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Price Dynamics and Market Integration of Red Chili Between Farmers and Consumers in Banyumas Regency, Indonesia

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Abstract. Chili is one of the food commodities that has a fluctuating price. The instability of this price movement makes red chili a cause of price inflation in Banyumas Regency. This study aims to find out the marketing channels, price behavior, and market integration of red chili commodities in Banyumas Regency. The types and sources of data in this study are primary and secondary data. Primary data were obtained based on interviews with traders. Secondary data in the form of red chili prices that apply at the farmer and consumer levels in Banyumas Regency in the period 2019 to 2023. Red chili price data at the farmer level comes from the Department of Agriculture and Food Security of Banyumas Regency. Red chili price data at the consumer level comes from the Department of Industry and Trade of Banyumas Regency. The analysis method in this study is a descriptive quantitative method. Data analysis uses descriptive analysis, coefficient of variation, and Vector Error Correction Model (VECM). The results of the study indicate that the behavior of red chili prices based on the KV values obtained indicates highly fluctuating and unstable behavior. The average KV value at the farmer level, which is 43%, tends to be greater than the consumer level, which is 41%. This shows that the price of red chili at the farmer level is more fluctuating than at the consumer level. The red chili market at the farmer and consumer levels in Banyumas Regency is integrated both in the long term and the short term. There is no causal relationship between the producer and consumer markets in the marketing of red chili in Banyumas Regency.

Keywords: marketing channel; marketing integration; price behavior; red chili; VECM

INTRODUCTION

Red chili is a type of horticultural crop belonging to the vegetable group, which is characterized by seasonal growth. Due to its nature, red chili prices tend to vary and fluctuate (Wardhono et al., 2020). The price volatility of chili in Indonesia is a phenomenon influenced by various structural factors, both external and internal. One of the primary factors is the dependency on weather conditions, as chili is highly sensitive to climatic changes that can impact harvest yields, leading to supply shortages and price surges (Nisa et al., 2020; Nugrahapsari & Arsanti, 2018). Additionally, the length of the marketing channels contributes to price volatility. The numerous intermediaries in chili distribution cause prices at the consumer level to be much higher, even though the prices at the farmer level remain relatively low (Farid & Subekti, 2012). The characteristics of horticultural commodity markets, such as chili, which have limited shelf life, further exacerbate price volatility. The limited shelf life of chili requires rapid and efficient distribution, so disruptions in the supply chain can result in shortages in the market (Supriadi & Sejati, 2018). Previous research, such as the study conducted by Farid & Subekti, (2012), Supriadi & Sejati (2018), indicates that improving distribution system efficiency and implementing policies that support supply stability can help reduce price volatility. Therefore, to mitigate price fluctuations, efforts should focus on enhancing storage technologies and strengthening more integrated distribution systems. This frequent price volatility has made red chili a primary contributor to inflation in the staple food category in Banyumas Regency in 2023 (Prasetyo et al., 2023). The inflation contributed by the red chili commodity amounted to 0.06% of the total monthly inflation rate of 0.43%. This inflationary issue impacts participants

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involved in the product marketing system. Farmers are among those most affected, as they incur losses if this issue is not promptly addressed (Muflikh et al., 2024). Although farmers act as producers, intermediaries are still needed in marketing their produce, leading to market inefficiencies.

Market equilibrium can be achieved when the demand and supply for a product are balanced. Marketing is considered efficient if it employs suitable marketing channels to distribute products. The length of a product's marketing channel influences its offered price; the longer the channel, the less efficient the marketing activities, and vice versa (Pamekas & Zahara, 2023). A market is also deemed efficient when price information flows effectively, benefitting business actors and beneficiaries alike (Setyawati et al., 2023).

Market integration connects multiple markets through effective price information transmission (Nuraeni et al., 2015). It reduces price disparities, benefiting farmers with broader market access and consumers with stable prices. Integrated markets optimize resource allocation, reduce transaction costs, and enhance efficiency (Kustiari et al., 2018; Muflikh et al., 2024). Weak integration causes price distortions and inefficiencies, especially for perishables like chili, leading to consumer price spikes and farmer losses (Hia et al., 2020). Strengthening integration ensures market stability and fairness. Long-term integration efficiently transmits price changes across market levels (Eliyatiningsih & Mayasari, 2019).

Research on price dynamics and market integration in Banyumas Regency provides new insights into local market fluctuations, which have not been extensively studied in previous literature that primarily focuses on national or regional levels. This study is novel in its combination of primary and secondary data, offering a detailed view of the local market structure, distribution patterns, and socio-economic factors affecting price dynamics. Additionally, the use of the Vector Error Correction Model (VECM) allows for the analysis of both short- and long-term price relationships across different markets in Banyumas. This approach fills a gap in understanding market integration at a more localized level, which has been overlooked in previous studies. This study aims to examine the marketing channels and determine the presence or absence of red chili market integration between the farmer and consumer levels in Banyumas Regency. Based on the above, understanding the red chili market integration in Banyumas Regency is essential to control price fluctuations in this commodity and ensure the stability of staple food prices.

METHODS

The research uses a quantitative descriptive method to systematically describe data characteristics related to price dynamics and market integration in Banyumas Regency. It analyzes numerical data, including price fluctuations and market behavior, using descriptive statistics to reveal trends and relationships. Conducted at Wage, Sokaraja, and Manis Markets, the study uses both primary data from semi-structured interviews with red chili traders and secondary data from Banyumas Regency agencies. Snowball sampling, recommended for accessing distribution networks, is employed (Parker et al., 2020; Ting et al., 2025). Traders were selected based on criteria like experience and market involvement to ensure relevant data.

The analysis employs descriptive methods, coefficient of variation, and VECM. The coefficient of variation, as defined by Susanawati et al. (2015), assesses red chili price behavior in Banyumas Regency. VECM, according to Samantha et al. (2021), examines red chili market integration, using tests such as data stationarity, optimal lag, cointegration, Granger causality, impulse response function, and variance decomposition. Data collection on chili prices precedes these tests, starting with stationarity to eliminate trends. Cointegration (Johansen test) checks for long-term market

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relationships, and VECM analyzes short- and long-term price relationships. IRF evaluates market shock impacts, while variance decomposition measures factor contributions to price fluctuations, providing insights into price dynamics and market integration.

Coefficient of Variation

The coefficient of variation represents a percentage value derived from the calculation of standard deviation over the average data value (Suharyadi & Purwanto, 2016). Price fluctuations can be observed through the calculation of the coefficient of variation (Eliyatiningsih & Mayasari, 2019). The variables used include red chili prices at the farmer and consumer levels in Banyumas Regency over the period 2019 to 2023. The coefficient of variation can be calculated using Equation 1.

$$KV = \frac{s}{\bar{x}} \times 100\% \text{ ...... (1)}$$

KV = coefficient of variation of red chili prices for 2019 – 2023
s = standard deviation of average red chili prices for 2019 – 2023
$\bar{x}$ = average red chili prices for 2019 – 2023

Data Stationarity Test

Time series data often exhibit instability, which can lead to spurious regression (Nuraeni et al., 2015). Therefore, a stationarity test is necessary to avoid this issue. If a series of data is not stationary at the level stage, testing continues to the differentiation stage, up to a maximum second degree (Nasution & Rahmanta, 2022). Testing is performed using the Augmented Dickey-Fuller (ADF) method with the following Equation 2:

$$P_t = \beta_0 + \beta_t + P_{t-1} + e_t \text{ .....(2)}$$

P_t = Red chili price variable at period t (Rp.kg $^{-1}$)
β_0 = Intercept
β_t = Red chili price coefficient at period t
P_{t-1} = Red chili price variable at period t-1 (Rp.kg $^{-1}$)
e_t = Error term
t = Time

Hypothesis testing:
H_0 : ADF test value ≤ MacKinnon critical value at 5% (data is non-stationary)
H_1 : ADF test value > MacKinnon critical value at 5% (data is stationary)

Optimal Lag Test

The optimal lag test is used to determine the required lag length for estimating VECM (Jumiana et al., 2018). The lag length in this test is determined using the Akaike Information Criterion (AIC) by identifying the minimum value, indicated by an asterisk (*) in the test results. This test helps to understand the influence of each variable Setiawan et al. (2018) and is also performed to eliminate autocorrelation issues in the VECM test.

Stability Test

This test is conducted to assess the accuracy of the model to be used. The testing criterion is based on the modulus value of the root. If the modulus value obtained is less than one, the model is considered stable (Sandra et al., 2012).

Johansen Cointegration Test

The cointegration test is used to determine market integration relationships, either in the long or short term (Jumiana et al., 2018). This test is conducted using the Johansen test available in EViews 12 software. Cointegration testing is only applicable to pairs of data that are stationary at the same level or are non-stationary at the level stage (Batafor & Sengadji, 2022). The test is conducted by comparing the trace statistic value with the critical value (Nasution & Rahmanta, 2022).

Hypothesis testing:
H_0 : t statistics ≤ 5% critical value, indicating no cointegration or no long-term market integration relationship

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H_1 : t statistics > 5% critical value, indicating cointegration or a long-term market integration relationship

Granger Causality Test

This test is conducted to determine causality or cause-and-effect relationship between the variables under study (Batafor & Sengadji, 2022) Causality testing can be performed on a series of variables that have a cointegration relationship (Sugiyanto & Hadiwigeno, 2018). The test is conducted by comparing each variable's probability value with $\alpha = 0.05$ (Sari et al., 2021).

Hypothesis testing :

H_0 : Probability value > 0.05, indicating no causal relationship between red chili prices at the farmer and consumer levels.

H_1 : Probability value ≤ 0.05, indicating a causal relationship between red chili prices at the farmer and consumer levels.

Vector Error Correction Model (VECM) Test

The VECM test aims to determine the market integration relationship in both the long and short term Batafor & Sengadji (2022). This test is applied to a series of data that is non-stationary at the level stage but has a cointegration relationship (Anani, 2025; Samantha et al., 2021).

Impulse Response Function (IRF)

The impulse response function is used to assess the response of one variable to shocks caused by other variables (Sari et al., 2021). In this study, the impulse response function analysis is conducted over a 10-period forecast, or 10 months. This analysis can also serve as an estimator of the VECM test model parameters (Gujarati, 2005).

Variance Decomposition

Variance decomposition is used to determine the percentage contribution of a variable's influence due to other variables (Sari et al., 2021). In this study, variance decomposition analysis is conducted over a 10-periode forecast, or 10 months.

RESULTS AND DISCUSSION

Red chili farming remains popular among the community in Banyumas Regency due to the potential for high profits if harvested and marketed at the right time. However, red chili is a vulnerable commodity, making its farming inherently risky. Therefore, success in red chili farming requires sharp timing and skill in cultivation and maintenance. The total area allocated for red chili harvest reached approximately 104 hectares, with a total production of 2,498 quintals in 2022. This high production value indicates that red chili productivity is also high.

Banyumas Regency has twenty-three traditional markets, three of which serve as price monitoring points for staple food commodities by the Department of Industry and Trade of Banyumas Regency. Traditional markets are markets built and managed by the government, featuring kiosks, shops, tents, or stalls freely used by business actors or traders, where bargaining is still practiced (Soelistiyono et al., 2018). The three staple food price monitoring markets in Banyumas Regency are Wage Market, Sokaraja Market, and Manis Market. Wage Market is a class-1 traditional market located on Brigjend Katamso Street, East Purwokerto, covering in area of 10,305.44 m^2 and housing approximately 1,778 traders. Sokaraja and Manis Markets are also class-1 traditional markets. Sokaraja Market, located on Jenderal Gatot Soebroto Street, Sokaraja, covers an area of 7,312 m^2, while Manis Market is located on Jenderal Gatot Soebroto Street, West Purwokerto, covering an area of 5,925 m^2.

Red Chili Marketing Channels

The red chili marketing channels at Wage Market, Sokaraja Market, and Manis Market in Banyumas Regency are illustrated in Figure 1.

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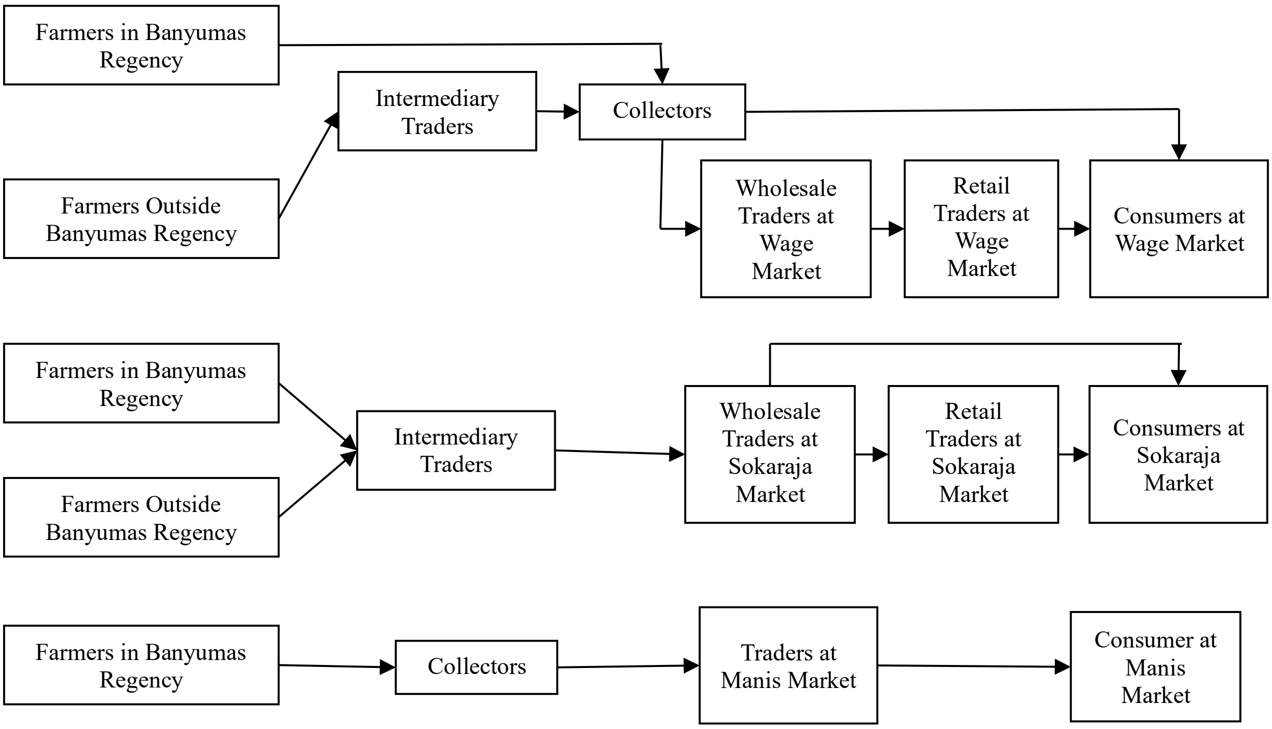

Figure 1. Red Chili Marketing Channels in Banyumas Regency

Based on Figure 1, it can be seen that there are three marketing channel patterns in Banyumas Regency, consistent with the general agricultural product marketing channel patterns. Generally, agricultural product marketing channels involve distributing the farmer's harvest to intermediaries or wholesalers, who then channel the produce to markets or consumers (Putri et al., 2018). The marketing channels at Wage Market are classified into three categories as follows:

1. Four-level marketing channel involving four marketing institutions in product distribution: farmer – intermediary trader – wholesaler – retailer – consumer.
2. Three-level marketing channel involving three marketing institutions in product distribution: farmer – wholesaler – retailer – consumer.
3. Two-level marketing channel: farmer – wholesaler – retailer – consumer.

Red chili supplies at Wage Market are sourced from both Banyumas farmers and outside Banyumas. Within Banyumas, red chili supplies are sourced from Limpakuwus farmers, while outside supplies come from farmers in Temanggung Regency.

The marketing channels at Sokaraja Market as classified into two categories:

1. Three-level marketing channel: farmer – intermediary trader – wholesaler – retailer – consumer.
2. Two-level marketing channel: farmer – wholesaler – retailer – consumer.

Red chili supplies at Sokaraja Market come from both Banyumas and outside Banyumas. Supplies within Banyumas are sourced from Limpakuwus farmers, while external supplies come from farmers in Purbalingga, Kroya, and Banjarnegara Regencies.

Manis Market has only one marketing channel category, where suppliers come from the Limpakuwus area. The red chili marketing channel at Manis Market is a two-level channel: farmer – wholesaler – retailer – consumer.

Coefficient of Variation Results

The coefficient of variation is a measure used to illustrate price movements for a

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commodity. According to the Ministry of Trade's KPI, price variability criteria are 5%, with a maximum threshold of 9%. If the coefficient of variation exceeds the maximum threshold, it indicates high price instability and fluctuation. Conversely, if the value is below the minimum threshold, it indicates price stability (Jumiana et al., 2018).

Table 1 shows the coefficient of variation analysis result for red chili prices at the farmer and consumer levels in Banyumas Regency from 2019 to 2023.

Table 1. Coefficient of Variation for Red Chili Prices at Farmer and Consumer Levels

Description	Unit	Year				
		2019	2020	2021	2022	2023
Farmer Level						
a. Average Price	$Rp.kg^{-1}$	21580	20648	21938	32508	13206
b. Standard Deviation	$Rp.kg^{-1}$	10073	11245	9959	9819	5274
c. KV	%	46,68	54,46	45,40	30,21	39,93
Consumer Level						
a. Average Price	$Rp.kg^{-1}$	32629	27766	31192	44757	36250
b. Standard Deviation	$Rp.kg^{-1}$	14904	13716	11247	18517	12103
c. KV	%	45,68	49,40	36,06	41,37	33,39

Based on Table 1, the coefficient of variation for red chili prices at both farmer and consumer levels exceeds 9%, indicating unstable and highly fluctuative prices. The average coefficient of variation at the farmer level is higher than at the consumer level (43% > 41%), suggesting greater fluctuation at the farmer level. Several structural and external factors contribute to this volatility. Red chili's dependency on weather conditions significantly impacts supply and price fluctuations. Farmers often have limited bargaining power, selling to wholesalers who control market prices. Information asymmetry plays a key role, as farmers lack access to transparent market data, hindering their ability to adjust prices. Addressing these issues through better price transparency and strengthening farmers' market position is crucial for reducing price volatility. High price variation results from high production volume, causing an imbalance between supply and demand. This is consistent with Nuraeni et al. (2015), which showed a higher producer KV than consumer KV (24.15% > 21.15%). Traders act as key intermediaries, causing price distortions, as farmer prices do not directly reflect consumer prices. Information asymmetry between farmers and traders worsens the situation, forcing farmers to accept offered prices. Long distribution channels and unstable supply-demand contribute to significant price fluctuations, worsening the imbalance between farmer and consumer prices.

Stationarity Test Results

The data stationarity test is the first stage in a series of VECM market integration analyses, aimed at assessing data stability. Testing is conducted using the ADF method at the level and first difference stages. The stationarity test results for red chili prices at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in table2.

Based on **Table 2**, the stationarity test results for red chili prices at the farmer and consumer levels are non-stationary at the level stage, as the ADF test value is < 5% critical value, and the probability value is greater than α = 0.05. Thus, H_0 is accepted and H_1 is rejected, indicating that the data is non-stationary and contains a unit root. Therefore, testing proceeds to the first difference stage.

The stationarity test results at the first difference stage show that red chili price data at the farmer and consumer levels is stationary, as the ADF test value > 5% critical value and the probability value is smaller than α = 0.05. Thus, H_0 is rejected and H_1 is

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accepted, indicating that the data is stationary and free from unit roots. This result is consistent with (Batafor & Sengadji, 2022) and Susanawati et al. (2015), who also achieved stationary data at the first difference level with ADF testing.

Optimal Lag Test Results

The optimal lag test is the second stage in a series of VECM market integration analyses, aimed at determining the lag length for VECM testing (Jumiana et al., 2018). Testing is conducted by identifying the smallest Akaike Information Criterion (AIC) valued, marked by an asterisk (*) at the selected lag (Sinambela et al., 2023). The optimal lag test results for red chili prices at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in Table3.

Table 2. Unit Root Test Results for Red Chili Prices at Farmer and Consumer Levels

Price Variable	Ordo	Intercept		Intercept & trend		Without intercept & trend		Description
		Prob.*	ADF Test	Prob.*	ADF Test	Prob.*	ADF Test	
Farmer	Level	0.0484	-2.925402	0.1611	-2.929332	0.2629	-1.047291	Non-stationary
	First difference	0.0000	-7.776819	0.0000	-7.731825	0.0000	-7.842953	Non-stationary
Consumer	Level	0.0017	-4.160669	0.0072	-4.240537	0.4701	-0.560775	Non-stationary
	First difference	0.0000	-6.072015	0.0000	-6.015398	0.0000	-6.102815	Stationary
McKinnon Critical Value 5%			-2.911730		-3.487845		-1.946447	

Table 3. Optimal Lag Test Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1122.694	NA	4.22e+15	41.65534	41.72900*	41.68375*
1	-1118.722	7.502406	4.23e+15	41.65638	41.87738	41.74161
2	-1112.161	11.90797	3.85e+15	41.56151	41.92984	41.70356
3	-1110.204	3.406554	4.16e+15	41.63717	42.15284	41.83605
4	-1106.095	6.847469	4.16e+15	41.63316	42.29615	41.88885
5	-1097.401	13.84698*	3.51e+15*	41.45928*	42.26961	41.77179

* indicates lag order selected by the criterion

Table 4. Stability Test Results

Root	Modulus
-0.217460 - 0.877454i	0.903999
-0.217460 + 0.877454i	0.903999
-0.879773	0.879773
0.531791 - 0.686616i	0.868471
0.531791 + 0.686616i	0.868471
0.588271 - 0.419197i	0.722349
0.588271 + 0.419197i	0.722349
-0.316838 - 0.624421i	0.700205
-0.316838 + 0.624421i	0.700205
-0.374339	0.374339

Based on Table 3, the optimal lag test based on AIC criteria shows that the selected lag is at lag 5, as indicated by the asterisk. This result is consistent with Samantha et al. (2021), who also used lag 5 in their analysis of curly red chili integration in Central Java.

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Stability Test Results

The stability test is the third stage in a series of VECM market integration analyses, aimed at assessing the stability of model estimates. The stability test results for red chili price data at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in table4. Testing is conducted by assessing the modulus values generated from the root.

Based on Table 4, the stability test results show that all root modulus values are less than 1, indicating model stability. A stable model positively influences the validity of the Impulse Response Function and Variance Decomposition analyses (Ginting et al., 2023).

Cointegration Test Results

The cointegration test is the third stage in a series of VECM market integration analyses, aimed at assessing long-term cointegration relationships. Testing is conducted using the Johansen test available in EViews 12 software. The cointegration test results for red chili price data at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in Table5.

Table 5. Johansen Cointegration Test Results for Red Chili Prices at Farmer and Consumer Levels

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.225654	16.25336	15.49471	0.0384
At most 1	0.038998	2.187854	3.841465	0.1391

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6. Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
CONSUMER_PRICE does not Granger Cause FARMER_PRICE	55	1.79895	0.1329
FARMER_PRICE does not Granger Cause CONSUMER_PRICE		1.23243	0.3102

Table 7. Long-Term VECM Test Results

Cointegrating Eq:	CointEq1
FARMER_PRICE(-1)	1.000000
CONSUMER_PRICE(-1)	0.291559
	(0.30580)
	[0.95345]
C	-33082.30

Based on Table 5, the Johansen cointegration test results show that the trace statistic value at the none level > 5% critical value. Therefore, H_0 is rejected and H_1 is accepted, indicating a long-term relationship between the variables. Meanwhile, the trace statistic value is at most 1 level < 5% critical value, so H_0 is accepted and H_1 is rejected, indicating no long-term relationship between the variables. This result is consistent with Ashari et al. (2019), who also found a single cointegration relationship at the none level. The maximum cointegration relationship that can occur in this study is one cointegration since only two variables are tested. Thus, it can be concluded that there is a cointegration relationship between red chili prices at the farmer and consumer levels in Banyumas Regency.

Granger Causality Test Results

The Granger causality test is the fourth stage in a series of VECM market integration analyses, aimed at identifying causality or cause-and-effect relationships between

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variables. The Granger causality test results for red chili price data at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in Table 6.

Based on Table 6, the Granger causality test results indicate that the probability values (0.1329 and 0.3102) for red chili prices at the farmer and consumer levels are greater than α = 0.05. Therefore, H_0 is accepted and H_1 is rejected, indicating no causal relationship between red chili prices at the farmer and consumer levels, and vice versa. Price information between the farmer and consumer levels is not well-transmitted due to non-transparent price information at each marketing institution and the involvement of numerous marketing institutions in red chili distribution in Banyumas Regency. This condition aligns with field observations, where farmers generally accept any price offered by wholesalers when selling their harvest. Wholesalers then sell the red chili to market traders according to the current market price, potentially resulting in profits or losses for farmers, who are generally unaware of red chili market prices. This finding is consistent with Jumiana et al. (2018), who also found no causality between red chili prices at the farmer and retailer levels, indicating poor price information transmission.

VECM Test Results

The VECM test is the fifth and final stage in a series of VECM market integration analyses, aimed as assessing the relationship between variables in both the long and short term. The long-term VECM test results for red chili prices at the farmer and consumer levels in Banyumas Regency from 2019 to 2023 are shown in Table 7.

Based on Table 7, the long-term VECM test results show that consumer-level red chili prices do not significantly affect farmer-level red chili prices, as the t-statistic (0.95345) is less than the critical t value (2.007). Therefore, H_0 is accepted and H_1 is rejected, indicating no long-term relationship between red chili prices at the farmer and consumer levels. This means that price information between the farmer and consumer levels is not well-transmitted in the long term. This result aligns with the previously conducted causality test. This means that price information between the farmer and consumer levels is not effectively transmitted in the long term. The lack of transmission suggests inefficiencies in the market structure, where price signals are distorted or delayed, preventing optimal adjustments in supply and demand. This finding aligns with the results of the previously conducted causality test, which indicated that price causality between the farmer and consumer markets is weak or non-existent in the long run. In the short term, however, the VECM test suggests that there are more immediate, though perhaps temporary, relationships between market prices, with quicker adjustments happening at the consumer level following changes in the farmer's market price. This highlights the importance of improving market integration to ensure more effective price transmission across all levels of the supply chain. The error correction model (ECM) results indicate that the adjustment coefficients for farmer and consumer prices are -0.313752 and -0.363269, respectively, showing significant error correction. Lagged variables of farmer prices (up to four lags) and consumer prices (up to four lags) exhibit varying levels of significance in influencing current price changes. Notably, the first and second lags of farmer prices, as well as the second lag of consumer prices, have strong impacts. The constant term is not statistically significant. These findings highlight the dynamic relationship between farmer and consumer prices over time. The short-term VECM test results show that certain levels are significant, as indicated by the t statistic values greater than the critical t values. Therefore, H_0 is rejected and H_1 is accepted, indicating a short-term integration relationship between red chili prices at the farmer and consumer levels. This means that price information between the farmer and

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consumer levels is well-transmitted in the short term. However, in the long term, red chili price information transmission in Banyumas Regency remains ineffective.

Impulse Response Function Analysis Results

The impulse response function analysis is used to describe the responses of a variable due to a shock caused by another variable. Figure 2 are the results for red chili price data at the farmer and consumer levels in Banyumas Regency from 2019 to 2023.

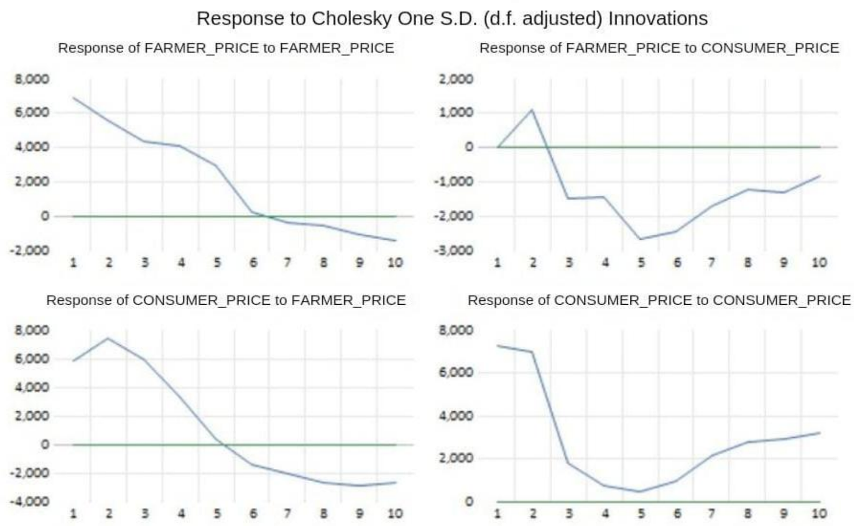

Figure 2. Impulse Response Function Curve

Based on Figure 2, red chili prices show responsive movements to price shocks at different levels. Ginting et al. (2023) explain that the horizontal axis represents the period of response to a shock, with positive responses above and negative below the axis. Nuraeni et al. (2015) observe that price declines at the farmer level often show negative responses, indicating consumer price changes do not affect farmer prices. Conversely, price declines at the consumer level indicate positive responses, suggesting integration with farmer-level prices. However, weak integration is evident as farmer-level price changes impact consumers, not vice versa. Similar to Xue et al. (2022) in the EU dairy market, Banyumas' chili market exhibits asymmetric price transmission, highlighting wholesalers' dominant role in price setting.

Variance Decomposition Analysis Results

Variance decomposition analysis is used to describe the contribution size of a variable's influence due to another variable. Table 8 presents the variance decomposition results for red chili price data at the farmer and consumer levels in Banyumas Regency from 2019 to 2023.

Based on Table 8, the variance decomposition results for red chili prices at the farmer level are dominated by the farmer-level price contribution itself, with a variance contribution of 100% in the first period. This contribution decreases over time but still dominates. The self-contribution of farmer-level red chili prices in the tenth period is 83.34%. Consumer-level red chili prices do not impact farmer-level prices in the first period. However, the consumer-level price contribution increases over time, reaching 16.66% in the tenth period. Table 9 presents the Variance Decomposition Results for Red Chili Prices at the Consumer Level.

Based on Table 9, the variance decomposition results for consumer-level red chili prices are dominated by the consumer price contribution itself, at 60.65% in the first

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month. This contribution decreases over time, with farmer-level prices increasingly contributing to consumer-level red chili prices. In the tenth period, the farmer-level price contribution is 54.81%, while the consumer-level price contribution is 45.19%. This result indicates that consumer-level red chili prices do not impact farmer-level price formation.

Table 8. Variance Decomposition Results for Red Chili Prices at the Farmer Level

Variance Decomposition of FARMER_PRICE:			
Period	S.E.	FARMER_PRICE	CONSUMER_PRICE
1	6900.846	100.0000	0.000000
2	8956.312	98.49475	1.505251
3	10057.39	96.65888	3.341122
4	10961.62	95.49308	4.506918
5	11672.77	90.72377	9.276227
6	11929.24	86.90125	13.09875
7	12052.67	85.20893	14.79107
8	12128.40	84.36253	15.63747
9	12247.77	83.49388	16.50612
10	12356.57	83.33544	16.66456

Table 9. Variance Decomposition Results for Red Chili Prices at the Consumer Level

Variance Decomposition of CONSUMER_PRICE:			
Period	S.E.	FARMER_PRICE	CONSUMER_PRICE
1	9337.454	39.34673	60.65327
2	13847.98	46.99757	53.00243
3	15193.77	54.63514	45.36486
4	15560.87	56.51389	43.48611
5	15571.84	56.50083	43.49917
6	15661.65	56.65336	43.34664
7	15938.82	56.38091	43.61909
8	16408.55	55.97272	44.02728
9	16919.17	55.57936	44.42064
10	17422.05	54.81419	45.18581

The findings by Valdés (2024) and Setyawati et al. (2023) emphasize the significant impact of transaction costs and intermediaries on market price flows within the red chili market of Banyumas Regency. Intermediaries, such as wholesalers, play a crucial role in setting consumer prices based on farmer prices, showing dependency on producer prices. Interviews with traders at various markets confirm that consumer prices typically follow farmer prices, factoring in intermediary costs. This pattern supports the notion that changes at the farmer level influence consumer prices, while consumer-level changes do not significantly affect farmer prices. The analysis of the coefficient of variation, VECM, IRF, and Granger causality test reveals significant volatility and price transmission issues in the red chili market in Banyumas Regency. High price volatility is noted at the farmer (43%) and consumer (41%) levels, with greater fluctuations at the farmer level due to oversupply. VECM indicates long-term market integration, but weak price transmission between farmer and consumer levels is evident. Granger causality test confirms no causal relationship, highlighting market inefficiencies. Improved market integration and better price transparency are needed to stabilize the market.

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CONCLUSION

The red chili marketing channels in Banyumas Regency are categorized into three levels: level-2, level-3, and level-4. Although the red chili market is integrated in both the long and short terms, the transmission of price information between farmers and consumers is ineffective, with price fluctuations at the farmer level not significantly impacting consumer prices. Conversely, price changes at the consumer level affect prices at the farmer level. This finding highlights an imbalance in price information flow, leading to price distortions and market inefficiencies. Therefore, future research should focus on analyzing distribution channels and policies that can reduce the role of intermediaries and enhance price transparency. Policies aimed at improving distribution efficiency and stabilizing chili prices are essential for improving the welfare of both farmers and consumers.

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