Anticipate risk and uncertainty through price forecasting strategies: Case study of curly red chili prices in traditional markets in several cities in West Java Province

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Abstract
Objective: To predict the selling price of curly red chilies in traditional/local markets in several cities in West Java Province to provide certainty about price trends in order to reduce potential risks that traders may face.
Methodology: This study uses secondary time series data on the daily price of curly red chillies from May to July 2023. Quantitative analysis of three trend regression models is used, and the best model for forecasting is the exponent trend. Forecasting is carried out for the next 45 days until August 2023. Risk analysis uses actual market data and forecasts accompanied by standard deviation analysis.
Findings: Actual data on the price per kilogram of curly red chilies in traditional/lokal markets in several cities experienced fluctuations from May to July 2023 with an average growth of 0.75%. The estimation results and the choice of the best model for forecasting is the exponential trend. Through forecasting, curly red chilli prices will continue to increase going forward, with an average growth of 1.51% per day. The risk of an increase in the price of curly red chillies on the Eid al-Adha 2023 is very large compared to a decrease in prices in conditions of a production surplus. The risk of rising prices is even greater after the holidays.
Conclusion: Chili price fluctuations are caused by changes in season, weather, harvest, and holiday conditions. The risk of rising chilli prices is getting bigger for future developments.

Keywords: curly red chilli, price, forecasting, risk

Introduction

Marketing is one of the main areas in management theory. Marketing management determines the success of the organization. The business organization has the potential to fail to achieve its goals if the marketing application fails to reach the set targets. The main objective of every business organization includes the delivery of products to customers/markets. In this case, the marketing function covers various aspects of how to determine products that have value and satisfy customer needs—also, providing easy access and clearly defined product features to customers (Burnett, 2008) [4]. More broadly, the marketing function also includes product development, pricing, channel management, and even specialization and development (Wirtz, *et al*., 2014) [25].

Based on actors, marketing management can be viewed from two sides of interest, namely 1) customers as the center for product delivery purposes, and 2) producers, companies, and organizations as marketing development planners (Polo & Sese, 2009) [19]. The development side of marketing for the benefit of customers is centred on developing product features, quality and quantity, competitive prices, market access, customer satisfaction, and so on. Marketing responsibility on the other hand originates from the planning carried out by the company as a product producer. Producers build product marketing according to the company's development plan which includes profit targets, development plans and use of raw materials, production planning, cost efficiency, advertising and promotion, distribution, and pricing (Gök & Hacioglu, 2010) [8].

In terms of marketing development, manufacturers are not free from various consequences that can pose a risk of loss to the

organization. This is related to the economic conditions faced which often change. Changes in economic conditions cause the company's marketing steps and strategies to be adjusted in order to reduce potential risks that may occur (Ostapchuk, *et al*., 2023) [16]. Various changing economic conditions cover global crises, including the effects of war and natural disasters to changes such as weather, seasons, supply surpluses or deficits, crop failures, and so on. Producers will always face difficulties and risks due to the frequent changes in economic conditions. The thing that is most often encountered is a change in product prices in the market. As a result of price changes due to various causes, various unwanted risk conditions may arise and be faced by producers, including changes in the planned production quantity, losses/losses on invested investments, and others (Huka, *et al*., 2014) [12].

Specifically, agricultural products often experience changes in production conditions due to the season, or crop failure. Changes like these cause prices to fluctuate seasonally and are often highly volatile. In Indonesia, one of the agricultural products that are known to experience price and sales fluctuations is curly red chilies and other types of chilies. Changes in conditions at the chilli producer level cause market prices to change rapidly. This condition causes traders in the local market to face the risk of receiving large economic values, even losses.

A step in marketing management that can be taken by market traders and producers, in general, is price forecasting. Price forecasting becomes a marketing strategy to provide certainty for traders. In this case, an unknown price change can be anticipated. Traders in traditional/local markets such as in several cities in West Java Province are facing fluctuations changes in the price of curly red chilies. Just like traders in other local markets, sharp price fluctuations in each season greatly affect their sales volume and revenue estimates. To reduce the risk and uncertainty of changes in market prices, it is necessary to forecast future market price developments. This forecast will provide information and guidance to traders in dealing with price changes that may occur and can reduce the risk/uncertainty faced by traders.

This study aims to forecast the selling price of curly red chilies in traditional/local markets in in several cities in West Java Province as part of marketing management. Forecasting helps traders obtain information on the price of their commodities in the future and predicts price levels that may pose a risk of loss to traders. In particular, forecasting is carried out based on the trend of price increases according to developments over time in traditional/local markets in several cities in West Java Province in the following month.

Literature Review

Decision-making

Most business decisions made by organizations and companies are faced with risk and uncertainty. Generally, organizations and companies do not know the actual situation that will occur in the future. The current state of the organization must make decisions for current and future applications. As stated by Septiani and Triwulandari (2022) [22] decision-making is currently in a state of uncertainty and has the potential to face unknown risks. When an event faces a high level of uncertainty, the risk is caused by making that decision.

According to Pasalong (2023) decisions can be made based on the environmental situation, including a) making decisions under certain conditions; b) decision making in risky conditions;

c) Decision making in uncertain circumstances; d) decision making in conditions of conflict; e) routine and non-routine decision making; and f) quantitative and qualitative decision making.

There are many decision choices that a manager can make. Some of the decisions include, in terms of receiving orders, the manager accepting or rejecting special orders at prices lower than the regular selling price. Managers can also make decisions to make and produce product components themselves or to purchase these components from suppliers. In terms of profit achievement, it can be decided whether to maintain or discontinue the business product division which has negative profit. Other decisions, for example, sell the product directly or hold and further process it into a higher value product. All of the manager's decisions require careful consideration in order to avoid various possible risks. Research by Dewi and Purbawangsa (2018) [6] shows that the knowledge and skills possessed by managers significantly influence the decisions of financial managers.

Price forecasting and risk management

Forecasting is defined as a process of using past and present data and information to predict future conditions. Why is it necessary to do forecasting, Amiens and Osamwinyi (2022) [1] say entrepreneurs and investors always face a state of uncertainty and inaccuracies in market developments. Therefore the market must be estimated to minimize unwanted changes. Forecasting can be done on several indicators and prices and serves as a tool to measure market results.

Uncertainty and inaccuracies in market developments can result in risks for entrepreneurs and investors. Risk is defined as an adverse event or deviation from the expected results (Arifudin *et al*., 2020) [2]. Furthermore, to manage potential risks that may occur, even preventing these risks from appearing in business activity, companies must carry out risk management as well as possible (Mulyawan, 2015) [15].

Why is risk management important, as explained by Power (2004) [20] applied risk management is a response to maintain efficiency against real-world facts that are risky and detrimental. Thus risk management demands increased attention to the risks that companies and organizations will experience in the future.

Agricultural Product Price Fluctuations

Agricultural products are types of products produced through natural processes. In contrast to manufactured products produced by machines, agricultural products are produced from the process of planting, fertilizing, caring for and harvesting. In a process like this, agricultural products are determined by the influence of the season, weather, and pest attacks. Changes in these conditions cause changes in production quantities which result in changes in market prices. The results of research by Hidayati and Suryanto (2015) [11] show that climate, in this case, is measured by the drought-prone land variable, which significantly affects the decline in agricultural products.

The effect of changes in the production of agricultural products causes their prices in the market to experience sharp changes. Agricultural products that are mainly consumed by the public, such as curly red chillies, cause their prices in the market to fluctuate uncontrollably. Sukiyono and Asriani

(2020) [23] state that chilli products have high economic value for farmers, but their prices fluctuate greatly and contribute to inflation in the economy. Furthermore, Sarif (2020) [21] stated that the price of curly red chillies on holidays is very high. This is due to high consumer demand according to the needs at that time.

Method

Research Data and Sources

The data used in this research is secondary time series data. The data includes the development of the daily price of the curly red chilli commodity in traditional/local market in several cities cities in West Java Province, in 2023. The data was obtained from the National Strategic Food Price Information Center (PIHPS Nasional, 2023) [18]. Daily price data was used from May 31 to July 5 2023, where the number of data items is 26 days. The use of data for the period May – July is associated with the development of chili prices around Hari Raya (Idul Adha 2023) where during this period, prices generally soar.

Stages of Analysis

1. *Data Tabulation and Regression Analysis*

The collected data is tabulated in the Microsoft Excel program and transferred into the SPSS application. The regression analysis model used according to the forecasting technique is linear trend regression, quadratic trend regression, and exponent trend regression. The regression estimation model for each trend is written as follows:

a) *Linear Trend* : $HCMKt = a + bT$ (1)

b) *Quadratic Trend* : $HCMKt = \beta_0 + \beta_1 T + \beta_2 T^2$ (2)

c) *Exponent Trend* : $HCMKt = \alpha_0 \exp^{(\square 1T)}$ (3)

Information:

HCMKt = Price of curly red chili in period T.

a, β_0, α_0 = constant values of each regression in the base period (T = 0). b, β_1, β_2, = absolute value of growth for each period.

2. Determination and Selection of the Most Appropriate Trend Estimation Model

In forecasting, the most appropriate trend model can be selected. The choice of the trend model is carried out through model evaluation. The most appropriate model will provide an estimated value that is closer to the actual value. In this case, the difference between the actual value and the estimated value with the trend is called the error. Trend matching will give the minimum error. The criteria used for the evaluation of a suitable trend model include the Standard Error of Estimation (SEE), R-square value, and Ajd.R-square. In general, the selected R-square and Ajd.R-square values are the largest values, while the corresponding SEE values are the smallest values.

3. Forecasting Curly Red Chili Prices in Traditional/Local Markets in in Several Cities in West Java Province

From the evaluation of the appropriate model, the regression results can be used to perform forecasting to determine the trend of increasing curly red chilli prices in traditional/local markets in several cities in West Java Province over the next 45 days.

4. Analysis of Potential Risks Faced by Traders of Curly Red Chili in Traditional Markets in Several Cities in West Java Province

Based on the results of the curly red chili price forecasting obtained, an analysis of the potential risks that may be faced by traders in that market is carried out before the forecasting period and after the forecasting period according to data developments and with standard deviation analysis. The standard deviation formula is written (Wey, *et al*., 2019):

$$\sigma = \sqrt{\sum_{i=1}^{n} (X_i - \bar{X})^2 . P_i} \quad \ldots\ldots\ldots \quad (4)$$

Information:

σ = standard deviation

N = number of data items

Xi = data item value

$\bar{X}$ = average value

i=1

Pi = probability of the estimated value.

Results and Discussion

1. Data Tabulation

Data on price developments for curly red chilies in traditional/local markets in several cities in West Java Province according to market conditions ahead of Eid al-Adha in 2023 are presented in Table 1 below.

Table 1: Actual Data on Curly Red Chili Prices in Traditional/Local Markets in Several Cities, West Java Province

Data Periode (T)	Date	Curly Red Chili Price (IDR/Kg)	Daily Growth (%)	Average Growth in Market Conditions (%)	Grouping Prices According to Market Conditions
1	May 31, 2023	33,500	--	0.00	Normal
2	01 June, 2023	33,500	0.00		Normal
3	02 June, 2023	33,500	0.00		Normal
4	05 June, 2023	32,500	-2.99	-1.52	Production Surplus
5	06 June, 2023	31,000	-4.62		Production Surplus
6	07 June, 2023	31,000	0.00		Production Surplus
7	08 June, 2023	31,000	0.00		Production Surplus
8	09 June, 2023	31,000	0.00		Production Surplus
9	12 June, 2023	32,000	3.23	0.36	Market Adjustment
10	13 June, 2023	32,000	0.00		Market Adjustment
11	14 June, 2023	32,000	0.00		Market Adjustment
12	15 June, 2023	32,000	0.00		Market Adjustment
13	16 June, 2023	32,000	0.00		Market Adjustment
14	19 June, 2023	32,000	0.00		Market Adjustment

15	20 June, 2023	32,000	0.00		Market Adjustment
16	21 June, 2023	32,000	0.00		Market Adjustment
17	22 June, 2023	32,000	0.00		Market Adjustment
18	23 June, 2023	36,000	12.50	2.58	Holiday
19	26 June, 2023	43,500	20.83		Holiday
20	27 June, 2023	45,000	3.45		Holiday
21	28 June, 2023	45,000	0.00		Holiday
22	29 June, 2023	45,000	0.00		Holiday
23	30 June, 2023	45,000	0.00		Holiday
24	03 July, 2023	45,000	0.00		Holiday
25	04 July, 2023	44,000	-2.22		Holiday
26	05 July, 2023	39,000	-11.36		Holiday
	Average	**35,865**	**0.75**		

Source: PIHPS data, processed

The data in Table 1 above shows that the price per kilogram of curly red chilies in traditional/local markets in several cities in West Java Province generally increased from May 2023 to July 2023.

The average growth in the price of curly red chilli during the 26 actual periods was 0.75%. From the actual data in Table 1, price developments can be grouped according to market conditions. It is known that curly red chilli is a commodity that has a fairly high market price and fluctuates very frequently. Prices are quite high due to high public consumption and seasonal supply conditions (Ekaputra, *et al*., 2018) [7]. Another condition that is enough to push the price of chili high is the soaring consumer demand for certain events or holidays. Therefore, fluctuations in the price of curly red chilies can change erratically in certain market periods.

According to market conditions which are the source of changes in curly red chili prices, the existing price development data can be grouped into 4 categories, respectively (1) the normal period, (2) the production surplus period, (3) the market adjustment period before the holidays, and (4) the holiday period. This grouping is not carried out based on the conditions or provisions of traditional market institutions, or certain institutional rules, but rather based on market theory concepts related to the characteristics of agricultural products (Ibdal and Sumaryatin (2022) [13].

Agricultural products have fluctuating characteristics in production due to crop failure, weather pests and diseases, and are seasonal. Changes in these factors cause the reduced supply and result in price spikes in the market. An additional factor that is strong enough to drive high prices in the market is the demand for certain events that soar. These conditions are unavoidable, so the market only makes adjustments according to existing conditions.

Normal conditions refer to price developments that occur in the market according to a certain level that is generally well received by consumers. Under normal conditions, prices do not change and remain at the general level accepted by consumers. In Table 1 data, the normal price level is shown at Rp. 35,000/Kg. In a surplus condition, the production of agricultural products is quite a lot, causing distribution to the market to increase thereby driving down the price per kilogram in the market. The price level in a surplus condition is Rp. 32,500 to 31,000/Kg. In conditions leading up to certain events or holidays, generally, both farmers as product producers and market traders as sellers prepare their respective circumstances for the upcoming event. In this period, the market usually adjusts the price level which is the basis for a higher increase in the face of later events. Therefore, during this period, prices were quite stable at a slightly higher level, above the normal period as well as production surplus. The price level in the market adjustment period before the holiday is Rp. 32,000/Kg. During the holiday period, consumer demand for products increases sharply followed by high price increases. This period lasts during the holiday period even after the holiday with erratic cycles. The price level during the holiday period is Rp. 36,000 to 45,000/Kg.

2. Results of Regression Analysis of Trend Models and Selection of Suitable Models for Forecasting

The results of the trend regression analysis carried out according to the price development data for curly red chilies above, are presented as follows:

a. Linear Trend

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
.764	.583	.566	3746.579		
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	471894401.709	1	471894401.709	33.618	.000
Residual	336884444.444	24	14036851.852		
Total	808778846.154	25			
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Case Sequence	568.034	97.969	.764	5.798	.000
(Constant)	28196.923	1512.973		18.637	.000

b. Quadratic Trend

Model Summary			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.851	.724	.700	3117.627

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	585228116.606	2	292614058.303	30.106	.000
Residual	223550729.548	23	9719596.937		
Total	808778846.154	25			

Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Case Sequence	-554.905	338.806	-.746	-1.638	
Case Sequence ** 2	41.590	12.180	1.556	3.415	
(Constant)	33437.308	1984.987		16.845	

c. Exponential trend

Model Summary			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.765	.585	.568	.099

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	.331	1	.331	33.839	.000
Residual	.235	24	.010		
Total	.566	25			

Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Case Sequence	.015	.003	.765	5.817	.000
(Constant)	28944.354	1156.141		25.035	.000
The dependent variable is ln (Harga).					

Source: Computer print out

In equation form, the results of the above analysis are written as follows:

a. Linear Trend :

$$HCMKt = 28196.923 + 568.034T \quad (5)$$

b. Quadratic Trend :

$$HCMKt = 33437.308 – 554.905T + 41.590T^2 \quad (6)$$

c. Exponent Trend :

$$HCMKt = 28944.354 \exp^{(0.015T)} \quad (7)$$

The estimation results of the linear trend model in Equation (5), the quadratic trend model in Equation (6), and the exponent trend model in Equation (7) give the following values. In the linear trend model, the price of curly red chilli in the period T = 0 (the period before the actual data), the price of chilli reaches Rp. 28,196.923/Kg. The price will increase at an average speed of Rp. 568.034 per kg daily. In the quadratic trend model, the price of curly red chillies in the period T = 0 (the period before the actual data) reaches Rp. 33,437.308/Kg. The price will decrease with an average speed of Rp. 554,905 per kg per day, but will increase by 41,590/Kg for each additional period (daily) squared. In the exponent trend model, the price of curly red chillies in the period T = 0 (the period before the actual data) reaches Rp. 28,944.354/Kg. The price will increase at an average speed of an exponential number of 0.015 times for each additional period (day).

Statistically, the coefficient of determination of adjustment (Adj. R2) in the linear trend model and the exponent trend model is almost the same, namely 0.566 and 0.568. This means that the development of curly red chilli prices in West Java Province. The remaining percentage is explained by other factors not included in the model. Meanwhile, in the quadratic trend model, the Adjustment Coefficient of Determination (Adj. R2) reaches 0.700, which means that 70% of the chilli price change is explained by changes and the square of time. The statistical results (F test) on the Coefficient of Determination of Adjustment from the three trend models show a probability value of 0.0001, which means that the use of the variable T (daily period) significantly influences the price of curly red chillies at traditional/local markets in several cities in West Java Province. Statistical results (F test) Coefficient of Determination Adjustment of the three trend models shows a probability value of 0.0001, which means that the use of the variable T (daily period) has a significant effect on the price of curly red chilies in traditional markets/local markets in several cities in West Java Province.

The results of testing the relationship between curly red chilli prices and the daily time period indicated by the value of the Correlation Coefficient (r) in the three models is more than 0.76, which indicates a strong relationship between the curly red chilli price and the time period (daily). For the results of the significance test (t-test), the daily variable (T) on curly red chilli prices in the three models is 0.0001, which means that the daily time period significantly affects the development of curly red chilli prices in several cities in West Java Province.

The daily variable (T) for the price of curly red chilies in the three models is 0.0001, which means that the daily time

period has a significant effect on the development of curly red chili prices in several cities in West Java Province.

From the results of the statistical analysis of the Standard Error of Estimation (SEE) in the three models, the smallest SEE value was obtained in the exponent trend model, which was 0.099. According to the statistical values generated, the selection of the appropriate model is the exponent trend. For data forecasting needs, selecting the most appropriate trend model will provide an estimated value that is closer to the actual data value. The difference between the actual value and the predicted value with the trend is known as the error. Trend match will give the minimum error. Generally, the criteria used to determine the suitability of the model for forecasting are the Standard Error of Estimation (SEE), and R-square, or Adj.R-square. According to the results of the statistical criteria for the three trend models above, the Adj.R-square value of the quadratic trend model is higher, but the SEE value of the exponent trend model is the smallest, so the model suitable for forecasting in research is the exponent trend.

3. Forecasting curly red chili prices at Traditional/Local Markets in Several Cities in West Java Province

In accordance with the choice of the best model above, then proceed with forecasting to determine the development of curly red chili prices in the Traditional/Local Markets of Bogor City over the next month (the next 45 days). The results of forecasting the price of curly red chilies are presented in Table 2.

Table 2: Forecasting Results of Curly Red Chili Prices at Traditional/Local Markets in West Java Province

Forecasting Period (T)	Date	Curly Red Chili Prices (IDR/Kg)	Price Growth (%)
27	06 July, 2023	43396.34	
28	07 July, 2023	44052.19	1.51
29	10 July, 2023	44717.96	1.51
30	11 July, 2023	45393.78	1.51
31	12 July 2023	46079.82	1.51
32	13 July, 2023	46776.23	1.51
33	14 July, 2023	47483.16	1.51
34	17 July, 2023	48200.78	1.51
35	18 July, 2023	48929.24	1.51
36	19 July, 2023	49668.71	1.51
37	20 July, 2023	50419.36	1.51
38	21 July, 2023	51181.35	1.51
39	24 July, 2023	51954.85	1.51
40	25 July, 2023	52740.05	1.51
41	26 July, 2023	53537.12	1.51
42	27 July, 2023	54346.23	1.51
43	28 July, 2023	55167.56	1.51
44	23 July, 2023	56001.31	1.51
45	26 July, 2023	56847.67	1.51
46	27 July, 2023	57706.81	1.51
47	28 July, 2023	58578.93	1.51
48	31 July, 2023	59464.24	1.51
49	01 August, 2023	60362.93	1.51
50	02 August, 2023	61275.20	1.51
51	03 August, 2023	62201.25	1.51
52	04 August, 2023	63141.31	1.51
53	07 August, 2023	64095.56	1.51
54	08 August, 2023	65064.24	1.51
55	09 August, 2023	66047.56	1.51
56	10 August, 2023	67045.75	1.51
57	11 August, 2023	68059.01	1.51
58	14 August, 2023	69087.59	1.51
59	15 August, 2023	70131.72	1.51
60	16 August, 2023	71191.62	1.51
61	17 August, 2023	72267.55	1.51
62	18 August, 2023	73359.73	1.51
63	21 August, 2023	74468.42	1.51
64	22 August, 2023	75593.87	1.51
65	23 August, 2023	76736.32	1.51
66	24 August, 2023	77896.04	1.51
67	25 August, 2023	79073.29	1.51
68	28 August, 2023	80268.33	1.51
69	29 August, 2023	81481.43	1.51
70	30 August, 2023	82712.87	1.51
71	31 August, 2023	83962.91	1.51
	Average	**61514.85**	**1.51**

Source: data from forecasting analysis results, processed

Forecasting the price of curly red chili presented in the table above follows the actual data period in Table 1. The forecasting period starts with T (27) for the next 45 days. The forecasting results above show that the price of curly red chilli has the potential to continue to increase in the months ahead. The average price increase reached Rp. 61514.85/Kg with an average growth per day of 1.51%. In the data from the forecasting results above, it is almost never seen that there is a decrease in chilli prices. This is because the forecasting method used is exponential trend where the trend uses a period of time. Forecasting analysis like this, which uses periods and time values, will continue to increase or increase the value of the data. Therefore, with the increase in the value of the time data, the chilli price forecasting value automatically continues to increase. Even though the average price growth per day is quite small, namely 1.51%, this will show an increasing trend going forward. Ibdal and Sumaryatin (2022) [13] state that the development of food prices, which also includes curly red chillies, will continue to increase due to the ever-changing seasons. The rainy or long dry season can cause the productivity of chilli plants to decrease so that the amount of production also decreases. This pushes the supply in the market to decrease and results in an increase in prices. In the market, changes in product demand due to certain conditions can attract chilli price increases. The accumulation of these conditions is the main source of chilli prices fluctuating uncontrollably in the market.

4. Price Forecasting and Risk Management of Curly Red Chili Traders in Traditional/Local Markets in West Java Province

Regarding marketing management and price forecasting, most business decisions made by companies and business actors are always faced with risk and uncertainty. The company must decide how much of each product to produce and how much it should be sold for. For this, the company will plan how much it will spend on advertising, the company must also make plans for the company's growth. All of these decisions are based on forecasts of the level of activity in the future, which also includes profit plans to be achieved. For this reason, the purpose of forecasting is to reduce the risks and uncertainties faced by companies in making short-term operational decisions and in planning for long-term growth. As stated by Danese and Kalchschmidt (2011) [5] forecasting is an important process to guide and direct several company activities effectively into the future. Thus, forecasting is used to support the decision-making process.

The situation of risk and uncertainty faced by curly red chilli traders in traditional markets is the tendency for product prices to change erratically from day to day. Generally, increased price movements have the potential to benefit traders, however, price increases will also cause buyers to reduce the number of purchases (Maulana and Safarida, 2021) [14]. As a result, traders who expect profits may, on the contrary, experience unexpected losses. Chilli products are agricultural products whose supply is highly dependent on the amount of production available. The number of products produced also depends on good harvest conditions, season conditions, pest attacks, and so on. Production conditions are not the only cause of uncertainty, market conditions regarding demand also contribute. Changes in market prices and demand can lead to rapid increases in product prices. This state of change is also closely related to certain events and holidays that trigger demand and prices to skyrocket.

Looking at these various changing circumstances, it is possible to analyze the potential risks and uncertainties of curly red chilli price movements and estimate the potential gains/losses that market traders may face, both in actual data and forecasting data.

In a general concept, the risk is defined as an adverse event or deviation from the expected results (Arifudin *et al*., 2020) [2]. In another sense, risk is defined as opportunities and scenarios or consequences or the severity of consequences that occur in a real-world situation (Aven, 2012) [3]. It is also stated that risk is a deviation from the reference level, namely an ideal state according to the planned or expected value, namely the goal to be achieved, also related to uncertainty. In the field of production, risk is associated with deviations in the values of various factors of production which cause losses or decreases in operating profit. Likewise with market demand, the risk of rising prices will cause product demand to decrease and harm public consumption (Heatubun, *et al*., 2022 & 2023) [9, 10].

Based on the results of the curly red chilli price forecasting obtained, an analysis of the potential risks that may be faced by traders in that market is carried out before and after the forecasting period. According to the actual data in Table 1, under normal market conditions, the average curly red chilli price growth is 0%, which indicates that there is no risk for market traders. On the other hand, in a production surplus market, chilli prices decrease by an average of 1.52%. This price reduction indicates a value where market traders experience a risk of decreasing their revenue by an average of 1.52% per kg of chilli compared to the normal price or a decrease of Rp. 532 per kg. During market adjustments ahead of the holiday, chilli prices increased by an average of 0.36%. In general, an increase in the price of chilli is synonymous with an increase in trader revenue per kg of chilli, but this is still categorized as uncertain, considering whether the price increase is followed by an increase in consumer demand or not. If market demand conditions do not encourage excess consumer purchases, the potential increase in traders' revenues is relatively uncertain. During holidays, chilli prices increase sharply, an average of 2.58% per day. This price increase was followed by an increase in demand for chillies due to the increased demand for the holidays. Therefore, it is certain that traders will experience a significant increase in revenue.

To measure the risk of price developments as well as actual data, the standard deviation (□) statistical criterion is used. The standard deviation is a statistical analysis tool that measures the degree of spread of the various possible outcomes of the estimated value. The higher the level of spread referred to, the greater the risk faced. According to the actual price data in Table 1, the standard deviation value is calculated according to the four market conditions, namely (1) the normal period, (2) the production surplus period, (3) the market adjustment period before the holidays, and (4) the holiday period. To calculate the probability of each market condition, refer to the total data period (n = 26) and the number of data items for each market condition. Opportunities in normal market conditions = 3/26 x 100% = 11.54; probability in a surplus condition = 5/26 x 100% = 19.23; market adjustment conditions = 9/26 x 100% = 34.62;

holiday conditions = 9/26 x 100% = 34.62. According to the probability of each situation, the standard deviation is:

a) Standard deviation of normal market conditions (pn):

$$\sigma_{pn} = \sqrt{(33{,}500 - 33{,}500)^2\ (11.54) + \ (33{,}500 - 33{,}500)^2\ (11.54) + \ (33{,}500 - 33{,}500)^2\ (11.54)}$$
$$\sigma_{pn} = \sqrt{0} = Rp.0$$

b) Standard deviation of production surplus conditions (sp):

$$\sigma_{sp} = \sqrt{(32{,}500 - 31{,}300)^2\ (19.23) + (31{,}000 - 31{,}300)^2\ (19.23) + (31{,}000 - 31{,}300)^2\ (19.23) +}$$
$$\sigma_{sp} = \sqrt{(31{,}000 - 31{,}300)^2\ (19.23) + (31{,}000 - 31{,}300)^2\ (19.23)}$$
$$\sigma_{sp} = \sqrt{34{,}615{,}384.62} = Rp.5{,}883.48$$

Standard deviation for market adjustment conditions ahead of holidays (phr):

$$\sigma_{phr} = \sqrt{(32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) +}$$
$$\sigma_{phr} = \sqrt{(32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) +}$$
$$\sigma_{phr} = \sqrt{(32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) + (32{,}000 - 32{,}000)^2\ (34.62) +}$$
$$\sigma_{phr} = \sqrt{0} = Rp.0$$

c) Standard deviation of market conditions on holidays (hr):

$$\sigma_{hr} = \sqrt{(36{,}000 - 43{,}056)^2\ (34.62) + (43{,}500 - 43{,}056)^2\ (34.62) + (45{,}000 - 43{,}056)^2\ (34.62) +}$$
$$\sigma_{hr} = \sqrt{(45{,}000 - 43{,}056)^2\ (34.62) + (45{,}000 - 43{,}056)^2\ (34.62) + (45{,}000 - 43{,}056)^2\ (34.62) +}$$
$$\sigma_{hr} = \sqrt{(45{,}000 - 43{,}056)^2\ (34.62) + (44{,}000 - 43{,}056)^2\ (34.62) + (39{,}000 - 43{,}056)^2\ (34.62) +}$$
$$\sigma_{hr} = \sqrt{2{,}984{,}615{,}384.62} = Rp.54{,}361.63$$

In accordance with the results of the standard deviation calculation above, the risk of rising curly red chili prices in the past holiday period is very large compared to falling prices due to a production surplus. This gives an indication of the production surplus condition, chili prices do not decrease drastically compared to the speed of price increases during the holidays. This situation can provide instructions to market traders how to manage sales during production surpluses and during holidays. On the other hand, during normal market conditions and market adjustments ahead of holidays, the risk of chili price increase is 0 (zero), which indicates that there is no risk of price changes that must be faced by traders.

Furthermore, to determine the risk of price changes in the forecasting data, the standard deviation calculation is carried out and the results are shown in Table 3 below.

Table 3: Standard Deviation Calculation Results for Curly Red Chili Price Forecasting Data

Grouping Data Periods in Forecasting Period (T)	Average Data Period Value	Data Odds Value on Period	Standard Deviation
15 Days I	48,302.06	33.33	69,966
15 Days II	60,489.77	33.33	87,620
15 Days III	75,752.71	33.33	109,782

Source: analysis results, processed

According to the results of the standard deviation analysis in the table above, the risk of increasing chili prices is higher after the actual data. This shows that in the future the price will continue to rise and traders will continue to face unwanted risks. For forecasting data, the analysis here uses a trend so that the trend of increasing chili prices continues over time.

Conclusion

Curly red chili as an agricultural product experiences high price fluctuations in the market due to changes in seasons, weather, harvest, holiday conditions, and so on. Under normal market conditions, the price of curly red chili at the traditional/local markets in several cities in West Java Province has not changed, and remains at the level of Rp. 35,000/Kg (0% growth).

Curly red chilies as an agricultural product experience high price fluctuations on the market due to changes in seasons, weather, harvest, holiday conditions, and so on. Under normal market conditions, the price of curly red chilies in traditional/local markets in several cities in West Java Province does not change and remains at the level of Rp. 35,000/Kg (0% growth). In a surplus condition, the price level decreases by Rp. 31,000/Kg (growth – 1.52%). Ahead of Eid al-Adha 2023, prices adjust to the level of Rp. 32,000/Kg (0.36% growth). On holidays, the price rises sharply to the level of Rp. 36,000 – 45,000/Kg (2.58% growth). The best trend model regression estimation results according to statistical criteria and can be used for price forecasting is the exponent trend model. The results of forecasting data on curly red chili prices for the next 45 days (until 31 August 2023) after the actual price is that prices continue to increase with an average increase of Rp. 61514.85/Kg with an average growth of 1.51% per day. The situation of risk and uncertainty faced by curly red chili traders in traditional markets is the tendency of price changes to move erratically from day to day. The risk faced by traders of curly red chilies in traditional markets in West Java Province is in a production surplus condition, namely a price reduction of IDR 532/Kg, which indicates a decrease in receipts received by traders. The potential for price increases during the holidays is quite high and will continue in the period after the holidays under conditions of uncertainty. Likewise, the risks faced by traders during the holidays and the period after the holidays are very high.

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