Red Chili Farming on Coastal Sand Land with Shower Irrigation System: A Review of Production Efficiency

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Abstract. Farming on marginal land, one of which is coastal land, requires its own efforts because it is quite a big challenge. The characteristics of marginal land are minimal nutrients, porous soil type, and quite extreme weather because it is located on the coast. This condition needs to be addressed. One alternative to overcome the problem is to provide large amounts of fertilizer and sufficient irrigation. The irrigation system is an important thing to address the water needs of the land. The use of large amounts of fertilizer must still be adjusted to the needs of red chili plants on coastal land, so that it does not have a negative impact on production and inefficient use. So, this research aims to determine the factors that influence production and determine the efficiency of using production factors in red chili farming with an irrigation system. *shower* on beach sand land in Panjatan District. The research sample was determined using the census method with a total of 50 farmers. Data was analyzed using a type of production function model *Cobb-Douglass* and then analyzed the level of efficiency. The results of the research analysis show that production factors influence red chili production using an irrigation system *shower* on coastal sand land are land area, liquid insecticide and solid fungicide. The use of land area production factors and liquid insecticides is at an efficient level.

1 Introduction

Red chilies have the ability to adapt to various types of land, making them a prime commodity for farmers. However, chili plants grow slowly when planted on land with highland characteristics. Red chili plants can grow in various types of soil, but soil drainage and aeration must be good enough, and water must be available during chili cultivation [1] [2]. Based on the 2023 Central Statistics Agency, the Special Region of Yogyakarta is one of 7 regions in Indonesia which is a center for red chili production [3]. Kulon Progo Regency is known as the largest red chili production area in first position in the Special Region of Yogyakarta Province.

Panjatan Subdistrict is known as the subdistrict with the highest production of red chilies on beach sand in Kulon Progo Regency [4]. Beach sand is one of the lands used by coastal farmers as a means of cultivation. Beach sand land has several limiting factors and obstacles, such as beach sand land which has minimal organic material, porous characteristics of the

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land which then causes the water holding capacity of beach sand land to be low and causes drastic temperature changes [5]. To overcome this, irrigation systems on sandy land are an important consideration in providing sufficient water for red chili plants because it is a factor that can influence production [6] [1]. The increasing use of modern technological inputs such as fertilizers, pesticides and manure in unstable irrigation conditions can cause difficulties in increasing agricultural productivity [7] [8]. Efficient and cost-effective ways of irrigation have emerged as the need of the hour due to limited water resources [7]. Most water is wasted due to inefficient ways of watering plants [9] [10]. Soil management to increase water productivity must be considered. In agricultural water management, reasonable allocation of irrigation water based on soil conditions should be considered [11]. Sand land has a low water holding capacity. So, it is necessary to use the right irrigation system, farmers in Panjatan District, Yogyakarta use a shower system [12].

Another weakness of beach sand land is the lack of organic material, so farmers need a lot of fertilizer to overcome the lack of nutrients in beach sand land. There are differences in the use of fertilizer and other production factors used by farmers compared to the use of production factors based on recommendations from the Kulon Progo Regency Agricultural Extension Agency. This will affect the production of red chilies produced by farmers. This research aims to find out what production factors influence red chili farming and to find out whether the use of production factors for red chili farming on beach sand in Panjatan District is, is not, or is not yet efficient.

2 Research Method

2.1 Sampling Technique

The location selection in this research was carried out using the method *purposive* in Panjatan District considering that red chili production in this district is the highest in Kulon Progo Regency. This research was conducted in two villages, namely Garongan Village and Pleret Village, because farmers planted red chilies on coastal sand land using an irrigation system. *shower*. The sampling technique in this research used the census method with a total of 50 farmers who planted red chilies on coastal sand land with irrigation *shower* which will be carried out in March - November 2023.

2.2 Data Analysis Techniques

The data analysis technique in this research is calculated using the production function *Cobb-Daouglas* using multiple linear regression tests. Mathematically, this equation can be written as:

$$\mathrm{Ln}Y = \mathrm{Ln}\ a + b_1\,\mathrm{Ln}X_1 + b_2\,\mathrm{Ln}X_2 + b_3\,\mathrm{Ln}X_3 + b_4\,\mathrm{Ln}X_4 + b_5\,\mathrm{Ln}X_5 + b_6\,\mathrm{Ln}X_6 + b_7\,\mathrm{Ln}X_7 + b_8\,\mathrm{Ln}X_8 + b_9\,\mathrm{Ln}X_9 + b_{10}\,\mathrm{Ln}X_{10} + b_{11}\,\mathrm{Ln}X_{11} + b_{12}\,\mathrm{Ln}X_{12} + b_{13}\,\mathrm{Ln}X_{13} + m \quad (1)$$

Function *productivity variance* red chilies are as follows:

$$\mathrm{Ln}\sigma_2 Y_i = \mathrm{Ln}\theta_0 + \theta_1\mathrm{Ln}X_{1i} + \theta_2\mathrm{Ln}X_{2i} + \theta_3\mathrm{Ln}X_{3i} + \theta_4\mathrm{Ln}X_{4i} + \theta_5\mathrm{Ln}X_{5i} + \theta_6\mathrm{Ln}X_{6i} + \theta_7\mathrm{Ln}X_{7i} + \theta_8\mathrm{Ln}X_{8i} + \theta_9\mathrm{Ln}X_{9i} + \theta_{10}\mathrm{Ln}X_{10i} + \theta_{11}\mathrm{Ln}X_{11i} + \theta_{12}\mathrm{Ln}X_{12i} + \theta_{13}\mathrm{Ln}X_{13i} + \mu \quad (2)$$

The production factors that influence red chili production will then be analyzed for their efficient level. A red chili farming business is said to be efficient if the marginal product value (NPM) of a production factor is the same as the price. Efficiency analysis can be formulated as follows:

$$NPMx = Px \text{ or } NPMx / Px = 1$$

Information:
NPMx : Marginal Product Value of production factors
Px : Average unit price of red chili production. Conditions:

a. If NPMx / Px = 1, it means that the use of production factors is efficient.
b. When NPMx / Px > 1 means the use of production factors *input* (x) is not yet efficient, needs to be added *input* (x) to be efficient.
c. If NPMx / Px < 1, it means that the use of production factors (x) is inefficient, so *input* (x) needs to be reduced to be efficient.

The level of efficiency in the use of production factors can be calculated using the variable t test using the K value based on the journal written by [8], as follows:
Ho: K = 1, meaning that the use of production factors is efficient.
Ha: K ≠ 1, meaning that the use of production factors is not yet or is not efficient.

3 Results and Discussion

3.1 Production Function Analysis

Using multiple regression analysis in the form of a type of production function *Cobb-Douglas* to find out what factors influence red chili production. There are dependent and independent variables in this analysis. The dependent variable is the production of red chilies (Y) and the independent variables include Land Area (X_1), Seeds (X_2), Urea Fertilizer (X_3), Phonska Fertilizer (X_4), NPK Fertilizer (X_5), ZA Fertilizer (X_6), Fertilizer Cage (X_7), Liquid Herbicide (X_8), Solid Insecticide (X_9), Liquid Insecticide (X_{10}), Solid Fungicide (X_{11}), Labor (X_{12}), and Irrigation Pump Fuel (X_{13}). Table 1 presents the results of the type of production function analysis *Cobb-Douglas.*

Table 1. Results of Type Production Function Analysis *Cobb-Douglas* Red chili pepper

Variable	**Regression Coefficients**	**T-count**
Red Chili Production (Y)	3.082**	2.40
Land Area (X_1)	0.373*	1.77
Seed (X_2)	0.345 ^{NS}	1.47
Pupuk Urea (X_3)	- 0.021^{NS}	- 1.04
Pupuk Phonska (X_4)	- 0.013^{NS}	- 0.56
NPK Fertilizer (X_5)	- 0.003^{NS}	- 0.12
Pupuk ZA (X_6)	- 0.002^{NS}	- 0.09
Manure (X_7)	- 0.045^{NS}	- 0.47
Liquid Herbicide (X_8)	0.017^{NS}	1.29
Solid Insecticide (X_9)	0.011^{NS}	0.83
Liquid Insecticide (X_{10})	0.053**	2.10
Solid Fungicide (X_{11})	- 0.059**	- 2.66
Labor (X_{12})	0.014^{NS}	0.08
Irrigation Pump Fuel (X_{13})	0.041^{NS}	0.53
R Square	0.734	
F-table	2.00	
F-count	7.64	
T-table a 5%	2.03	
T-table a 10%	1.69	

Note: ***significant at α:1%; **significant at α:5%; *significant at α:10%: and NS is not significant

The results of the regression equation based on multiple regression analysis are obtained as follows:

$$\text{Ln}Y = 3.082 + 0.373X_1 + 0.345X_2 - 0.021X_3 - 0.013X_4 - 0.003X_5 - 0.002X_6 - 0.045X_7 + 0.017X_8 + 0.011X_9 + 0.053X_{10} - 0.059X_{11} + 0.014X_{12} + 0.041X_{13}$$

The equation is then converted back into a type of production function *Cobb- Douglas* by anti-Ln Constant as follows:

$$Y = 21.802\ X_1^{0.373}\ X_2^{0.345}\ X_3^{-0.021}\ X_4^{-0.013}\ X_5^{-0.003}\ X_6^{-0.002}\ X_7^{-0.045}\ X_8^{0.017}\ X_9^{0011}\ X_{10}^{0.053}\ X_{11}^{-0.059}\ X_{12}^{0.04}\ X_{13}^{0.04}$$

Variables such as climate can be one of the factors causing chili production to not meet farmers' needs or desires due to farmers' weak knowledge of climate change [9]. Then, the results of the research above show that not all the production factors tested have a significant effect on red chili production. The factors that have a positive and significant influence on red chili production are firstly land area. This is not in line with research on red chilies on the slopes of Mount Merapi which stated that land area had no real effect and had a negative value [13]. The second factor that has a positive and significant effect on red chili production is liquid insecticide. However, this is not in line with research in Algeria which stated that the production factor of liquid insecticide (Bamex) had no real effect on chili production. The third production factor that has an influence is solid fungicides, this is in line with research on horticultural crops in Algeria which shows that solid fungicides have a significant effect on red chili production [14].

3.2 Analysis of the Efficiency of Using Production Factors

An analysis of the efficiency of using production factors is used to determine whether red chili farming uses an irrigation system *shower* on coastal sand land, what is being done is efficient or not yet efficient. In this research, there are three production factors that have a significant effect on the multiple regression coefficient test, namely land area, liquid insecticide and solid fungicide. Production factors that are analyzed for efficiency are production factors that are in the irrational area, namely between 1 and 0, so that production factors that have a negative influence are not continued for efficiency analysis. The production factors that will be analyzed for efficiency consist of land area and liquid insecticide. Solid fungicides were not analyzed because they had negative effects. The level of efficiency in the use of each production factor can be seen in Table 2.

Table 2. The level of efficiency in the use of production factors

Variable	Px	NPMx	NPMx/Px	T-count	T-table	Information
Land area	825	5.794	7.023	-1.523*	1.69	It's efficient
Liquid Insecticide	592	1.265	2.137	- 1.128**	2.03	It's efficient

Note: Significant α = 5% (**) Significant α = 10% (*)

Based on Table 2, it can be seen that the NPMx/Px value for the land area production factor is 7,023 > 1 and the liquid insecticide production factor with NPMx/Px 2.137 > 1. The calculated NPMx/Px value needs to be tested using the t test. Testing efficiency of using red chili farming production factors using a significant level of α 5% and 10%. Based on the results of the analysis, the t value obtained for the use of land area production factors is |-1.523| smaller than the t table value, namely 1.523 < 1.69, meaning that Ho is accepted, and Ha is rejected. This means that the use of land area production factors is efficient. Average land used in red chili farming with an irrigation system *shower* on coastal sand land of 1,624 m^2 or 0.1624 ha has been used efficiently. The results of this research are not in line with research conducted in Bau-Bau City, Southeast Sulawesi Province, that the use of land area

production factors with an average of 0.99 ha is not efficient, this also happens in Turkey, land use shows inefficient results [15] [16].

Based on the analysis results, the calculated t value for the liquid insecticide production factor is |-1.128| is smaller than the t table value, namely 1.128 < 2.03, then Ho is accepted and Ha is rejected. This means that the use of liquid insecticide production factors is efficient. The average use of liquid insecticide production factors is 6,508.68 ml/ha, this use is efficient. So the use of liquid insecticide production factors in red chili farming with an irrigation system *shower* on coastal sand land is already efficient. This is not in line with research conducted in Kaban Village, Karo Regency, which stated that the use of insecticide production factors was not efficient [17].

4 Conclusion and Recommendations

4.1 Conclusion

Based on production function analysis *Cobb-Douglass*, production factors in red chili farming with an irrigation system *shower* on coastal sand land in Panjatan District which has a significant positive effect on red chili production, namely land area and liquid insecticide. Meanwhile, the solid fungicide production factor has a significant negative effect on red chili production.

Based on the results of the analysis of the efficiency of using red chili production factors with an irrigation system *shower* on coastal sand land in Panjatan District, the use of the two production factors, namely land area and liquid insecticide, is at an efficient level. On land use with an average of 1,624 m^2 or 0.1624 ha and the use of liquid insecticides with an average of 1,057.01 ml/m^2 or 6,508.68 ml/ha.

4.2 Recommendations

In red chili farming activities with an irrigation system *shower* on coastal sand land in Panjatan District, farmers can maintain the level of use of land area production factors and liquid insecticides so that they are still used efficiently. And farmers need to pay attention to the use of fungicide production factors so that they reach an efficient level. To streamline the use of pesticide production factors, farmers can follow the recommendations or recommendations that have been determined on the packaging or recommendations from the Agricultural Extension Agency in Kulon Progo Regency.

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