Determinants of Price Fluctuation for Cooking Oil Commodity in Aceh Province, Indonesia

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Abstract

Aceh Province is still one of the regions in Indonesia whose primary commodities are still largely dependent on other regions that can cause uncontrolled fluctuations in the price especially cooking oil product. One step to overcome these problems is to make accurate price fluctuation predictions so preventive actions can be taken to minimize error estimation of these fluctuations so appropriate policies can be applied. This study focuses on analyzing of forecasting fluctuations in cooking oil prices and the influence of its determinants in the Aceh Province, Indonesia. Price forecasting uses the Autoregressive Integrated Moving Average (ARIMA) approach and determinant estimation uses the Ordinary Least Square (OLS) method. The data used in this study is time-series monthly data from January 2016 to December 2020 from Statistics Indonesia publication. The results of price forecasting show that the monthly price of cooking oil for 2021 and 2022 tends to increase. In early 2021, it is predicted that the price of cooking oil will be in the range of IDR14,500/kg and at the end of the year and early 2022 it is predicted to touch the price range of IDR15,500/kg. Then at the end of 2022 it is predicted that the price of cooking oil will reach IDR17,000/kg. Furthermore, the results of the econometric estimation show that all of the variable determinants have a significant effect on cooking oil prices fluctuations. The variable price of raw materials and the price index received by farmers were found to have a positive effect, while the rainfall variable was found to have a negative effect on cooking oil price fluctuation. According to these findings, it is hoped that the Aceh Provincial Government will be able to take strategic policies on the predicted prices and determinant of variables that have been proven to have a significant effect on cooking oil prices so in the future price fluctuations can be more stable and supply of goods can be maintained, as well as increase the competitiveness of provincial agricultural products.

Keywords: Cooking oil price fluctuation, Autoregressive Integrated Moving Average (ARIMA)

1. Introduction

Food is the most important basic human need and its fulfillment is part of the human rights of every individual (Kumar and Choudhury, 2021). In a certain period of time, basic commodities will experience an increase or decrease in prices which will affect the economy. The basic commodities that experience price increases are usually rice, cooking oil, corn, soybeans, wheat flour, sugar, shallots, chilies, eggs, meat and milk (Chandra, 2013; Pudjiastuti et al., 2013; Murniati, 2016). Until now, the government has always tried to keep basic commodity prices stable, including cooking oil, by conducting market operations and holding low-cost markets (Silalahi et al., 2019). Meanwhile in Aceh Province, the Aceh Government made a breakthrough through program Aceh Food Independent Movement which aims to anticipate food shortages and economic recession.

Based on previous studies, it was found that food prices in Indonesia are not competitive when compared to other developing countries in Asia such as the Philippines, China, Cambodia, India, Thailand, and Vietnam. The increase in food prices will put pressure on 81% of the Indonesian population, where the food sector contributes 73% to the poverty rate (Darma and Darma, 2020). Throughout year 2020 alone, the movement of cooking oil commodity prices in Indonesia continued to increase every month. In Aceh Province, the movement of cooking oil prices is not much different where it fell at the beginning of the year but towards the end of 2020 the movement tends to increase again.

Research about this issue has been carried out. Rahmanta et al. (2020) examines the effect of price fluctuations of several agricultural commodities such as the price of rice, red chilies, cooking oil, broiler meat, broiler eggs and corn

on inflation in North Sumatra Province. Also research by Hanisah and Rivani (2018), which examines the effect of raw material prices on the final product produced in a case study of tofu business in Langsa Regency, Aceh Province. Then study by Jati (2018), conducted research related to the effect of weather on food commodity prices in Indonesia through Autoregressive and Moving Average (ARMA) and Autoregressive Conditional Heteroskedasticity/Generalized Autoregressive Conditional Heteroskedasticity (ARCH/GARCH) methods. Also research by Sundoro and Putlia (2021), predict how the price of CPO (crude palm oil) in influencing the price of cooking oil in Indonesia during the era of labeling Palm Oil Free using Vector Error Correction Model (VECM) with Impulse Response Function (IRF) analysis and variance decomposition. Then study by Nelly et al. (2018), using panel data from 2007-2015 in 21 districts/cities in Aceh Province using the Two Method Stage Least Square (2SLS) to prove that food production was influenced by the price of the previous year.

However, until now Aceh Province is still one of the regions whose basic commodities are still largely dependent on other regions. Cooking oil and other basic commodities until now are still mostly supplied from the neighboring province of North Sumatra. Uncontrolled fluctuations in the price of basic commodities can cause losses for both consumers and producers. One of the steps to overcome these problems is to make accurate price predictions so that preventive actions can be taken to minimize price fluctuations and estimate the determinants of these fluctuations so that appropriate policies can be taken against these factors. Based on the results of this study, it is hoped that it can be used for the Aceh Provincial Government in taking strategic policies related to price predictions and determinant variables that significantly affect cooking oil prices, so that in the future cooking oil prices can be more stable and supply of goods can be maintained, and can improve the competitiveness of Aceh's agricultural products.

2. Literature Review

Price is the amount of money charged for a product or service, or the amount of value that consumers exchange for the benefits of having or using the product or service (Kostyra et al., 2016). In some cases, dissatisfaction causes political pressure from the public on the Government which is then expected to maintain prices at a certain level so that they do not increase too high or fall too low through a price control policy in the form of setting the highest the lowest retail price.

Price fluctuations are inaccuracies or shocks that indicate price up to and down instability (Hasbullah et al., 2020; Mahdi and Khaddafi, 2020). The theory of price fluctuations can be adopted from the law of supply and demand that occurs in the market. From the law of supply and demand, if prices increase and uncertainty makes income decrease, and if income decreases purchasing power will decrease because one of the factors that affect purchasing power is the amount of income from the merchants themselves (Syarifah, 2021). In the long run, prices are flexible in response to changes in supply or demand, while prices tend to be rigid in the short term. Therfore, many prices, especially basic commodities, do not respond to monetary policy in the short term.

The factors that influence the occurrence of price fluctuations include: 1) The balance between market supply and demand. The relationship between commodity price and the quantity demanded and the relationship between the price of a commodity and the quantity supplied (Kaming, 1997). 2) Change of seasons. Fluctuations in food commodity prices are highly dependent on stability between seasons (Santosa and Sihombing, 2015). 3) Number of production and stock items. The amount of production of a product/service that is unstable or even tends to decrease will open up more opportunities for fluctuations in the price of goods circulating in the market that make it difficult to control (Wulandari et al., 2020). 4) Production costs. The costs used in the production process include raw material costs, direct labor costs, and factory overhead costs which are larger than other costs.

Many studies have been carried out on primary commodity prices fluctuations and the factors that influence changes in the price. Some of them study by Nelly et al. (2018), using panel data from 2007-2015 in 21 districts/cities in Aceh Province using the Two Method Stage Least Square (2SLS). The results showed that food production was influenced by the previous year's price, the area harvested, and the fertilizer price. The price and amount of income influences food consumption, and commodity prices are influenced by the price of raw materials, production, and the highest retail price (HET). Hanisah and Rivani (2018) examines the effect of raw material prices on the final product produced. The object of research is tofu entrepreneurs located in Langsa City, Aceh Province. From the study results, it was found that the variables of raw material prices, selling prices and production together affected the final product, but only the price of raw materials partially had a positive and significant effect.

Jati (2018) conducted research related to the influence of weather on food commodity prices in Indonesia. The Autoregressive and Moving Average (ARMA) and Autoregressive Conditional Heteroskedasticity/Generalized Autoregressive Conditional Heteroskedasticity (ARCH/GARCH) approaches, the dry season variable significantly affects basic commodity prices compared to the rainy season variable. (Rahmanta et al., 2020) examines the effect of price fluctuations of several agricultural commodities such as rice, red chilies, cooking oil, broiler meat, broiler eggs and corn on inflation in North Sumatra Province. It was found that the price of cooking oil had a positive effect on inflation for the current month during the study period. Sundoro and Putlia (2021) predict how the price of CPO (crude palm oil) influencing the price of cooking oil in Indonesia during the era of labeling Palm Oil Free using

Vector Error correction Model (VECM) with Impulse Response Function (IRF) analysis and variance decomposition. The study results show that the price of CPO has a positive and significant effect on the price of cooking oil.

3. Materials and Methods

3.1. Materials

This study aims to predict the price fluctuation of cooking oil in a certain period of time in the future and to see whether raw material prices, rainfall and the price index received by farmers (plantation sub-sector) affect cooking oil price fluctuation in Aceh Province. The type of data used in this research is monthly time-series data from January 2016 to December 2020.

3.2. Methods

3.2.1. Autoregressive Integrated Moving Average (ARIMA)

ARIMA approach is used to determine predicted price fluctuation of cooking oil in a certain period in the future. ARIMA model used in this study is formulated with the following notation (Singh et al., 2020):

$$\text{HMG}_t = \mu' + \phi_1 \text{HMG}_{t-1} + \phi_2 \text{HMG}_{t-2} + \cdots + \phi_p \text{HMG}_{t-p} + e_t \qquad (1)$$

which are,

HMG_t	= Cooking oil value at year *t;*
μ'	= Constant;
ϕ_p	= Autoregressive parameter *p;*
e_t	= Error term;

3.2.2. Determinants of Cooking Oil Price Fluctuation

Ordinary Least Square (OLS) approach is used to determine whether rainfall, palm oil prices and the price index received by farmers (plantation sub-sector) affect cooking oil prices in Aceh Province from January 2016 to December 2020 period. The regression equation is written as follows (Pusra et al., 2021):

$$\text{HMG}_t = a + b_1 \text{CH}_t + b_2 \text{HTBS}_t + b_3 \text{IH}_t + \mu \qquad (2)$$

Which are,

HMG_t	= Cooking oil prices at year *t;*
CH_t	= Rainfall at year *t;*
HTBS_t	= Raw material prices at year *t;*
IH_t	= Price index received by farmers at year *t;*
a	= constant
b_1, b_2, b_3	= estimated coefficient
μ	= error term

4. Results and Discussion

4.1. Analysis of The Autoregressive Integrated Moving Average (ARIMA) of Cooking Oil Price Fluctuation

Before determining the order of ARIMA model, a stationarity test in variance was performed and it was found that all variables were stationary in variance. Then we conduct plotting ACF and PACF from the stationary data, and a Try and Error test to determine the best model based on the smallest MAPE and RMSE values. As shown in table 4.1, the test results obtained 4 out of 8 models that have MAPE values below 1 and RSME values that are not much different, which are ARIMA 2, ARIMA 4, ARIMA 6 and ARIMA 8. Then the White Noice test was carried out on the four models and obtained a p-value greater than 0.05, indicating that the four models have met the White Noice assumption.

Before price forecasting, a parameter significance test was conducted to determine whether or not the influence of a parameter was significant in the four models. In the first model test of ARIMA 2, it was found that there were no significant parameters in the model with all p-values greater than 0.05. However, in the second model test of ARIMA

4, there are 3 significant parameters and 1 insignificant parameter. Furthermore, in the third model of ARIMA 6, as with the first model, it was found that there were no significant parameters. Then in the fourth model of ARIMA 8 found 3 significant parameters and 3 insignificant parameters in the model. Therefore, based on the test results conducting to all four models, it was found that ARIMA 4 and ARIMA 8 models had 3 significant parameters in the model, but ARIMA 4 model was simpler than ARIMA 8 model so ARIMA 4 model was chosen as the best model for forecasting fluctuations in cooking oil prices in Aceh Province. The estimation results of Arima try and error test can be seen in Table 1.

. **Tabel 1** Estimation Results of ARIMA Try and Error Test

	Order	MAPE	RMSE
ARIMA 1	(1,2,0)	1.063632	255.5866
ARIMA 2	(1,2,2)	0.938199	245.8425
ARIMA 3	(2,2,0)	1.128448	276.0410
ARIMA 4	(2,2,2)	0.977249	241.4122
ARIMA 5	(3,2,0)	1.064257	259.2221
ARIMA 6	(3,2,2)	0.914952	243.0546
ARIMA 7	(4,2,0)	1.063632	255.5866
ARIMA 8	(4,2,3)	0.975545	240.9788

Source: RStudio

Using ARIMA 4 model, forecasting is carried out based on monthly data year 2016-2020 and obtained predictions of cooking oil prices year 2021-2022 as shown in Figure 1
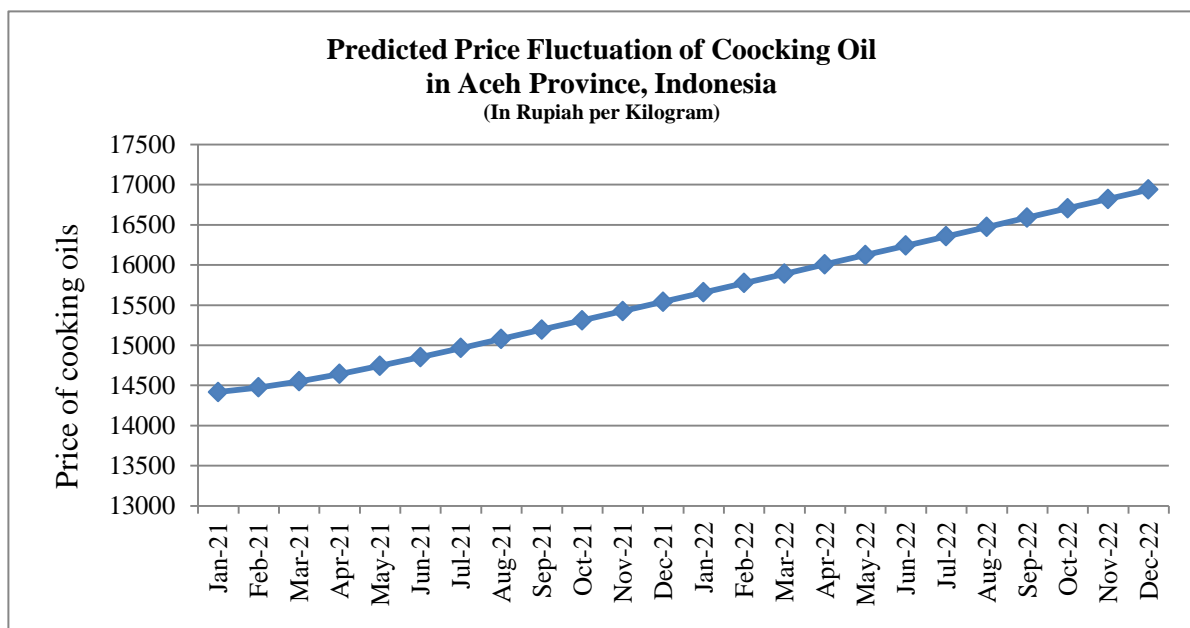

Figure 1. Predicted Price Fluctuation of Coocking Oil in Aceh Province, Indonesia

Based on Figure 1, the price of cooking oil in Aceh Province year 2021-2022 is predicted to increase. Although the price prediction above does not include certain conditions in a calendar year where cooking oil prices can rise high, during the fasting month and holidays, or decrease when cooking oil supply conditions exceed market demand, the predictions above can provide an overview of cooking oil price predictions in Aceh Province year 2021-2022. In Figure 1, it is predicted that the price of cooking oil in early 2021 will be in the range of IDR14,500/kg, then in the middle of the year it is estimated to be in the price range of IDR15,000/kg, and at the end of the year it is predicted to reach a price range of IDR15,500/kg. Furthermore, for year 2022, in the middle of the year it is estimated that the price of cooking oil in Aceh Province will reach the price range of IDR16,750/kg and at the end of the year it is predicted to be able to touch the price range of IDR17,000/kg.

4.2. Estimation Results of Determinants Cooking Oil Price Fluctuation

Results of econometric estimation using Ordinary Least Square (OLS) approach based on time-series data from January 2016 to December 2020 is showed that all selected independent variables which are raw material prices, rainfall and price index received by farmers have a significant effect toward dependent variable cooking oil prices. The simultaneous effect of independent variables based on the results show in Table 2, the probability value of the F-statistics obtained is 0.000 (<0.05), indicating that the selected independent variables together have a significant effect on cooking oil prices. Furthermore, the value obtained of R^2 is 0.536 which indicates that the variation of the cooking oil prices value explained by the independent variables is 53.6%.

. **Tabel 2** Estimation Results of Ordinary Least Square (OLS) Approach
of Determinants Cooking Oil Price Fluctuation

Variable	Coefficient	Prob.
C	7.367638	0.0000
Ln_Raw_Material_Prices	0.226751	0.0000
Ln_Rainfall	-0.016151	0.0538
Price_Index_Received_by_Farmers	0.005826	0.0000
R-squared	0.536175	
Adjusted R-squared	0.511327	
F-statistic	21.57842	
Prob(F-statistic)	0.000000	

4.3. Discussion

The variable price of raw materials was found to have a positive and significant effect on the price of cooking oil. This is in accordance with the theory that an increase in the price of raw materials will increase production costs increasing the price of the product produced. Conversely, a decrease in the price of raw materials will reduce production costs which will reduce product prices. The estimated coefficient is 0.227 which indicates that when there is an increase in the price of raw materials by 1%, it will increase the price of cooking oil by 0.227%. On the other hand, when there is a decrease in raw material prices by 1%, cooking oil will decrease by 0.227%. This finding is in line with previous research, such as the study by Sundoro and Putlia (2021), Hanisah and Rivani (2018), and (Nelly et al., 2018), which also found that the cost of raw materials had a positive and significant effect on the final agricultural product.

Furthermore, the rainfall variable was also found to have a significant and negative effect on cooking oil prices. The theory says that if there is a significant change in weather, it will affect the production of raw materials for agricultural products which will affect the price of the final product produced. The estimated coefficient is -0.016 which states that when there is an increase in rainfall of 1%, the price of cooking oil will decrease by 0.016%. Conversely, when there is a 1% decrease in rainfall, the price of cooking oil will increase by 0.016%. This finding is also in line with previous research where a study by Jati (2018) found that rainfall had a significant effect on the final agricultural product.

Then, the variable price index received by farmers was found to have a positive and significant effect on the price of cooking oil. In accordance with the theory where the increase in prices received by farmers will increase the cost of production of final agricultural goods increasing the price of the selling products. On the other hand, a decrease in the price received by farmers will also reduce the cost of producing agricultural final goods which will reduce the price of the product produced. The coefficient of estimation results obtained is 0.006 which indicates that when there is an increase in the price index received by farmers by 1%, the price of cooking oil will also increase by 0.006%. Conversely, when there is a 1% decrease in the price index received by farmers, the price of cooking oil will also decrease by 0.006%. Previous research is in line with this finding. A study by Nelly (2018) found the final agricultural product produced was significantly influenced by the labor price index of the agricultural sector.

5. Conclussion

Results of ARIMA forecasting show that the monthly price of cooking oil in Aceh Province year 2021-2022 tends to increase. In early 2021, it is predicted that the price of cooking oil will be in the range of IDR14,500/kg and at the end of the year and early 2022 it is predicted to touch the price range of IDR15,500/kg. Then at the end of 2022 it is predicted that the price of cooking oil will reach IDR17,000/kg. Furthermore, the results of the econometric

estimation show that all of the variable determinants have a significant effect on fluctuations in cooking oil prices. The variable price of raw materials and the price index received by farmers were found to have a positive effect, while the rainfall variable was found to have a negative effect on cooking oil price fluctuation. Based on these findings, it is hoped that Aceh Province government will be able to control and suppress the market price of cooking oil with more strategic policy in the future so basic needs can keep maintained at all levels and price fluctuations can be more stable.

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