uses three types of hypothesis tests: Determination Coefficient Test (R^2), Simultaneous Test (F Test), and Partial Test (t Test).

Coefficient of Determination (R^2) Test

The R^2 test is used to measure the extent to which variation in the dependent variable (Y) can be explained by the independent variables (X_1, X_2, ..., X_7). The R^2 value ranges from 0 to 1, with the closer to 1 indicating that the regression model explains most of the variation in the data. R^2 is calculated using the following formula:

$$R^2 = 1 - \frac{SS_{residual}}{SS_{total}}$$

Where:

- SSresidualis the sum of the squares of the residuals (model errors),
- SStotalis the total sum of squares that describes the total variation in the data.

As a reference, Sudirman et al. (2020) showed that a high R^2 (above 0.7) indicates that the regression model has good predictive ability in explaining food price variability (Sudirman et al., 2020).

Simultaneous Test (F Test)

The F test is used to test the overall significance of the regression model. The hypotheses tested are:

- H_0: All regression coefficients (except the intercept) are 0, meaning there is no influence of the independent variables on the dependent variable.
- H_1: There is at least one regression coefficient that is not equal to 0, meaning that there is an influence of the independent variable on the dependent variable.

The F test is calculated using the formula:

International Journal of Environmental Sciences
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$$F = \frac{(SS_{regression}/k)}{(SS_{residual}/(n-k-1))}$$

Where:

- SSregressionis the sum of squares explained by the model,
- Kis the number of independent variables,
- nis the total number of observations.

If the p-value of the F test is less than 0.05, then H_0 is rejected, which means that the overall regression model is significant in explaining variations in food prices in Bali.

Partial Test (t-Test)

The t-test is conducted to test the significance of each regression coefficient in the model. This test aims to determine whether a particular independent variable has a significant effect on the dependent variable. The hypotheses tested are:

- H_0: Regression coefficient βi=0\beta_i = 0βi=0, which means that the independent variable has no effect on the dependent variable.
- H_1: Regression coefficient βi≠0\beta_i \neq 0βi≠0, which means that the independent variable has an effect on the dependent variable.

The t-test is calculated using the formula:

$$t = \frac{\hat{\beta}_i}{SE(\hat{\beta}_i)}$$

Where β^i is the estimated regression coefficient and SE(β^i) is the standard error of the regression coefficient. If the p-value for the regression coefficient is less than 0.05, then H_0 is rejected, which means the coefficient is significant.

In this study, multiple regression analysis is used to identify factors that influence FTT to Crops in Bali. The use of R^2 test, simultaneous test (F), and partial test (t) will help in evaluating the overall significance of the model and the influence of each independent variable on the dependent variable. With this approach, this study is expected to provide better insight into the dynamics of food prices in Bali, which can be used to design more effective food security policies.

Results and Discussion

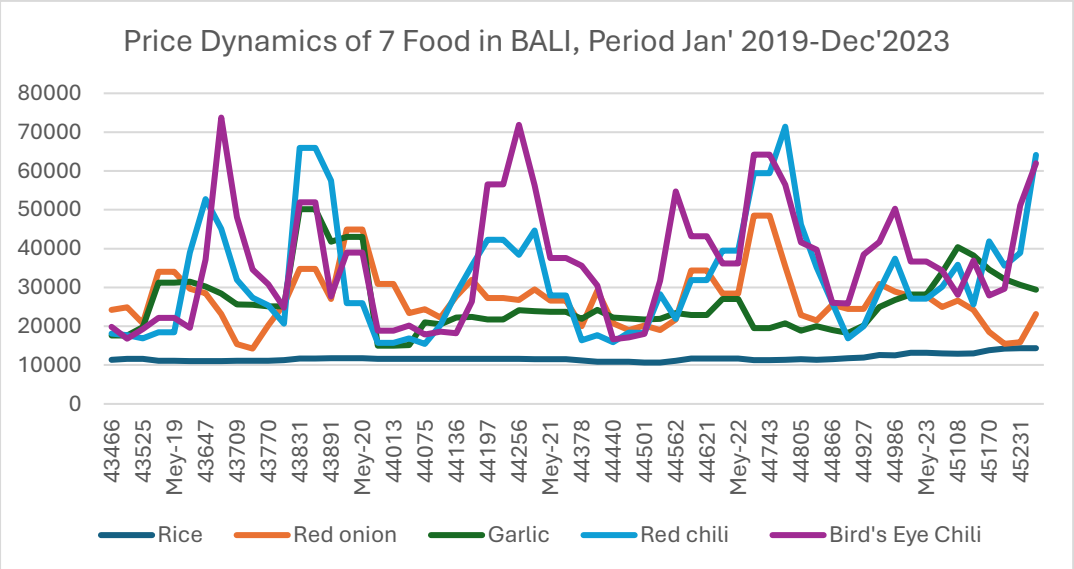

Fig 1. Farmer's Trade Value (FTT) for Food Crops January 2019 - December 2023

Fluctuations in food commodity prices in Bali during the period from January 2019 to December 2023 reflect complex market dynamics, influenced by various external and internal factors. This study analyzes seven main commodities—rice (X1), shallots (X2), garlic (X3), red chili (X4), cayenne pepper (X5), cooking oil (X6), and granulated sugar (X7)—in the context of food commodity prices in Bali. Each commodity shows a unique fluctuation pattern, influenced by imbalances between supply and demand, changes in weather, and global import and trade policies. This analysis also focuses on the effect of commodity price fluctuations on FTT to Crops (Y), which represents the overall food commodity price index in Bali.

Fluctuations in Food Commodity Prices

Rice Price (X1)shows a steady upward trend throughout the 2019-2023 period, with some minor declines in some months. Starting at IDR 11,400 per kg in January 2019, the price of rice has increased gradually, peaking at IDR 14,350 per kg in December 2023. This fluctuation can be explained by a decrease in supply due to weather factors and an increase in demand in certain periods. Widianto (2021) explains that rice prices are often influenced by import policies and domestic supply disruptions, which cause rice prices in Bali to be unstable and contribute directly to the food price index (Y) (Widianto, 2021) Link.

Red Onion Price (X2)shows very large fluctuations. In January 2019, the price of shallots was recorded at around IDR 24,250 per kg, but peaked in July 2020 at around IDR 48,500 per kg. The price then decreased and was recorded at IDR 15,500 per kg in December 2023. This shallot price fluctuation was caused by supply disruptions triggered by weather changes and dependence on imports. The price decline that occurred at the end of this period reflected the recovery of supply, but prices remained higher than the initial price. Sudirman et al. (2022) stated that dependence on imports and fluctuations in domestic production greatly affect shallot prices and, in turn, contribute to fluctuations in FTT to Crops (Y) (Sudirman et al., 2022) Link.

Garlic Price (X3)also experienced large fluctuations with a peak in January 2020 reaching IDR 50,150 per kg. Prices then declined significantly in the post-pandemic period, reflecting major disruptions to global supply, particularly from major producing countries such as China. Garlic prices were heavily influenced by dependence on imports and distribution issues that occurred during the global crisis. The decline in prices after the spike in early 2020 illustrated a more stable recovery although prices still did not return to their initial levels. Akbar et al. (2021) explained that these garlic price fluctuations are closely related to Indonesia's dependence on imports, which makes it highly vulnerable to changes in the international market, which in turn affects FTT to Crops (Y) in Bali (Akbar et al., 2021) Link.

Red Chili Price (X4)also showed sharp fluctuations, with the highest price recorded in March 2020, reaching IDR 71,400 per kg. This price spike was caused by supply disruptions, both due to natural disasters and crop damage caused by bad weather. This fluctuation in the price of red chili directly affects the price of FTT to Crops (Y), because red chili is one of the most important commodities in household consumption in Bali. The price decline that occurred in late 2020 and 2021 showed the impact of supply normalization, although prices remained unstable. Research by Sudirman et al. (2022) highlights that the price of red chili is heavily influenced by fluctuations in domestic production and climate change, which causes sharp price volatility and has a significant impact on FTT to Crops (Y) (Sudirman et al., 2022) Link.

Price of Cayenne Pepper (X5)also showed a significant price spike, with the highest price recorded at IDR 73,750 per kg in August 2019. The price fluctuation of cayenne pepper was greatly influenced by the decrease in supply caused by climate change and distribution disruptions. This price spike, like red chili, has a direct impact on FTT to Crops (Y). The price decline after this spike indicates a dependence on domestic production and trade policies that affect local supply and affect overall food price stability.

Cooking Oil Price (X6)showed a steady increase throughout the period, with prices starting at IDR 13,300 per kg in January 2019 and increasing to IDR 20,550 per kg in December 2023. This price increase reflects the increase in world oil prices and changes in palm oil import-export policies, which have an impact on domestic cooking oil raw material supplies. The gradual increase in cooking oil prices has contributed to the increase in the food price index (Y), indicating dependence on global factors that affect production costs.

Price of Granulated Sugar (X7), although showing more moderate fluctuations compared to other commodities, still experienced a stable increase from IDR 13,000 per kg in January 2019 to IDR 17,750 per kg in December 2023. This price increase was influenced by the increase in global raw material prices and restrictions on sugar imports. Although granulated sugar prices showed higher stability, global price fluctuations still affected domestic prices, which ultimately affected FTT to Crops (Y).

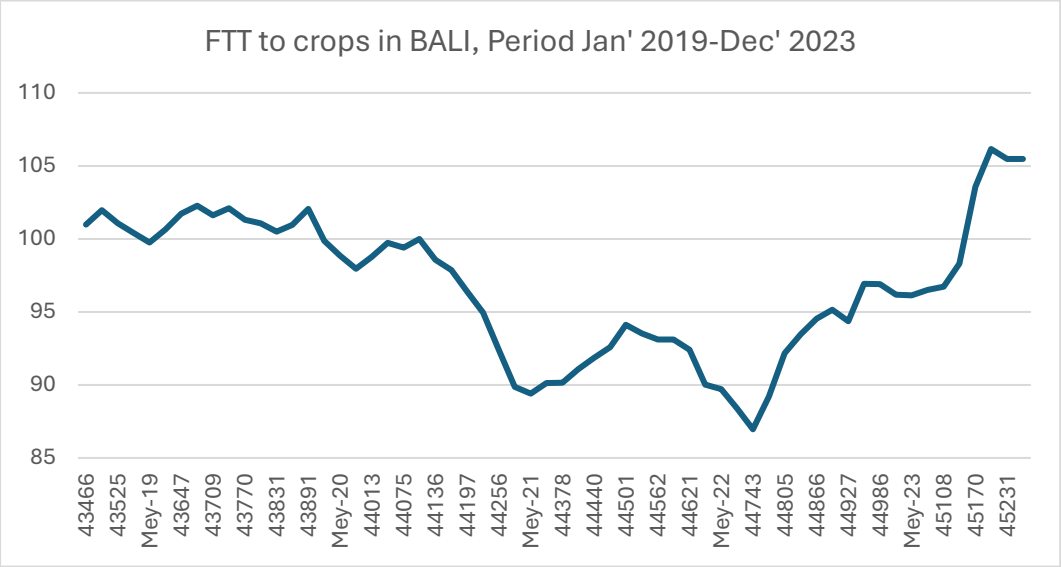

Fig 2. FTT to crops in BALI, Period Jan' 2019-Dec' 2023

Fig 2. FTT to Crops (Y), which represents the food commodity price index in Bali, shows significant fluctuations throughout the period from 2019 to 2023. Starting at 100.99 in January 2019, the food price index decreased to 86.96 in October 2020, reflecting the decline in people's purchasing power and the impact of the COVID-19 pandemic which disrupted supply and distribution. After a period of sharp decline, food prices in Bali have again experienced a steady recovery, reaching 106.16 in March 2023. The significant increase at the end of the period reflects economic recovery and increased demand accompanied by rising prices of key commodities such as rice and chili.

The lower price decline in 2020 was related to lower consumption during the pandemic, while the price spike in late 2022 and early 2023 was influenced by reduced supply and higher global commodity prices. Overall, the fluctuation of FTT to Crops (Y) provides a clear picture of the instability of food prices in Bali which is heavily influenced by changes in global commodity prices, import policies, and domestic production. These food price fluctuations have a direct impact on the socio-economic welfare of the Balinese people, especially in terms of purchasing power and access to affordable food.

Regression Analysis Results

Table 1.R Square

Multiple R	0.837
R Square	0.701
Adjusted R Square	0.661
Standard Error	2,795

Coefficient of Determination (R2)

In the first stage of the analysis, we measure the coefficient of determination or R2 to assess the extent to which the regression model can explain the variability in the dependent variable. The R2 value produced in this analysis is 0.701, which indicates that 70.1% of the variability in food commodity prices in Bali can be explained by this regression model. This means that most of the variations in food prices can be predicted using the selected independent variables, while the remaining 29.9% is influenced by other factors not included in this model. Therefore, this model can be considered quite good in describing the factors that influence food prices in Bali.

Simultaneous Test (F Test)

Next, a simultaneous test (F test) is conducted to test the overall significance of the regression model. This test aims to determine whether all independent variables in the model together have a significant effect on the dependent variable, in this case the price of food commodities in Bali. In other words, this test tests the hypothesis that there is no significant effect of independent variables on food prices if we look at the model as a whole.

The hypotheses tested are:

- H0 (null hypothesis):All regression coefficients (except the intercept) are 0, which means there is no effect of the independent variables on the dependent variable.
- H1 (alternative hypothesis):There is at least one regression coefficient that is not equal to 0, which means that at least one independent variable has an effect on the dependent variable.

Table 2. Simultaneous Test

ANOVA

	Df	SS	MS	F	Significance F
Regression	7	953,1573	136,1653	17,434	0,000
Residual	52	406,1356	7,8103		
Total	59	1359,293			

Dependent: Y = FTT to Crops, BALI

The results of the F test show a p-value of 0.000, which is much smaller than the commonly used significance level of 0.05. Because this p-value is very small, the null hypothesis (H0) is rejected, which means that there is at least one independent variable that has a significant effect on the price of food commodities in Bali. Thus, this regression model as a whole is considered significant and relevant for use in the analysis

Partial Test (t-Test)

After the simultaneous test, the analysis is continued with a partial test (t-test) to assess the effect of each independent variable on the dependent variable individually. This t-test examines whether the regression coefficient of each independent variable is significantly different from 0, indicating that the variable has an effect on the dependent variable, namely the price of food commodities.

The hypotheses tested are:

- H0 (null hypothesis):The regression coefficient $\beta i=0$, which means that the independent variable has no effect on the dependent variable.
- H1 (alternative hypothesis):The regression coefficient $\beta i\neq 0$, which means that the independent variable has an effect on the dependent variable.

In this analysis, each independent variable is tested to see if they have a significant effect on food prices. Based on the results of the t-test, we can see that some independent variables show a significant effect, while others do not.

Table 3. Partial Test

	Coefficients	Standard Error	t Stat	P-value
Intercept	76.11933	6,0848	12,5098	0.0000
X1 = Rice	0.00263	0.0007	3,9086	0.0003
X2 = Shalot	-0.00017	0.0001	-2.7574	0.0080
X3 = Garlic	0.00008	0.0001	1,3566	0.1808
X4 = Red chili	0.00004	0.0000	1,0982	0.2772
X5 = Bird's Eye Chili	-0.00006	0.0000	-1.8587	0.0687
X6 = Cooking oil	-0.00113	0.0002	-6,9943	0.0000
X7 = Granulated sugar	0.00082	0.0006	1,3608	0.1794

Dependents:Y = FTT to Crops, BALI

After ensuring the overall significance of the model with the F test, the analysis is continued with a partial test (t-test) to assess the influence of each independent variable individually on the dependent variable. The t-test aims to determine whether each regression coefficient of the independent variable is significantly different from zero. If the regression coefficient of an independent variable is significantly different from zero, this means that the variable has an effect on the dependent variable.

The hypotheses tested in this t-test are as follows: H0 (null hypothesis) states that the regression coefficient $\beta i=0$, which means that the independent variable has no effect on the price of food commodities. Meanwhile, H1 (alternative hypothesis) states that the regression coefficient $\beta i\neq 0$, which means that the independent variable has an effect on the dependent variable.

The results of the t-test show that the price of rice (X1) has a p-value of 0.00027, which is smaller than 0.05. This shows that the price of rice has a significant effect on FTT to Crops in Bali. In other words, changes in the price of rice will have an impact on changes in the overall FTT to Crops in Balinese traditional markets. Meanwhile, the price of shallots (X2) also shows a p-value of 0.00802, which means

that the price of shallots also has a significant effect on FTT to Crops. This means that fluctuations in the price of shallots also significantly affect FTT to Crops in Bali.
Then, the price of cooking oil (X6) has a p-value of 5.05×10^{-9}, which is very small, which confirms that the price of cooking oil has a significant effect on FTT to Crops. This shows that the price of cooking oil in the market greatly affects the overall FTT to Crops in Bali, which is most likely due to its role as a staple food that is widely used in various household consumptions. Thus, the three variables, namely the price of rice, shallots, and cooking oil, are proven to have a very strong and significant effect on FTT to Crops in Bali.
On the other hand, other variables show different results. The price of garlic (X3) has a p-value of 0.18076, which is greater than 0.05, indicating that the price of garlic does not significantly affect FTT to Crops in Bali. This shows that the fluctuation of the price of garlic does not significantly affect the overall FTT to Crops. The same applies to the price of red chili (X4), with a p-value of 0.27718, which is also greater than 0.05. This means that the price of red chili does not contribute significantly to changes in FTT to Crops in Bali. In addition, the price of granulated sugar (X7) also has a p-value of 0.17943, which is greater than 0.05, so we can conclude that the price of granulated sugar does not significantly affect FTT to Crops in Bali.
However, there is one variable that shows marginal results. The price of cayenne pepper (X5) has a p-value of 0.06873, which is greater than 0.05, but close to the significance value. The effect of cayenne pepper prices on food prices can be considered marginal, meaning that although there is an indication that cayenne pepper prices have an effect on FTT to Crops, the effect is not strong enough to be considered significant at the 0.05 significance level. This shows that although cayenne pepper prices fluctuate, their effect on FTT to Crops is still not dominant enough.
The results of the partial test show that several variables, such as the price of rice, the price of shallots, and the price of cooking oil, have a significant effect on the price of food commodities in Bali, while others, such as the price of garlic, the price of red chilies, and the price of granulated sugar, do not show a significant effect. The price of cayenne pepper has an almost significant effect, but is not strong enough to be stated as a statistically significant effect.

DISCUSSION

This study examines food commodity price fluctuations in Bali from January 2019 to December 2023, with the aim of understanding the relationship between food commodity price fluctuations and FTT to Crops (Y), which reflects the welfare of food farmers in Bali. As a province that relies on the agricultural sector and has high household consumption of food commodities, food price fluctuations in Bali have a significant impact on the socio-economic welfare of the Balinese people. A number of food commodities studied—rice, shallots, garlic, red chilies, cayenne peppers, cooking oil, and granulated sugar—have been shown to have a significant impact on the welfare of food crop farmers as a whole.
The fluctuation of food commodity prices in Bali shows a pattern that is greatly influenced by external and internal factors that interact with each other. Therefore, this study also focuses on the analysis of the relationship between food commodity prices and FTT to Crops (Y), which represents the welfare of food crop farmers as a whole. Based on the regression model used in this study, several independent variables such as the price of rice, shallots, and cooking oil show a significant effect on FTT to Crops (Y), while others do not.
Rice (X1)shows a relatively stable price increase trend throughout the period 2019 to 2023. Rice prices started at IDR 11,400 per kg in January 2019 and increased gradually to IDR 14,350 per kg in December 2023. This increase was mainly influenced by a decrease in domestic supply due to extreme weather that disrupted the harvest. In addition, the rice import policy that limits domestic supply also plays a major role in price fluctuations. Widianto (2021) revealed that rice price fluctuations are often closely related to import policies, which affect the stability of domestic food prices. The decrease in rice supply that occurred in late 2022 and early 2023 had a direct impact on overall food prices in Bali, which is reflected in FTT to Crops (Y) (Widianto, 2021). In this case, rice price fluctuations are not only related to domestic supply, but also to dependence on the global market, which makes Bali vulnerable to changes in international prices.
Red onion (X2)showed a very large price fluctuation, starting from IDR 24,250 per kg in January 2019 and peaking at IDR 48,500 per kg in July 2020. After that, the price decreased and was recorded at IDR 15,500 per kg in December 2023. Fluctuations in the price of shallots are greatly influenced by supply

disruptions due to weather changes and dependence on imports from major producing countries such as India and China. Sudirman et al. (2022) noted that fluctuations in the price of shallots are greatly influenced by dependence on imports, which makes the price of this commodity very vulnerable to changes in international trade policies and extreme weather conditions (Sudirman et al., 2022). Thus, this spike in the price of shallots has a direct impact on FTT to Crops (Y), which illustrates the instability of food prices that are closely related to fluctuations in the price of shallots in Bali.

Garlic (X3)experienced a significant spike in January 2020, reaching IDR 50,150 per kg, followed by a sharp decline in the following years. This spike was caused by disruptions in global supply, especially from China, which is the main producing country. Akbar et al. (2021) stated that dependence on imports and international distribution problems greatly affect the fluctuation of garlic prices in Indonesia, which in turn affect domestic food prices and FTT to Crops (Y) (Akbar et al., 2021). Given that Indonesia is highly dependent on garlic imports, fluctuations in garlic prices can lead to decreased purchasing power and increased food prices, which then have an impact on the food price index that forms FTT to crops in Bali.

Red chili (X4)showed sharp fluctuations throughout the observed period. The price of red chili was recorded at IDR 71,400 per kg in March 2020 and then dropped to IDR 38,900 per kg in December 2023. This price spike was caused by supply disruptions, mainly due to crop damage caused by extreme weather and natural disasters. Sudirman et al. (2022) stated that climate change and fluctuations in domestic production are the main factors influencing the price fluctuations of red chili, which in turn affect FTT to Crops (Y). Fluctuations in the price of red chili provide a clear picture of how domestic supply instability can affect overall food prices, especially when this commodity becomes scarce and demand increases.

Cayenne pepper (X5)also showed a significant price spike, with the highest price recorded at IDR 73,750 per kg in August 2019. The fluctuation of cayenne pepper prices is greatly influenced by the decline in domestic supply caused by climate change and crop damage due to bad weather. Widyanthini et al. (2023) stated that fluctuations in cayenne pepper prices have a significant impact on the food price index, especially in Bali, because cayenne pepper is an important ingredient in household consumption (Widyanthini et al., 2023). Fluctuations in cayenne pepper prices indicate that Bali's dependence on unstable domestic production can affect the stability of food prices, which has implications for the welfare of food crop farmers as a whole.

Cooking oil price (X6)showed a stable increase during the 2019-2023 period, from IDR 13,300 per kg in January 2019 to IDR 20,550 per kg in December 2023. The increase in cooking oil prices was caused by the increase in world oil prices and changes in palm oil import-export policies. Imam et al. (2022) showed that fluctuations in cooking oil prices were greatly influenced by changes in world oil prices and domestic palm oil production, which affected the domestic supply of cooking oil (Imam et al., 2022). The decline in cooking oil prices that occurred in several months illustrated a recovery in distribution, although prices remained at a higher level than in previous years. The stable increase in cooking oil prices had a significant impact on FTT to Crops (Y), considering that cooking oil is a staple food that is very much needed in household consumption.

Price of granulated sugar (X7)shows a steady increase from IDR 13,000 per kg in January 2019 to IDR 17,750 per kg in December 2023. The increase in granulated sugar prices is largely due to the increase in global raw material prices and restrictions on sugar imports. Bahar et al. (2021) explained that fluctuations in granulated sugar prices are greatly influenced by import policies and domestic production, which play an important role in the stability of food prices in Bali (Bahar et al., 2021). Although the impact is more moderate than other commodities such as chili or rice, fluctuations in granulated sugar prices still affect FTT to Crops (Y), which reflects the overall welfare of food crop farmers.

Research Implications

This study provides important policy implications for managing food security in Bali. Price fluctuations in various food commodities indicate that dependence on imports and fluctuations in domestic production are key factors influencing food price stability and have implications for the instability of farmers' welfare. Policies that focus on increasing domestic production, especially for commodities that are highly vulnerable to international price fluctuations such as shallots, chilies, and rice, are essential to maintaining food price stability. In addition, this study shows the importance of better management of domestic food distribution to reduce the impact of supply disruptions due to natural disasters or climate change.

The study also highlights the need for investment in agricultural infrastructure and climate change mitigation as a measure to reduce the impact of food price fluctuations that are often caused by extreme weather. Increasing local food security through diversification of food sources and efficient management will greatly contribute to reducing Bali's dependence on international markets that are often vulnerable to global price fluctuations.

This study analyzes the fluctuation of food commodity prices in Bali and its impact on FTT to Crops (Y), which reflects the welfare of food crop farmers. The results show that the prices of rice (X1), shallots (X2), and cooking oil (X6) have a significant impact on farmer welfare, with a coefficient of determination (R^2) of 0.701, meaning that 70.1% of food price variability can be explained by this model. The price of rice shows a stable upward trend, while shallots and cooking oil experience significant fluctuations during the 2019–2023 period. Simultaneous and partial tests confirm that the three commodities have a significant impact, while other commodities such as garlic, red chilies, and granulated sugar do not show a significant impact. This study emphasizes the importance of understanding the dynamics of food prices to improve farmer welfare and strengthen food security in Bali.

To maintain food price stability and improve farmers' welfare, integrated strategic steps are needed. Bali must encourage diversification of local food production by developing crop varieties that are resistant to climate change and utilizing agricultural technology innovations to reduce dependence on imports. Strengthening food distribution infrastructure is also key to ensuring equitable food availability throughout the region, reducing distribution disruptions, and maintaining supply stability. Climate change mitigation through the implementation of sustainable agriculture using environmentally friendly technology needs to be prioritized to deal with extreme weather. Responsive import policies must be designed to balance local production and domestic needs to reduce the impact of global price fluctuations without sacrificing the sustainability of the local agricultural sector. In addition, education and counseling for farmers on modern agricultural technology and price risk management strategies are needed to increase farmer productivity and resilience to market uncertainty. The government also needs to strengthen the market transparency system by better monitoring food prices and providing accurate information to all stakeholders. With these steps, Bali is expected to achieve better food price stability, improve farmers' welfare, and strengthen food security in the long term.

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