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Abstract. The growing awareness of the negative impact of using inorganic fertilizers on the environment in a small number of rice farmers has made them switch from conventional to organic farming. So far, economic research on the application of organic fertilizers has been widely carried out in irrigated rice fields. Economic research on the application of organic fertilizer use in tidal and *lebak* land areas has not been widely carried out. Differences in land types are expected to affect the amount of use of organic fertilizers and are also thought to affect production yields and income levels. The purpose of this study was to analyze the reduction in the use of inorganic fertilizers for rice farmers using organic fertilizers and their marginal substitution, as well as the impact of using organic fertilizers on the costs and income of rice farmers using organic fertilizers in tidal and *lebak* land. This research was conducted in Telang Sari Village, Tanjung Lago District and Sako Village, Rambutan District, Banyuasin Regency, South Sumatra Province, Indonesia. Data was collected in April 2021. The research method was a survey with proportional stratified random sampling. The results showed that (1) the highest reduction of inorganic fertilizer in tidal land was 65.4 percent, while in *lebak* land it was 57.6 percent; the cost of production factors in tidal and *lebak* and areas increased by 4.94% and 18.56%; The income of rice farmers in *lebak* land increased by 60.58%, while on tidal land it was only 32.94%, (2) The marginal substitution of organic fertilizers to inorganic fertilizers was -2.61 and -5.68, (3) The use of these factors production for farmers who use organic fertilizers in both tidal and lebak land have not been efficien yett. The use of factors of production must be increased to obtain optimal profits.

1. Introduction

Intensive use of inorganic fertilizers and the neglected use of organic materials to pursue high yields are one of the causes of the decline in soil organic elements. This situation reduces land productivity [1][2][3]. The use of inorganic fertilizers has caused serious problems. Agricultural land ecosystems are damaged, natural predators are lost, and the balance of nutrients in the soil is disturbed. Pest and disease attacks on plants are increasingly widespread, crop failures are increasingly experienced, productivity leveling-off, and chemical residues are left behind in foodstuffs that are harmful to human health [3][4].

The growing awareness of the negative impact of using inorganic fertilizers on the environment in a small number of farmers has made them switch from inorganic farming to organic farming. The use of organic fertilizers derived from natural ingredients will help improve soil conditions that have been damaged by chemical fertilizers. The sustainability of lowland rice farming can be encouraged, one of which is the use of organic fertilizers as a substitute for inorganic fertilizers. Currently, the level of use

of organic fertilizers in Indonesia is still low, only around 500,000 tons or 4.55 percent of the total use of fertilizers in Indonesia. The introduction of organic farming needs to be encouraged and breakthroughs to produce fertilizers that have the stated criteria need to be followed up [4] [5][6].

The condition of different types of paddy fields will certainly affect the differences in the needs of production factors and the different levels of treatment for rice farming. In acidic swampy land requires a different level of fertilizer use than in other swampy land. The existence of differences in the ecophysiology of swampy land will affect the level of efficiency in the use of production factors on each land. The results of previous research showed that the productivity of organic and inorganic rice was statistically significantly different, but the income of organic rice farmers was higher than that of medium rice and statistically significantly different. The application of organic farming with all its technological components will increase soil fertility resulting in an increase in productivity. The financial income received by organic farmers is also higher [6][7][8][9][10][11]. So far, economic research on the application of organic fertilizers has been widely carried out in irrigated rice fields, but very little in swamp land.

Research on marginal substitution and technical efficiency by using organic fertilizers in swamp land has not been done much also. The conditions of different types of paddy fields will of course also affect differences in behavior, one of which is on tidal and *lebak* areas [12][13]. Differences in land types are expected to affect the amount of use of organic fertilizers and are also thought to affect production yields and income levels.

In South Sumatra, the development of organic swampy rice farming is still very slow due to the reluctance of farmers to use it and consumers are still not concerned with the quality of the agricultural products they buy. Banyuasin Regency is one of the regencies in South Sumatra that has implemented programs using organic fertilizers such as Muara Sugihan District, Air Saleh District, Banyuasin I District, Tanjung Lago, Rambutan and other sub-districts in Banyuasin Regency. Some of them use organic fertilizers as a complement to chemical fertilizers. With the typology of tidal and *lebak* land, it is suspected that there are behavioral differences in the use of organic fertilizers in these two types of land. The problem of time and impracticality in making organic fertilizers makes farmers prefer chemical fertilizers. The nature of tidal and *lebak* land that have unfavorable land conditions makes farmers have to be wiser in fertilizing. Especially lebak land which is inundated by water for some time contains many substances that can damage the condition of the land [14][13].

The aims of this study were: (1) to analyze the amount of reduction in the use of inorganic fertilizers by rice farmers using organic fertilizers, and its impact on the costs, revenus and income, and (2) to analyze the marginal substitution between organic and inorganic fertilizers in tidal and *lebak* areas, and (3) to analyze the level of technical efficiency of rice farming using organic fertilizers in tidal and *lebak* land.

2. Research Methodology

This research was conducted in Telang Sari Village, Tanjung Lago Subdistrict and Sako Village, Rambutan Subdistrict, Banyuasin Regency on rice farmers who used organic fertilizers in tidal land and *lebak* land. Data was collected from April to June 2021. The research method is a survey method. The sampling technique was Stratified Proportinoned Random Sampling. For tidal land in Telang Sari Village were taken 20 people from a population, while for lebak land in Sako Village 20 samples were taken from a population. Total aample were 40 farmers using organic fertilizers.

To answer the first objective, the existing data is presented in tabulation and then discussed and then analyzed qualitatively and quantitatively. Refer to [15][16][17], to answer the second objective, we use the production function of type *Cobb-Douglas* $Y = \beta_0 {X_1}^{\beta_1} {X_2}^{\beta_2}$. Marginal Substitution X_1 and X_2 is formulated by $DSM_{x_1x_2} = -\frac{PM_{x_1}}{PM_{x_2}}$. To answer the third objective, namely the level of production efficiency, it can be done by using a production function of type *Cobb-Douglas* $Y = \beta_0 {X_1}^{\beta_1} {X_2}^{\beta_2} {X_3}^{\beta_3} {X_4}^{\beta_4}$. Classical Assumption Test is conducted to ensure the goodness of fit using normality test, multicollinearity test, and heteroscedasticity test. Based on the concept of relative

efficiency of farming, it can be seen from the comparison of the actual profit function of farming so that the efficiency of the use of production factors is implied with the maximum profit that will occur if the value of the marginal product (NPM) is equal to the price of the production factor.

With the following decision rules: (1) $NPM_{xi} = \beta_i \frac{y}{x} py = Pxi$, This means that the use of factors of production is efficient; (2) $NPM_{xi} = \beta_i \frac{y}{x} py < Pxi$, This means that the use of factors of production is unefficient, and (3) $NPM_{xi} = \beta_i \frac{y}{x} py > Pxi$, This means that the use of factors of production is not efficient yet.

3. Result and Discussion

3.1. The Impact of the Use of Organic Fertilizers on the Use of Inorganic Fertilizers

The use of organic fertilizers has helped farmers reduce the use of chemical fertilizers. For rice farmers in tidal land, although the use of chemical fertilizers is still used, the amount of use has begun to be reduced. Inorganic fertilizers are still used for reasons of plant growth.

Table 1. Average Changes in the Use of Inorganic Fertilizers in Paddy Farmers in Tidal and *Lebak* Lands

Input Production	Before Using Organic Fertilizer (kg/ha)	After Using Organic Fertilizer (kg/ha)	Change in unit	Change in %
Tidal Land				
Urea fertilizer	260	90	170	- 65,4
NPK fertilizer	70	40	30	- 42,8
SP36 fertilizer	90	65	25	- 27,8
***Lebak* Land**				
Urea fertilizer	273,75	116,00	157,75	- 57,6
NPK fertilizer	117,50	48,50	69,00	- 58,7
SP36 fertilizer	90,00	57,50	32,50	- 36,1

Meanwhile, for farmers in lebak land areas, the effect of using solid organic fertilizers is very helpful in improving the properties of soils that have high acidity. For tidal and lebak land, the use of urea, NPK, and SP 36 as an inorganic fertilizers decreased respectively as on Table 1. The total cost and income for both tidal and lebak land areas increased significantly at the 5% level of significance as on Table 2. The result of this result are similar with finding research of [18][19].

Table 2. Production, Revenue, and Income of Organic User Farmers on Tidal and *Lebak* Lands

Component	Before Using Organic Fertilizer	After Using Organic Fertilizer	Change in unit	Change in %
Tidal Land				
a. Product	3.720	5.220	1.500	28,74
(Kg/Ha/Season)	13.020.000	18.270.000	5.250.000	28,74
b. Revenue				
(Rp/Ha/Season)	2.610.083	2.746.000	135.917	4,95
c. Total	10.409.917	15.524.000	5.114.083	32,94
Cost(Rp/Ha/Season)				
d. Income				
(Rp/Ha/Season)				
***Lebak* Land**				
a. Product	3.510	5.830	2.320	37,79
(Kg/Ha/Season)	12.285.000	27.349.500	15.064.500	55,08

b. Revenue (Rp/Ha/Season)	2.935.405	3.604.164	668.759	18,56
c. Total Cost(Rp/Ha/Season)	9.349.595	23.718.336	14.368.741	60,58
d. Income (Rp/Ha/Season)				

3.2. Marginal Substitution of Organic Fertilizer to Anorganic Fertilizer in Rice Farming in Tidal and Lebak Lands

Marginal Substitution of organic fertilizer to inorganic fertilizer in tidal and l*ebak* land areas were -2.61 and -5.68, respectively. The Marginal Substitution value of -2.61 in tidal land means that every use of 2.61 kg/ha of inorganic fertilizer can be replaced by 1 kg of organic fertilizer, as well as for use in lebak land areas as seen on Table 3. The result of this result are similar with finding research of [11][8].

Table 3. Marginal Substitution of Organic Fertilizer to Anorganic Fertilizer in Rice Farming in Tidal and *Lebak* Lands

Mathematical Functions based on Estimation Results			Quantity (Kg/ha)	Dosis	Marginal Substitution (DSM $_{X1X2}$)
Total production (PT)	Marginal Production (PM)	Marginal Substitution (DSM $_{X1X2}$)	Organic Fertilizer	Anorganic Fertilizer	
Tidal land					
$PT = -0{,}71PO^{0{,}25}PNO^{0{,}25}$	$PM_{PO} = -0{,}18PO^{-0{,}75}PNO^{0{,}25}$ $PM_{PNO} = -0{,}18PO^{0{,}25}PNO^{-0{,}75}$	$DSM_{PO,PNO} = -\frac{PNO}{PO}$	72	195	-2,67
***Lebak* land**					
$PT = -2{,}82PO^{0{,}65}PNO^{0{,}31}$	$PM_{PO} = -1{,}83PO^{-0{,}35}PNO^{0{,}31}$ $PM_{PNO} = -0{,}87PO^{0{,}65}PNO^{-0{,}69}$	$DSM_{PO,PNO} = -2{,}22\frac{PNO}{PO}$	86,8	222,5	-5,68

3.3. Allocative Efficiency of Using Organic Fertilizer in Tidal Land and Lebak Land

The estimation result of the production function model of *Cobb-Douglas Type* $Y = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4}$ are :

Tidal Rice Production Function: $Y_{ps} = 1{,}414957\ L^{0{,}115066}\ B^{0{,}443824}\ PO^{0{,}805884}\ U^{0{,}200145}\ TK^{-0{,}688283}$
Lebak Rice Production Function: $Y_L = -1{,}601691\ L^{0{,}273907}\ B^{0{,}372053}\ PO^{0{,}021215}\ U^{0{,}102023}\ TK^{0{,}287180}$

Whereas: Yps= Paddy Production on Tidal Land (Kg/Ha); YL= Paddy Production on *Lebak* Land (kg/Ha); L = land area (ha); B = Paddy Seeds (Kg/Ha); PO = Organic Fertilizer (Kg/ha); U = Anorganic Fertilizer (Kg/ha); TK = Labor (Man Working Day/Ha).

Goodness of Fit showed that (1) The estimation results of the production equation for tidal rice farming gave an R-square of 0.9413. This means that 94.13 percent of rice farming production can be explained by the independent variables of land, seeds, organic fertilizers, urea fertilizers, and labor, while the remaining 5.87 percent is explained by other variables; The results of the estimation of the production equation for rice farming in the *Lebak* land give an R-square obtained of 0.9828, which means that 98.28% of the production of rice farming can be explained by the independent variables of land, seeds, organic fertilizers, urea fertilizers, and labor, while The remaining 1.72 percent is explained by other variables outside the equation. (2) The calculated F-values are 9.620 and 56.987, respectively, which are significant at α = 5%, and (3) The t-test results show that the factor of seed and

organic fertilizers has a significant positive effect on rice production at α = 5% and α = 10%, while inorganic fertilizers no longer affect production. The labor production factor has a negative effect in tidal land, and is significantly positive in *lebak* land at α = 5%.

Table 4. Allocative Efficiency of Organic Fertilizer and Other Inputs Use on Tidal and *Lebak* Land Paddy Farming

Input Production	Tidal Land		*Lebak* Land	
	NPMxi/Pxi	Efficiency	NPMxi/Pxi	Efficiency
Land Area	3,003223	not efficient yet	11,8879	not efficient yet
Paddy Seeds	0,638679	not efficient yet	0,24481	not efficient yet
Organic Fertilizer	63,90408	not efficient yet	0,5213	not efficient yet
Anorganic Fertilizer	0,250799	not efficient yet	0,11419	not efficient yet
Labor	-0,06869	Unefficient	0,04957	not efficient yet

The average value of NPMxi/Pxi based on the results of the analysis of the efficiency of the use of production factors on tidal and *lebak* land has a value of less than 1 (Table 4). This shows that the use of factors of production has not yet reached the level of efficiency, and the use of factors of production needs to be increased to achieve efficiency except for the factor of production of labor on tidal land. The result of this result are similar with finding research of [11][8][9].

4. Conclusion

The use of organic fertilizers causes a reduction in the use of inorganic fertilizers for rice farmers, both on tidal and *lebak* areas. Although the cost of production factors incurred by rice farmers in tidal and lebak lands has increased by 4.94% while for rice farmers in lebak lands 18.56%, the income of rice farmers in lebak lands has increased quite significantly, namely 60.58%. while on tidal land it is only 32.94%. The marginal substitution of organic fertilizer (DSM X_1X_2) to inorganic fertilizer in tidal and *lebak* land was -2.61 and -5.68, respectively. The DSM X_1X_2 value of -2.61 in tidal land means that every use of 2.61 kg/ha of inorganic fertilizer can be replaced by 1 kg of organic fertilizer, as well as for use in *lebak* land. The results of the analysis of the efficiency of the use of production factors on organic rice farmers in tidal and *lebak* land are not yet efficient, where the average NPM/Pxi value is less than one. However, if we look at each NPM/Pxi value, rice farming on lebak land is more efficient than tidal land.

The results of the analysis show that the use of organic fertilizers has a positive impact on rice farming in tidal land. Therefore, the use of organic fertilizers should be encouraged among rice farmers. There are several ways that can be taken, namely (1) government counseling regarding the benefits of organic fertilizers socially, economically, technically, and environmentally, (2) demonstrations on how to make and use organic fertilizers, (3) outreach the use of organic fertilizers using farmer-to-farmer extension methods.

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