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Comparative Study of Chilli Business Before and After Getting Pump Assistance in Pucuk Village, Mojokerto Regency

Fitri Purwanti[1], Endang Yektiningsih[2], Indra Tjahaja Amir Tan Malayu[3]

[1] Student at Magister Agribusiness Study Program, Faculty of Agriculture, UPN "Veteran" Jawa Timur

[2,3] Agribusiness Study Program, Faculty of Agriculture, UPN "Veteran" Jawa Timur

ABSTRACT: Irrigation is an important component in supporting and increasing agricultural productivity. The pump irrigation assistance provided by the government is expected to be able to increase the effectiveness of chili farming in Pucuk Village, so the IPAIR payment is planned to launch existing pumping irrigation operations. The purpose of this study was to determine differences in farm income, farming feasibility, and the level of technical efficiency of chili farming before and after the IPAIR payment was made. This research was conducted on 60 respondents who are chili farmers who are members of the Sumber Rejeki farmer group in Pucuk Village. The data analysis methods used are farming analysis & paired t-test, B/C Ratio analysis, and Stochastic Frontier Analysis (SFA) analysis. The results of this study indicate that there is a significant difference in chili farming income, namely the average chili farming income after receiving pump assistance is greater than before. The value of the B/C Ratio B/C Ratio after payment of IPAIR is greater than before paying for IPAIR. Chili farming in Pucuk Village is more technically efficient after the implementation of IPAIR than before the implementation of IPAI with an average technical efficiency value of 79% (<70%) with a 21% opportunity to increase chili farming productivity.

KEYWORDS- Feasibility of farming, Irrigation, Income, Technical Efficiency.

I. INTRODUCTION

Agriculture is an important sector that supports the lives of Indonesian people, especially in rural communities. The agricultural sub-sector that is very important in daily life is horticultural crops, especially those that are always needed by the Indonesian people, namely chili (Nisa et al., 2018). Irrigation is an important component of agricultural activities in the chili area. The availability of irrigation water will also greatly support the program to increase agricultural production, by improving the implementation of the irrigation system in an efficient and effective manner. Irrigation has the purpose to meet the water needs in the rainy season for agricultural purposes such as wetting the soil, fertilizing, regulating soil temperature, avoiding pests in the soil, and so on. Therefore, it is necessary to innovate irrigation systems and institutional systems that manage water resources to meet the needs of economic and agricultural development (Saputra, 2018).

Irrigation networks as a medium to meet agricultural water needs need to be managed effectively and efficiently, one way of managing groundwater and from the river is used optimally, it needs the right system in its application, including underground water with pumps distributed to rice fields according to its water capacity (Hariyanto, 2018). Irrigation water management fee (IPAIR) is an attempt to solve a problem related to operation and maintenance which is handed over to farmers who use irrigation water for services and services received (Dieny et al., 2018). The amount of farmers' ability to pay IPAIR is influenced by the level of income that farmers get from their business and the area of their land (Rahman et al., 2019).

Pucuk Village is one of the villages with a rainfed system that has a reservoir in Dawarblendong District, Mojokerto Regency which is able to contribute to irrigation in the agricultural sector. Pucuk Village received assistance from the government which is commonly referred to as pumping irrigation in the form of a water pump managed by the Sumber Rejeki farmer group. However, there are limited funds or funds to handle irrigation operations and maintenance activities, so the Irrigation Water Management Fee (IPAIR) policy was launched. The IPAIR policy is the implementation of the water pump operation and maintenance financing policy carried out by the source of fortune farmer groups as reservoir irrigation managers. The aim is to empower the participation of chili farmers who use water in financing water irrigation networks and achieve full cost recovery for the costs of operating and maintaining irrigation networks (Dieny et al., 2018).

Pumping assistance is said to be successful if it is effective and efficient in increasing chili farming income. If farm income increases, the welfare of farmers will also increase (Tola, 2020). Pump irrigation efficiency can be determined through technical efficiency analysis. According to (Sumarno et al., 2020) Technical efficiency is a quantity that shows the comparison between actual production and potential production that can be achieved. Technical efficiency can be used to measure the ability of farmers to obtain a maximum output with a combination of input use. Technical efficiency in farming shows the relationship between the factors of production used to produce output.

There is a difference in chili farming income before farmers get pump assistance and after farmers get pump assistance. It is hoped that farmers in Pucuk Village will be more prosperous after receiving pump irrigation assistance from the government. Therefore, it is necessary to do a comparative analysis of chili farming before and after receiving pump assistance. The purpose of this study was to determine the difference in the income of chili farming before and after payment of IPAIR, to determine the feasibility of farming before and after payment of IPAIR, and to determine the level of technical efficiency of chili farming before and after payment of IPAIR.

II. REVIEW LITERATUR

A. Agricultural Irrigation System

irrigation comes from the terms irrigation in Dutch and irrigation in English. Irrigation can be interpreted as an effort made to bring water from its source for agricultural purposes, drain and distribute water regularly and after use, it can also be disposed of again. The term irrigation that is often heard can also be interpreted as an effort to use water in general, which means that irrigation is included in it. The village irrigation system is communal and does not receive assistance from the government, and its development and management are carried out by the community. Meanwhile, government irrigation development and management require assistance from the government which is divided into three categories:

1. Technical Irrigation, an irrigation network that gets a separate water supply from the drainage network, and the supply of water can be measured, regulated, and controlled at certain points, and all buildings are permanent.
2. Semi-Technical Irrigation, irrigation to rice fields can be regulated, but the amount of flow cannot be measured, and has few permanent structures.
3. Simple irrigation, usually receiving assistance from the government for development or improvement. However, it is managed and operated by village officials. Has a semi-permanent building, and does not have a flow meter and controller, so the flow cannot be regulated and measured.

B. Irrigation Water Management Fee (IPAIR)

Irrigation water management fee (IPAIR) is an effort to solve a problem related to operation and maintenance which is handed over to water user farmers for the services and services received. Farmers are trained to be able to finance the operation and maintenance (O&M) of irrigation in tertiary plots independently through the Water User Farmers Association (P3A). Therefore, irrigation areas which are developed by the government and have good irrigation performance are subject to an Irrigation Water Management Fee (Fajar et al., 2016). The Irrigation Water Management Fee (IPAIR) policy was issued by the government due to limited costs in handling irrigation O&M activities and has the aim of achieving recovery of irrigation network O&M costs.

III. RESEARCH METHODS

The research was conducted in Pucuk Village, Dawarblandong District, Mojokerto Regency, and East Java Province. The location of the research was determined based on the consideration that Pucuk Village is the largest area in Dawarblandong District where the majority of farmers do chili farming, Pucuk Village also has irrigation potential in the form of village reservoirs. The population in this study are members of the source of fortune farmer groups. The number of samples of farmers was calculated using the Slovin formula with an error rate of 10% so the number of samples was 60 chili farmers.

Collecting research data obtained from primary data and secondary data. Primary data from observations and direct interviews with farmers using open questionnaires. Meanwhile, secondary data was obtained from publications, literature studies, journals, and other libraries, as well as institutions/agencies involved in this research, namely the Central Statistics Agency and the Agricultural Extension Agency which could be used to complete the primary data.

A. Paired Sample t-test

The farming analysis is used to determine the difference in chili farming income before and after farmers pay IPAIR. Mathematically, farm income can be written as follows.

$\pi = TR - TC$

Information:

π = farm income (Rp)

TR = Total revenue (Rp)

TC = Total cost (Rp)

To test the difference in income, using a t-test analysis with the help of the IBM SPSS version 23 analysis tool, the steps are as follows:

1. Hypothesis testing using paired t test with = 0.05. The T-test procedure for two paired samples is as follows (Sugiyono, 2011)

$$t = \frac{\overline{X}_D - \mu_0}{s_D/\sqrt{n}}.$$

$$\overline{X}_d = \frac{\sum D}{n}$$

$$s_d = \sqrt{\frac{1}{n-1}\left\{\sum D^2 - \frac{(\sum D)^2}{n}\right\}}$$

Information :

D = Difference X1 and X2 (X1-X2)

n = Number of Samples

X = Average

Sd = Standard Deviation of d

Test criteria:

H_0 : X1 = X2

H_1 : X1 ≠ X2

Information :

H_0: There is no difference between chili farming income before and during IPAIR

H_1: There is a difference between chili farming income before and during IPAIR dilaksanakan

2. Create a table containing data on chili farming income before and during IPAIR to facilitate data input in SPSS version 23
3. Perform a normality test on the data, to see whether the data to be analyzed has a normal distribution or not. If in the Saphiro-Wilk test, the significance value is >, then the data is normally distributed.
4. Performing a t-test (paired sample t-test) with the following test criteria:

– H_0 is rejected if the value of significance (2-tailed) (0.05) means that there is a significant difference in chili farming income before and after IPAIR is implemented.

– H_0 is accepted if the value of significance (2-tailed) > α (0.05) means that there is no significant difference in chili farming income before and after IPAIR is implemented.

B. B/C Ratio Analysis

B/C Ratio analysis is used to analyze the feasibility of farming before and after farmers pay IPAIR. The value of the B/C ratio is obtained from the calculation of the following formula:

$$\text{B/C Ratio} \frac{\pi}{\text{TC}}$$

Information:

B/C = Benefit/Cost Ratio

π = Profit (Rp)

TC = Total Cost (Rp)

With Criteria:

- Value B/C = 1, then chili farming breaks even
- B/C value > 1, then chili farming is feasible and provides benefits
- B/C value < 1, then chili farming is not feasible and does not provide benefits (Suratiyah, 2015)

C. Stochastic Frontier Analysis

The Frontier analysis is used to analyze technical efficiency. This analysis was carried out with the help of Frontier 4.1 software. To determine the level of technical efficiency of chili farming, it can be analyzed using the Cobb-Douglas Stochastic Frontier

production function model and the Maximum Likelihood (MLE) estimation method. The Cobb-Douglas Stochastic Frontier production function model used in this study is formulated with the following mathematical equation:

$Ln\ Y = \beta0 + \beta1\ ln\ X1 + \beta2\ ln\ X2 + \beta3\ ln\ X3 + \beta4\ ln\ X4 + \beta5\ ln\ X5 + \beta6\ lnX6 + \beta7\ lnX7 + \beta8\ lnX8 + vi\text{-}ui$

Information :

Y = Total number of chili production
X1 = Seed
X2 = Fertilizer
X3 = Insecticide
X4 = Systemic herbicide
X5 = Fungicide
X6 = Fruit Stimulus
X7 = Foliar Fertilizer
X8 = Labor
eg = Error, where eg = vi-ui
vi = a symmetric, normally distributed random error
ui = a one-sided error term($ui \leq 0$)

The expected parameter signs are: $\beta1, \beta2, \beta3, \beta4, \beta5, \beta6, \beta7, \beta8 > 0$.

To get the value of technical efficiency (TE) of chili farming is calculated using the following formula:

$TEi = E [exp (- Ui)/\varepsilon i]\ i = 1,2,3,.....N$

Information :

TEi = technical efficiency of the i-th farmer
Exp (- E [ui| i]) = expected value (mean) of ui with condition εi, so $0 \leq TE, \leq 1$.

The value of technical efficiency is inversely related to the effect of technical inefficiency and is only used for functions with a certain number of outputs and inputs (cross section data). The TE value of farmers is categorized as quite efficient if it is > 0.7 and not efficient if it is 0.7 (Barus et al., 2021).

IV. RESULT AND DISCUSSION

Farming is an activity to cultivate agricultural products on a certain land with the aim of meeting the needs of farmer households. Farmers must manage their farming well to get high profits, so farmers try to minimize expenses and increase farm revenues (Rizqullah & Syamsuddin, 2020). The success of chili farming is determined by cultivation techniques, especially in controlling plant pests and diseases, selecting varieties, proper land management and efficient plant fertilization, and adequate irrigation. This is also influenced by the role of farmers in managing their farms which is supported by an irrigation system in which irrigation is very adequate and ready to be processed to plant cayenne pepper (Nurhafsah et al., 2021).

A. Differences in Farm Income

Differences in farm income can be seen in the amount of revenue and costs of farming. The following is the average chili farming revenue before and after farmers receive pump assistance.

Table 1. Receipts of chili farming before and after receiving pump assistance

No	Description	Before and after getting pump assistance
1	Production (Kg)	1.607
2	Selling Price (Rp/Kg)	20.000
Total Revenue (Rp)		32.133.333

Source: Data Analysis (2022)

Based on table 1, it can be seen that the total receipts of chili before and after receiving pump assistance are the same, namely Rp. 32,133,333. Chili farming revenue is obtained from multiplying the production and selling prices of chilies. The highest revenue from chili farming in Pucuk Village is Rp. 84,000,000 with a land area of 1 Ha, while the lowest revenue is Rp. 8,000,000 with a land area of 0.1 Ha. The area of land managed by farmers ranges from 0.1 – 1 Ha. The high and low yields of chili production are influenced by the area of land and the treatment carried out. According to (Kerepesina et al., 2020) If all production factors are used properly it will increase production to the maximum.

Table 2. Differences in chili farming costs before and after receiving pump assistance

No	Output Type	Before pump assistance (Rp)	After pump assistance (Rp)
1	**Variable cost**	**10.407.812**	**9.871.479**
	- Seed	1.190.000	1.190.000
	- Fertilizer	490.058	490.058
	- Insecticide	71.867	71.867
	- Systemic herbicides	169.813	169.813
	- Fungicide	244.017	244.017
	- Fruit stimulant	63.625	63.625
	- Foliar fertilizer	41.900	41.900
	- Fuel Pump	303.833	-
	- Labor	7.832.700	7.600.200
2	**Fixed cost**	**2.031.181**	**2.009.625**
	- Land rental fee	1.815.833	1.815.833
	- Tax	92.417	92.417
	- Tool shrinkage	122.931	61.708
	- IPAIR Payment	-	39.667
Total Cost (Rp)		**12.438.992**	**11.881.104**

Source: data analysis (2022)

Based on the table, it is known that the total cost of farming chili before receiving pump assistance is Rp. 12,438,992, while the total cost of farming after receiving pump assistance is Rp. 11,881,104. The difference in costs incurred by farmers before and after receiving pump assistance is Rp. 557,888 in one planting season. This means that the costs incurred by farmers before receiving pump assistance are higher than after receiving pump assistance. The difference in the number of farming costs incurred by chili farmers in Pucuk Village shows that farmers save more on costs after getting pump assistance. Reducing farm costs can lead to an increase in farmers' income, thereby increasing profits for farmers. Production and net income can be used as indicators to measure farmers' welfare (Amanullah et al., 2020).

Table 3. Differences in chili farming income before and after receiving pump assistance

No	Criteria	Before pump assistance (Rp)	After pump assistance (Rp)
1	Variable cost	10.407.812	9.871.479
2	Fixed cost	2.031.181	2.009.625
3	Total Cost	12.438.992	11.881.104
4	Revenue	32.133.333	32.133.333
Total Income (Rp)		**19.694.341**	**20.252.229**

Source: data analysis (2022)

Based on the table, it can be seen that there are significant differences before and after getting pump assistance. The average value of chili farming costs before receiving pump assistance was greater than when receiving pump assistance. Meanwhile, the average income obtained from chili farming before receiving pump assistance was smaller than the income when receiving pump assistance. Calculation of farm income can be used to reflect the level of farmer welfare (Fahmi & Rusyadi, 2020).

After doing farming analysis, then the paired t-test was carried out on the two incomes using SPSS version 23 software. The results of the SPSS test are presented in the following data form.

Table 4 T-test of chili farming income before and after getting pump assistance

Paired Samples Test

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Before Pump Assistance - After Pump Assistance	-557887,883	314794,743	40639,827	-639207,988	-476567,778	-13,728	59	,000

Source: data analysis (2022)

Based on table 4, it can be seen whether or not there is a significant difference in chili farming by looking at the magnitude of the sig (2-tailed) value. If the significance (2-tailed) ≤ α (0.05) then H_0 is rejected, while if the significance (2-tailed) > α (0.05) then H_0 is accepted. The table shows that the value of sig (2-tailed) is 0.000 < α (0.05), then H_0 in this study is rejected and H_1 is accepted. This means that there is a significant difference in the income of chili farming before and during IPAIR. So it can be concluded that the pump assistance provided by the government has an effect on increasing the income of chili farmers in Pucuk Village, Dawarblandong District, and Mojokerto Regency. Through pump assistance, it can motivate farmers to increase their income by using agricultural production technology and can be a solution to overcome the problems experienced by farmers (Aroran et al., 2020). Therefore, it is hoped that farmers will implement appropriate irrigation development programs on paddy fields and maintain or maintain irrigation so that they have a long economic period (Sitorus & Sitepu, 2021).

B. Differences in Farming Eligibility

The feasibility of farming can be seen from the comparison of the B/C Ratio values produced before and after the IPAIR payment is made. B/C Ratio is obtained from the comparison of the income obtained from chili farming with the total costs incurred during farming activities take place. A business is said to be feasible and beneficial if the B/C ratio is greater than one (B/C>1), the greater the B/C ratio, the greater the feasibility and benefits to be obtained from the business (Hajar et al. , 2019). The following is a table of B/C Ratio values before and after IPAIR payments are made

Table 5. B/C Ratio Value Before and After IPAIR Payments

No	Criteria	Before IPAIR Payment (Rp)	After IPAIR Payment (Rp)
1	Income	19.694.341	20.252.229
2	Total Cost	12.438.992	11.881.104
3	B/C Ratio	1,58	1,70

Source: data analysis (2022)

Based on the table, it can be seen that the value of the B/C Ratio before farmers pay IPAIR is 1.58, and the value of the B/C Ratio after farmers pay IPAIR is 1.70. Both have a B/C Ratio > 1, meaning that chili farming is feasible and can provide benefits to farmers. The value of the B/C Ratio after paying for IPAIR is greater than before paying for IPAIR. This shows that the benefits received by chili farmers are greater after paying IPAIR. The benefits of the pumped irrigation system have increased farmers' income (Darmawan et al., 2014)

C. Differences in Farming Technical Efficiency Levels

Technical efficiency (Technical Efficiency-TE) is the ability of a company (farming) to obtain maximum output from the use of a set of inputs (bundles) (Anggraini et al., 2017). The stochastic frontier analysis is one of the methods used in estimating the production limit (frontier) and also measuring the level of production efficiency. This analysis uses a parametric approach and includes the use of econometric methods in calculating efficiency. The method used in this research is the stochastic frontier production function which is estimated using the Maximum Likelihood Estimation (MLE) approach.

Table 6. Estimation Results of Stochastic Frontier Production Function in chili farming before and after farmers pay IPAIR with the Maximum Likelihood Estimation (MLE) method

Variabel	Maximum Likelihood Estimation (MLE)					
	Before IPAIR			After IPAIR		
	Koef	Standart Eror	t- Count	Koef	Standart Eror	t- Hitung
Intersep	2.902	1.000	2.902	3.194	0.124	2.561
Seed (X1)	-0.120	0.945	-0.127	-0.118	0.147	-0.806
Fertilizer (X2)	0.169	0.542	0.311	-0.702	0.392	-0.178
Insecticide (X3)	-0.294	0.957	-0.307	-0.290	0.102	-0.282
Systemic Herbicides (X4)	0.128	0.890	0.144	0.550	0.229	0.239
Fungicide (X5)	0.645	0.825	0.782	0.536	0.147	0.363
Fruit Stimulant (X6)	-0.349	0.804	-0.434	-0.401	0.181	-0.220
Foliar Fertilizer (X7)	0.571	0.710	0.804	-0.119	0.113	-0.105
Labor (X8)	0.146	0.516	0.284	-0.306	0.157	-0.194
Sigma Squared	0.166	1.000	0.166	0.141	0.352	0.401
Gamma	0.500	1.000	0.050	0.910	0.064	0.140
LR Function	-0.112			2.929		
LR Test	3.829			9.901		

Source: data analysis (2022)

Based on the table, it can be seen that the value of sigma squared (σ2) before paying IPAIR is 0.166 and after paying IPAIR is 0.141. The value of 2 which is greater than zero indicates the influence of technical inefficiency on the stochastic frontier production function. This value is quite small and significant at α = 1%, so it can be concluded that the error components ui and vi are normally distributed.

The value of gamma (γ) in the table has a significant effect on the level of α = 1%. The gamma value (γ) before paying IPAIR is 0.500, meaning that 50% of the variation in chili production before farmers pay IPAIR is caused by technical efficiency while the remaining 50% is influenced by stochastic effects. While the gamma value (γ) after paying IPAIR is 0.910, it means that 90% of chili production variation before farmers pay IPAIR is caused by technical efficiency while the remaining 10% is influenced by stochastic effects. This means that the technical efficiency of farmers after paying for IPAIR is higher than before paying for IPAIR.

Technical efficiency is the ability of farmers to combine the use of inputs in farming, so that maximum output is obtained (Mardhiah & Suhartini, 2020). Based on the results of the analysis using the stochastic frontier production function model, the level of efficiency achieved by farmers is different for each farmer. The level of technical efficiency achieved by farmers can be seen in the following table.

Table 7. Distribution of Chili Farming Technical Efficiency Before and After Farmers Pay IPAIR

Efficiency Level (%)	Before IPAIR		After IPAIR	
	Farmers	Persentase (%)	Farmers	Persentase (%)
<0,36	4	6,7	4	6,7
0,36 – 0,54	2	3,3	0	0
0,55 – 0,73	50	83,3	6	10
0,74 – 0,92	4	6,7	50	83,3
Average	0,649		0,790	
Maximum	0,841		0,961	
Minimum	0,218		0,347	

Source: data analysis (2022)

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Table 7 shows that chili farming in Pucuk Village before farmers pay IPAIR has a lower efficiency level than after paying IPAIR. It is known that before farmers pay IPAIR there are 6.7% or 4 farmers with very low-efficiency levels (<0.36%), there are 3.3% or 2 farmers with low-efficiency levels (0.36-0.54 %), 83 .3% or as many as 50 farmers with a moderate level of efficiency (0.55-0.73%), and as many as 6.7% or 4 farmers with a high level of efficiency above (0.74-0.92%). Meanwhile, after the farmers paid IPAIR there were 6.7% or 4 farmers with very low-efficiency levels (<0.36%), 10% or as many as 6 farmers with moderate efficiency levels (0.55-0.73%), and as many as 83 farmers. .3% or 50 farmers with a high efficiency level above (0.74 – 0.92%).

A farm can be categorized as efficient if the efficiency value is more than 0.70 (Fadwiwati et al., 2016). Based on the table, it can be seen that the average technical efficiency of chili farming before farmers pay IPAIR is 0.649 lower than the average technical efficiency after farmers pay IPAIR, which is 0.790. This shows that chili farming after paying IPAIR is more efficient because the efficiency value is more than 0.70. The high value of farmers' technical efficiency after paying for IPAIR shows that farmers have been able to utilize existing irrigation properly so that optimal production can be achieved optimally.

V. CONCLUSION

The average income of chili farming when receiving pump assistance is greater than before. The results of the t-test analysis of chili farming income before and when receiving pump assistance showed that the value of sig (2-tailed) was 0.000 < α (0.05). This means that there is a significant difference in chili farming income before and when receiving large pump assistance. The B/C Ratio value before and after the IPAIR payment is >1, meaning that both are feasible. However, the value of the B/C Ratio after payment of IPAIR is greater than before paying for IPAIR. This shows that the benefits felt by farmers are greater when IPAIR payments are made. Chili farming in Pucuk Village is more technically efficient after the implementation of IPAIR than before the implementation of IPAIR with an average technical efficiency value of 79% (<70%) with a 21% opportunity to increase chili farming productivity.

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