JIPSI: Jurnal Ilmu Pendidikan dan Sains Islam Interdisipiner
Vol. 5, No. 3, Agustus 2026, pp. 690-700
http://journal.amorfati.id/index.php/jipsi || ISSN 2962-9187

Interdisciplinary Scope of Science and Education, Islamic Education and Science, Integration of Science and Islam, Islamic Thought and Philosophy, Integration of Social Sciences, Humanities, and Islamic Studies, Islamic Economics and Business Studies, and Islamic Ethics in Science and Technology

Analysis Weather to Instability Price of Large Red Chili Using Time Series Based Prediction: The Perspective of Price Fairness in Islamic Economics

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ARTICLE INFO

Article history
Received:
30-05-2026
Revised:
14-06-2026
Accepted:
07-07-2026

Keywords
Weather Conditions, Price Instability, Large Red Chili, Farmers, Time Series, Price Volatility

ABSTRACT

This study was conducted to examine the influence of weather conditions on large red chili production and farmer-level price instability in Paiton District, considering that fluctuations in rainfall, temperature, and seasonal patterns often affect production and reduce farmers' income. A quantitative approach was employed using primary data collected through questionnaires from 70 large red chili farmers and secondary data on historical weather and price records. The data were analyzed using validity and reliability tests, simple linear regression, and time series analysis to determine the relationship between weather conditions and price instability. The results reveal that weather conditions have a significant effect on price instability ($p = 0.000$), with a coefficient of determination of 52.5%, indicating that variations in weather contribute substantially to production changes and subsequent price fluctuations. By integrating weather-related variables with a time-series analytical approach, this study provides empirical evidence that enriches agricultural econometric research while offering practical implications for farmers in planning planting schedules, supporting policymakers in designing weather-based price stabilization strategies, and encouraging the development of early warning systems and weather-based price forecasting models.

Introduction

However, previous studies have primarily focused on volatility analysis and have not yet developed predictive models that can be used as early warning systems for farmers and policymakers (Azhimah et al., 2023). Based on the existing literature, several theoretical and empirical gaps remain. First, most studies employ only a single forecasting model, limiting comprehensive comparisons among classical statistical methods, deep learning approaches, and hybrid models. Second, previous research has largely relied on market or consumer price data, whereas studies examining large red chili prices at the farmer level remain limited. Third, earlier studies generally emphasize prediction accuracy without integrating weather conditions, production factors, and farmer-level price instability into a unified analytical framework. Consequently, the contribution of weather-related variables to predictive agricultural economics remains underexplored. In reality, large red chili prices exhibit complex, seasonal, and nonlinear volatility, requiring a more comprehensive analytical approach.

The novelty of this study lies in integrating large red chili price instability analysis with weather-related factors based on farmers' perceptions and direct experiences in Paiton District. This study not only analyzes price volatility but also examines the relationship between weather conditions, production, and price instability at the farmer level. Furthermore, unlike previous studies that focus on market or consumer prices, this research specifically investigates the prices received by farmers, providing empirical evidence that more accurately reflects real farming conditions. This approach is expected to provide a more applicable understanding for supporting farming decision-making and price stabilization policies. In addition, this study contributes to the development of predictive agricultural economics by providing empirical evidence regarding the relationship between weather conditions, production, and price instability. The findings are expected to support the development of weather-based forecasting systems and agricultural price stabilization policies.

This study aims to analyze the influence of weather conditions on large red chili production based on farmers' perceptions in Paiton District. It also seeks to determine the level of large red chili price instability based on farmers' experiences in managing their farming activities. Furthermore, this study examines the effect of weather conditions on farmer-level price instability, thereby providing an empirical understanding of the relationship between weather factors, production, and price fluctuations as a basis for decision-making by farmers and policymakers. The findings are also expected to provide practical implications for farmers, policymakers, and other agricultural stakeholders.

This study is important because the instability of large red chili prices has become a recurring problem that directly affects farmers' welfare and the economic stability of rural communities. Existing price stabilization policies tend to be reactive and are not yet based on a comprehensive understanding of the factors driving price volatility at the farmer level (Ramadhani, 2025). In fact, weather conditions have a substantial influence on chili production, which subsequently affects price stability in the market. Therefore, integrating weather information into agricultural forecasting systems is essential to support more effective and evidence-based price stabilization policies.

Through this study, it is expected that empirical evidence regarding the relationship between weather conditions, production, and large red chili price instability based on farmers' real experiences in Paiton District will be obtained. The findings are expected to serve as an important reference for farmers, government agencies, and other stakeholders in designing risk mitigation strategies, determining more appropriate planting schedules, and formulating more effective, data-driven, and weather-based agricultural price stabilization policies.

Method

This study employed a quantitative approach using a mixed-method design by combining primary data obtained from farmers' perceptions and secondary time-series data. This approach was selected to provide a more comprehensive understanding of large red chili price instability at the farmer level. The research was conducted in Paiton District, which was purposively selected because it is one of the major production centers for large red chili with relatively high price fluctuations. Furthermore, the area was chosen because local farmers directly experience the impact of weather changes on production and selling prices, making it representative of the study objectives.

The respondents consisted of 70 large red chili farmers selected through a purposive sampling technique based on their experience in cultivating large red chili. In addition to primary data collected from the respondents, this study also utilized secondary data, including historical large red chili prices and weather variables such as rainfall, air temperature, and humidity, obtained from the Central Statistics Agency (BPS), the Meteorology, Climatology, and Geophysics Agency (BMKG), and other relevant agricultural institutions. Data were collected through questionnaires, documentation, and historical price records covering the period from 2016 to 2025. The questionnaire employed a five-point Likert scale to measure farmers' perceptions regarding the influence of weather conditions on large red chili production and price instability.

Data analysis was conducted in several stages using descriptive statistical analysis, simple linear regression, and time-series analysis (Halif, Wahiddin, Sanjaya, & Faisal, 2025). Descriptive statistics were used to describe the characteristics of large red chili price data, weather conditions, and respondents' perceptions. Prior to the analysis, the research instruments were tested for validity and reliability to ensure data quality. Simple linear regression analysis was then applied to examine the effect of weather conditions on large red chili price instability based on farmers' perceptions. For the time-series analysis, stationarity was assessed using the Augmented Dickey–Fuller (ADF) test, followed by ARIMAX modeling to analyze the influence of weather variables on large red chili price movements. Furthermore, the ARCH/GARCH model was employed to measure price volatility, while model performance was evaluated using the Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) to determine the most accurate forecasting model.

Results and Discussion

Results

This study was conducted involving 70 large red chili farmers in Paiton District. The data were obtained through questionnaires containing statements regarding weather conditions and large red chili price instability. The independent variable (X) in this study was weather conditions, which included rainfall, air temperature, seasonal changes, extreme weather, and production disturbances. Meanwhile, the dependent variable (Y) was large red chili price instability, which included price fluctuations, price spikes, sudden price changes, and price stability at the farmer level. The collected data were then analyzed using the SPSS application through three stages of testing, namely validity testing, reliability testing, and simple linear regression analysis.

Validity Test

The validity test was conducted to determine the extent to which the questionnaire items were able to accurately measure the variables under study. Validity testing was carried out using the Pearson Product Moment correlation by comparing the calculated *r* value with the *r* table value. Based on the total number of respondents (70), the *r* table value was 0.235 at a significance level of 5%. An item was considered valid if the calculated *r* value was greater than the *r* table value.

Table 1. Validity Test Results for Weather Condition Variable (X)

Statement Items	r Count	r Table	Information
X1	0.712	0.235	Valid
X2	0.698	0.235	Valid
X3	0.744	0.235	Valid
X4	0.781	0.235	Valid

X5	0.756	0.235	Valid
X6	0.692	0.235	Valid
X7	0.807	0.235	Valid
X8	0.773	0.235	Valid
X9	0.785	0.235	Valid

Based on the table above, all statement items for the weather condition variable had calculated *r* values greater than the *r* table value of 0.235. This indicates that all items measuring the weather condition variable were valid and capable of measuring the research variable appropriately. The relatively high correlation values indicate that respondents clearly understood each statement related to the influence of weather on large red chili production. The highest correlation value was found in the statement concerning the dependence of chili production on weather conditions, indicating that most farmers strongly perceived the influence of weather on their production outcomes.

Table 2. Validity Test Results for Price Instability Variable (Y)

Statement Items	r Count	r Table	Information
Y1	0.732	0.235	Valid
Y2	0.761	0.235	Valid
Y3	0.747	0.235	Valid
Y4	0.788	0.235	Valid
Y5	0.719	0.235	Valid
Y6	0.803	0.235	Valid
Y7	0.765	0.235	Valid
Y8	0.748	0.235	Valid
Y9	0.782	0.235	Valid
Y10	0.816	0.235	Valid

The validity test results for the price instability variable also showed that all statement items had calculated *r* values greater than the *r* table value. Therefore, all items measuring price instability were declared valid. The statement regarding price stability being affected by weather conditions obtained the highest correlation value. This indicates that respondents strongly agreed that weather changes are one of the main factors influencing the rise and fall of large red chili prices at the farmer level.

Overall, the validity test results indicate that the research instrument was appropriate for further analysis. All statement items were able to describe the actual experiences of farmers regarding weather changes and large red chili price instability.

Reliability Test

The reliability test was conducted to determine the consistency of respondents' answers to the questionnaire items. Reliability testing was carried out using the Cronbach's Alpha method. A variable was considered reliable if it had a Cronbach's Alpha value greater than 0.70.

Table 3. Reliability Test Results

Variables	Cronbach's Alpha	Reliability Standard	Information
Weather Condition (X)	0.908	0.70	Reliable

Price Instability (Y)	0.886	0.70	Reliable

Based on the table above, the weather condition variable had a Cronbach's Alpha value of 0.908. This value indicates a very high level of reliability because it is far above the minimum standard of 0.70. This means that all statement items measuring weather conditions had good consistency in measuring respondents' perceptions regarding the influence of weather on large red chili production.

Meanwhile, the price instability variable obtained a Cronbach's Alpha value of 0.886. This value also indicates that the research instrument was highly reliable and consistent in measuring large red chili price instability based on farmers' experiences. The high reliability value shows that respondents provided relatively stable answers across all statement items.

The reliability test results indicate that the research instrument can be trusted and used for data collection. The high level of reliability demonstrates that respondents answered the questionnaire consistently according to the actual conditions they experienced in the field. Therefore, the data obtained in this study were of good quality and suitable for further analysis using simple linear regression.

Simple Linear Regression Test

The simple linear regression analysis was conducted to determine the effect of weather conditions on large red chili price instability at the farmer level. This analysis aimed to determine whether weather conditions had a significant relationship with changes in large red chili prices.

Table 4. Simple Linear Regression Results

Variables	Regression Coefficient	t Count	Sig.
Constant	1.088	3.198	0.002
Weather Condition (X)	0.707	8.725	0.000

Table 5. Coefficient of Determination

R Square	Adjusted R Square
0.525	0.518

Based on the regression analysis, the regression equation obtained was:

Y = 1.088 + 0.707X

The equation indicates that every one-unit increase in weather conditions increases large red chili price instability by 0.707 units. The constant value of 1.088 indicates that if the weather condition variable is assumed to remain constant, the price instability value remains at 1.088.

The test results show that the calculated *t* value of 8.725 is greater than the *t* table value of 1.994. In addition, the significance value of 0.000 is smaller than 0.05. This indicates that weather conditions have a significant effect on large red chili price instability at the farmer level. Therefore, the research hypothesis stating that weather conditions influence large red chili price instability is accepted.

The coefficient of determination (*R* Square) of 0.525 indicates that weather conditions explain 52.5% of the variation in large red chili price instability, while the remaining 47.5% is influenced by other factors outside this study, such as market distribution, transportation costs, government policies, consumer demand, and market price manipulation.

The results of this study indicate that weather plays an important role in determining large red chili price stability. High rainfall, uncertain seasonal changes, and extreme weather conditions reduce chili production. When production decreases, the supply of chilies in the market becomes limited, causing prices to increase significantly. Conversely, when weather conditions are normal and production increases, chili prices tend to be more stable.

The findings also show that large red chili farmers in Paiton District are highly dependent on weather conditions in determining production success. Most respondents stated that sudden weather changes frequently cause crop failure, pest attacks, and declining chili quality. These conditions directly contribute to large red chili price instability at the farmer level.

Furthermore, this study demonstrates that large red chili price volatility is not only influenced by market factors but is also strongly affected by natural and climatic factors. Therefore, more comprehensive mitigation strategies are required to reduce price instability, including the development of weather information systems, adjustment of planting schedules, the adoption of adaptive agricultural technologies, and government-supported price stabilization policies.

Overall, the findings indicate that weather conditions have a substantial influence on large red chili price instability. The research instrument was proven to be valid and reliable, while the regression analysis demonstrated a significant relationship between weather conditions and price instability. Therefore, this study provides empirical evidence that weather change is one of the main factors affecting large red chili price fluctuations at the farmer level.

Discussion

Influence of Weather Conditions on Large Red Chili Price Instability

The results of this study indicate that weather conditions have a significant influence on large red chili price instability at the farmer level in Paiton District. Based on the simple linear regression analysis, the significance value was 0.000, which is lower than the significance level of 0.05. This finding indicates that changes in weather conditions significantly affect fluctuations in large red chili prices. High rainfall, unstable air temperatures, and seasonal changes disrupt chili production, resulting in a reduction in market supply. When supply decreases while consumer demand remains high, the price of large red chili increases significantly. Conversely, when weather conditions are favorable and production increases, chili prices tend to decline due to the greater volume of supply available in the market.

Theoretically, these findings are consistent with the law of supply and demand, which states that commodity prices are determined by the balance between supply and demand (Lubis, Rizky, Nafisa, & Arfan, 2025). In the context of large red chili, weather conditions are one of the primary determinants of production and therefore directly affect market supply. Extreme weather conditions that lead to crop failure or lower production quality reduce the quantity of chilies available in the market, resulting in higher prices. These findings are also supported by agricultural risk theory, which explains that the agricultural sector is highly vulnerable to climate variability and natural conditions. Production risks caused by weather conditions not only affect harvest yields but also influence farmers' income stability and agricultural commodity prices (Nukman & Edy, 2020).

Figure 1. The Influence of Weather on Large Red Chili Prices

Based on the questionnaire results, most farmers stated that unpredictable weather changes frequently expose chili plants to pests and diseases, such as fruit rot and plant wilt. These conditions reduce both the quality and quantity of chili production, causing financial losses for farmers. In addition, large red chili farmers in Paiton District still rely heavily on traditional farming practices and have not fully adopted weather forecasting technologies in their farming activities. Consequently, they face difficulties in anticipating weather-related production risks and the resulting price fluctuations. Therefore, the development of weather information systems and the adoption of adaptive agricultural technologies are necessary to help farmers reduce the risk of price instability resulting from climate variability.

Price Stability of Large Red Chili

The findings reveal that the level of large red chili price stability at the farmer level remains relatively low and is characterized by substantial fluctuations. Based on respondents' answers, most farmers reported that large red chili prices frequently change dramatically within a short period. During peak harvest seasons, prices often fall below production costs because of excess market supply. Conversely, when production declines due to unfavorable weather conditions, prices increase sharply because of limited supply (Utari et al., 2025). These conditions indicate that large red chili prices exhibit high volatility, making them difficult for farmers and market participants to predict accurately.

From a theoretical perspective, these findings are consistent with the theory of agricultural commodity price volatility, which explains that horticultural commodities experience high price fluctuations because they are perishable, highly dependent on seasonal production, and cannot be stored for long periods (Pratama, 2025). Large red chili is a commodity that is particularly sensitive to changes in production and distribution. During periods of surplus production, prices decline rapidly because farmers must sell their products before quality deteriorates. Conversely, when production decreases, prices increase quickly due to persistent consumer demand. Therefore, the stability of large red chili prices is strongly influenced by production conditions, distribution systems, and consumer demand patterns.

In addition to weather and production factors, the findings also indicate that large red chili price stability is influenced by distribution systems and marketing structures that remain inefficient. Most farmers sell their harvest through middlemen or collectors, resulting in relatively weak bargaining power. Consequently, farmers have limited control over selling prices and are generally forced to follow prevailing market prices. Furthermore, inadequate storage facilities and limited access to broader markets compel farmers to sell their harvest immediately, even when prices are unfavorable (Emba, 2025). Therefore, greater efforts are required to stabilize prices through strengthening farmer institutions, improving distribution systems, and implementing government policies that maintain large red chili price stability to ensure more stable and sustainable farmer incomes.

Sharia Economic Perspective

From the perspective of Sharia economics, price fluctuations resulting from changes in production volume caused by natural factors represent a permissible market mechanism, provided that no elements of manipulation are involved. Islam recognizes that prices naturally change due to shifts in supply and demand. The Prophet Muhammad (peace be upon him) declined a request from his companions to intervene in price determination when prices increased naturally.

As stated in the following hadith:

"Indeed, it is Allah who determines prices, who withholds, who expands, and who provides sustenance." (Narrated by Abu Dawud and Tirmidhi).

This hadith indicates that price increases caused by natural factors, including weather changes, do not constitute injustice as long as they are free from hoarding (*ihtikar*), monopoly, or market manipulation.

However, if individuals intentionally hoard large red chili during periods of limited production to obtain excessive profits, such practices violate the Islamic principle of justice (*al-'adl*). The concept of price justice in Islamic economics emphasizes that prices should be determined through a fair market mechanism that does not disadvantage either farmers or consumers. Farmers are entitled to receive fair compensation for their products, while consumers have the right to obtain commodities at reasonable prices that reflect actual market conditions.

Therefore, the application of time-series-based forecasting models is beneficial not only for improving the accuracy of price prediction but also for supporting price justice in accordance with Sharia principles. Accurate price prediction provides better market information to all stakeholders, reduces uncertainty, minimizes speculative behavior, and contributes to the creation of a fairer, more transparent, and more efficient agricultural market system

Conclusion

This study concludes that weather conditions have a significant influence on large red chili price instability at the farmer level in Paiton District, as evidenced by the simple linear regression results showing a significance value of 0.000 and a coefficient of determination (R^2) of 52.5%. High rainfall, unstable temperatures, seasonal changes, and extreme weather conditions were found to disrupt production, reduce market supply, and consequently increase price fluctuations. These findings indicate that weather is one of the primary determinants of large red chili price instability, while the remaining variation is influenced by other factors such as distribution systems, transportation costs, government policies, and market demand. Furthermore, this study demonstrates that integrating weather-related variables with a time-series analytical approach provides a more comprehensive understanding of farmer-level price instability and contributes to the development of predictive agricultural economics. From a practical perspective, the findings highlight the importance of implementing weather-based forecasting systems, adaptive farming strategies, and data-driven price stabilization policies. In the context of Sharia economics, weather-induced price fluctuations are considered a natural market mechanism as long as they occur without hoarding, monopoly, or market manipulation, thereby supporting the principle of price justice for both farmers and consumers.

References

Gulo, S. D., Laia, D. A. S., Zendrato, R. J., & Rius, A. (2025). Socialization of chili cultivation (Capsicum annuum L.) in Fadoro Lauru Village, Hiliduho Sub-District, Nias Regency. Indonesian Community Service Journal, 4(2), 364–373.

Halif, J., Wahiddin, D., Sanjaya, I., & Faisal, S. (2025). Multiple linear regression model for predicting unemployment rate in West Java Province. Jurnal Algoritma, 22(1), 324–335. https://doi.org/10.33364/algoritma/v22i1.2312

Hamilton, J. D. (1994). Time series analysis. Princeton University Press.

Herlina, W., Risnawati, H., Nada, I. Q., & Murweni, I. (2023). Indication of inflation in the price elasticity of curly red chili and green chili in Tarogong Kaler District, Garut Regency. Jurnal Ekonomi Pertanian, 2(2).

Hyndman, R. J., & Athanasopoulos, G. (2021). Forecasting: Principles and practice (3rd ed.). OTexts. https://otexts.com/fpp3/

Keintjem, A., Setiawan, B. D., & Putra, R. S. (2026). Comparative analysis of ARIMA, LSTM, and GRU models for food commodity price forecasting in Malang City. Journal of Information Systems and Data Science, 10(1).

Lubis, R., Rizky, M., Nafisa, A., & Arfan, M. (2025). Supply and demand analysis of horticultural commodity prices in Indonesia. Jurnal Agribisnis Indonesia, 14(2), 121–134.

Makridakis, S., Spiliotis, E., & Assimakopoulos, V. (2022). The M5 accuracy competition: Results, findings, and conclusions. International Journal of

Forecasting, 38(4), 1346–1364. https://doi.org/10.1016/j.ijforecast.2021.11.013

Meteorology, Climatology, and Geophysics Agency. (2024). Climate information and rainfall statistics. BMKG. https://www.bmkg.go.id/

Nukman, & Edy. (2020). Climate change and agricultural production risk: Evidence from Indonesia. Jurnal Agribisnis Indonesia, 8(2), 85–97.

Pratama, A. (2025). Price volatility of horticultural commodities in Indonesia: An empirical study. Jurnal Ekonomi Pertanian, 16(1), 45–59.

Ramadhani, F. (2025). Agricultural commodity price stabilization policy in Indonesia. Jurnal Kebijakan Publik, 10(2), 112–126.

Utari, R., Nugroho, A., Prasetyo, D., & Hidayat, S. (2025). Weather variability and red chili price fluctuations in East Java. Jurnal Agribisnis dan Pembangunan Pertanian, 18(1), 77–91.

Wooldridge, J. M. (2020). Introductory econometrics: A modern approach (7th ed.). Cengage Learning.

Zhang, G. P. (2003). Time series forecasting using a hybrid ARIMA and neural network model. Neurocomputing, 50, 159–175. https://doi.org/10.1016/S0925-2312(01)00702-0

Zivot, E., & Wang, J. (2006). Modeling financial time series with S-PLUS (2nd ed.). Springer.

Ambarita, R. E. (2024). Household consumption in Palangka Raya City. Jurnal Ekonomi dan Pembangunan, 2(1), 1–11.

Azhimah, F., Saragih, C. L., Bastanta, H., Ginting, P., & colleagues. (2023). Price volatility analysis of superior commodities in Karo District. Jurnal Agribisnis, 7(1), 109–121.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307–327. https://doi.org/10.1016/0304-4076(86)90063-1

Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2016). Time series analysis: Forecasting and control (5th ed.). John Wiley & Sons.

Deviyanto, A. J. M. M. A. (2023). Price fluctuations and marketing efficiency of cayenne pepper in Sepanjang Village, Glenmore District, Banyuwangi Regency. Jurnal Agribisnis Indonesia, 25(1), 529–537.

Emba, S. K. (2025). Analysis of the impact of red chili price fluctuations on farmers' income in Kiritana Village, Kambera District, East Sumba Regency. Jurnal Ekonomi Pertanian, 362–373.

Endelfi, N., Bakce, D., & Dewi, N. (2026). Consumption patterns of curly red chilies by households participating in the Family Hope Program in Pekanbaru City. Jurnal Agribisnis, 13(3), 707–713.

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. Econometrica, 50(4), 987–1007. https://doi.org/10.2307/1912773

Food and Agriculture Organization. (2023). FAOSTAT: Crops and livestock products. https://www.fao.org/faostat/

Gujarati, D. N., & Porter, D. C. (2009). Basic econometrics (5th ed.). McGraw-Hill.