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Rising production, fluctuating prices: exploring shallot market trends in South Sulawesi, Indonesia

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ABSTRACT

Purpose: to analyze the trends and fluctuations in shallot production in South Sulawesi province and shallot prices in Makassar city during the 2021–2026 observation period using linear trend analysis.
Method: this study used a quantitative descriptive method and secondary monthly and annual time-series data from the South Sulawesi Central Statistics Agency and the National Strategic Food Price Information Center. Data were analyzed using descriptive statistics and the Least Squares Method to identify production and price trends over the observation period.
Findings: revealed that shallot production in South Sulawesi increased by 76.30% during 2021–2025, reaching 323,000 metric tons in 2025, with a positive annual trend of 33,961 metric tons (R^2 = 0.7963). Meanwhile, shallot prices in Makassar city exhibited an upward trend of IDR 209.37/kg per month during January 2023–October 2026 (R^2 = 0.2075), indicating considerable price fluctuations despite increasing regional production.
Implications: the findings highlight the importance of integrating production development with efficient post-harvest management, improved distribution systems, and market monitoring to strengthen shallot agribusiness sustainability and promote price stability in South Sulawesi.
Originality: lies in its integrated analysis of shallot production trends in South Sulawesi province and price fluctuations in Makassar city, providing recent empirical insights into the contrasting dynamics of regional production growth and consumer-level price movements during 2021–2026.

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Introduction

Shallots are among the essential horticultural commodities in Indonesia, playing an important role in household consumption, culinary activities, and the agricultural

economy (Prabawati et al., 2026). As a fundamental ingredient in Indonesian cuisine, shallots are widely consumed and have relatively consistent market demand (Rozaki et al., 2025). Beyond their culinary uses, shallots are also recognized for their potential health benefits and traditional medicinal uses (Ahmed et al., 2025). Population growth and the expansion of food-related industries have further contributed to rising demand for shallots, making this commodity strategically important for maintaining food availability and market stability (Asriaty et al., 2026). However, despite their economic and consumption significance, shallots are characterized by seasonal production patterns and considerable price volatility (Kodrat, 2024). Market prices are strongly influenced by changes in supply, consumer demand, and commodity availability in distribution channels (Hamid et al., 2018; Hoirunisa et al., 2022; Nasution et al., 2020). Consequently, maintaining a balance between production, market supply, and consumer demand remains a major challenge in the shallot agribusiness sector.

The development of shallot production in South Sulawesi province during 2021–2025 illustrates an interesting phenomenon that warrants further investigation. Based on the available data, shallot production reached 183,210 metric tons in 2021 before declining to 175,159 metric tons in 2022, representing a decrease of approximately 4.40%. Production subsequently increased to 201,421 metric tons in 2023, 235,187 metric tons in 2024, and 323,000 metric tons in 2025. Overall, production increased by approximately 76.30% between 2021 and 2025, indicating a substantial expansion despite the temporary decline in 2022. Nevertheless, increasing production does not necessarily indicate a proportional improvement in productivity, as total output is also affected by harvested area, climatic conditions, input availability, pest and disease disturbances, and the adoption of agricultural technologies (Adetya et al., 2024; Utari et al., 2022). This production trend raises an important market-related question: whether the substantial increase in shallot production has been accompanied by more stable or declining prices, particularly in Makassar as one of the important consumption and distribution centers in South Sulawesi. In economic terms, increased production may put downward pressure on prices when supply rises while demand remains relatively constant. However, the relationship may differ when demand increases, distribution systems face constraints, or seasonal variations affect market supply. Therefore, the coexistence of rising production and fluctuating prices is an important phenomenon that requires empirical investigation rather than explanation solely through the conventional supply–demand relationship (Bag et al., 2025; Tomek & Kaiser, 2017).

Price fluctuations in shallot markets constitute a significant problem because they affect both producers and consumers. During periods of abundant harvest, increased market supply may place downward pressure on prices, potentially reducing farmers' income when production costs remain relatively high. Conversely, during periods of limited supply, prices may increase considerably, placing additional financial pressure on consumers. This situation is particularly relevant to horticultural commodities because of their seasonal characteristics, perishability, limited storage capacity, and vulnerability to disruptions in distribution and marketing channels (Tomek & Kaiser, 2017; Yeshiwas et al., 2026). Furthermore, differences between production periods and consumption patterns may create temporal imbalances between supply and demand, resulting in price instability even when annual production demonstrates an increasing trend (Yu et al., 2025). Previous studies have also highlighted the importance of understanding shallot price movements through trend analysis, forecasting, and examining factors influencing production and market behavior (Asriaty et al., 2026; Dahara et al., 2022; Hoirunisa et al., 2022; Maure, 2023; Putri,

2014). These conditions indicate that the central research problem is not merely whether shallot production increases or decreases, but also how production developments correspond with market price movements over time. In particular, the extent to which increasing regional production is reflected in consumer-market prices in Makassar remains an important empirical issue.

Previous studies have examined various aspects of shallot production, price behavior, market integration, and forecasting in Indonesia. Fadhilah et al. (2023), for instance, examined shallot price behavior and market integration in Indonesia, offering insights into relationships among prices across market levels. Research by Maure (2023) and Asriaty et al. (2026) focused on shallot price trends in specific regional markets, while Hoirunisa et al. (2022) examined price estimation using market price data. In addition, Dahara et al. (2022) investigated shallot forecasting, and Rahman et al. (2021) applied clustering and time-series forecasting approaches to analyze provincial-level shallot production in Indonesia. Other studies have focused on production determinants, farming efficiency, and consumer demand, including research by Nasution et al. (2020); Utari et al. (2022); and Adetya et al. (2024). Meanwhile, Salsabilah et al. (2025) explored applying hybrid classification and artificial neural network algorithms to predict shallot prices. Although these studies contribute valuable insights into shallot agribusiness, most have emphasized specific dimensions of the commodity, such as production determinants, price forecasting, market integration, or regional price trends. Consequently, there remains an opportunity to develop an integrated descriptive analysis that examines shallot production development at the provincial level alongside price fluctuations in the Makassar market over the same observation period. This study addresses this gap by linking regional production dynamics with market price developments within a specific geographical and temporal context. Its novelty lies in examining the 2021–2025 production trend in South Sulawesi alongside shallot price fluctuations in Makassar, providing a more contextual understanding of how rising production coincides with changing market prices.

This research is primarily grounded in the supply–demand framework and agricultural price behavior theory. Under basic microeconomic principles, an increase in market supply, holding other factors constant, tends to lower the equilibrium price, whereas an increase in demand tends to raise it (Cai et al., 2025; Guo & Xiao, 2026). In agricultural markets, however, the relationship between production and prices is not always straightforward because agricultural commodities are influenced by seasonal production cycles, biological production constraints, time lags, perishability, and limitations in storage and distribution systems. Tomek & Kaiser (2017) explain that agricultural product prices are shaped by interactions between supply and demand, market structure, and adjustments occurring along agricultural marketing channels. Furthermore, the transmission of market information and price signals across stages of commodity distribution may influence how changes in supply are reflected in consumer prices (Figiel et al., 2026; Lloyd, 2017). In the case of shallots, an increase in annual production may not immediately translate into lower consumer prices if the additional output is concentrated during particular harvest periods, if distribution is inefficient, or if demand simultaneously increases. Accordingly, this study conceptualizes shallot production development and market price fluctuations as interconnected but not necessarily inversely proportional phenomena. This theoretical perspective provides a basis for examining production and price trends without assuming that increasing production will automatically lower market prices.

Based on these considerations, this study aims to analyze the development of shallot production in South Sulawesi province and fluctuations in shallot prices in Makassar from 2021 to 2025. Specifically, the study seeks to identify annual production trends, describe the patterns and magnitude of price fluctuations, and examine the extent to which changes in regional production correspond with market price movements during the observation period. This research matters because it examines whether rising agricultural output is accompanied by greater market stability and whether production growth is reflected in consumer-level price changes. This analysis matters because production growth alone cannot guarantee price stability, particularly in agricultural markets shaped by seasonality and distribution constraints. A clearer understanding of these dynamics can provide useful information for evaluating how effective agricultural production development is at supporting market availability and price stability. Furthermore, focusing on the relationship between provincial production developments and prices in Makassar provides a regional perspective that can complement broader studies of shallot markets in Indonesia.

This study is expected to contribute to agricultural economics and agribusiness literature by providing empirical evidence on the dynamics of shallot production and market price fluctuations in a specific regional context. From a scientific perspective, the findings are expected to enrich the discussion of agricultural supply–price relationships by demonstrating how production growth and market price movements may develop differently over time. From a practical perspective, the results may serve as a reference for local governments, agricultural policymakers, farmers, traders, and other agribusiness stakeholders in formulating more responsive production planning, distribution strategies, and market stabilization policies. In particular, identifying periods of production increases and significant price fluctuations may help stakeholders anticipate potential market imbalances and improve the coordination between production and marketing activities. Ultimately, this research is expected to support more sustainable shallot agribusiness development in South Sulawesi by improving understanding of the interaction between agricultural production performance and market price stability.

Method

This study employed a quantitative descriptive research approach to examine the development of shallot production and price fluctuations in South Sulawesi province, particularly in Makassar city. The quantitative descriptive method was selected because it enables the systematic presentation, measurement, and interpretation of numerical data to identify patterns and trends in production and price movements over a specified period. The research location was determined using purposive sampling, with Makassar city selected as the study area because it is the capital of South Sulawesi province and an important center for shallot distribution, consumption, and price formation in the region.

This study used secondary data in the form of monthly time-series observations from January 2023 to December 2026. The data consisted of two main variables: shallot production and shallot prices. Production data were obtained from the Central Statistics Agency of South Sulawesi province, while shallot price data were collected from the National Strategic Food Price Information Center. Monthly time-series data were used to capture changes in production and price movements over time, allowing identification of upward or downward trends and fluctuations throughout the observation period.

Data collection was conducted using the documentation method, which involved

identifying, collecting, recording, classifying, and compiling relevant secondary statistical information from official institutional publications and databases. The collected data were subsequently organized into a chronological monthly series to ensure consistency in the observation period and facilitate further analysis. Before analysis, the data were checked for completeness, consistent measurement units, and chronological accuracy. This procedure was intended to minimize data inconsistencies and ensure that the production and price series could be analyzed systematically.

The data were analyzed using descriptive statistical analysis and trend analysis based on the Least Squares Method. Descriptive analysis presented the overall development of shallot production and prices, including increases, decreases, and fluctuations during the observation period. Meanwhile, trend analysis was applied to identify the general direction and pattern of changes in production and prices over time. The Least Squares Method was selected because it estimates the trend line by minimizing the sum of squared deviations between observed values and estimated values. This method provides a mathematical basis for identifying whether shallot production and prices exhibit increasing, decreasing, or relatively stable trends (Fadhilah et al., 2023). The trend analysis was performed separately for shallot production and prices using a linear trend equation expressed as follows:

$$Y_t = a + bX_t$$

Where:

Y_t = Estimated value of shallot production or price in period t (IDR)
a = constant
b = slope of the trend line
X_t = time variable, expressed in monthly units.
t = observation period.

The parameters a and b were estimated using the least squares method. When the time variable is coded symmetrically around zero, the parameter estimates can be calculated using the following equations:

$$a = \frac{\Sigma Y}{n}$$

$$b = \frac{\Sigma XY}{\Sigma X^2}$$

The estimated slope coefficient (b) was used to determine the direction and magnitude of the trend. A positive b indicates an increasing trend in shallot production or prices, whereas a negative b indicates a decreasing trend. A value of b approaching zero indicates that the series does not exhibit a substantial linear trend over the observation period. The estimated trend equations were subsequently used to describe and compare the development of production and prices throughout the study period. All data processing and trend estimations were performed using Microsoft Excel. The results were presented as tables, trend equations, and graphical representations to facilitate interpretation of production developments and price fluctuations in the shallot market.

Results and Discussion

Shallot price trends from 2023 to 2026

Shallot prices fluctuate over time because of changes in market supply and demand, seasonal production patterns, and distribution conditions. Analyzing price movements is essential to understanding market dynamics and identifying periods of price increases and decreases. This study examines shallot price development in Makassar city using secondary monthly data from the National Strategic Food Price Information Center. The observation period covers January 2023 to October 2026, providing 46 monthly observations. The analysis identifies the highest and lowest prices each year and compares price movements across the observation period. The monthly average shallot prices are presented in Table 1.

Table 1 monthly average shallot prices in Makassar city, January 2023–October 2026 (IDR/kg)

Month	2023	2024	2025	2026
January	37,000	36,250	38,250	48,750
February	33,250	38,250	30,000	40,000
March	34,500	35,000	38,750	40,000
April	34,250	33,750	40,000	45,500
May	31,250	51,250	36,750	43,750
June	33,750	40,000	35,500	42,500
July	35,750	40,000	41,250	38,750
August	35,750	29,250	48,750	35,000
September	26,250	25,000	41,250	33,250
October	24,500	29,000	37,500	35,000
November	25,000	32,500	38,750	-
December	28,750	41,250	43,750	-

Source: secondary data

As shown in Table 1, shallot prices in 2023 generally declined, although several temporary increases occurred during the observation period. The highest monthly average price was recorded in January at IDR 37,000/kg, followed by relatively high prices in July and August at IDR 35,750/kg. Subsequently, prices tended to decrease, reaching IDR 24,500/kg in October, the lowest level during the year. Prices rose slightly in November and December, reaching IDR 25,000/kg and IDR 28,750/kg, respectively. This pattern indicates that shallot prices came under downward pressure in the second half of 2023, particularly between August and October, before showing signs of recovery toward the end of the year.

In 2024, shallot prices fluctuated more sharply than in the previous year. As shown in Table 1, prices rose from IDR 36,250/kg in January to IDR 38,250/kg in February, then declined slightly in March and April. Prices rose sharply in May, when the monthly average reached IDR 51,250/kg, the highest recorded during the 2023–2026 observation period. After this peak, prices fell to IDR 40,000/kg in June and stayed there in July. Prices fell further in August, September, and October, reaching IDR 29,250/kg, IDR 25,000/kg, and IDR 29,000/kg, respectively. However, prices subsequently increased to IDR 32,500/kg in November and IDR 41,250/kg in December. These movements indicate that 2024 was characterized by substantial intra-year price variations, particularly the sharp increase in May followed by a considerable decline during the subsequent months.

In 2025, shallot prices followed a different pattern, with an overall upward trend in the second half of the year. Prices initially fell from IDR 38,250/kg in January to IDR

30,000/kg in February, the lowest monthly average of the year. Prices then rose to IDR 38,750/kg in March and IDR 40,000/kg in April before declining temporarily in May and June. Prices rose more sharply from July onward, reaching IDR 41,250/kg in July and peaking at IDR 48,750/kg in August. Although prices decreased to IDR 37,500/kg in October, they increased again to IDR 38,750/kg in November and IDR 43,750/kg in December. As shown in Table 1, price movements in 2025 suggest a stronger upward trend in the second half of the year, particularly between July and August, reflecting persistent price fluctuations despite the availability of shallot production.

Meanwhile, shallot prices in 2026, based on available data from January to October, were relatively high at the start of the year, then gradually declined in the following months. The highest monthly average price was recorded in January at IDR 48,750/kg, which was also the highest January price across the four observation years. Prices then fell to IDR 40,000/kg in February and March before rising to IDR 45,500/kg in April. From May to June, prices fell from IDR 43,750/kg to IDR 42,500/kg, then declined further to IDR 38,750/kg in July and IDR 35,000/kg in August. The downward trend continued in September, when prices fell to IDR 33,250/kg, the lowest level recorded in 2026. However, prices increased slightly to IDR 35,000/kg in October. These findings indicate that although shallot prices remained relatively high at the beginning of 2026, the market trended downward over the following months, particularly from April to September.

Overall, the monthly price data in Table 1 show that shallot prices in Makassar fluctuated considerably throughout the 2023–2026 observation period, without a consistent upward or downward trend across all years. The highest price was recorded in May 2024 at IDR 51,250/kg, whereas the lowest price occurred in October 2023 at IDR 24,500/kg. The comparison also indicates that 2024 and 2025 were characterized by substantial price increases during particular months, while 2026 exhibited a declining pattern from its relatively high initial level. These variations suggest that shallot price movements are dynamic and may be influenced by seasonal supply conditions, changes in consumer demand, and distribution-related factors. Therefore, annual production increases do not necessarily correspond to continuously declining market prices, as price developments may also be determined by the timing and distribution of available supply. Further analysis of production trends and price movements is consequently necessary to provide a more comprehensive understanding of shallot market dynamics in South Sulawesi.

Linear trend analysis of shallot prices

Linear trend analysis was conducted to identify the long-term direction of shallot price movements in Makassar city during the January 2023–October 2026 observation period. The analysis employed the Least Squares Method to estimate the general tendency of price developments based on monthly time-series data. This approach allows us to identify whether shallot prices show an increasing or decreasing trend over time, despite short-term fluctuations. The results of the linear trend estimation are illustrated in Figure 1.

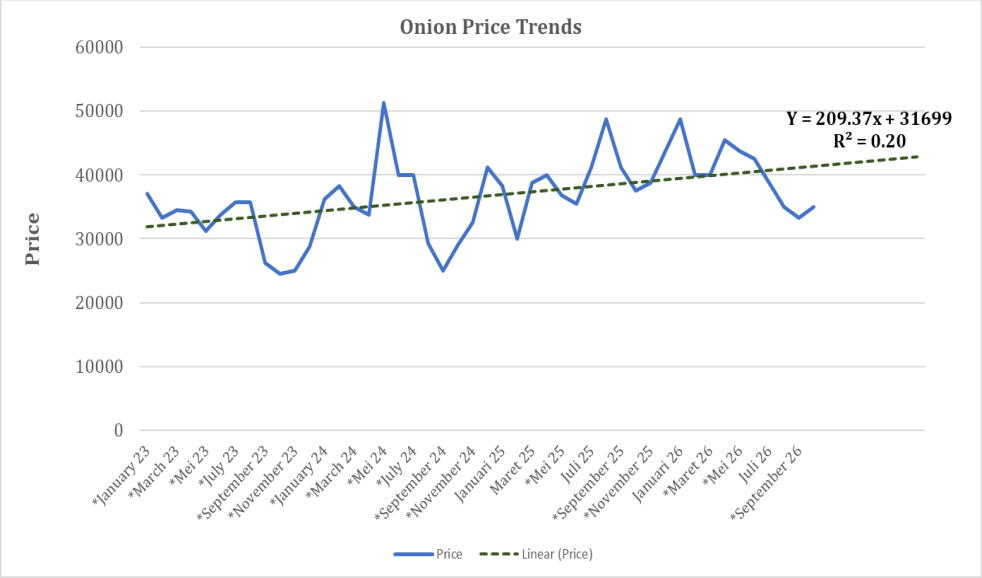


Figure 1 shallot price trends from 2023 to 2026
Source: secondary data, processed

As illustrated in Figure 1, the observed shallot prices fluctuated considerably throughout the study period, with several periods of substantial increases and decreases. Nevertheless, the estimated linear trend line indicates a positive overall direction. The regression equation obtained from the Least Squares estimation is expressed as follows:

$$Y = 209.37x + 31699$$
$$R^2 = 0{,}2075$$

The positive slope coefficient of 209.37 indicates that the estimated shallot price increased by approximately IDR 209.37/kg for each additional month of observation. This finding suggests that, despite temporary price declines, shallot prices in Makassar City showed an overall upward trend during the observation period. Meanwhile, the intercept of 31,699 represents the estimated price when the time variable equals zero. Furthermore, the coefficient of determination (R^2) of 0.2075 indicates that the linear time trend explains approximately 20.75% of the variation in shallot prices. The remaining 79.25% represents variation that is not explained by the linear trend model. This suggests that shallot prices are not driven solely by a gradual upward trend but also by considerable fluctuations that a simple linear equation cannot capture. These fluctuations may be linked to other market factors, including seasonal supply conditions, changes in consumer demand, weather variability, harvesting patterns, distribution efficiency, and transportation costs. Therefore, the estimated trend provides an overview of the general direction of price movements rather than a complete explanation of the factors determining shallot price fluctuations.

The positive price trend observed in this study reflects the dynamic interaction between supply and demand in the shallot market. From an agricultural economics perspective, prices may rise when demand grows faster than supply or when the distribution of agricultural commodities cannot keep pace with changing consumption needs. Shallots are an important horticultural commodity with relatively continuous household demand, while their production is influenced by seasonal cultivation cycles and environmental conditions (Mesang et al., 2025). Consequently, differences between

production periods and market demand may create temporary supply shortages that contribute to upward price pressure. This interpretation is consistent with Fadhilah et al. (2023), who emphasized the importance of price behavior and market integration in understanding shallot market dynamics in Indonesia. Similarly, Tomek & Kaiser (2017) explained that agricultural commodity prices are determined by interactions between supply, demand, and the characteristics of agricultural marketing systems. These perspectives suggest that the upward price trend identified in this study should be understood within the broader context of agricultural market dynamics rather than as an isolated, time-based phenomenon.

Another important aspect of shallot price behavior concerns the structural characteristics of horticultural commodities, particularly seasonality, perishability, and limitations in post-harvest handling. Unlike non-perishable commodities, shallots require appropriate storage and distribution facilities to maintain product quality and ensure availability over time. During periods of abundant harvest, market supply may increase substantially, potentially generating downward pressure on prices. Conversely, when production declines or harvesting periods are limited, shallot availability may decrease, resulting in higher market prices. Shahbazi et al. (2025) highlighted that inadequate storage, post-harvest handling, and distribution systems contribute to food losses and affect the availability of agricultural products. In addition, Chandana & Arumugam (2026) emphasized the role of price signal transmission within decentralized commodity marketing systems, where market information and distribution mechanisms influence price developments across different marketing stages. In this context, fluctuations in shallot prices may reflect not only changes in production but also differences in the efficiency of commodity distribution from producing areas to consumer markets. Thus, strengthening post-harvest management and distribution infrastructure is important to reduce potential supply imbalances and support greater market stability.

The findings of this study are also supported by previous research examining shallot price trends in different regions of Indonesia. Putri (2014), in their study of shallot prices in Banyumas Regency, reported a positive trend coefficient of 207.50, indicating an upward price trend during their observation period. The similar direction of the estimated coefficients suggests that rising price trends are not limited to the Makassar market but have also been observed in other regional shallot markets. Nevertheless, differences in geographical characteristics, observation periods, and market structures mean that the magnitude of the estimated trends should not be interpreted as directly equivalent. Furthermore, Maure (2023), who examined shallot price trends in Alor regency, reported a coefficient of determination of 0.1064 or 10.64%. Compared with that study, the present research produces a relatively higher R^2 value, although both findings indicate that a linear time trend explains only a limited proportion of price variation. These comparisons reinforce the argument that shallot price movements are influenced by multiple factors beyond the passage of time. The present study therefore extends previous regional analyses by providing more recent empirical evidence on shallot price developments in Makassar city over the 2023–2026 period.

Furthermore, the findings provide relevant implications for understanding the relationship between increasing shallot production in South Sulawesi and price developments in Makassar city. According to the supply–demand framework, an increase in supply, assuming other factors remain constant, generally reduces the equilibrium price (D. M.-C. Chen et al., 2025). However, this theoretical relationship does

not necessarily occur proportionally in agricultural markets because annual production levels do not always represent the actual availability of commodities in consumer markets at a particular time. Differences in harvesting schedules, seasonal supply conditions, distribution efficiency, and marketing costs may prevent increased regional production from being immediately reflected in lower consumer prices. Therefore, production growth needs to be accompanied by improvements in post-harvest management, storage facilities, market information systems, and distribution coordination. From a policy perspective, these findings highlight the importance of integrating production planning with market supply management to minimize potential price instability. Better coordination between production centers and consumer markets is expected to improve the effectiveness of agricultural development programs while supporting the sustainability of South Sulawesi's shallot agribusiness sector.

Trends in shallot production, 2021–2025

Shallot production in South Sulawesi province during the 2021–2025 period exhibited an overall increasing trend, although a temporary decline occurred in 2022. This period's production development provides an overview of changes in regional agricultural output and serves as an important indicator of the shallot agribusiness sector's performance. Analyzing annual production changes is particularly relevant for understanding changes in production capacity and identifying periods of growth and contraction. The annual production figures, absolute changes, and percentage changes in shallot production are presented in Table 2.

Table 2 development of shallot production in South Sulawesi province, 2021–2025

Year	Production (metric tons)	Change in production	Change (%)
2021	183,21	–	–
2022	175,159	−8,051	−4.39
2023	201,421	26,262	+14.99
2024	235,187	33,766	+16.76
2025	323	87,813	+37.34

Source: secondary data, processed

As presented in Table 2, shallot production in South Sulawesi province reached 183,210 metric tons in 2021 before declining to 175,159 metric tons in 2022. This was a reduction of 8,051 metric tons, or 4.39% from the previous year. However, production subsequently recovered in 2023, reaching 201,421 metric tons, an increase of 26,262 metric tons or 14.99%. The upward trend continued in 2024, when production rose to 235,187 metric tons, up 16.76%. The largest increase occurred in 2025, with production reaching 323,000 metric tons, up 87,813 metric tons, or 37.34%, from 2024. Overall, shallot production increased by 139,790 metric tons between 2021 and 2025, for cumulative growth of about 76.30%. These figures show that, despite the temporary contraction in 2022, regional shallot production expanded substantially, particularly in the final two years of the observation period.

The production pattern shows a recovery after the 2022 decline, followed by increasingly strong growth through 2025. Nevertheless, the increase in total production should not automatically be interpreted as improved agricultural productivity. Total production is determined by both harvested area and yield per unit of land. Consequently, the observed expansion may have resulted from increased harvested area, improved yields, or a combination of both. Other factors, including climatic conditions, the incidence of pests and diseases, the availability and quality of production

inputs, and the adoption of cultivation technologies, may also contribute to changes in agricultural output. Because this analysis focuses on total production, additional information on harvested area and productivity is needed to identify the specific sources of production growth.

The increasing trend in shallot production reflects the growing importance of horticultural agriculture in supporting regional agricultural development and food availability in South Sulawesi. From an agribusiness perspective, sustained production growth can indicate an expanded capacity in the agricultural sector to supply commodities for both household consumption and commercial distribution. However, sustaining this growth requires effective management of production resources, particularly land, seeds, fertilizers, labor, and crop protection inputs. The availability and efficient allocation of these resources are essential because agricultural production depends not only on the scale of cultivation but also on the technical efficiency with which production inputs are utilized (Amrullah et al., 2026). Therefore, evaluate shallot production development not only by output but also by the efficiency and sustainability of the production process.

The importance of production input management is supported by Utari et al. (2022), who found that the technical efficiency of shallot farming in Aceh province was positively and significantly influenced by production factors, including seeds, fertilizers, labor, and harvested area. Their findings demonstrate that the effective allocation of agricultural inputs plays an important role in improving farming performance. Similarly, Adetya et al. (2024) identified farming experience, land area, seed quality, and pesticide use as important factors influencing shallot production in Nganjuk District. These studies suggest that differences in production performance may reflect variations in farmers' access to resources, cultivation practices, and input management capabilities. In the context of South Sulawesi, these findings offer a relevant perspective on the factors that may underlie regional production expansion. Nevertheless, without additional empirical data from the study area, the specific contribution of each production factor to the observed increase cannot be established.

Furthermore, shallot production development must be considered in relation to the characteristics of horticultural cultivation, particularly seasonal production cycles and environmental variability. Shallot farming is susceptible to changes in rainfall, temperature, water availability, and pest and disease disturbances, which may influence both harvested area and crop yields (Mesang et al., 2025; Wibowo et al., 2025). Consequently, increasing production in one period does not necessarily guarantee consistent output in subsequent periods. This condition highlights the importance of strengthening farmers' adaptive capacity through appropriate cultivation technologies, improved seed quality, integrated pest management, and better access to agricultural information. Adetya et al. (2024) also highlight the importance of farming experience and production input management, reinforcing the need to consider both technical and managerial aspects in developing shallot farming. In addition, the technical efficiency perspective discussed by Utari et al. (2022) suggests that sustainable production growth should be supported by improving the use of available resources rather than relying exclusively on expanding cultivated land.

From a broader agribusiness perspective, increased production also affects regional market availability, distribution management, and price stability. Higher agricultural output can potentially strengthen market supply and improve commodity availability, provided that production is supported by effective post-harvest handling, storage, transportation, and marketing systems (Kotwaliwale & Mohapatra, 2025).

However, production expansion does not automatically ensure stable consumer prices because harvest timing, geographical distribution, and market demand can influence commodity availability at specific periods. This consideration is particularly relevant when examining the relationship between increasing shallot production in South Sulawesi and price fluctuations in Makassar. Therefore, regional agricultural development policies should integrate production planning with market information systems, distribution infrastructure, and post-harvest management. This integrated approach is expected to improve the efficiency of the shallot agribusiness supply chain, strengthen farmers' market access, and ensure that increased production benefits both producers and consumers. Ultimately, sustainable shallot agribusiness development requires balancing production growth, resource-use efficiency, environmental adaptability, and market stability.

Linear trend analysis of shallot production

Linear trend analysis was conducted to identify the direction and magnitude of changes in shallot production in South Sulawesi province during 2021–2025. This analysis employed the Least Squares Method to estimate the relationship between production levels and time, providing an overview of the long-term development of regional shallot production. This approach identifies the general production pattern, including whether production tends to increase, decrease, or remain relatively stable over the observation period. The results of the linear trend estimation are presented in Figure 2.

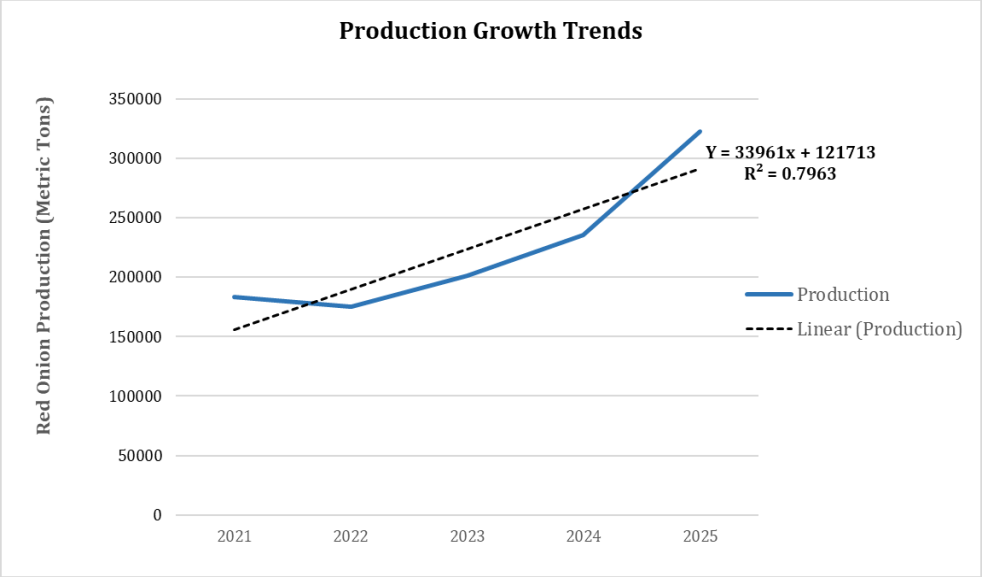


Figure 2 linear trend of shallot production in South Sulawesi province, 2021–2025
Source: secondary data, processed

As shown in Figure 2, shallot production showed an overall upward trend, although actual production figures varied across observation years. The estimated regression equation obtained from the linear trend analysis is expressed as follows:

$$Y = 33961x + 121713$$
$$R^2 = 0.7963$$

The positive regression coefficient of 33,961 indicates that shallot production in South Sulawesi province tended to increase by approximately 33,961 metric tons for each additional year of observation. This positive coefficient confirms an upward production trend during the study period. Meanwhile, the intercept of 121,713 represents the estimated production level when the time variable equals zero, based on the time coding used in the regression model.

Furthermore, the coefficient of determination (R^2) of 0.7963 indicates that approximately 79.63% of the variation in shallot production is explained by the linear time trend model. In comparison, the remaining 20.37% represents variation not explained by the model. This unexplained variation may be associated with other factors, including harvested area, climatic conditions, seed availability, fertilizer application, pest and disease incidence, and the adoption of cultivation technologies. However, these factors were not directly examined in the present model. Overall, the findings indicate a relatively strong upward production trend during the observation period, although actual production levels remain subject to annual fluctuations. Therefore, the estimated trend provides an overview of the general direction of production development rather than a comprehensive explanation of the factors determining changes in shallot output.

The upward production trend reflects the horticultural subsector's important role in supporting agricultural development and regional food availability in South Sulawesi. From an agricultural economics perspective, sustained production growth can be linked to expanding productive capacity and farming systems' growing ability to supply agricultural commodities to regional markets. Nevertheless, production growth should not be evaluated exclusively through the quantity of agricultural output. The sustainability of such growth also depends on efficient resource allocation, the availability of production inputs, and farmers' capacity to maintain consistent cultivation performance. In this regard, improving agricultural production requires an integrated approach that considers land use, input management, farming practices, and technological development. Therefore, shallot production development should emphasize not only output expansion but also improvements in the efficiency and sustainability of farming operations.

Shallot production also depends closely on technical and environmental conditions that affect agricultural performance (Wibowo et al., 2025). Land availability, seed quality, fertilizer management, labor use, and crop protection practices are key factors that determine farming efficiency (X. Chen, 2025). In addition, shallot cultivation is particularly sensitive to climatic variability, water availability, and pest and disease outbreaks, which can affect crop growth and harvest outcomes. These conditions highlight the importance of adaptive cultivation strategies and appropriate agricultural technologies to maintain production continuity. Utari et al. (2022) demonstrated that the technical efficiency of shallot farming in Aceh province was positively and significantly influenced by seeds, fertilizers, labor, and harvested area. Similarly, Adetya et al. (2024) identified farming experience, land area, seed quality, and pesticide use as important factors affecting shallot production in Nganjuk District. These findings reinforce the argument that increasing agricultural output requires effective management of production resources and improved farmers' technical capabilities. Consequently, the sustainability of shallot production in South Sulawesi depends not only on increasing cultivation activities but also on optimizing the utilization of available production factors.

This study's findings align with previous research on the development of shallot production across different regions of Indonesia. Rahman et al. (2021), in their analysis of provincial-level shallot production, identified variations in production patterns across regions, showing that this commodity develops differently depending on regional characteristics and production conditions. Their findings highlight the importance of time-series analysis and forecasting in identifying production patterns and anticipating future developments. Similarly, Dahara et al. (2022) reported an increasing tendency in shallot production in North Sumatra province based on their forecasting analysis. These studies support the relevance of linear trend analysis for describing the general direction of agricultural production development. However, this study adds regional evidence by examining production dynamics in South Sulawesi over 2021–2025. Differences in geographical coverage and observation periods also emphasize that production trends should be interpreted within each region's specific agricultural and environmental characteristics. Thus, this study complements previous research by providing updated empirical information on shallot production development in one of Indonesia's major shallot-producing provinces.

From a broader agribusiness perspective, increasing shallot production affects regional food supply, agricultural market development, and price stability. In economic theory, higher agricultural output can increase supply and reduce price pressure, provided demand and other market conditions remain constant. However, the benefits of production expansion depend on the effectiveness of post-harvest handling, storage facilities, transportation infrastructure, and commodity distribution systems. Inadequate coordination between production centers and consumer markets may limit how much increased agricultural output translates into greater market availability. This issue is particularly relevant to the shallot market in South Sulawesi, where production development needs to be considered alongside price movements in Makassar city. Therefore, agricultural development strategies should integrate production planning with market information systems, post-harvest management, and distribution improvements. Such integration is expected to strengthen the competitiveness of shallot farming, improve farmers' market access, and support more stable commodity supplies. Ultimately, sustainable shallot agribusiness development requires balancing production expansion, technical efficiency, environmental adaptability, and effective market management.

Conclusions

This study concludes that shallot production in South Sulawesi province showed a substantial upward trend from 2021 to 2025, despite a temporary decline in 2022. Production increased from 183,210 metric tons in 2021 to 323,000 metric tons in 2025, representing cumulative growth of approximately 76.30%. The linear trend analysis confirmed this positive development, with an estimated annual increase of 33,961 metric tons and a coefficient of determination (R^2) of 0.7963. Meanwhile, shallot prices in Makassar city during January 2023–October 2026 also demonstrated an upward tendency, with an estimated monthly increase of IDR 209.37/kg and an R^2 of 0.2075. These findings indicate that increasing regional production does not necessarily coincide with declining consumer-level prices. The difference in the explanatory power of the two models also suggests that production followed a more consistent temporal trend. In contrast, price movements were characterized by greater fluctuations and market dynamics.

The findings advance understanding of regional shallot agribusiness

development by providing empirical evidence of contrasting patterns between production growth and price movements. From a practical perspective, the results highlight the importance of integrating production development with effective post-harvest management, storage facilities, market information systems, and distribution infrastructure to improve market availability and support price stability. For policymakers, farmers, and agribusiness stakeholders, the findings provide a basis for formulating strategies that balance production expansion, resource-use efficiency, and market management. However, this study has several limitations. First, the analysis relies on descriptive time-series data and linear trend models, which identify general temporal patterns but do not establish causal relationships between production and prices. Second, the study does not explicitly incorporate explanatory variables such as harvested area, productivity, production inputs, climatic conditions, consumer demand, and distribution costs. Third, the production and price observations cover different geographic and temporal scopes, limiting direct comparisons between the two variables.

Future research should address these limitations by incorporating a broader range of explanatory variables and applying more comprehensive quantitative approaches to examine the determinants of shallot production and price fluctuations. In particular, further studies should examine the relationships among production, harvested area, productivity, production costs, seasonal supply, consumer demand, and distribution efficiency using consistent geographical and temporal observations. Applying econometric time-series methods, such as multiple regression, seasonal analysis, or appropriate forecasting models, may also provide deeper insights into the dynamics and interrelationships between production and prices. Comparative studies across shallot-producing and consuming regions would also be valuable for understanding regional market integration and price transmission mechanisms. Such research is expected to provide a stronger empirical foundation for developing efficient, adaptive, and sustainable shallot agribusiness policies in South Sulawesi and other shallot-producing regions of Indonesia.

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