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Modeling the Demand for Curly Red Chili Using a Cobb–Douglas Production Function Approach through the Integration of Demographic and Economic Variables

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Abstract: Curly red chili is a strategic horticultural commodity that plays an important role in household consumption and regional economic stability. In Tangerang City, its demand fluctuates due to changes in prices, income levels, and population growth. As an urban area with a steadily increasing population and rapid development of the culinary sector, Tangerang City has a high dependence on supplies from other regions, making chili demand and prices relatively sensitive to economic factors. This study aims to analyze the response and elasticity of curly red chili demand in Tangerang City. The research uses secondary data with a quantitative approach through the Cobb–Douglas function model to estimate the effects of price, income, population, and consumption on the quantity demanded. The Cobb Douglas model was selected because it allows direct measurement of elasticity and demonstrates the sensitivity of demand to changes in each variable. The results show that all variables simultaneously affect the demand for curly red chili. The elasticity values obtained indicate whether demand is elastic or inelastic, providing useful insights for maintaining price stability and ensuring adequate supply availability.

Keywords: Curly Red Chili, Price, Income, Population, Cobb Douglas Model.

INTRODUCTION

The agricultural sector, particularly the horticulture sub-sector, plays a strategic role in the economy because it contributes to food supply, employment, and price stability (Badan Pusat Statistik Provinsi Banten. 2023; Pemerintah Kota Tangerang 2022). Chili is one of the horticultural commodities that is of strategic value because it is an important part of household consumption and contributes to food inflation (Dinas Pekerjaan Umum Kota Tangerang 2022). The relatively high price fluctuations of chili often have a direct impact on people's purchasing power and regional economic stability. This is in line with the statement (Departemen Pertanian, Direktorat Jenderal Hortikultura, dan Direktorat Budidaya Tanaman Sayuran dan

Biofarmaka, 2009), which states that chili peppers are a leading vegetable commodity with an important role in meeting food needs and have a fairly high economic value in the community.

In Tangerang City, the demand for curly red chili tends to increase in line with population growth, which reached around 1.9 million in 2023 (Astuti, Wanto, and Koesriwulandari 2021; Siahaan, Aruan, and Siahaan 2022). As an urban area and a satellite city of the capital, Tangerang plays more of a role as a consumer area than a producer, so it is highly dependent on supplies from outside the region. This dependence causes chili prices and demand to be sensitive to changes in supply, distribution, and economic factors such as prices and income (Siahaan, Aruan, and Siahaan 2022).

Theoretically, demand is influenced by price, income, and population (Asa et al. 2024). A number of previous studies have shown varying results. Some studies found that price and income have a significant effect on chili demand, while others show that income does not always have a significant effect and that demographic factors are more dominant (Rahayu and Utami 2015). These differing findings indicate that regional characteristics influence the structure of chili demand and that the results cannot be generalized (Saragih and Kennedy 2017).

However, research on the elasticity of demand for curly red chili peppers in urban areas surrounding the capital, such as Tangerang City, is still limited (Dinas Pekerjaan Umum Kota Tangerang 2022). In addition, most previous studies used a linear regression approach without explicitly measuring the elasticity and relative contribution of each variable (Supriyanto et al. 2024).

Research (Erwandri 2022; Masri Ramadhan 2021; Rasidin, Nuddin, and Irmayani 2022) shows differences in the results regarding the factors that influence chili demand. Erwandri (2022) in Batang Hari Regency states that chili prices are the most dominant factor, followed by population and per capita income, which also have a significant effect. Rasidin et al (2022) in Sidenreng Rappang Regency also found that the price of red chili peppers, the price of curly chili peppers, and family income significantly affect demand. However, (Masri Ramadhan 2021) in Central Aceh Regency showed different results, where the price of chili peppers and the number of family members had a significant effect, while household income had no significant effect. These differing findings indicate that the effect of income on chili demand is not always consistent and can be influenced by socioeconomic conditions and the characteristics of the research area.

Based on this gap, this study offers something new through its analysis of the elasticity of demand for curly red chili in Tangerang City using the Cobb–Douglas function model, which allows for direct measurement of elasticity while identifying the sensitivity of demand to changes in price, income, and population. The results of this study are expected to provide empirical contributions to understanding the characteristics of chili demand in urban areas and to serve as a basis for formulating price stabilization and supply control policies.

METHODS

This research was conducted in the city of Tangerang. The selection of the research location was based on the characteristics of Tangerang as an urban area with a high population growth rate and rapidly developing economic activity, resulting in fluctuations in demand for horticultural commodities such as curly red chilies. The research was conducted in 2025 using time series data from several previous years obtained from relevant agencies.

The type of research used was quantitative research with a descriptive and explanatory approach (Sugiyono 2016). The descriptive approach was used to describe the development of prices, per capita income, population, and consumption of curly red chilies in Tangerang City. Meanwhile, the explanatory approach was used to analyze the influence of these variables on the demand for curly red chilies through an econometric model (Rismawati 2022).

The research variables consisted of dependent and independent variables. The dependent variable in this study was the demand for curly red chilies (Q), measured in kilograms (kg). The independent variables include the price of curly red chilies (P) in rupiah per kilogram (Rp/kg), per capita income (I) in rupiah per capita per year (Rp/capita/year), population (N) in persons, and per capita chili consumption (C) in kilograms per capita per year (kg/capita/year). To facilitate the interpretation of elasticity, all variables were transformed into natural logarithms (ln).

The sampling technique in this study used secondary data in the form of time series. Because the study used regional aggregate data, no direct sampling of respondents was conducted. All data available in the observation period were used as research samples (saturated samples) (Srinivasan 2022).

The data collection technique was carried out through a documentation study, namely by collecting secondary data from the Tangerang City Statistics Agency (BPS) (Badan Pusat Statistik Kota Tangerang. 2023; Badan Pusat Statistik Kota Tangerang 2024; Tangerang 2023), Banten Province BPS, and other related agencies such as the Food Security Agency. The data collected included the average price of curly red chilies, per capita income, population, and per capita chili consumption. The data obtained was then selected, tabulated, and analyzed according to the research needs.

The data analysis design used the Cobb–Douglas function model, which was transformed into a log-linear form and estimated using the Ordinary Least Squares (OLS) method. The research model was formulated as follows:

$$\ln Q = \ln \beta 0 + \beta 1 \ln P + \beta 2 \ln I + \beta 3 \ln N + \beta 4 \ln C + \varepsilon$$

In this model, the coefficient β1 indicates price elasticity, β2 indicates income elasticity, β3 indicates population elasticity, and β4 indicates per capita consumption elasticity. Hypothesis testing was conducted using the t-test to examine the partial effect of each independent variable on the dependent variable, as well as the F-test to examine the simultaneous effect of all independent variables. The significance level used is 5 percent. In addition, classical assumption tests are performed, including normality, multicollinearity, heteroscedasticity, and autocorrelation tests to ensure that the model meets the Best Linear Unbiased Estimator (BLUE) criteria.

RESULTS AND DISCUSSION

The research results are presented based on data processing that has been carried out in accordance with the methods used. The variables in this study are suspected to influence the demand for curly red chilies in Tangerang City, namely the population, per capita income, and the price of curly red chilies. The data used in this study is secondary data covering a period of 10 years. The population of Tangerang City during the 2013-2023 period generally increased, although there were fluctuations in certain years (BPS Kota Tangerang, 2022). From 2014 to 2019, the population continued to grow at a positive rate, which tended to decline gradually, from 2.43 percent in 2014 to 2.04 percent in 2019 (BPS Kota Tangerang, 2024).

However, in 2020, there was a significant decline in population, with a growth rate of −15.00 percent. This decline caused the population to decrease dramatically compared to the previous year. After this decline, the population increased again in 2021 and 2022 with growth rates of 0.87 percent and 0.98 percent, respectively. However, in 2023, there was another slight decline with a percentage of −0.93 percent.

Population growth tended to stagnate with a large decline in certain years. This condition was influenced by various factors, such as the dynamics of births and deaths, as well as

population mobility, including migration into and out of the regency (D. P. U. K. Tangerang, 2022; P. K. Tangerang, 2022).

Real per capita income tended to increase during the 2013–2023 period (Tangerang City Statistics Agency, 2023), despite fluctuations in certain years. Per capita income was obtained from the deflation of per capita GRDP using an implicit index with a base year of 2018 = 100, thereby illustrating the real income conditions of the community. The most significant increase occurred in 2018 with a growth of 62.7 percent, in line with changes in the base year of the implicit index, which caused real income to increase sharply. Conversely, in 2019, there was a significant decline of −35.5 percent, indicating a weakening of people's purchasing power during that period. In the following years, per capita income was relatively stable in 2020 and 2021, then increased again in 2022 by 13.4 percent and continued in 2023 by 6.3 percent. This upward trend indicates an improvement in economic activity in Tangerang City, which has an impact on increasing the real income of the community through the growth of various business sectors and employment opportunities.

The real price of chili in Tangerang City during the 2013–2023 period experienced significant fluctuations (Tangerang City Central Statistics Agency, 2023). At the beginning of the period, real chili prices rose sharply in 2014 by 121.82 percent. However, in 2015, there was a decline of −47.63 percent. After that, prices rose again in 2016 by 92.78 percent and continued to rise in 2017 by 36.93 percent. In 2018, there was a significant decline of −45.01 percent, which was related to the adjustment of the CPI base year. Subsequently, chili prices fluctuated relatively, with an increase in 2019 of 40.38 percent, then a decline in 2020 of −29.30 percent and in 2021 of −1.26 percent. In 2022, real chili prices rose again quite high, by 85.54 percent, before falling again in 2023 by −17.08 percent. The fluctuations in the price of curly red chili are influenced by various factors, such as changes in curly red chili production, seasonal conditions, distribution, and the dynamics of public demand in Tangerang City (Masri Ramadhan 2021).

The demand for chili peppers in Tangerang City during the 2013–2023 period showed significant fluctuations (Tangerang City Central Statistics Agency, 2023; Pertanian et al., 2009). In 2013, the demand for chili peppers was recorded at 2,772,402.32 kg per year. This demand increased in 2014 to 2,899,846.30 kg per year, with a growth of 4.60 percent, in line with the increase in population and per capita consumption. However, in 2015, there was a sharp decline in demand of −78.82 percent, with estimated chili demand falling to 614,131.50 kg per year. This drastic decline was mainly influenced by the decline in per capita chili consumption, even though the population continued to increase (Republic of Indonesia et al., 2009).

The regression coefficient estimated using the Ordinary Least Square (OLS) method meets the BLUE (Best Linear Unbiased Estimator) criteria, and the regression model must meet all assumptions in classical linear regression.

Table 1. Normality Test

Kolmogorov-Smirnov	Test Statistic	Asymp. Sig.
Understandarized Residual	0,221	0,140

Source: Secondary Data Analysis (2026)

Based on the table above, the Asymp. Sig. value is 0.140. Because 0.140 > 0.05 or greater than the 5% significance level, it can be concluded that the residuals are normally distributed. Thus, the normality assumption is satisfied.

Table 2. Multicollinearity Test

Independent Variables	VIF	Tolerance

Population (X_1)	1,043	0,959
Per Capita Income (X_2)	2,148	0,466
Per Capita Consumption (X_3)	2,229	0,449
Red Chili Price (X_4)	1,250	0,800

Source: Secondary Data Analysis (2026)

Based on the table above, all VIF values are less than 10.00 and all Tolerance values are greater than 0.10. It can be concluded that there are no signs of multicollinearity in the regression model. Thus, the assumption of heteroscedasticity is fulfilled.

Table 3. Heteroscedasticity Test

Independent Variables	t	Sig.
Population (X_1)	-0,344	0,743
Per Capita Income (X_2)	-1,744	0,132
Per Capita Consumption (X_3)	-1,642	0,152
Red Chili Price (X_4)	2,356	0,057

Source: Secondary Data Analysis (2026)

Based on the table above, the Sig. value is greater than 0.05. This indicates that there is no heteroscedasticity in the regression model. This is supported by the scatter plot, which shows that the points are scattered without any particular pattern. Thus, the homoscedasticity assumption is fulfilled. Based on the model testing results, the regression equation obtained is:

$$\ln Y = 0{,}005 + 0{,}999 \ln X_1 - 0{,}001 \ln X_2 + 0{,}999 \ln X_3 + 0{,}000 \ln X_4 + e$$

The regression function model obtained earlier is still in natural logarithm form, so it needs to be transformed back into the Cobb-Douglas function form. Based on the estimation results, the Cobb-Douglas function model for red chili demand is as follows:

$$Q_d = e^{0{,}005} X_1^{0{,}99} X_2^{-0{,}001} X_3^{0{,}999} X_4^{0{,}000} e$$

Based on the Cobb-Douglas model, it can be seen that population and per capita consumption have the greatest elasticity in relation to red chili demand, as indicated by the respective coefficient values of 0.999. This means that a 1% increase in population or per capita consumption will increase red chili demand by almost 1%. Meanwhile, per capita income has a very small negative elasticity (-0.001), which indicates that changes in per capita income have almost no effect on the demand for red chilies. The price of red chilies also has an elasticity close to zero, so that price changes do not have a significant effect on the demand for red chilies during the study period.

Table 4. Demand Elasticity

Variable	Elasticity
Population (X_1)	0,999
Per Capita Income (X_2)	-0,001
Per Capita Consumption (X_3)	0,999

Red Chili Price (X_4)	0,000

Source: Secondary Data Analysis (2026)

Based on these results, the population elasticity of 0.999 indicates that if the population increases by 1 percent, the demand for red chili peppers will increase by almost 1 percent. An elasticity value of less than one indicates that the effect of population on the demand for red chili peppers is inelastic, so that changes in population do not cause significant changes in demand.

The per capita income elasticity of -0.001 indicates that a 1 percent increase in per capita income is followed by a 0.001 percent decrease in demand for red chilies. However, because the value is very small and close to zero, it can be concluded that changes in per capita income do not have a significant effect on the demand for red chilies, and that the demand for red chilies is inelastic with respect to income.

The per capita consumption elasticity of 0.999 indicates that a 1 percent increase in per capita consumption will increase the demand for red chilies by almost 1 percent. This elasticity value shows that per capita consumption is a very strong factor in influencing the demand for red chilies, even though it is still classified as inelastic in terms of elasticity.

Meanwhile, the price elasticity of red chili peppers is 0.000, indicating that changes in the price of red chili peppers do not affect changes in the demand for red chili peppers. An elasticity value in the range of $0 < e < 1$ indicates that the demand for red chili peppers in the study area is inelastic to price, so that even if there is a change in price, the quantity of red chili peppers demanded tends to remain constant.

CONCLUSION

Based on the results of the analysis of the elasticity of demand for curly red chili peppers in Tangerang City, it can be concluded that the demand for curly red chili peppers is simultaneously and significantly influenced by the population, per capita income, per capita consumption, and the price of red chili peppers. The partial test results show that the population and per capita consumption have a positive and significant effect on demand, while per capita income and the price of red chili peppers do not have a significant effect. This indicates that an increase in population and consumption levels are the main factors driving the demand for curly red chilies in Tangerang City.

The elasticity values of each variable show that the demand for curly red chilies is inelastic, as all elasticity values are less than one. The elasticity of population and per capita consumption is 0.999, the elasticity of per capita income is -0.001, and the elasticity of red chili prices is 0.000. This condition indicates that changes in these variables do not cause significant changes in the demand for curly red chili, so this commodity is classified as a relatively stable commodity in public consumption.

Based on these findings, local governments need to maintain the stability of the supply and distribution of curly red chilies to avoid price fluctuations that could trigger food inflation. In addition, further research could add other variables such as the price of substitute goods, seasonal factors, or distribution policies to obtain a more comprehensive picture of the demand behavior for curly red chilies.

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