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PRICE BEHAVIOR AND FORECASTING PRODUCER PRICES OF SHALLOTS IN THE SPECIAL REGION OF YOGYAKARTA

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Abstract. Shallots represent a significant component of Indonesia's vegetable crop production. They are widely consumed across the country, leading to an annual increase in demand. However, shallot production tends to remain stable or even decline, resulting in supply and price instability. In the Special Region of Yogyakarta, shallots are a prominent horticultural commodity with substantial production. Producer prices for shallots in this region exhibit fluctuations, particularly at the producer level compared to wholesale or consumer prices. Forecasting producer-level shallot prices utilizes the ARIMA (Autoregressive Integrated Moving Average) method, chosen for its accuracy in short-term time series prediction. Data sourced from the Strategic Food Price Information Center (PIHPS) via the hargapangan.id platform includes consumer prices and spans from January 2019 to May 2024. The analysis reveals that producer prices in the Special Region of Yogyakarta are influenced by previous month price increases, with the optimal ARIMA model identified as ARIMA (1,0,0) with the equation D(Y) = 21885.24 + 0.569977AR(1), as determined by the study findings.

Keywords: ARIMA, Forecasting, Producer Prices, Shallots

INTRODUCTION

Shallots are among Indonesia's top five commodities contributing significantly to the overall production of vegetable crops, accounting for 13.59% (Director General of Horticulture, 2024). However, in recent years, there has been a slight decrease in the harvested area by 1.78%. Specifically, the harvested area of shallots decreased from 184,984 hectares in 2022 to 181,683 hectares in 2023. Despite the reduction in harvested area, shallot production experienced a modest growth rate of 0.14% in 2023 (Director General of Horticulture, 2024).

The shallots commodity is consumed by almost all people in Indonesia, so demand tends to increase from year to year. This is because shallots are the main raw material in various food processing industries. Apart from that, shallots are also widely consumed at household level. This condition causes the demand for shallots to continue to increase. (Al Rosyid, et. al., 2021) The high economic value of shallots makes many farmers interested in cultivating this commodity (Monica, et.al., 2021).

However, shallot production shows a tendency to remain steady or decline, leading to situations of supply and price instability (Khoirani, et al., 2022). Efforts aimed at boosting shallot production should focus on agroclimatology, agricultural practices, and management considerations. These factors vary across different regions in Indonesia, thus certain regions possess the potential for cultivating shallots (Harahap, et al., 2023). The production of shallots in Indonesia is still reliant on seasonal and agro-climatic conditions, leading to inconsistent availability across different regions. Some areas experience a surplus due to favorable agro-climatic potential. (Tomycho, et.al., 2020).

The impact of production surplus is an increase in supply that exceeds market demand, leading to a decrease in prices from their normal levels. Conversely, production deficits can result in price increases due to insufficient harvests to meet demand. One strategy to maintain price stability is to transfer surplus production from regions with excess to those experiencing deficits, thereby promoting interregional trade (Putri, 2023).

In 2023, East Java Province emerged as the top contributor to shallot production in Indonesia, yielding 484,669 tonnes, followed closely by Central Java Province with 479,091 tonnes (Director General of Horticulture, 2023). The Yogyakarta Special Region is also recognized as a shallot-producing area, albeit smaller in scale compared to other regions, yet it plays a crucial role in meeting local horticultural demands. Recognizing the significance of shallots, the government has prioritized efforts to enhance their production capacity.

Horticultural commodities play a significant economic role in the Special Region of Yogyakarta, with shallots being a prominent example. The shallot cultivation area in Yogyakarta spans 2,439 hectares, with over 50% located in Bantul Regency. In terms of production, the total shallot output in Yogyakarta reached 223,066 quintals in 2022 (BPS Yogyakarta Special Region, 2022). Production and cultivation areas of shallots in Yogyakarta exhibit fluctuations across years, yet show a positive long-term trend. A major challenge faced by shallot commodities is price instability, influenced by the inelasticity of supply and demand. Natural factors, pests, and diseases frequently disrupt shallot supply, leading to instability. On the demand side, fluctuations often occur during specific periods such as holidays. This volatility results in significant price fluctuations for shallots, both at producer and consumer levels (Putri, 2023). Additionally, due to their seasonal production nature and inability for long-term storage, shallots cannot be available year-round, further contributing to dynamic price fluctuations.

Fluctuations in shallot prices tend to fluctuate at the producer price level compared to prices at the wholesale market level or consumer prices. This is indicated by the existence of short-term asymmetry between marketing institutions both at the producer level and in the wholesale market. This means that in the shortterm producers do not benefit from price increases in the wholesale market. This shows that fluctuations in shallot prices are predominantly caused by upstream sector activities. This is because shallots are a seasonal agricultural product where shallot harvest only occurs in certain months, as a result the availability of shallots is not available throughout the year (Sahara, 2019). This is in accordance with research (Apriyani, 2021) which explains that the increase in shallot prices is due to a shortage of supply, usually occurring during the planting seasons. Meanwhile, the price of shallots falls during the main harvest, which causes the number of shallots on the market to be greater than demand. Price fluctuations can cause people's ability to buy to decrease. The consequence of decreasing people's purchasing power is a reduction in the welfare of society in general, from producers to consumers (Windhy, et.al., 2018). According to (Paranata and Takhlishul, 2014) there is a negative relationship between production and the price of shallots. When the price of shallots rises shallot production falls and when the price of shallots falls this happens because shallot production increases. This causes farmers' profits to fluctuate and tend to be low so that in the next planting season the farmer's capital will decrease.

This fluctuating pattern of shallot prices underlies the importance of conducting shallot price forecasting analysis. Forecasting shallot prices at the producer level is carried out using the ARIMA (Autoregressive Integrated Moving Average) method. The ARIMA method was chosen because this method is quite accurate in predicting time series data in the short term because the type of error value is close to zero and is flexible because it can adapt to existing data patterns (Khoirani, et.al., 2022). This forecasting is carried out so that shallot producers, especially in the Special Region of Yogyakarta, can have an alternative in determining the commodities to be cultivated and when is the right cultivation time for shallots by setting fixed costs based on the price forecast which will protect farmers from large losses (Afridar, et .al., 2022).

METHOD

This research uses descriptive analysis to predict consumer prices for shallots in the Special Region of Yogyakarta. The data used is consumer prices obtained from the Strategic Food Price Information Center (PIHPS) website which is accessed via thehargapangan.id page. Data analyzed using the ARIMA method includes producer prices for shallots in the Special Region of Yogyakarta from January 2019 to May 2024, with a total of 65 producer price data. To predict the price of shallots at the consumer level, this research uses the Box-Jenkins Method (ARIMA).

The Auto Regressive Integrated Moving Average (ARIMA) method is a time series forecasting technique introduced by Box and Jenkins in the 1970s. This method combines the Auto Regressive (AR) approach with Moving Average (MA) and is used based on time series data. ARIMA is suitable for short-term forecasting and can predict data on a large scale. However, this method has a weakness, namely that the time series data used must be stationary, which means there is no element of trend or seasonality. Apart from that, there are several different stages in determining the best ARIMA model (Tantika, et.al., 2018).

The ARIMA model consists of three components: autoregressive (AR), moving average (MA), and integrated (I). These three components can be modified to form new models, such as autoregressive and moving average (ARMA) models. The general form of this forecasting model is expressed as ARIMA (p,d,q), where p is the AR order, d is the Integrated order, and q is the moving average order. If the model is only AR, the general form becomes ARIMA (1,0,0). Forecasting prices for shallot producers in the Special Region of Yogyakarta is carried out using the ARIMA method through several stages as follows (Susilawati and Sunendiari, 2022):

1. Identify a model to evaluate data stationarity by plotting the data or using the Augmented Dickey-Fuller unit root test. According to the test criteria, if the absolute value of the t-statistic in the ADF test is greater than the critical value, the data is considered stationary; otherwise, the data is considered non-stationary. If the data is not stationary at the initial level, differencing needs to be carried out until the data reaches stationary conditions (Nugroho and Prasada, 2020).
2. If the data is stationary, calculate and analyze the ACF and PACF from the data to estimate the AR and MA orders that will be used. However, if the data is not stationary, carry out a differencing process on the data to make it stationary.
3. If the training data is stationary, estimate the AR and MA orders that will be used by plotting the ACF and PACF of the data.
4. Based on the selected AR and MA orders, determine which ARIMA models may be appropriate.
5. Carry out significance testing of the AR(p) and MA(q) parameters for each ARIMA model considered.
6. Perform diagnostic testing
7. Make predictions for test data. Next, calculate the Mean Absolute Percentage Error (MAPE) using test data.
8. Finally, choose the optimal model based on the evaluation of the MAPE results and then carry out the forecasting process

RESULT AND DISCUSSION

Shallots (*Allium cepa L.*) is one of the main commodities in the horticultural sector which has many benefits and is a priority agricultural commodity in the Special Region of Yogyakarta. The development of shallots in the Yogyakarta Special Region has experienced significant fluctuations both in price and production. On the other hand, demand continues to increase in line with increased production and availability of quality seeds in the field (Rahmawati, 2022). As a strategic commodity, the price fluctuations of shallots require special attention from the government. The government needs to implement efforts to stabilize shallot prices at affordable levels in line with the purchasing power of the population. To formulate appropriate price stabilization policies and enhance the effectiveness of these programs, comprehensive data on shallot price behavior, including its volatility, is necessary. This information is crucial for devising more effective anticipatory measures (Putri, 2023)

Table 1. Production and Harvested Area of Shallots in the Special Region of Yogyakarta

Year	Production (Quintal)	Harvest Yield (Ha)
2018	149.497	1.499
2019	169.985	1.739
2020	188.105	1.891
2021	298.087	3.020
2022	223.066	2.439
2023	329.530	2.980

Source: Director General of Horticulture, 2024

Based on the table above, it can be seen that the development of shallot production in the Special Region of Yogyakarta has a positive trend even though there will be a decline in production and harvested area in 2022. This is not due to a decrease in land planted with shallots, but is caused by years that tend to be more plentiful. there was rain that year. The decline did not only occur in the Special Region of Yogyakarta but also occurred in other regions in Indonesia.

The trend of increasing production and harvested area of shallots in the Yogyakarta Special Region shows that shallots are still a profitable commodity choice for farmers. So there are still many farmers who work on it. Apart from that, government support in the form of shallot cultivation technologies is still needed, for example pest and disease resistant varieties or water resistant varieties can be developed so that farmers can have a greater chance of success in cultivating greater shallots.

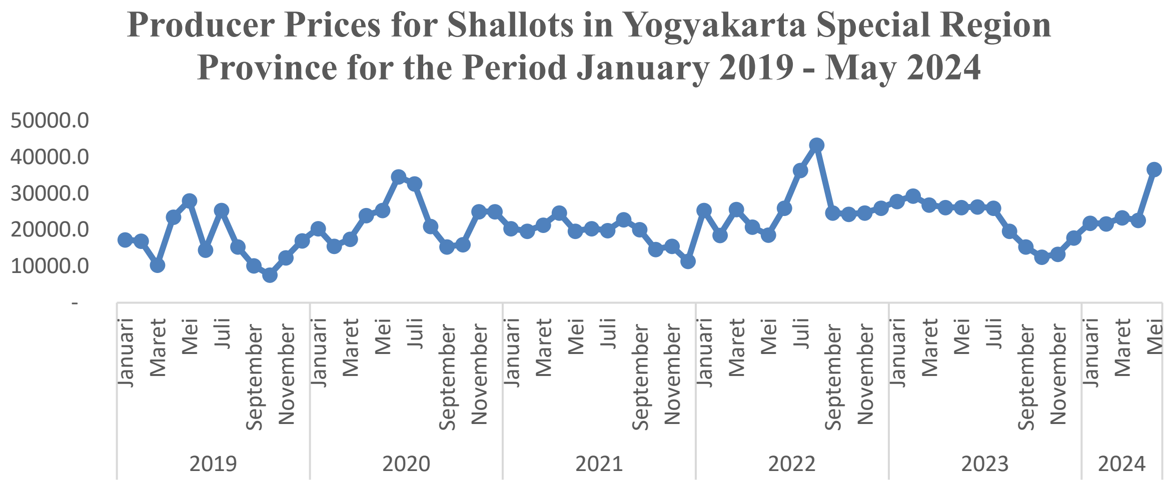


Figure 1. Graph of Shallots Producer Prices for Yogyakarta Special Region Province for the Period January 2019 – May 2024
Source: PIHPS (processed), 2024

Based on the graph of prices for shallot producers in the Special Region of Yogyakarta Province which is presented in Figure 1, it can be seen that prices have fluctuated. The increase and decrease in the price of shallots can be seen from the average monthly price per year. Based on the data that has been analyzed, it is known that the average price of shallot producers in the Special Region of Yogyakarta has increased in 2019, 2020, 2022 and 2024 (until May) respectively by 12.09%, 6.70%, 13 .80% and 17.63%. In 2024, the producer price of shallots will increase due to decreasing yields due to changes in weather (Wartajogjakota, 2024). Meanwhile, in 2021 and 2023 the average producer price of shallots in the Special Region of Yogyakarta will decrease by 5.15% and 1.96%. This price decrease was caused by the increase in shallot production in the Yogyakarta Special Region (can be seen in table 1). When production is abundant, the supply of shallots is also abundant, this will cause prices to fall.

Table 2. Seasonal Index of Shallot Producer Prices for Yogyakarta Special Region Province, 2019-2023

No	Months	Seasonal Index
1	January	104.00
2	February	93.47
3	March	95.13
4	April	111.45
5	May	110.19
6	June	113.97
7	July	131.14
8	August	114.30
9	September	80.11
10	October	70.29
11	November	84.98
12	December	90.96

Source: Secondary Data Analysis (processed), 2024

The price behavior of shallot producers can also be linked to seasonal indices. The seasonal index is a value that is used to determine whether or not there are price movements caused by seasonal movements. Seasonal movement is a regular movement or up and down movement that occurs at the same time or very close together. For example, when the harvest season arrives, prices tend to fall. Meanwhile, during the planting season, stocks decrease, so prices tend to increase.

Continuous and unpredictable price fluctuations may indicate unstable price volatility. Shallots, being a seasonal commodity, tend to experience price volatility due to uneven production across Indonesian provinces, while consumers are widely dispersed throughout the country. Consequently, Indonesia is susceptible to price fluctuations that can impact inflation and consumer purchasing power. Beyond affecting consumers, price volatility also influences business decisions for market participants and producers (Putri, 2023).

The seasonal index numbers presented in Table 2 show the relative values of periodic data for twelve months of one year. In this study the seasonal index was calculated using the simple average method. Based on the results in table 2, it can be said that prices in January, April, May, June, July and August for shallot producer prices were above the average price. This is also in accordance with the planting time for shallots, namely during the dry season around May to July, so that during the planting period, the stock or supply of shallots is low, this can cause an increase in prices.

For example, in July the seasonal index was 131.14%, meaning that the producer price of shallots per kg in the Special Region of Yogyakarta in July was 31.14% above the average price of shallot producers per kg in the Special Region of Yogyakarta. Meanwhile, in February, March, September, October, November and December, the price of shallot producers in the Special Region of Yogyakarta was below the average price. One of the reasons prices are lower than the average price is because these months are the harvest season. Thus, the stock or supply of shallots is high, causing prices to fall or their value to be below the average price. For example, in October the seasonal index value was 70.29%, this means that the price of shallot producers in the Special Region of Yogyakarta in October was below the average price of shallot producers in the Special Region of Yogyakarta.

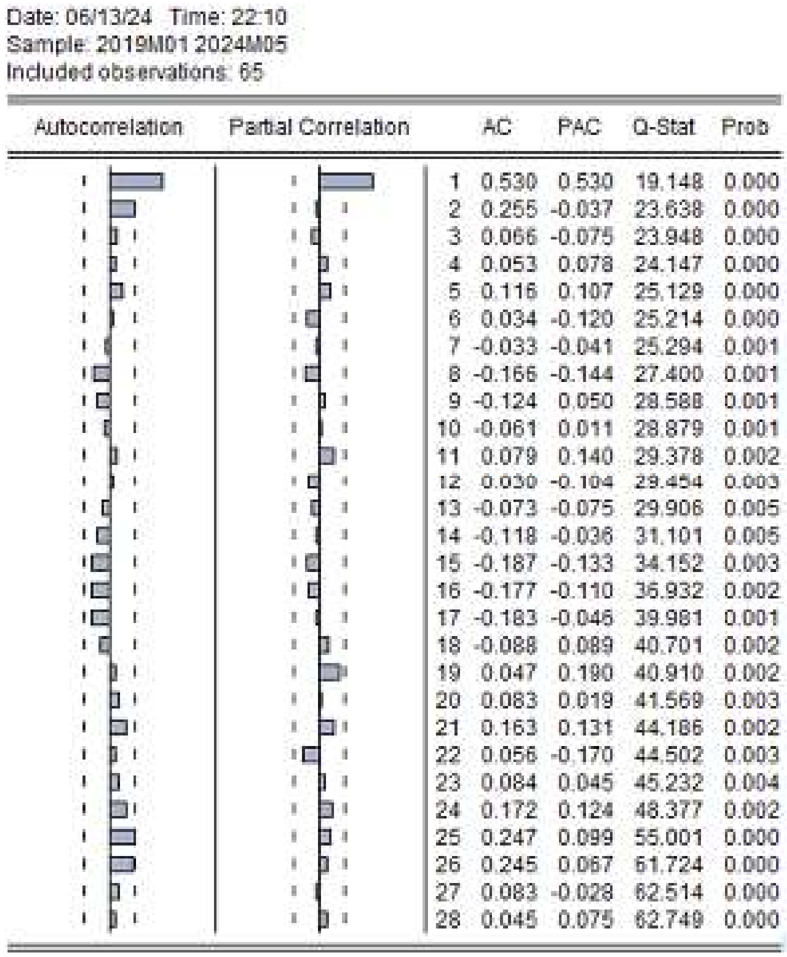
Table 3. Stationarity Test Results for Shallots Producer Prices in Yogyakarta Special Region

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.861032	0.0039
Test critical values	1% level	-3.536587	
	5% level	-2.907660	
	10% level	-2.591396	

Source: Secondary Data Analysis (processed). 2024

Time series data tends to be non-stationary. Data that is not stationary can produce a pseudo-regression model. namely a condition where the results of statistical analysis show a high R^2 and a significant t-statistic. but these results have no scientific meaning. The data stationarity test can be carried out using the unit root test for each variable. If a variable does not have a constant mean. variance and covariance. then the variable is considered non-stationary (contains unit roots) (Putri. 2023).

Based on the results of the stationary test using the Augmented Dickey-Fuller statistical test method. it can be seen that the data is stationary. This can be seen in the ADF test statistic value |-3.861032|> t-test 5% |-2.907660|. This test is carried out to detect whether the data to be analyzed contains unit roots. If the data contains unit roots. it means that the data is not yet stationary at its level. The ADF test can also determine at what level of differencing the data becomes stationary (Putri. 2023). Therefore. from these results. the analysis can be continued at the next stage. namely identifying the best model for forecasting prices for shallot producers in the Special Region of Yogyakarta.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Sample: 2019M01 2024M05
Included observations: 65

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.530	0.530	19.148	0.000
		2	0.255	-0.037	23.638	0.000
		3	0.066	-0.075	23.948	0.000
		4	0.053	0.078	24.147	0.000
		5	0.116	0.107	25.129	0.000
		6	0.034	-0.120	25.214	0.000
		7	-0.033	-0.041	25.294	0.001
		8	-0.166	-0.144	27.400	0.001
		9	-0.124	0.050	28.588	0.001
		10	-0.061	0.011	28.879	0.001
		11	0.079	0.140	29.378	0.002
		12	0.030	-0.104	29.454	0.003
		13	-0.073	-0.075	29.906	0.005
		14	-0.118	-0.036	31.101	0.005
		15	-0.187	-0.133	34.152	0.003
		16	-0.177	-0.110	36.932	0.002
		17	-0.183	-0.046	39.981	0.001
		18	-0.088	0.089	40.701	0.002
		19	0.047	0.180	40.910	0.002
		20	0.083	0.019	41.569	0.003
		21	0.163	0.131	44.186	0.002
		22	0.056	-0.170	44.502	0.003
		23	0.084	0.045	45.232	0.004
		24	0.172	0.124	48.377	0.002
		25	0.247	0.099	55.001	0.000
		26	0.245	0.067	61.724	0.000
		27	0.083	-0.028	62.514	0.000
		28	0.045	0.075	62.749	0.000

Figure 2. Correlogram Table of Shallots Producer Prices for Yogyakarta Special Region Province
Source: Secondary Data Analysis (processed). 2024

The selection of the best model was carried out based on the results of the unit root test and correlogram. The results show that the model is stationary at level level. The selection of the best model is carried out on a model that does not contain autocorrelation. is homoscedastic. and has a normal distribution. In addition. the best model is selected by looking at the regression results which have Adj values. The highest R^2 and R^2. and the lowest SE. AIC and SIC values. Based on these criteria. it is hoped that the best model will be obtained. The ARIMA model that is most likely to be the best model has a combination as shown in table 3. which is then carried out with diagnostic checking to identify whether the model is homoscedastic. does not contain autocorrelation and is normally distributed.

Table 4. Criteria for Selection of the Best ARIMA Model for Shallots Producer Prices. Yogyakarta Special Region Province

No	Model Terbaik	R^2	Adj R^2	S.E. of Regression	Log likelihood	AIC	SIC
1	ARIMA c(1.0.0)	0.307485	0.285146	5670.380	-652.6875	20.17500	20.27536
2	ARIMA c(0.0.1)	0.254475	0.230425	5883.407	-655.0313	20.24712	20.34747
3	ARIMA c(0.0.2)	0.316188	0.282558	5680.637	-652.3086	20.19411	20.32792
4	ARIMA c(1.0.3)	0.354084	0.299345	5613.782	-650.6762	20.20542	20.40613

Source: Secondary Data Analysis (processed). 2024

Based on table 4. it is known that the best model among the four existing models is seen based on the Adj value. R^2 and R^2 are the highest and also have the lowest Akaike Info Criterion (AIC). Schwarz Criterion (SIC). and SE values. It can be seen from Table 4 that there are two models that have opposing criteria. Namely the ARIMA c(1.0.3) model and the ARIMA c(1.0.0) model. The ARIMA model c(1.0.3) has the value Adj. R^2 and R^2 are the highest but the AIC and SIC values are not the smallest. whereas for the ARIMA model c(1.0.0) has the lowest AIC and SIC values but the Adj. R^2 and R^2 are not the highest. Based on research results (Tan and Astuti. 2020); (Dianco. R.F. & Novita. M.. 2021) the selection of the best model is based on the smallest AIC. SIC and MSE values. This is also in line with research conducted by (Putri and Aghsilni. 2019) which states that the model that has the minimum AIC. SIC and HQC values and the smallest significant value is the best model. So in this research a model was chosen that complies with the best model criteria based on previous research. namely the ARIMA c(1.0.0) model as the best model. This model is then used in the process of forecasting or predicting prices for shallot producers in the Special Region of Yogyakarta.

Table 5. ARIMA Model Regression Output c(1.0.0) Shallots Producer Prices Yogyakarta Special Region Province

Variabel	Koefisien	Std.Error	t-Statistic	Prob.
C	21885.24	1679.024	13.03450	0.0000
AR(1)	0.569977	0.083112	6.857948	0.0000
SIGMASQ	30669220	5666321	5.412546	0.0000
R-Squared	0.307485	Mean dependent var		21677.89
Adjusted R-Squared	0.285146	S.D. dependent var		6706.617
S.E. of regression	5670.380	Akaike info criterion		20.175000
Sum squared resid	1.99E+09	Schwarz criterion		20.275360
Log likelihood	-652.6875	Hannan-Quinn criter.		20.214600
F-statistic	13.76439	Durbin-Watson stat		1.804130
Prob(F-statistic)	0.000011			

Source: Secondary Data Analysis (processed). 2024

Based on the results of the regression analysis in table 5. it shows the results of the ARIMA analysis c(1.0.0) which has the equation D(Y) = 21885.24 + 0.569977AR(1). Furthermore. the regression output from the ARIMA c(1.0.0) model. namely AR(1). influences the price of shallot producers in the Yogyakarta Special Region. which. seen from the probability value. is at a significance level below 1%.

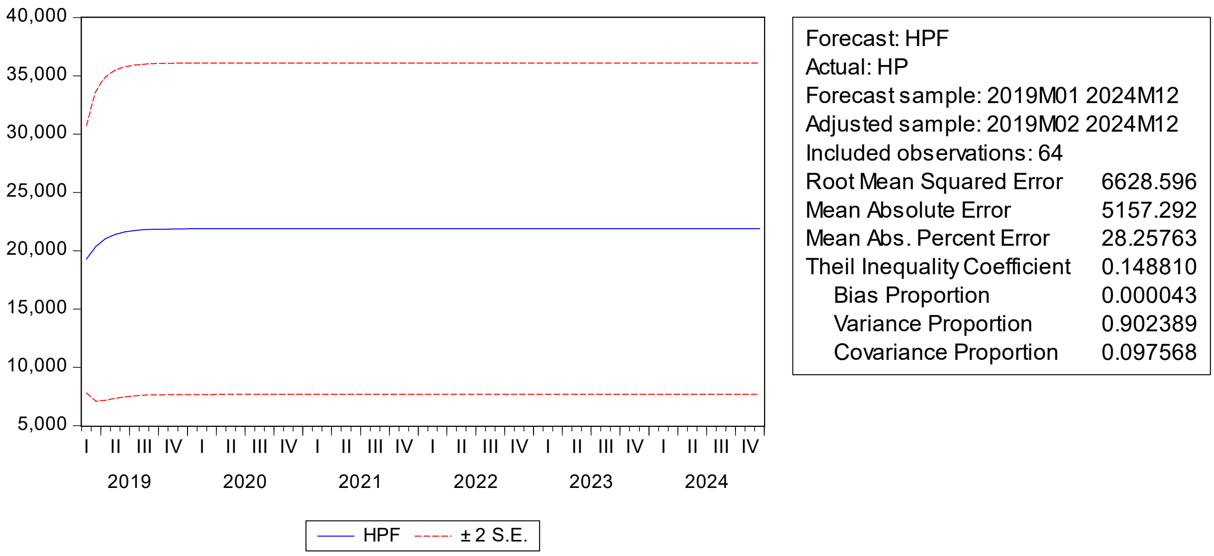

Figure 3. Graph of Dynamic Model Forecasting Results of Shallot Producer Prices for Special Region of Yogyakarta Province ARIMA Model c(1.0.0)
Source: Secondary Data Analysis (processed). 2024

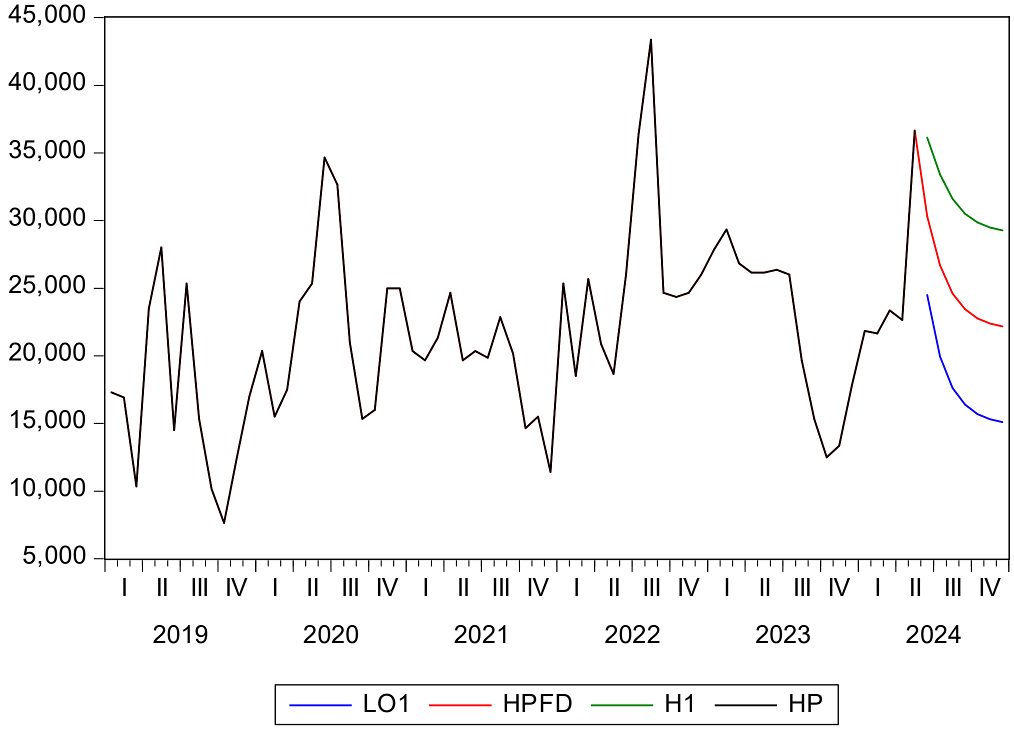

Figure 4. Graph of Dynamic Forecasting Results of Shallots Producer Prices for Yogyakarta Special Region Province ARIMA Model c(1.0.0)
Source: Secondary Data Analysis (processed). 2024

Based on the results of dynamic forecasting. it can be seen that the price of shallot producers in the Special Region of Yogyakarta from 2019 to 2024 has a stable tendency with the same fluctuation pattern. The stability of shallot producer prices in the Special Region of Yogyakarta is when viewed as a whole between years. However. if you look at it daily or monthly. the price fluctuations will be clearer as seen in Figure 4. It's just that the fluctuation pattern looks the same and tends to repeat itself over and over again. This happens because shallot production is usually abundant only in certain months. as the nature of shallots. like other agricultural products. is seasonal.

Table 6. Forecasting Results of Shallots Producer Prices for Yogyakarta Special Region Province ARIMA Model c(1.0.0)

Year	Month	Shallots Producer Price (Rupiah)
2024	June	30.300.82
2024	July	26.681.93
2024	August	24.619.24
2024	September	23.443.56
2024	Oktober	22.773.45
2024	November	22.391.50
2024	December	22.173.80

Source: Secondary Data Analysis (processed). 2024

Based on forecasting results for the next 7 months from June 2024 to December 2024 using ARIMA analysis. it is known that the price of shallot producers in the Special Region of Yogyakarta tends to decline. This condition can occur when shallot production is greater than demand for shallots. The majority of shallots in the Special Region of Yogyakarta are produced in Bantul Regency and Kulon Progo Regency. There are two planting seasons for shallots. namely planting season 1 (MT 1) May-July and planting season 2 (MT 2) in July-September. After September. the stock of shallot products at the farm level is usually still abundant. so prices at the farm level experience a decline. This was also conveyed by (Alfiah and Sugiarti. 2023) who explained that the decline in shallot prices occurred due to relatively simultaneous harvests in several shallot producing areas. causing abundant shallot stocks. As a result. the price of shallots decreased. The need for shallots in the Special Region of Yogyakarta can actually be met from production within the region. However. due to the distribution of the harvest not at all times throughout the year. during the main harvest. farmers sell their products outside the region and during the harvest season there is a shortage of shallots. so they have to bring in shallots from outside the region in the Special Region of Yogyakarta.

CONCLUSSION

Based on the research results. it can be concluded that the price of shallot producers in the Special Region of Yogyakarta is influenced by the increase in prices in the previous month with the best ARIMA model. namely ARIMA c(1.0.0) with the equation model. namely D(Y) = 21885.24 + 0. 569977AR(1).

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REFERENCES

Afridar. H.. Gunawan. Andriani. W.. 2022. Penerapan Metode Arima untuk Prediksi Harga Komoditi Bawang Merah di Kota Tegal. IJIR. 3 (2): 18 – 29.

Alfiyah. S. dan Sugiarti. T. 2023. Fluktuasi Harga Komoditas Bawang Merah Sebelum Dan Pada Saat Masa Pandemi Covid-19 Di Kabupaten Nganjuk. Jurnal Ekonomi Pertanian dan Agribisnis (JEPA). 7(2): 660-673.

Al Rosyid. A.H.. Viana. C.D.N.. Saputro. W.A. 2021. Penerapan Model Box Jenkins (ARIMA) Dalam Peramalan Harga Konsumen Bawang Merah Di Provinsi Jawa Tengah. Agri Wiralodra Jurnal Agribisnis. 13 (1): 29-37.

Apriyani Nelma. E. A. R. D. Y. (2021). Analisis Fluktuasi Harga dan Saluran Pemasaran Bawang Merah (*Alium Ceva L*) di Kota Bengkulu. Agritech. XXIII(2). 167–173.

BPS Daerah Istimewa Yogyakarta. 2022. Statistik Hortikultura Daerah Istimewa Yogyakarta 2022. BPS Provinsi DI Yogyakarta. Yogyakarta.

Dianco. R.F. & Novita. M.. 2021. Real time prediction of four main food commodities in Indonesia and the mapping based on autoregressive integrated moving average model. Journal of Physics: Conference Series. 1725 012023. DOI 10.1088/1742-6596/1725/1/012023

Direktorat Jenderal Hortikultura. Kementerian Pertanian. 2024. Buku Angka Tetap Hortikultura Tahun 2023. Direktorat Jenderal Hortikultura. Kementerian Pertanian. Jakarta.

Harahap. M.. Putra. Y.A.. Yunita. A.. 2023. Pengembangan Agribisnis Tanaman Bawang Merah Di Desa Sukajadi Kecamatan Banda Mulia Kabupaten Aceh Tamiang. Journal of Agribusiness Science. 07 (2): 131-143.

Khoirani. N.. Anees. R.. Annisa. S.. Rusyda. H.. 2022. Peramalan Harga Bawang Merah Di Pasar Tradisional Sulawesi Selatan Dengan Metode Arima. Jurnal Agribisnis. 24 (2): 274-287.

Mahayana. I.B.B. Mulyadi. I.. Soraya. S. 2022. Peramalan Penjualan Helm dengan Metode ARIMA (Studi Kasus Bagus Store). INFERENSI. 5 (1): 45-50.

Monica. E.. Hartati. A.. Wijayanti.. I.K.E.. 2021. Efisiensi Teknis Usahatani Bawang Merah Pada Lahan Pasir Di Kecamatan Adipala Kabupaten Cilacap. Jurnal Pertanian Agros. 23 (1): 134-147.

Nugroho. A. D. & Prasada. I. Y. 2020. Performance and forecast of Indonesian pepper exports to Italy. Bulgarian Journal of Agricultural Science. 26 (5). 927–934

Putri. A.P.. 2023. Transmisi Volatilitas Harga Bawang Merah di Indonesia. Tesis. Magister Sains Agribisnis. Fakultas Ekonomi dan Manajemen. Institut Pertanian Bogor. Bogor.

Putri. D.M. dan Aghsilni. 2019. Estimasi Model Terbaik untuk Peramalan Harga Saham PT. Polychem Indonesia tbk. dengan ARIMA. MAP Journal. 1 (2):1-12.

Rahmawati. A.A.N. 2022. Varietas Bawang Merah Unggul Spesifik dari Daerah Istimewa Yogyakarta. Buletin Teknologi dan Inovasi Pertanian. 1 (1): 9-12.

Sahara. Utari. M.H.. Azijah. Z.. 2019. Volatilitas Harga Bawang Merah di Indonesia. Buletin Ilmiah Litbang perdagangan. 13 (2): 309-336.

Susilawati. R. dan Sunendiari. S. 2022. Peramalan Jumlah Penumpang Kereta Api Menggunakan Metode ARIMA dan Grey System Theory. Jurnal Riset Statistika. 2 (1): 1-12.

Tantika. H.N.. Supriadi. N and Anggraini. D. 2018. Metode Seasonal ARIMA untuk Meramalkan Produksi Kopi Dengan Indikator Curah Hujan Menggunakan Aplikasi R di Kabupaten Lampung Barat. Matematika.17 (2): 49–58.

Tan. E. dan Astuti. I. 2020. Metode Autoregressive Integrated Moving Average untuk Meramalkan Penjualan. Ekomabis: Jurnal Ekonomi Manajemen dan Bisnis. 1(2): 149-158.

Tomycho. O.. Roy. N.D.. Nikmatul. K.. Arifatus. S.A.. 2020. Shallot Spatial Market Integration Between Surplus and Deficit Areas. RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences. 9 (10): 163-175.

Wartajogjakota. 2024. Awal 2024 Harga Bawang dan Cabai Naik Akibat Perubahan Cuaca. https://warta.jogjakota.go.id/detail/index/31104. Diakses pada tanggal 15 Juni 2024.

Windhy. A.M.. Suci. Y.T.. Jamil. A.S.. 2018. Seminar Nasional Fakultas Pertanian Universitas Jambi tahun 2018. Prosiding: 591-604. ISBN 978-602-970571-7-1.