Effect of Irrigation System on Production and Profit in Red Chili Farming on Rice Land, Kretek District, Bantul Regency

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Abstract. The purposes of this research are to determine the factors that affect the costs, income, income, and profits of red chili farming on rice land in Bantul Regency. Determination of respondents using a random sampling method with 45 samples of farmers and the census method with 15 samples of farmers. Data were obtained through interviews using the help of a questionnaire. Then the data were analyzed using multiple linear regression analysis, production costs, revenues, revenues, and profits. The results showed that the production factors that significantly influenced the production of red chili were land area, labor, manure and type of irrigation technology. The production costs incurred on an area of 3,500 m2 are IDR. 13,674,700 for manual irrigation and IDR. 10,214,518 in the shower irrigation area. The income obtained by red chili farmers is IDR. 21,345,619 for manual irrigation and IDR. 20,252,666 for shower irrigation. The income received by farmers is IDR. 12,643,8182 for manual irrigation and IDR. 12,770,400 in shower irrigation. The profit obtained by the farmer is IDR. 7,670,919 for manual irrigation and IDR. 10,038,148 shower irrigation.

1 Introduction

Red chili is a horticultural commodity that is often the prima donna because its price often fluctuates at certain times. In addition, this plant is widely cultivated in Indonesia, especially on the island of Java. The adaptability of red chili is good enough so that it can be cultivated in both lowland and highland areas, but in the highlands its growth is slower. Red chili can grow on various types of soil, but the drainage and soil aeration must be good enough, and water is available during chili cultivation [1].

Bantul Regency consists of 17 sub-districts, Kretek sub-district is the highest red chili producing district in 2018-2020. However, productivity in Kretek sub-district has fluctuated from 2018-2020. Productivity decreased in 2019 to 28.58 kw/ha then increased in 2020 by 120.97 kw/ha. This is different from the harvested area and the amount of production which continues to increase in 2018-2020. A decrease in productivity can be interpreted that the input factor used is not proportional to the output produced. In other words, land area is not the only production input factor that can affect the amount of red chili production.

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Another factor that can affect production is the irrigation system. The increasing use of modern technological inputs such as fertilizers, pesticides and manure under unstable irrigation conditions can make it difficult to increase agricultural productivity [2]. An efficient and cost-effective way of irrigation has emerged as a necessity nowadays due to limited water resources. Most of the water is wasted due to inefficient ways of watering plants [3]. 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 [4].

There are two irrigation systems used by rice farmers in Kretek District, namely manual and shower systems. The manual irrigation system is irrigation on chili plants by farmers using a manual dipper. While the shower system is irrigation of plants carried out by farmers using a floating water pump or floating pump attached to a hose, then the end of the hose is installed with nozzle shower. The advantage of using manual irrigation is that it is easy to use and low cost. While the advantage of using shower irrigation is that it is fast in the watering process and can save labor, but the cost is expensive. The difference in costs incurred will affect the income and profits of the red chili farming business that is run.

2 Methods

2.1 Sampling technique

Determination of the research location is done intentionally with various considerations. According to BPS data (2020), Kretek District is the area that produces the highest chili production in Bantul Regency. In addition, there are irrigation systems in paddy fields, namely manual irrigation systems and shower irrigation with floating water pumps.

The research sample was taken using the simple random sampling method and the census method. Simple random sampling was used to select respondents randomly in the manual irrigation system with a sample of 45 farmers from 100 farmers who used manual irrigation systems. While the census method was used to select all respondents who were in irrigation using a shower/floating water pump with a total sample of 15 farmers. The total respondents were 60 farmers.

2.2 Data analysis technique

The data of the factors that affect the production of red chili is calculated by the Cobb-Douglass and using multiple linear regression test.

3 Results and Discussion

3.1 Analysis of Production Factors

Several factors that influence the production of red chili in paddy fields in Kretek District are land area (X1), seeds (X2), labor (X3), manure (X4), N fertilizer (X5), P fertilizer (X6), K fertilizer (X7), insecticide (X8), fungicide (X9), irrigation technology (D1), and red chili varieties (D2). Table 1 are the results of the analysis of the production function:

Table 1. The results of the regression of factors that affect the production of red chilies

Variable	Regression Coefficient	t-count	Sig
Constant	8,679 2,719	***	0,009
Land Area (X1)	0,869	2,151**	0,037
Seeds (X2)	- 0.562	-1.376	0.175
Labor (X3)	0.751	2.885***	0.006
Manure (X4)	-0.040	*	-1.737
Fertilizer N (X5)	0.051	0.420	0.676
Fertilizer P (X6)	-0.086	-0.793	0.432
Fertilizer K (X7)	- 0.045	-0.472	0.639
Insecticide (X8)	0.103	1.549	0.128
Fungicide (X9)	-0.028	-1.135	0.262
Dummy (D1)	0.418	2.821***	0.007
Dummy Red Chili Variety	1.123	0.807	0.267
R Squared	18.255		
F count	0.171		
F table	2.642		
t table at = 1%	2.679		
t table at = 5%	2.009		
t table at = 10%	1.676		
N	60		
Description: *** significance at = 1% ** significance at = 5% * significance at = 10%			

Based on the results of calculations using the SPSS program, the results of the regression equation are as follows:
Ln Y = 2.161 + 0.869 X1 – 0.562 X2 + 0.751 X3 – 0.0 40 X4 + 0.051 X5 – 0.086 X6 – 0.045 X7 + 0.103 X8 – 0.028 X9 + 0.418 D1 + 0.171 D2

3.2 F Test (Simultaneous Testing)

The f test is used to see whether the independent variables have a joint effect significantly to the dependent variable. This test was carried out at a 99% confidence level from the results of the regression coefficient test. Based on the calculation results above, the f-count value is 18.255 while the f-table value is 2.642 (f-count 18.255 f-table 2.642) at an error rate of 1%. The f-count value is greater than the f-table value so that H0 is rejected, meaning that together the variables are land area (X1), seeds (X2), labor (X3), manure (X4), fertilizer N (X5), P fertilizer (X6), K fertilizer (X7), insecticide (X8), fungicide (X9), irrigation technology (D1) and red chili varieties (D2) had a significant effect on red chili production in Kretek District at 99% confidence level.

3.3 T Test (Individual Test)

Based on Table 1 it can be seen that not all use of production factors (inputs) has a significant effect on red chili production in Kretek District. Production factors that significantly influence the production of red chili are land area, labor, and dummy irrigation technology. The following is an explanation of these factors using the t-test:

3.3.1 Constants

The results of the test using the t-test for constants obtained t-count 2.719 t-table 2.679 with 99% confidence level. Thus, Ho is rejected and Ha is accepted, indicating a unidirectional influence between the independent variable and the dependent variable. The constant value in the production of red chili in paddy fields is 8.679, meaning that if other variables are considered constant, the total production of red chili is 8.679 kg.

3.3.2 Land Area

Based on the test results with the t-test for the production factor of land area (X1) obtained t-count 2.151 t-table 2.009 with 95% confidence level. Thus, Ho is rejected, and Ha is accepted, which means that there is a real influence between land use and red chili production. The regression coefficient value of 0.869 can be interpreted by the addition of the use of labor by 1%, the red chili production will increase by 0.869% with the use of fixed variables.

These results are in line with research conducted in Trimulyo Village, Tegineneng District, Pesawaran Regency, that the land area factor has a significant effect on red chili production [5]. The use of land area for planting red chilies affects the production of red chilies because the wider the area cultivated, the greater the yield obtained. The area of land greatly determines the amount of red chili production because if the area of land is increased, the production of red chili will also increase.

3.3.3 Labor

The results of the t-test for the labor production factor variable (X3) obtained t-count 2.885 t-table 2.679 with 99% confidence level. Thus Ho is rejected and Ha is accepted which means that there is a real influence between the use of labor on the production of red chili. The regression coefficient value of 0.751 can be interpreted by the addition of the use of labor by 1%, the red chili production will increase by 0.751% with the use of fixed variables. These results are in line with research in Pidie Jaya Regency, where the labor variable has a significant effect on chili production [6]. This also happens in the Musanze region of North Rwanda, labor affects crop production [7]. The use of labor is more focused on maintenance activities, such as watering, fertilizing, and controlling plant pests and diseases. This is done so that the use of labor can be optimal so as to increase the production of red chili. Similar to research conducted in Tapenpah Village, Insana District, North Central Timor Regency, the results of the analysis show that labor has a very positive and very significant effect on the production of red cayenne pepper [8].

3.3.4 Manure

The results of the t-test for the variable manure production factor (X4) obtained t-count 1.737 t-table 1.676 with a 90% confidence level. Thus, Ho is rejected and Ha is accepted, which means that there is a significant effect between the use of manure on the production of red chili. The regression coefficient value of -0.040 can be interpreted as an increase in the use of labor by 1%, the red chili production will tend to decrease. These results are in line with research in Kampung Melayu Village, Bermani Ulu District, Rejang Lebong Regency where the use of organic fertilizers has a positive effect on red chili production [9]. Farmers use manure in large quantities, where manure is an organic fertilizer which, when used in large quantities, will increase soil fertility.

3.3.5 Irrigation Technology

Based on the test results with the t-test for the production factor (dummy) irrigation technology (D1) obtained t-count 2.704 t-table 2.679 with a confidence level of 99%. Thus Ho is rejected and Ha is accepted, which means that irrigation technology has a significant effect on red chili production in paddy fields. If the other variables used remain constant, then there is a difference in production between red chili farming using a manual irrigation system and a shower irrigation system. The regression coefficient is positive, which means the amount of red chili production with a shower irrigation system is higher than with manual irrigation. Seeds, N fertilizers, P fertilizers, K fertilizers, insecticides, fungicides, and varieties of red chili are non-significant production factors. The following is an explanation of these factors using the t-test

3.3.6 Seedlings

Based on the results of the test with the t-test for seeds (X2), the t-count is -1.167 < t-table 1.676. Thus, Ho is accepted, and Ha is rejected, which means that there is no real effect between the use of seeds on the production of red chili. Seed variable regression coefficient of -0.467 indicates that if the use of seeds is added and other factors are considered constant, there will be a tendency to decrease the amount of red chili production in paddy fields.

The use of seeds has no significant effect on the production of red chilies in paddy fields because the seeds used do not meet standard operating procedures, where the seeds that must be used are certified seeds, while in the research area farmers use more local seeds from the previous chili plants so that the quality of the seeds used has decreased. Therefore, not all of the seeds planted can grow well, chili farmers also rarely do weed of damaged red chili plants. So that the chili production results obtained are less than optimal. These results are not different from research conducted in Argapura District, Majalengka Regency, according to Ayu Andayani (2016) that seed production factors have no significant effect on chili production. This is because in the research area, farmers are still using improvised seeds and have not thought about the use of superior seeds so that the results are not as expected.

3.3.7 N. Fertilizer

The results of the t-test for the variable fertilizer production factor N (X5) obtained t-count 0.590 < t-table 1.676. Thus, Ho is accepted and Ha is rejected, which means that there is no significant effect between the use of N fertilizer on red chili production. The regression coefficient of the seed variable of 0.071 indicates that if the use of N fertilizer is added and other factors are considered constant, the increase in the amount of red chili production in paddy fields will tend to increase. Sutrisna and Surdianto (2014) state that if sufficient N fertilizer is applied to chili plants, it will ensure the plants grow well, yield higher yields, and fully develop fruit. This is in line with research conducted in Nowa Wies, Poland that N and K fertilization significantly affect the total volume of red chili yield, at a lower fertilization rate the yield is 2.39 kg/m2, while at a higher level 2.63 kg /m2 [12]. Ortas (2013) stated that increasing the addition of N can increase production yields. This means that the frequency of application of N fertilizer in the study area still has to be increased so that the production of chili plants increases.

3.3.8 P. Fertilizer

Based on the test results with the t-test on fertilizer P (X6) obtained t-count -0.674 < t-table 1.676. Thus, Ho is accepted and Ha is rejected, which means that P fertilizer has no significant effect on red chili production. The regression coefficient for the fertilizer P variable is -0.073 indicating that if the use of P fertilizer is added and other factors are considered constant, there will be a tendency to decrease the amount of red chili production in paddy fields. The application of high P fertilizer on agricultural land will tend to cause a stronger soil binding capacity for these P nutrients and make the soil denser [14]. Therefore, the application of P fertilizer must be supported by the selection of nutrient sources, grain size, method of application, or placement in accordance with the nature of the reaction of the fertilizer with the soil and the timing of application in accordance with the needs of the plant.

3.3.9 K. Fertilizer

Based on the test results with obtained t-count –0.458 < t-table 1.676. Thus, Ho is accepted and Ha is rejected, which means that there is no significant effect between the use of K fertilizer on red chili production. The regression coefficient for the seed variable is -0.044, indicating that if the use of K fertilizer is added and other factors are considered constant, there will be a tendency to decrease the amount of red chili production in paddy fields. Giving too much potassium can cause other nutrients needed by plants to be limited in availability compared to potassium fertilizers [15]. So that plant absorption of other nutrients will be hampered, and plants can experience a deficiency. Deficiency is a lack of material (material) in the form of food for plants to carry out their lives.

3.3.10 Insecticides

The results of the t-test for the variable of insecticide production factor (X8) obtained t-count 1.370 < t-table 1.676. Thus, Ho is accepted and Ha is rejected, which means that there is no significant effect between the use of insecticides on the production of red chili. Seed variable regression coefficient of 0.090 indicates that if the use of insecticides is added and other factors are considered constant, there will be a tendency to increase the amount of red chili production in paddy fields. In line with research conducted in Pidie Jaya Regency that the pesticide variable has no significant effect on the production of red chili [6]. This situation is caused by the type and method of using pesticides in the research location is not right. The majority of farmers use pesticides for red chili plants that have been attacked by pests and plant diseases, so the use of these pesticides does not really have an impact on increasing red chili production. This means that farmers have not used proper and correct methods of controlling pests and diseases.

3.3.11 Fungicides

Based on the test results with the t-test for fungicides (X9) obtained t-count –1.047 < t-table 1.676. So, Ho is accepted, and Ha is rejected, which means that there is no real effect between the use of fungicides on red chili production. Seed variable regression coefficient of -0.025 indicates that if the use of fungicides is added and other factors are considered constant, there will be a tendency to decrease the amount of red chili production in paddy fields. These results are in line with research in Mandalahaji Village, Pacet District that the use of fungicides does not significantly affect the amount of chili production [16]. At the time of planting red chili, the rainfall in the study area was still high so that the plants were more susceptible to disease.

3.3.12 Red Chili Varieties

Based on the test results with the t-test for red chili varieties (D2), it was obtained t-count 1.123 < t-table 1.676. So Ho is accepted and Ha is rejected, which means that there is no real effect between the use of red chili varieties on red chili production. If the other variables used are constant, then there is no difference in production between the use of TW chili varieties and imperial chili varieties.

3.4 Analysis of Red Chili Farming

Analysis of red chili farming in paddy fields in Kretek District, Bantul Regency was carried out with the aim of knowing the costs, revenues, income, and profits of farming. In red chili farming, farmers have to pay to buy production inputs. Production input costs are obtained from the sum of explicit costs and implicit costs. Table 2 is the total cost incurred by farmers for one red chili season:

Table 2. Total cost of red chili farming in paddy fields per 3,500 m^2

Description	Manual Irrigation Amount (IDR)	Irrigation Shower Irrigation Total (IDR)
Explicit		
Cost Seedling Cost	233.797	296,396
Fertilizer Cost	2,049 .579	1,222,531
Pesticide Costs	510,940	550,469
Labor Costs	3,781,220	2,932,181
Equipment Depreciation Costs	120,455	217,838
Land Rent Costs	432,099	381,621
Other Costs	1,512,783	1,670,909
Total Explicit Costs	8,702,437	7,482,265
Implicit Costs		
Cost of Own Seedling	826,121	744,554
Interest Cost of Own Capital	174,049	149,645
Cost of Rent Owned Land	293,210	312,824
Labor Cost in the Family	3,678,883	1,525,229
Total Implicit Cost	4,972,263	2,732,252
Total Cost	13,674,700	10,214,518

Explicit costs consist of cost of production facilities, labor costs outside the family, depreciation costs of equipment, land rental costs, and other costs. Based on the table above, it is known that the largest explicit cost value in doing red chili farming is the cost of labor outside the family of IDR. 3,781,220 for manual irrigation and IDR. 2,932,181 for shower irrigation. The total explicit costs incurred by farmers in conducting red chili farming in paddy fields in Kretek District, Bantul Regency are IDR. 8,702,437 for manual irrigation and IDR. 7,482,265 for shower irrigation.

The implicit costs consist of the cost of own seeds, the cost of own capital interest, the cost of renting one's own land, and the cost of labor in the family. The most implicit costs incurred are labor costs in the family. The cost for manual irrigation is IDR. 3,678,883 and for shower irrigation IDR. 1,525,229. The total implicit costs incurred by farmers in carrying out red chili farming in paddy fields in Kretek District, Bantul Regency are IDR. 4,972,263 for manual irrigation and IDR. 2,732,252 for shower irrigation.

So the total cost incurred by farmers for one season of red chili with a land area converted to 3,500 m2is IDR. 13,674,700 for manual irrigation and IDR. 10,214,518 for shower irrigation. The results of the research conducted in Talang Kelapa District, Banyuasin Regency showed that the total cost incurred in running a red chili farming was IDR. 6,882,313 per area of 35.00 m2[17]. The total costs incurred in farming red chilies in paddy fields in Kretek District are greater than in Talang Kelapa District, this is due to the large costs incurred for labor.

3.5 Total Revenue

Most of the farmers' crops from red chili farming are sold by auction. Income is obtained from the calculation of the selling price of red chili multiplied by the amount of production produced by farmers. Table 3 is the red chili farmers' income for one season:

Table 3. Red chili farming revenue per 3,500 m2

Description	Manual	Shower Irrigation
	Amount (IDR)	**Total (IDR)**
Production (Kg)	2,852	3,144
Selling Price (IDR)	7,483	6,441
Total Revenue	**21,345,619**	**20,252,666**

Based on the table above, it can be seen that the land with an area of 3,500 m2can produce an average red chili production of 2,852 kg and with a selling price of IDR. 7,483/kg using manual irrigation and the total production is 3,144 kg and with a selling price of IDR. 6.441/kg with shower irrigation . So that the average income obtained by red chili farmers with manual irrigation is IDR. 21,345,619/planting season and IDR. 20,252,666/planting season using shower irrigation. Farmers' acceptance of using manual irrigation is greater than that of shower irrigation. This is because the price of red chili can fluctuate because red chili farmers sell their products to different middlemen/collectors and the chili price follows the market price.

The number of harvests varies from one farmer to another due to the influence of production inputs, climate, and pests and diseases that attack plants. According to research results [18] in Belitang District, a land area of 3,500 m2can generate revenue of IDR. 29.924832. This amount is greater than the revenue in Kretek District. This is due to the cheaper price of chili in Kretek District and the long rainy season which makes chili plants more susceptible to pests and diseases.

3.6 Net Revenue

Net revenue is the value of the difference between revenues and total explicit costs. Table 4 is the income of red chili farmers in rice fields in Kretek District, Bantul Regency for one season:

Table 4. Red chili farming income per 3,500 m^2

Description	Manual Irrigation	Shower Irrigation
	Amount (IDR)	**Total (IDR)**
Total Revenue (IDR)	21,345,619	20,252,666
Explicit Costs (IDR)	8,702,437	7,482,265
Net Revenue (Income)	**12,643,182**	**12,770,400**

To find out the income, the value of the revenue is reduced by explicit costs. Then the income obtained from red chili farming in the rice fields in Kretek District with an area of 3,500 m2is IDR. 12,643,182/season using manual irrigation and IDR. 12,770,400 use shower irrigation. The income obtained by farmers using shower irrigation is higher than manual irrigation. This is because the explicit costs incurred with shower irrigation are smaller. If the income is greater and the costs incurred (explicit costs) are smaller, the income obtained by farmers will be greater. The results of the study in Kalianda District, South Lampung Regency showed that the income received by red chili farmers was IDR. 32,031,834 in a land area of 3,500 m2 [19]. This amount is greater than the income of red chili farmers in Kretek District. This is because the average price of red chili in Kalianda District is higher, namely IDR. 26,367/kg.

3.7 Profit

Profit is the value of revenue minus the total cost (explicit and implicit costs), so that the profit value of red chili farming in paddy fields can be known. Table 5 is the benefits of red chili farmers in paddy fields in Kretek District, Bantul Regency for one season:

Table 5. Benefits of red chili farming in paddy fields per 3,500 m2

Description	**Manual Irrigation**	**Shower Irrigation**
	Amount (IDR)	**Amount (IDR)**
Revenue (IDR)	21,345,619	20,252,666
Total Cost (IDR)	13,674,700	10,214,518
Profit	**7,670,919**	**10,038,148**

The profit obtained by red chili farmers in paddy fields can be influenced by revenues and total costs (explicit and implicit). The greater the income obtained and the smaller the total cost used by the farmer, the greater the profit obtained by the farmer and vice versa. Based on the Table 5, it can be seen that the land with an area of 3,500 m2can produce an average profit on red chili farming of IDR. 7,670,919/season using manual irrigation and IDR. 10,038,148/season using shower irrigation. According to the results of research in Tegineneng District, Pesawaran Regency, it shows that the profits obtained by red chili farmers are IDR. 8,582,310/season in an area of 3,500 m2 [5]. This shows that the profit of red chili farming in the sub-district of Kretek by using shower irrigation is greater than that of the District of Tegineneng.

4 Conclusion and suggestion

The production of red chili in paddy fields in Kretek District, Bantul Regency is influenced by land area, labor, manure and irrigation technology. Meanwhile, seeds, N fertilizer, P fertilizer, K fertilizer, insecticide, fungicide, and red chili varieties did not significantly affect the production of red chili.

Production costs incurred on a land area of 3,500 m2using manual irrigation are IDR. 13,674,700 and IDR. 10,214,518 using shower irrigation. The revenue obtained by red chili farmers is IDR. 21,345,619 on manual irrigation and IDR. 20,252,666 on shower irrigation. The income received by manually irrigated red chili farmers is IDR. 12,643,182 and for irrigation showers of IDR. 12,770,400. The profit obtained by manual irrigation farmers is IDR. 7,670,919 and IDR. 10,038,148 in shower irrigation.

Shower irrigation technology has advantages in terms of using less labor and higher production yields. So it needs to be considered as an alternative to irrigation in paddy fields.

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