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Regional Disparities in Shallot Production: A Comparative Study of Five Districts in Nganjuk Regency

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Abstract: Shallots (*Allium ascalonicum*) are an important horticultural commodity that plays a role in food sustainability and strengthening the agricultural economy. Nganjuk Regency is one of the main production centers in East Java, but production levels show significant differences between subdistricts. This study aims to analyze the differences in shallot production in five subdistricts in Nganjuk Regency using secondary data from BPS for 2020–2024. The analysis was conducted using descriptive and inferential approaches, including normality tests, homogeneity tests, One-Way ANOVA, and Tukey HSD follow-up tests. The results show significant differences in production between subdistricts with an F value of 47.2 and significance < 0.001. Rejoso Subdistrict has the highest and most stable production level, followed by Gondang and Bagor Subdistricts as medium-productivity areas, while Sukomoro and Wilangan are at low productivity levels. These differences were influenced by agronomic conditions, planting area, availability of irrigation, and the application of cultivation technology. These results indicate the importance of production improvement strategies in low productivity areas through improvements in agricultural infrastructure and increased farmer capacity.

Keywords: ANOVA; Horticulture; Regional Productivity; Shallot Production

1. Introduction

Shallots (*Allium ascalonicum*) are an important horticultural commodity that contributes significantly to food sustainability in Indonesia. As a staple ingredient, shallots are widely used as a seasoning in various dishes, resulting in consistently stable and increasing demand. Moreover, this commodity provides substantial economic value for farmers and other stakeholders in the agricultural sector. The demand for shallots in Indonesia continues to rise across household consumption, the food industry, and supply stabilization programs. These conditions underscore the development of shallot farming as a strategic effort to strengthen the national agribusiness sector. However, increasing demand that is not supported by a stable supply often leads to price fluctuations at both consumer and producer levels. This supply instability remains one of the primary challenges in managing the shallot agribusiness in Indonesia (Fathurrahman, 2020).

East Java Province is one of the largest shallot-producing regions in Indonesia, ranking second nationally. According to (Pusdatin, 2024), shallot production in this province is concentrated in five main districts, which together contribute 79.28% of East Java's total output. These districts are Nganjuk, Probolinggo, Malang, Sampang, and Bojonegoro. Among them, Nganjuk Regency is the largest contributor, accounting for 37.91% or approximately 183.76 thousand tons, making it the most dominant shallot production center in the province. In contrast, Bojonegoro Regency contributes the smallest share, at 5.46% or around 26.45 thousand tons. This disparity in contribution highlights the strategic importance of Nganjuk Regency in maintaining the stability of

shallot supply at both regional and national levels. Therefore, this region is highly relevant as the focal point for research involving comparative analyses of shallot production.

Shallot production faces various challenges, including pest infestations, plant diseases, and price fluctuations that can negatively impact farmers. The land area has a significant effect on increasing the production of high-quality shallots (Susilowati, 2021). Therefore, farmers must apply appropriate cultivation practices, such as effective land preparation, balanced fertilization, and integrated pest management to maintain optimal productivity. Strengthening farm management practices is essential for addressing these challenges. Several studies also indicate that regional differences in shallot production are strongly influenced by variations in cultivation techniques, the types of varieties used, and local agroecosystem conditions. Differences in practices ranging from land preparation and fertilizer application to pest control can result in substantial disparities in production across regions. In addition to technical factors, variations in regional agricultural policies further affect farmers' capacity to improve productivity (Fitrianata & Rozci, 2023).

The selection of superior varieties is another key factor determining the success of shallot cultivation. Research by (Sinaga et al., 2021) indicates that varieties well-adapted to local conditions can produce more optimal yields, both in terms of quality and quantity. This finding is supported by (Krismiratsih et al., 2025), who reports that the high level of shallot production in Rejoso District, along with the feasibility and profitability of its cultivation, is partly attributable to the use of adaptive varieties and the implementation of appropriate cultivation techniques. Furthermore, (Sunariadi et al., 2022) emphasize that shallot production in Nganjuk Regency is influenced by a combination of factors, including seed variety, cultivation practices, and annual climatic conditions. The application of proper cultivation techniques, from seed selection to plant maintenance can substantially improve both the quality and quantity of production. These studies collectively demonstrate that optimizing shallot production depends heavily on the synergy between technical practices, the use of suitable varieties, and supportive environmental conditions (Nuryani, 2020).

Evaluating shallot production levels is an important step in supporting food sustainability and strengthening the agricultural economy. A comprehensive understanding of effective and efficient cultivation practices, as well as the utilization of appropriate technologies, is also essential. Many farmers combine organic and inorganic inputs to increase production, thereby achieving optimal productivity (Acheampong et al., 2022). This study aims to identify differences in shallot production across subdistricts and to evaluate production levels in five subdistricts within Nganjuk Regency. The findings are expected to provide an empirical overview of production variations among regions, which can serve as a basis for formulating strategies aimed at increasing productivity and developing the shallot agribusiness sector at the regional level in Nganjuk Regency.

2. Materials and Methods

This study is quantitative research employing a comparative approach aimed at analyzing differences in shallot production across five districts in Nganjuk Regency. The data used in this study are secondary data obtained from the Badan Pusat Statistik (BPS) of Nganjuk Regency for the period 2020–2024. Nganjuk Regency was selected as the research site because it is the largest shallot-producing region in East Java, contributing 37.91% to regional production (Pusdatin, 2024). The research objects consist of the five districts with the highest shallot production, namely Rejoso, Bagor, Gondang, Sukomoro, and Wilangan (BPS Nganjuk, 2025). The analyzed data comprise the total shallot production over the past five years. The dependent variable in this study is the volume of shallot production (measured in quintals), which is compared across the five districts.

Data analysis was conducted in two stages: descriptive analysis and inferential analysis. Descriptive analysis was employed to provide an overview of production in each district using mean, minimum, maximum, and variability measures. Prior to the comparative tests, the data were first examined using normality tests (Shapiro–Wilk or Kolmogorov–Smirnov) and homogeneity of variance tests (Levene's Test) to ensure that the parametric assumptions were met. Inferential analysis was carried out using One-Way ANOVA to examine the differences in mean production among districts, as the study involves a single distinguishing factor. If the ANOVA results indicate statistical significance, the analysis is followed by Tukey's HSD test to identify district groups that differ significantly. Preliminary data processing was performed using Microsoft Excel for data organization and cleaning, whereas advanced statistical analyses, including assumption testing and One-Way ANOVA, were conducted using SPSS version 20.

3. Results and Discussion

Shallot production across the five districts in Nganjuk Regency during the 2020–2024 period demonstrates substantial variation (Table 1). Rejoso consistently recorded the highest production levels, although it experienced a declining trend in recent years. Gondang ranked second, exhibiting considerable annual fluctuations, while Sukomoro and Wilangan reported the lowest production levels. Bagor and Wilangan showed unstable production patterns, with Wilangan tending to increase over the last two years. These differences indicate the presence of productivity disparities among districts, necessitating further statistical analysis.

Table 1. Shallot Production in Five Districts of Nganjuk Regency (in quintals)

Years	Districts				
	Rejoso	Gondang	Sukomoro	Bagor	Wilangan
2020	720423	310415	163370	375900	116825
2021	688320	390370	75270	536270	112700
2022	644110	603810	76515	421153	103065
2023	646996	450413	186525	363632	114090
2024	566177	530224	230930	482720	154055

Source: Badan Pusat Statistik (BPS) of Nganjuk Regency (2025)

Based on data from (BPS Nganjuk, 2024), Rejoso has the second-largest harvested area in Nganjuk Regency (5,263 ha) after Gondang (7,209 ha), yet it records the highest average production. The descriptive analysis (Table 2) reinforces this pattern. Table 2 shows that the average shallot production in Rejoso reaches 653,205 quintals with a low standard deviation, indicating consistent production levels. In contrast, Gondang has an average production of 457,046 quintals, but its annual fluctuations are relatively high. Bagor's average production is close to that of Gondang, with moderate variability, while Sukomoro and Wilangan record the lowest averages, with Wilangan showing the smallest variation. These productivity differences may be associated with agronomic factors such as larger harvested areas, better irrigation access, soil fertility, and the adoption of improved cultivation technologies and superior varieties that support production in Rejoso (Kusuma, 2019).

Table 2. Descriptive Statistics of Shallot Production in Five Districts of Nganjuk Regency

Description					
Districts	N	Mean	Minimum	Maximum	Std. Dev
Bagor	5	435935,00	363632	536270	72983,527
Gondang	5	457046,40	310415	603810	114983,724
Rejoso	5	653205,20	566177	720423	57979,449
Sukomoro	5	146522,00	75270	230930	68895,996
Wilangan	5	120147,00	103065	154055	19651,513

The normality test using the Shapiro–Wilk method (Table 3) indicates that the production data across all districts follow a normal distribution, with significance values exceeding 0.05. The Wilangan district, which has the value closest to the normality threshold (0.064), still meets the assumption. Furthermore, the homogeneity of variance test using Levene's method (Table 4) shows that the variances among districts can be considered homogeneous (significance = 0.057). Therefore, the data satisfy the assumptions required for conducting a one-way ANOVA.

Table 3. Results of Data Normality Test

	Districts	Saphiro Wilk	
		Df	Sig.
Shallot Production	Bagor	5	0,575
	Gondang	5	0,978
	Rejoso	5	0,757
	Sukomoro	5	0,358
	Wilangan	5	0,064

Table 4. Results of the Homogeneity of Variance Test (Levene's Test)

Variables	Levene Statistic	df1	df2	Sig.
Shallot Production	2,752	4	20	0,057

The hypotheses proposed in this study are as follows: H_0 states that there is no difference in the mean production among districts, whereas H_1 states that there is a difference in the mean production among districts. The ANOVA results show an F-value of 47.200 with a significance level of 0.000 (Table 5). Based on these results, H_0 is rejected and H_1 is accepted, indicating that there are significant differences in shallot production among the districts. Moreover, the variation in production across districts is shown to be greater than the variation within districts, suggesting that location factors have a significant influence on the level of shallot production.

Table 5. Results of the One-Way ANOVA Test

	Shallot Production		
	Df	F	Sig
Between Groups	4	47,200	0,000
Within Groups	20		

The Post Hoc Tukey HSD analysis (Table 6) shows that Rejoso differs significantly from all other districts, reaffirming its position as the primary production center. Gondang and Bagor do not differ significantly from each other and form a medium-productivity group, whereas Sukomoro and Wilangan fall into the low-productivity group. Thus, the five districts can be classified into three productivity levels: high (Rejoso), medium (Gondang and Bagor), and low (Sukomoro and Wilangan).

Table 6. Post Hoc Test Results for Shallot Production by District (Tukey HSD)

Location		Mean Differences	Sig.	Decision
Rejoso	Gondang	196.159	0.003	Signifikan
	Sukomoro	506.683	0.000	Signifikan
	Bagor	217.270	0.001	Signifikan
	Wilangan	533.058	0.000	Signifikan
Gondang	Rejoso	-196.159	0.003	Signifikan
	Sukomoro	310.524	0.000	Signifikan
	Bagor	21.111	0.991	Tidak signifikan
	Wilangan	336.899	0.000	Signifikan
Sukomoro	Rejoso	-506.683	0.000	Signifikan
	Gondang	-310.524	0.000	Signifikan
	Bagor	-289.413	0.000	Signifikan
	Wilangan	26.375	0.978	Tidak signifikan
(Bagor	Rejoso	-217.270	0.001	Signifikan
	Gondang	-21.111	0.991	Tidak signifikan
	Sukomoro	289.413	0.000	Signifikan
	Wilangan	315.788	0.000	Signifikan
Wilangan	Rejoso	-533.058	0.000	Signifikan
	Gondang	-336.899	0.000	Signifikan
	Sukomoro	-26.375	0.978	Tidak signifikan
	Bagor	-315.788	0.000	Signifikan

This disparity can be explained by several factors. Districts with larger cultivated areas and adequate irrigation systems tend to achieve higher and more stable production levels. The extent of cultivated land significantly influences productivity differences (Subagja et al., 2024). Topography and soil fertility also play essential roles, while the adoption of modern cultivation technologies and superior varieties supports productivity in major production centers (Junaidi, M., et al., 2020). In addition, high technical efficiency reflects effective use of inputs by farmers, enabling production to approach optimal levels, whereas low efficiency indicates suboptimal input utilization and non-optimal production (Laili, 2022). Conversely, limited infrastructure and greater vulnerability to pests or climate variability contribute to the lower and less stable production observed in Sukomoro and Wilangan.

Based on these findings, production enhancement strategies should be directed toward low-producing areas through improvements in irrigation, farmer training, and the provision of superior varieties. Meanwhile, production in Gondang can be stabilized through integrated pest management and better cropping planning, and Bagor requires further improvement to achieve productivity levels comparable to Gondang. Rejoso should be maintained as the primary production center, including through the development of post-harvest facilities and efficient distribution systems. This study has several limitations. The data cover only a five-year period, which may cause the results to be influenced by seasonal fluctuations and external factors. The analysis assesses

differences in mean production without quantitatively incorporating causal factors such as rainfall, input prices, or pest infestations. Future research is recommended to employ regression models or panel data approaches to more comprehensively evaluate the effects of these factors on shallot productivity.

4. Conclusions

This study demonstrates that shallot production across the five districts in Nganjuk Regency differs significantly. Rejoso exhibits the highest and most stable productivity, Gondang and Bagor fall within the medium productivity category, while Sukomoro and Wilangan show lower productivity levels. These differences are primarily influenced by variations in agronomic conditions, irrigation availability, and the adoption of cultivation technologies. The findings indicate the need for production improvement strategies in low-productivity districts through enhanced agricultural infrastructure and farmer capacity building, as well as strengthened post-harvest facilities in major production areas. Future research is recommended to incorporate agronomic and environmental variables quantitatively to obtain a more comprehensive understanding.

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