**THE DETECTION OF THE ECONOMIC APPEARANCE AND THE PROFITABILITY FUNCTION ESTIMATION OF DRIP IRRIGATION TECHNOLOGY IN TIDAL LAND:**

**The Case of The Chilli Farming**

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**Abstract**

The purpose of this research are (1) to identify chili farming system with using drip irrigation technology in Tidal Area of Budi Mulya Village, (2) to analyze the impact of drip irrigation technology on farm income with and without using drip irrigation technology in Tidal Area of Budi Mulya Village, and (3) to analyze the impact of chili farming efficiency level with and without using drip irrigation technology in Budi Mulya Village. This research was done at Budi Mulya Village Air Kumbang Sub-district Banyuasin Regency. Collecting data was held on March and April of 2018. Sampling method was proportionate stratified random. The process of chilli farming cultivation with using drip irrigation technology is not quite opponent than without using drip irrigation technology. Watering and fertilization of chilli farming with utilizing drip irrigation technology was done by using water pump machine. Drip irrigation affected positive impact for increasing of chilli farming revenue. Efficiency of chilli farming with using drip irrigation technology is higher than chilli farming without using drip irrigation technology. Economic of scales is 2.547, that means in increasing returns to scale condition.

**Keywords** : economic, drip irrigation, swampy land

**Introduction**

To increase the productivity of paddy farming in the tidal land, various technology components can be developed [1] [2] [3] [4] [5] [6]. The components of agricultural machine tool technology and superior varieties accompanied with balanced fertilization can be an alternative improvement to the existing farming system. In some cases, increased productivity has been carried out through the implementation of rice-livestock integration systems, especially cattle, chickens, and ducks, or combined with fish [7], as well as the development of local resources (local wisdom), horticulture and other agribusinesses [8] [9] [10] [11].

Of course, there is great optimism regarding the success of tidal land use for food crop. Utilization of tidal land to support the national food production increase program can be carried out because various technological innovations are available such as: (1) water and soil management technologies, including micro-water management, land management, amelioration and fertilization; (2) new superior varieties that are more adaptive and productive; and (3) agricultural tools and machinery suitable for the typology of the land. However, the development and optimization of tidal swamp land use also faces non-technical barriers, including capital, labor availability, and technology mastery by farmers [12] [13]. [14] [15] detailly states that the use of technology has a negative impact (1) on an increasing unemployment by 3.87%, and a decrease in work time allocation by 10.91%, and (2) positive on increasing income and household productivity - respectively 362% and 388%.

As stated earlier that the limitations of tidal land in developing agricultural businesses need to be supported by technology applications. The situation can be changed by means of technological improvements. One way is to use a drip irrigation. A system that uses plastic pipelines and drippers to deliver water at low pressure directly to the roots of plants. This technology is considered able to overcome the problem of water availability in the dry season on tidal land. The drip irrigation system prevents most of the water loss through evaporation, run off, and soil erosion and weather changes [16].

One of the potential commodities developed in tidal land, besides rice, is horticultural crops. Horticultural plants that have the potential to be developed are chili. Red chili is a horticultural commodity that has a high sale value and is usually cultivated in rural areas. This high price is a driving factor for farmers to plant it. But at certain times the price of these commodities can also decline to the lowest price. This is because in general, red chili farmers concentrate their business on the optimum planting season (in-season), while in off-season production there are not many farmers who cultivate it so that the supply to the market will be limited and prices will rise. However, at the beginning of the dry season, farmers competed to plant red chillies, so that in May-July production and supply was abundant, and prices fell. The dynamics of unpredictable price changes make large red chilli farming also have a high risk.

Thus, weather conditions affect the economic behavior of farming mainly related to the risks faced. Like most farms conducted by farmers, the amount of production is very influential on the level of farmer revenue. Farmers who are commercial, usually have to calculate the costs and income. Costs play an important role to compare with the income to be obtained. This means that the measurement of economic efficiency is very important to analysis to which each rupiah invested by farmers can provide income. A good farm is always said to be a productive and efficient farm. Farming efficiency is divided into physical efficiency and economic efficiency. Physical efficiency is the amount of production that can be obtained from the unity of inputs and if valued with Rupiah will turn into economic efficiency, in other words economic efficiency depends on the price of production factors and physical efficiency calculation. Based on this theory, the efficiency in this case is a balance between the total value of production with production costs [17] [18] [19].

During this time, the use of the profit function in measuring efficiency has not been widely applied to horticultural crops on tidal land. The Cobb-Douglas profit function used in this study is the profit function derived from the Cobb-Douglas function which is a function that involves the cost of production factors in the form of natural logarithm [20]. This function is used to measure the effect of various changes in input and output. This technique is based on the assumption that the goal of farmers in production is to maximize profits.

Banyuasin Regency has an area of 11,875 km2 which has a topography of 80 percent of the wetland in the form of tidal and swampy land, while 20 percent is in dryland. In this area, almost all farmers cultivated paddy farming, corn farming, oil palm plantation, and rubber plantation. In the late of 2015, some group of farmers tried to cultivate chili in dry season. Solving the lack of water, they used drip irrigation. Chili farmers in the Air Kumbang subdistrict of Banyuasin Regency have used drip irrigation technology to water and fertilize chili plants. Drip irrigation technology has begun with an expectation to develop chili farming in the dry season. Based on the description above, this study aims to determine economic appearance and estimate the profit function of the application of drip irrigation technology for chilli farming in tidal land.

**RESEARCH METHODOLOGY**

This research was conducted in Budi Mulya Village, Air Kumbang District, Banyuasin Regency. The location was selected purposively with the consideration that the location was one of the villages that planted on chilli and there was a farming that had applied drip irrigation technology. The research method is a survey method. In Budi Mulya Village, Air Kumbang District, there are two groups in chilli farming, namely with and without drip irrigation technology. The number of farmers who use drip irrigation technology is 27 people with 14 samples and farmers who do not use drip irrigation is 10 people with 5 people. So, in this case the determination of the sample is using the proportionate stratified random sampling method which means that two groups of chilli farmers sample are taken based on the same percentage. Sources of data were primary and secondary. Data collected was analyzed quantitatively. To assess the profit, the economic efficiency, and the economics scale of business; then we need an analysis tool in the form of a profit function. With this tool, almost all parameters directly related to production can be obtained [21].

Another reason for using the profit function model according to [22] is because this model is considered to have several advantages when compared to production functions and linear programs, including:

1. The output supply function and the input demand function can be predicted together without having to make an explicit production function.

2. The profit function can be used to examine technical, price, and economic efficiency.

3. In the profit function model, the observed variables are the cost and revenue variables.

The assumptions used in the profit function model are:

1. Farmers as a unit of economic analysis who try to maximize profits.

2. Farmers buy input and sell output in a perfectly competitive market, or farmers as price takers.

3. The production function is in the form of concaves in variable inputs.

The type of profit function that is widely used is the Cobb-Douglas profit function and the translog function. In Indonesia, the Cobb-Douglas profit function has been widely used for research on various types of businesses, as seen on [17] and [18] .

The chilli cultivation business with the drip irrigation system also has a profit function that can generally be described through a process of mathematical decline based on [22] as follows. Suppose that the production function is:

*Y*  *f* *X* 1 , *X* 2 ,......, *X m* ; *Z*1 , *Z* 2 ,.....,*Z n* 

π  *p*. *f* *X* 1 , *X* 2 ,....., *X m* ; *Z*1 , *Z*2 ,.....*Zn*   Σ *Wi* .*X i*

Whereas:

π: Short term profit

p: Output price per unit

Xi: Variable input for i (i = 1,2, ... ,m)

Zj: Fixed input for-j (j = 1,2, ... , n)

Wi: Input price

According to [18], the specification of the profit function used in this study is the Cobb-Douglas profit function derived from the Cobb-Douglas production function. Through the process of deriving from equations (1) to (9) above, the Cobb Douglas profit function is obtained as follows:

ln π \*  ln *A*\*  *i* \*.ln *W1* \*  *bj* \*.ln *W2* \*

nformation:

A : Intercept

π \* : Income (Rp / planting season)

W1 \* : Labor Costs (Rp / planting season)

W2 \* : Capital Costs (Rp / planting season).

i \* : Labor input coefficient.

j \* : Capital input coefficient.

Proof whether the drip irrigation system chilli farming has Increasing Return to Scale (IRS), Constant Return to Scale (CRS), or Decreasing Return to Scale (DRS) conditions can be tested using the fixed input coefficient of the Cobb Douglas profit function (Saragih, 1980 ; Mandaka and Parulian, 2005) using the following calculation:

If Σ βi = 1, the chilli cultivation business in drip irrigation system has a CRS condition

If Σ βi > 1, the chilli cultivation business in drip irrigation system has an IRS condition

If Σ βi <1, the chilli cultivation business in drip irrigation system has DRS condition.

**RESULTS AND DISCUSSION**

**A. Economic Performance of Drip Irrigation System Application in Tidal Land for Chili Farming**

a.1. Costs, Renevue and Income

Production costs are costs incurred by farmers in farming production activities. In this case the production costs include fixed costs and variable costs. The total production costs of farmers with and without using drip irrigation technology in the Tidal Land can be seen in Table 1.

Table 1. Production Costs of Chilli Farming with and without Using Drip Irrigation Technology on Tidal Land

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | | Cost | Drip Irrigation Technology | |
| Not Using  (Rp/ha/planting season) | Using (Rp/ha/ planting season) |
| 1 | | Fixed Cost | 512.000,00 | 3.590.925,00 |
| 2 | | Variable Cost | 27.732.000,00 | 37.496.487,00 |
| 3 | Total Cost | | 28.224.000,00 | 41.087.412,00 |

Based on Table 1, it can be seen that the total production costs in chilli farming incurred by farmers using drip irrigation technology is greater than that for example farmers without using drip irrigation technology with a difference in the average total production cost of Rp 12,863,412.00 per hectare per planting season, meaning that there is an impact of the use of drip irrigation technology on the production costs of chilli farming. This is because the example of farmers who use drip irrigation technology (drip irrigation) require pumping machines, drip hoses (parent and child), body and other agricultural equipment for the survival of chilli farming using drip irrigation technology so that there is an increase in production costs.

The following comparison of the Revenue of chili farming without using and using drip irrigation technology can be seen in Table 2.

Table 2. Revenue of Chili Farms With and Without Using Drip Irrigation Technology on Tidal Land.

|  |  |  |  |
| --- | --- | --- | --- |
| No | Component | Drip Irrigation Technology | |
| Not Using  (Rp/ha/ planting season) | Using (Rp/ha/ planting season) |
| 1 | Production (Kg) | 1.560 | 3.152 |
| 2 | Price (Rp) | 29.200,00 | 26.000,00 |
| 3 | Revenue (Rp) | 45.552.000,00 | 81.988.290,00 |

Based on Table 2. it can be seen that the revunue in chilli farming received by sample farmers using drip irrigation technology is greater than that for sample farmers without using drip irrigation technology with a difference of revenue of Rp. 36,436,290.00 per hectare per planting season. The difference in revenue is due to the production produced by farmers using drip irrigation technology is higher than farmers without using drip irrigation technology, the average production difference of 1,399 kg per hectare per planting season, which means the impact of the application of drip irrigation technology on the acceptance of chilli farming.

After analysing the amount of revenue from chilli farming, then we can calculated the amount of income that will be received by the farmers. The income of farmers can be done by reducing the amount of revenue obtained by sample farmers by the average total production costs of chilli farming for farmers using and without using drip irrigation technology (drip irrigation) can be seen in Table 3.

Table 3. Income of Chili Farms With and without Using Drip Irrigation Technology on Tidal Land

|  |  |  |  |
| --- | --- | --- | --- |
| No | Component | Drip Irrigation Technology | |
| Not Using  (Rp/ha/ planting season) | Using (Rp/ha/ planting season) |
| 1 | Revenue | 45.552.000,00 | 81.988.290,00 |
| 2 | Total Cost | 28.244.000,00 | 41.087.321,00 |
| 3 | Income | 17.308.000,00 | 40.900.878,00 |

Based on Table 3, it can be seen that the chili farming farm income without using drip irrigation technology is Rp. 17,308,000.00 per hectare per planting season, while the income of farmers using drip irrigation technology was Rp. 40,900,878.00 per hectare per planting season. The income of chilli farming from farmers using drip irrigation technology is greater than farmers without using drip irrigation technology with an income difference of Rp. 23,592,878.00 per hectare per planting season. It means there is an impact of the application of drip irrigation technology on the income of chilli farming.

Comparison of chili farming income is a calculation comparing two values, namely chili farming income using drip irrigation technology and chilli farming income without using drip irrigation technology. The difference in income received by farmers who use and without the use of drip irrigation technology can be determined by using parametric statistical analysis, namely the t-test. But before calculating the comparison using the t-test values, it is necessary to know first whether the data distribution is normally distributed. For that we need to do a test that is the normality test.

Table 4. Results of Kolmogorov-Smirnov Normality Test Results Chilli Farmers With and Without Using Drip Irrigation Technology Drops on Tidal Land

|  |  |  |
| --- | --- | --- |
| No | Variable | Probability |
| 1 | Using Drip Irrigation Technology | 0,20 |
| 2 | Without Using Drip Irrigation Technology | 0,06 |
| Result | | Normal |

In Table 4, it is known that the results of the normality test with a significance value for farmers using drip irrigation technology is 0.066 meaning greater than 0.05 and for farmers without using drip irrigation technology is 0.20 meaning greater than 0.05 it can be concluded that the variables using and for variables without using meet normality assumptions. It means they are normally distributed. Furthermore, the comparison of farmers' chili farm income with and without drip irrigation technology can be seen in Table 5.

Table 5. Results of Comparative Test Analysis of Income of Chili Farms With and Without Using Drip Irrigation Technology in Tidal Land

|  |  |  |
| --- | --- | --- |
| No | Component | Result |
| 1 | t-value | 2.558 |
| 2 | t-table (0.05;19) | 2.110 |
| 3 | Sign. (2-tailed) | 0.05 |
|  | Conclution | Ho Rejected |

Based on Table 4.15, it can be seen that the t-value of 2.558 obtained from data processing using SPSS and the significance level of α = 0.05 (19) was chosen in the t-table of 2.110. It can be seen that the t-value is greater than the t-table, so the decision to rejected Ho is taken, which means that at a 95 percent confidence level, the chili farming income with and without using drip irrigation is different. This t-test proves that the use of drip irrigation technology has an impact on increasing chili-farming income (income among chili farmers using drip irrigation technology is greater than the income of chili farmers without using drip irrigation technology in tidal land).

**a.2. Efficiency of Chili Farm in Tidal Land**

Table 6 presents the R/C and B/C value of chili farming with and without using drip irrigation technology. Chili farming with and without using drip irrigation technology is equally feasible or efficient. R/C value of chili farming without drip irrigation technology is 1.61 while those using drip irrigation are 2.00. Furthermore, chili farming without using drip irrigation technology has a B/C value of 0.61 meaning greater than zero and similar to chili farming using drip irrigation can be said to be efficient with a B/C value of one. Difference in income from chili farming with and without using drip irrigation technology, amounting to Rp. 23,592,878.00 while the value of the difference in the production cost of chili farming income with and without using drip irrigation technology is Rp. 10,314,956.00 so we get an Incremental Ratio value of 2.29. It means that each additional 1 unit of cost will add 2.29 unit of income.

Table 6. R / C and B / C of Chili Farms Without and Using Drip Irrigation Technology on Tidal Land

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No | Drip Irrigation Technology | R/C | B/C | *Incremental Ratio* | Result |
| 1 | Not Using | 1.61 | 0.61 | 2.29 | Efficient |
| 2 | Using | 2.00 | 1.00 | Efficient |

**B. Estimation of the Benefits Function of Drip Irrigation System Application in Tidal Land in Chili Farming**

Based on the estimation results using the OLS (Ordinary Least Square) method the results can be seen as listed in Table 7 as follows:

Table 7. Results of estimating parameters Function of Advantages of Chili Farming Using Drip Irrigation Technology on Tidal Land

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Coefficient** | **t-value** | **P-*Value*** |
| Constanta | -0.913 | -0.792 | 0.445 |
| Labor | 2.827 | 2.736 | 0.019\* |
| Capital | -0.280 | -0.305 | 0.766 |
| R2 = 0.416 | F-value 3.386 | Sig-F 0.052 |  |

Note: \* Significantly influential at the level of 0.05

The estimation results of the model by the Ordinary Least Square (OLS) method show that the model is representative enough to estimate the profit function of chili farming by using Drip Irrigation Technology. The coefficient of determination (R2) in the equation is quite high, 0.416. This shows that all explanatory variables in the model can explain the behavior of the model well. The explanatory variables in each equation together quite clearly explain the diversity of endogenous variables as shown by the statistical value of F value of 3.912, real at the 0.05 levels. The Durbin Watson (DW) statistical test showed that there was no autocorrelation problem with the DW value of 2.066. The model also did not experience multicollinearity problems with a VIF value of 1.111. Based on t-test, the most important things and the main orientation of this research is that all allegations of parameters in the model are in line with expectations based on both theory and economic logic, linier with [24] finding research result. This statistical value of F shows that all the explanatory variables in the equation have a significant effect on the dependent variable at the real level of 0.001. In addition, the results of the t test showed that partially each independent variable was significantly affected by the explanatory variables of labor at the level α 0.05.

The form of the Advantage Function is as follows:

Ln. π \*  -8.184  *2.827. Ln*. *W1* \* - *0,280. Ln*. *W2* \*

Ln. π \*  0.1913 Ln. *W1* 2.827\*Ln. *W****2*** 0.280\*

The independent variable of labor has a positive effect on the profitability of chili farming with a drip irrigation system on tidal land. The given regression coefficient is 2.827. This value means that if labor use increases by 1 percent, profits increase by 2.827 percent. The independent variable of capital has no significant effect on the profitability of chili farming with drip irrigation in tidal land. The economic condition of the business scale is increasing returns to scale where this reality is supported by the value of Σ β i greater than one, which is 2.547 (Table 1). This means that any increase in input in the long run is always followed by an increase in output with increasing results.

**CONCLUSION**

The economic performance results showed that the R / C ratio of chili farming without using drip irrigation technology was 1.61 while those using drip irrigation were 2.00. Chili farming without using drip irrigation technology has a B / C value of 0.61 and chili farming using drip irrigation can be said to be efficient with a B / C value of 1. Incremental Ratio value of 2.29, meaning that each addition of 1 unit costs will add 2.29 in revenue. Economic conditions on a business scale are increasing returns to scale where this reality is supported by a value of j greater than one, which are 2.547. This means that any increase in input in the long run is always followed by an increase in output with increasing results.

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