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ALLOCATIVE EFFICIENCY OF RICE FARMING UNDER LANDSCAPE INTEGRATED PEST MANAGEMENT PROGRAM IN KLATEN DISTRICT

Muhammad Pradipta Natriasukma[1], Suhatmini Hardyastuti[2],& Irham[2]
[1,2]Department of Agricultural Socio-Economics, Faculty of Agriculture, Universitas Gadjah Mada
Corresponding author: m.pradipta.natriasukma@gmail.com

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ABSTRACT

The research aims to (1) identify the factors that influence rice production of landscape IPM and non-landscape IPM farming, (2) analyze the allocative efficiency of rice production factors use under landscape IPM and non-landscape IPM farming, (3) analyze the factors that influence rice farming income of landscape IPM and non-landscape IPM farming, and (4) analyze of IPM field school on the use of chemical pesticides. This research was conducted in December 2018 - July 2019. The basic method of this research was survey. The research location was in Klaten District as one of the landscape IPM program sites. The sample consisted of 30 landscape IPM rice farmers and 30 non-landscape IPM rice farmers who determined by simple random sampling. Data were analyzed by using multiple linear regressionequation and Ordinary Least Square (OLS) method with Cobb-Douglas production function. The results of the study are as follow: (1) farmers in Klaten District who applied the principle of landscape IPM had higher rice productivity and farm income, (2) the use of land size and seed on landscape IPM farmers and land use in landscape IPM has not been efficient so that it can still increase land size and seeds to increase rice production (3) increasing in seed prices and wages of hired labor can reduce rice farming income. Meanwhile, the expansion of land size can increaserice farming income, (4) IPM field school has the effect of using fewer chemical pesticides by farmers.

Keywords: rice farming, production function, revenue function, landscape IPM, allocative efficiency

INTRODUCTION

Several farmer groups in Klaten Regency have been introduced to scientific knowledge since 2017 by the Klaten Agriculture and Food Security Service and assisted by higher education academics regarding integrated pest management (IPM) landscapes. In 2018, it turned out that the insights obtained about the concept of landscape IPM were not consistently applied by farmers in Klaten Regency due to a lack of assistance after large-scale IPM field school activities based on the statement of the farmer group leader. This understanding can fade and farmers who have followed IPM field school have the potential to use pesticides on a scheduled basis again and tend to be unwise in controlling plant pests (OPT).

Irham (2002) show that the advantage of IPM technology is that IPM technology has succees in reducing the application of chemical pesticides without sacrificing the productivity level of rice farming. In addition, it was found that IPM technology provides incentives for farmers in the form of lower yield losses, lower pest attacks, and better productivity, so that farmers are willing to adopt this technology in their rice farming. The difference in input and the amount of input used by rice farmers will affect farm income. Each input can provide a different significance to rice productivity, whether managed with landscape IPM and non-landscape IPM. Suzana et al. (2011) show that the factors of production of land, seeds, fertilizers, and labor together or partially have a significant effect on rice production and the use of inefficient seed production factors so that it needs to be reduced. Muzdalifah (2012) states that rice farmers' income is influenced by land area, urea prices, phonska fertilizer prices, labor prices, and dummy varieties. The increase in land area, urea prices and varieties are in line with the increase in rice farming income, while the price of phonska fertilizer and the price of labor have the potential to reduce rice farming income.

It is necessary to analyze between landscape IPM rice and non landscape IPM rice in Klaten Regency in terms of input use, factors that affect rice production, factors that affect farm income, and see the impact of IPM field school on farmers in using pesticides. This is to see the achievements of the introduction of the landscape IPM program and evaluate the implementation of the program. In addition, farmers want the use of farm production factors to a minimum and maximize farm income so that they can be allocatively efficient (Hanafie, 2010). One way that can be used to determine the use of rice farming production factors efficiently is by calculating allocative efficiency. The results of the analysis can be the basis for determining the right policy for the government.

METHOD

The basic method used in this research is descriptive analysis method with survey techniques. This research is a research grant from the Faculty of Agriculture in the 2018 budget entitled "The Impact of the Implementation of Landscape Integrated Pest Management on Rice Farming Income in Central Java" chaired by Dr. Ir. Suhatmini Hardyastuti, S.U.

Sampling from sub-districts, villages, and farmer groups was carried out by purposive sampling. The determination in Klaten Regency was carried out because the area was the center of rice in Central Java and the landscape IPM program had been socialized by the Office of Agriculture and Food Security of Klaten Regency.

Sampling was carried out on 60 farmers from 4 farmer groups totaling 211 people by simple random sampling. The 4 farmer groups are divided into two villages, namely Juwiran Village and Jetis Village. Juwiran Village, Juwiring Subdistrict, Klaten Regency consists of 50 rice farmers and Gemah Ripah 45 rice farmers. Jetis Village, Juwiring Subdistrict, Klaten Regency consists of 60 Kismo Budoyo farmer groups and 56 Sadar Budoyo rice farmers.

The sample consisted of 30 landscape IPM farmers and 30 landscape IPM farmers. The sample of landscape IPM rice farmers came from Juwiran Village and Jetis Village with 15 rice farmers each. Meanwhile, the sample of non-landscape IPM rice farmers was only taken in Juwiran Village as many as 30 rice farmers. Comparative considerations were made on the different methods of rice farming after the introduction of the IPM concept landscape in the Integrated Pest Management Field School (IPM field school) program marked by the planting of refugia flowers by farmers around the rice fields. Integrated Landscape Pest Management (ILPM) farmers are farmers who have attended the Integrated Pest Management Field School (ILPM field school) and apply the principles and components of Integrated Landscape Pest Management (ILPM) in their farming. Non-Integrated Pest Management (IPM) Landscape Farmers are farmers who do not and / or have not attended the Integrated Pest Management Field School (IPM field school) and do not apply the principles and components of Integrated Landscape Pest Management (ILPM field school) in their farming.

Retrieval of data by interview, observation, and note-taking methods. The types of data used are primary data and secondary data. The study was conducted for data from three growing seasons (February 2017-February 2018). The range of these months includes the rainy season, the first dry season and the second dry season). The data analysis method used in this research is :

1. Factors Affecting Rice Production

A regression analysis was performed using the Cobb-Douglas model and transformed into a natural logarithm for landscape IPM farmers as follows :

$$\ln Y1 = \beta 0 + \beta 1 \ln X1.1 + \beta 2 \ln X2.1 + \beta 3 \ln X3.1 + \beta 4 \ln X4.1 + \beta 5 \ln X5.1 + \beta 6 \ln X6.1 + \beta 7 \ln X7.1 + \beta 8 \ln X8.1 + \beta 9 \ln X9.1 + e \quad \text{......} (1)$$

In which :

- $Y1$ = Landscape IPM farmer rice production (kg)
- B_0 = Constant
- β_n = Regression coefficient
- $X_{1.1}$ = Land area of landscape IPM farmers (ha)
- $X_{2.1}$ = Age of landscape IPM farmers (years)
- $X_{3.1}$ = Landscape IPM farmer experience (years)
- $X_{4.1}$ = Use of landscape IPM farmer seeds (kg)
- $X_{5.1}$ = Use of landscape IPM farmer compost (kg)
- $X_{6.1}$ = Use of phonska fertilizer for landscape IPM farmers (kg)
- $X_{7.1}$ = Use of hired labor of landscape IPM farmers (HKO)
- $X_{8.1}$ = Use of the ratio of pest attack to land area in landscape IPM farmers (%)
- $X_{9.1}$ = Use of refugia flowers IPM farmers landscape (trees)
- e = Residual

Whereas for Non-landscape IPM farmers use the following model :

$$\ln Y2 = \beta 0 + \beta 1 \ln X1.2 + \beta 2 \ln X2.2 + \beta 3 \ln X3.2 + \beta 4 \ln X4.2 + \beta 5 \ln X5.2 + \beta 6 \ln X6.2 + \beta 7 \ln X7.2 + \beta 8 \ln X8.2 + e \quad \text{......} (2)$$

In which :

- $Y2$ = Non-Landscape IPM farmer rice production (kg)
- B_0 = Constant
- β_n = Regression coefficient
- $X_{1.2}$ = Land area of Non-Landscape IPM farmers (ha)
- $X_{2.2}$ = Age of Non-Landscape IPM farmers (years)
- $X_{3.2}$ = Non-Landscape IPM farmer experience (years)
- $X_{4.2}$ = Use of Non-Landscape IPM farmer seeds (kg)
- $X_{5.2}$ = Use of Non-Landscape IPM farmer compost (kg)

$X_{6.2}$ = Use of phonska fertilizer for Non-Landscape IPM farmers (kg)
$X_{7.2}$ = Use of hired labor of Non-Landscape IPM farmers (HKO)
$X_{8.2}$ = Use of the ratio of pest attack to land area in Non-Landscape IPM farmers (%)
$X_{9.2}$ = Use of refugia flowers Non-Landscape IPM farmers (trees)
e = Residual

2. Allocative Efficiency Analysis

The allocative efficiency of production factors is known by the value of MPV / Px or ki (efficiency index) of each significant production factor. The value of ki can be calculated by means of a formula :

$$Ki = \frac{Y.bi}{Xi}\frac{Py}{PXi} \quad (3)$$

In which :
bi = Regression coefficient (elasticity of production factor i)
Y = Production average (output)
Py = Product price average (output)
Xi = The average use of factors of production i
Pxi= The average price of the factors of production i

Ki was tested with a one sample t-test to determine the significant difference between the value of ki obtained and the value of ki = 1 as a control. The number 1 is used as a control because it is a number that indicates the efficient use of an input.

3. Factors Affecting Farming Income

The relationship between the output price and the income of rice farming was analyzed using multiple linear regression with the ordinary least square (OLS) method on the income function of the unit output price (UOP) of Cobb-Douglas as follows:

$$\ln Y^* = \ln A + \sum \alpha i \ \ln wi^* + \sum \beta j \ \ln Zj + \quad (4)$$

If the estimator model above is written in full for landscape IPM, it is as follows:

$$\ln Y1^* = \ln A + \alpha 1 \ \ln X1.1^* + \alpha 2 \ \ln X2.1^* + \alpha 3 \ \ln X3.1^* + \alpha 4 \ \ln X4.1^* + \alpha 5 \ \ln X5.1^* + \alpha 6 \ \ln X6.1^* + \beta 1 \ \ln X7.1 + e \ldots\ldots\ldots\ldots (5)$$

In which :
Y1* = Normalized landscape IPM farm income against output prices (Rp/kg)
lnA = Constants
αi = The expected variable input parameters, i = 1, 2, 3, 4, 5, and 6
βi = The presumed fixed input parameter, j = 1, 2
X1.1* = Normalized seed price for landscape IPM farmers against the output price (Rp/kg)
X2.1* = Normalized compost price for landscape IPM farmers against output prices (Rp/kg)
X3.1* = Price of phonska fertilizer to landscape IPM farmers normalized against the output price (Rp/kg)
X4.1* = Regent pesticide prices for landscape IPM farmers normalized against output prices (Rp/mL)
X5.1* = Dangke pesticide price to landscape IPM farmers normalized against output price (Rp/gr)
X6.1* = Wages of landscape IPM hired labor who are normalized against the price of output (Rp/HOK)
X7.1 = Land area (ha)
e = Residual

Whereas for Non-Landscape IPM farmers use the following model:

$$\ln Y2^* = \ln A + \alpha 1 \ \ln X1.2^* + \alpha 2 \ \ln X2.2^* + \alpha 3 \ \ln X3.2^* + \alpha 4 \ \ln X4.2^* + \alpha 5 \ \ln X5.2^* + \alpha 6 \ \ln X6.2^* + \beta 1 \ \ln X7.2 + e \ldots\ldots\ldots\ldots (6)$$

In which :
Y2* = Normalized non-landscape IPM farm income against output prices (Rp/kg)
lnA = Constants
αi = The expected variable input parameters, i = 1, 2, 3, 4, 5, and 6
βi = The presumed fixed input parameter, j = 1, 2
X1.2* = Normalized seed price for non-landscape IPM farmers against the output price (Rp/kg)
X2.2* = Normalized compost price for non-landscape IPM farmers against output prices (Rp/kg)
X3.2* = Price of phonska fertilizer to non-landscape IPM farmers normalized against the output price (Rp/kg)
X4.2* = Regent pesticide prices for non-landscape IPM farmers normalized against output prices (Rp/mL)
X5.2* = Dangke pesticide price to non-landscape IPM farmers normalized against output price (Rp/gr)
X6.2* = Wages of non-landscape IPM hired labor who are normalized against the price of output (Rp/HOK)

$X_{7.2}$ = Land area (ha)
e = Residual

4. Impact of IPM field school on the Use of Chemical Pesticides

The impact of IPM field school on the use of chemical pesticides is known by regression analysis using the following Ordinary Least Square (OLS) method:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \delta DIPM\ field\ school + e \quad \text{.......... (7)}$$

In which :

Y = The use of chemical pesticides by farmers in Klaten Regency (ml)
β_0 = Constants
β_n = Regression coefficient
X_1 = The price of chemical pesticides (Rp/ml)
X_2 = Ratio of pest attacks to land area (%)
DIPM field school = Dummy variable, D = 1 for the category of farmers who participated in IPM field school and D = 0 for the category of farmers who did not participate in IPM field school
e = Residual

RESULT AND DISUSSION

1. Production and Revenue of Rice Farming

Table 1 explains that the average production of landscape IPM rice farmers is higher than the average production of non-landscape IPM rice farmers with a difference of 4,290.99 kg with the form of dry grain harvested per hectare in one year. This makes landscape IPM rice farmers have higher revenue than non-landscape IPM rice farmers. The introduction of the landscape IPM program by the Klaten Regency Government in 2017 was able to make farmers implementing landscape IPM get more revenue than farmers who did not apply it. Table 2 shows that landscape IPM farming income is higher than non-landscape IPM farm income. This can be influenced by differences in yields where landscape IPM farms get higher yields. Even so, the average total costs incurred by landscape IPM farmers are also higher. However, the difference is not as big as the difference in average revenue.

Non-landscape IPM farmers are advised to apply landscape IPM principles because they can have a greater impact on the ecosystem in Klaten Regency. These impacts include avoiding the environment from pollution due to chemical pesticides and preventing farmers from the dangers of diseases that can be caused by inhaling chemical pesticides. In addition, farm income can increase.

Table 1. Average Production and Revenue of Rice Farming per ha in One Year

Components	IPM field school farmers (n=30)	Non IPM field school farmers (n=30)	Difference
Production (Kg)	22.494,50	18.203,51	4.290,99
Price average (Rp/Kg)	4.200	4.200	0
Revenue (Rp)	94.476.918	76.454.755	18.022.100

Source : Primary Data Analysis, 2019

Table 2 Average Rice Farm Income per ha in One Year

Components	IPM field school farmers (Rp)	Percentage of Total Cost (%)	Non IPM field school farmers (Rp)	Percentage of Total Cost (%)
Revenue	94.477.918		76.454.755	
Variable cost				
Seed	2.269.077	8,68	1.913.702	8,04
Fertilizer	5.001.068	19,14	6.386.527	26,84
Labor	9.424.674	36,07	8.396.612	35,28
Total Variable Cost	16.694.819		16.696.841	
Fixed cost				
Land rental cost	3.091.233	11,83	2.246.256	9,44
Land tax cost	146.273	0,56	102.413	0,43
Total Fixed Cost	3.237.506		2.348.669	

Miscellaneous expense				
Profit Sharing	2.210.216	8,46	1.075.603	4,52
Selamatan	383.565	1,47	237.105	1,00
Water Fee	519.401	1,99	588.602	2,47
Suck Water	526.216	2,01	895.591	3,76
Tool Repair	64.311	0,25	13.519	0,06
Fuel	817.319	3,13	228.952	0,96
Total Miscellaneous Expense	4.521.028		3.039.372	
Pesticide	1.515.298	5,80	1.854.696	7,75
Refugia Flower	169.051	0,65	-	-
Total Cost	26.137.701	100,00	23.939.578	100,00
Income	68.339.216		52.515.178	

Source : Primary Data Analysis, 2019

2. Factors Affecting Rice Production

Regression analysis was carried out to determine the factors that influence rice production in Klaten Regency, which then can be seen from the model accuracy test, F test, and t test (Table 3).

Tabel 3. Results of Regression Analysis on Factors Affecting Rice Production in Landscape IPM and Non-Landscape IPM Farming

Variable	*Expected Sign*	IPM field school farmers (n=30)		Non IPM field school farmers (n=30)	
		Regression Coefficient	Significant t	Regression Coefficient	Significant t
Constant	+/-	0,826 ns	0,508	5,671**	0,008
lnLandArea	+	0,842**	0,000	0,671**	0,000
lnAges	-	0,202 ns	0,415	-0,587 ns	0,211
lnExperience	+	0,001 ns	0,987	-0,052 ns	0,670
lnSeed	+	0,143*	0,049	-0,048 ns	0,467
lnCompostFertilizer	+	-0,016 ns	0,389	0,019 ns	0,647
lnPhonskaFertilizer	+	0,009 ns	0,654	0,025 ns	0,667
lnHiredLabor	+	-0,017 ns	0,617	0,120 ns	0,273
lnRatioAttack	-	-0,038 ns	0,221	-0,042 ns	0,686
lnRefugiaFlower	+	-0,011 ns	0,429	-	-
F-value		48,555**		5,355**	
F significant		0,000		0,001	
Adjusted R^2		0,937		0,546	

Explanation: ns: not significant; **: significant at α = 1%; *: significant at α = 5%

To explain the contents of the table, it can be detailed as follows:

a. Testing the accuracy of the model

The regression model analyzed for landscape IPM rice farmers had an adjusted R^2 value of 0.937 or 93.7% (Table 3). This value shows that the independent in the form of land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, refugia flower plants, and the ratio of pest attacks to land area can explain 93.7% of the variation of the dependent variable, the rice production.

Meanwhile, 6.3% of the variable variation is explained by other variables that are not included in the model. The regression model analyzed for non-landscape IPM rice farmers had an adjusted R^2 value of 0.546 or 54.6% (Table 3.). This value shows that the independent variables in the form of land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, and pest attacks on land area can explain 54.6% of the variation of the dependent variable, the rice production. Meanwhile, 45.4% of the variable variation is explained by other variables that are not included in the model.

b. F test

Table 3 shows that the F-value for landscape IPM rice farmers is 48.555 and a significant F value for 0.000 ($p < 0.01$). This means that the independent variables in the form of land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, refugia flowers, and pest attacks on land area together significantly influence the dependent variable in the form of rice production. The F-value for non-landscape IPM rice farmers is 5.355 and a significant F value is 0.001 ($p < 0.01$). This means that the independent variables in the form of land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, and pest attacks on land area together significantly influence the dependent variable in the form of rice production.

c. T test

Variables that have a significant effect on landscape IPM rice farmers are land area and seeds. Meanwhile, the variables that have a significant effect on non-landscape IPM rice farmers are constants and land area. This is similar to research by Mahananto et al. (2009); Salsinha (2005); and Suzana (2011) which states that land area partially affects significantly. Suzana (2011) also reported that the use of seeds has a significant effect.

1. Constant

Based on the results of the regression analysis in Table 3, it can be seen that the IPM landscape rice farmers have a significant t value of 0.508 (p> 0.1) while the regression coefficient value is 0.826. This indicates that the constant does not have a significant effect on landscape IPM rice production. Meanwhile, non-landscape IPM rice farmers have a significant t value of 0.008 (p <0.01) while the regression coefficient value is 5.671. This indicates that the constant has a significant effect on non-landscape IPM rice production. This value states the minimum production of non-landscape IPM farmers if all independent variables are zero, then it is exponential (5,671) or 290,325 kg per hectare.

2. Land area

The significant t value for the land area of landscape PHT rice farmers is 0.000 (p <0.01), which means that land area has an individually significant effect on rice production. The land area regression coefficient of 0.842 means that each additional 1% of the land area used will cause an increase in rice production by 0.842%. Meanwhile, the significant t value for the land area of non-landscape IPM rice farmers is 0.000 (p <0.01), which means that land area has an individually significant effect on rice production. The land area regression coefficient of 0.671 means that each additional 1% of the land area used will cause an increase in rice production by 0.671%. The positive coefficient value indicates that the wider the planted area will increase rice production. The land area factor is a production factor with the highest production elasticity (0.842) compared to other variables and is in a rational area (0> x> 1) so that the expansion of planted land will significantly increase rice production. Increasing land area can be done by extensification of rice fields in the same topography.

3. Age

The significant t value for the age of landscape IPM rice farmers is 0.415 (p> 0.1), which means that the age of farmers does not have an individually significant effect on rice production. Meanwhile, the significant t value for the age of non-landscape IPM rice farmers is 0.211 (p> 0.1), which means that the age does not have an individually significant effect on rice production. In this study it has been stated that there are productive and unproductive ages. The productive age of landscape IPM rice farmers is 80% and non-landscape IPM rice farmers 63% shows no significant effect on rice farming production. This is because most of the landscape IPM and non-landscape IPM farmers are older than 55 years of age, so they are approaching unproductive age and their farming abilities are decreasing.

4. Farmer’s experience

The experience of the farmer in question is the experience of the farmer in units of years in working on farming. The significant t value for the experience of landscape IPM rice farmers is 0.987 (p> 0.1), which means that the experience of farmers does not have an individually significant effect on rice production. Meanwhile, the significant t value for the experience of non-landscape IPM rice farmers is 0.670 (p> 0.1), which means that the experience of farmers does not have an individually significant effect on rice production. With this result, the longer the farmer's experience in farming cannot be said to have a significant effect on rice productivity. This is because around 30% of landscape and non-landscape IPM farmers have relatively young experience in 1-20 years who still lack the experience to adopt new innovations.

5. Seed

The significant t value for the seeds of landscape IPM rice farmers is 0.049 (p <0.05), which means that seeds have an individually significant effect on rice production. The seed regression coefficient of 0.143 means that every 1% addition of seeds used will cause an increase in rice production by 0.143%. The 0.143 figure shows that the elasticity of production is at 0 <Ep <1, which means that the addition of seed use is still rational. In this area, the maximum income can be achieved because by using optimal input, optimal production and maximum income can be obtained (Debertin, 2012). Meanwhile, the significant t value for the seeds of non- landscape IPM rice farmers was 0.467 (p> 0.1), which means that individual seeds did not have an individually significant effect on rice production. This is due to many things such as the quality of the seeds is not the best, rice tillers are attacked by pests and diseases due to the way of cultivating plants that are reluctant to adopt new innovations.

6. Compost fertilizer

The significant t value for compost fertilizer of landscape PHT rice farmers is 0.389 (p> 0.1), which means that compost fertilizer does not have an individually significant effect on rice production. Meanwhile, the significant t value for non-landscape IPM rice farmers compost is 0.647 (p> 0.1), which means that compost fertilizer does not have an individually significant effect on rice production. This is because a lot of compost fertilizer is leached out when it is applied, so it is not effective. In fact, soil that is used continuously or is not rested for several months will reduce its fertility due to the low availability of nutrients. The availability of nutrients in the soil acts as a source of nutrition for rice plants so that production can be maximized.

7. Phonska fertilizer

The significant t value for phonska fertilizer for landscape PHT rice farmers was 0.654 (p> 0.1) so that H_o failed to be rejected, which means that phonska fertilizer does not have an individually significant effect on rice production. Meanwhile, the significant t value for phonska fertilizer for non-landscape IPM rice farmers was 0.667 (p> 0.1), which means that phonska fertilizer does not have an individually significant effect on rice production. This is because many phonska fertilizers are leached out when applied, so they are not effective. In fact, land that is used continuously or is not rested for several months will reduce its fertility due to the low availability of nutrients. The availability of nutrients in the soil acts as a source of nutrition for rice plants so that production can be maximized. Therefore, knowledge of sufficient water management for rice growth is needed so that the water does not become too much or too little which causes the soil to become acidic.

8. Hired labor

The significant t value for hired labor of landscape PHT rice farmers is 0.617 (p> 0.1), which means that hired labor does not have an individually significant effect on rice production. Meanwhile, the significant t value for hired labor of non-landscape IPM rice farmers was 0.273 (p> 0.1), which means that hired labor does not have an individually significant effect on rice production. This is because not all of hired labors are skilled in planting seeds or are precise in providing fertilizer, and they are not careful when milling when harvesting so that a lot of dry unhulled rice is wasted.

9. The ratio of pest attacks to land area

The significant value of t for the ratio of pest attack to land area of landscape IPM rice farmers is 0.221 (p> 0.1), which means that the ratio of pest attack to land area in farmers' paddy fields does not have an individually significant effect on rice production. Meanwhile, the significant t value for the ratio of pest attack to land area of non-landscape IPM rice is 0.686 (p> 0.1), which means that the attack of pests on the land area of farmers' paddy fields does not have an individually significant effect on rice production. This is due to the fact that the attack population is not so high in a wide expanse of rice fields so that pests can still be controlled by natural enemies around the rice fields. In addition, farmer groups regularly hold meetings with agricultural extension workers so that they still get a lot of input in controlling pest populations.

10. Refugia flower

Refugia flowers are used as an independent variable on the implementation of the landscape IPM program in rice farming in Klaten Regency. The significant t value for refugia flowers applied by landscape IPM rice farmers is 0.429 (p> 0.1), which means that individual refugia plants do not have a significant effect on rice production.

Refugia flowers are supposed to be useful in controlling pests such as brown planthoppers and stem borer to maintain rice growth. However, until now it has not been widely planted in every paddy embankment. Only the bunds that have been planted with refugia flowers are on the side of the hamlet road. There are still many farmers in Klaten Regency who have not participated in the landscape IPM program and local people who do not understand the function of planting refugia flowers on rice fields. Many people think that these flowers are planted only to add to the aesthetics of agricultural land. Therefore, the effect is insignificant on production. On the other hand, due to a lack of understanding of the function of refugia, not a few refugia flowers were damaged as a result of their growth being disturbed by the local community.

3. Allocative Efficiency Analysis

Allocative efficiency relates to how to regulate the use of factors of production in such a way that the marginal product value of an input equals the price of the factor of production. This condition can maximize the profits obtained by farmers. This analysis is carried out by looking for the marginal product value (MPV) and the production factor price (Px). The efficiency of input use is obtained if the marginal product value (MPV) for input use equals the price of the input.

After analyzing separately for each sample farmer (landscape IPM rice farmers and non-landscape landscape IPM) farmers in Klaten District, the significant production factors for landscape IPM rice farmers were land area and seed. Meanwhile, the significant production factors for landscape IPM rice farmers are land area. Table 4 shows the efficiency index value (ki) of each production factor from rice farming of the landscape IPM and non-landscape IPM rice farmer groups. The value of ki of all factors of production is not equal to one (1). This means that the production factor is inefficient. The value of ki for each factor of production was then tested using the one sample t-test.

Table 4. Results of the Analysis of Allocative Efficiency of Rice Farming for Landscape IPM Farmers and Non-Landscape IPM Farmers

Variable	MPVxi	Pxi (Rp.)	ki	*Probability*	Explanation

Landscape IPM					
Land Area (m^2)	8.785,09	1.818	4,83*	0,000	Inefficient
Seed (kg)	75.593,54	11.160	7,02*	0,000	Inefficient
Non- Landscape IPM					
Land Area (m^2)	5.497,56	1.818	3,02*	0,000	Inefficient

Explanation: MPVxi = The marginal product value of the i production factor; Pxi = Price of i production factor; ki = The value of the allocative efficiency index; * : significant at α = 1%

1. Landscape IPM Farmers

1.) Allocative Efficiency of Land Area

Table 4 shows the MPVx / Px of land use area has a ki value of 4.83, which is greater than 1 and then analyzed by one sample t-test to determine the level of significance. The results of this analysis indicate a probability t-count of 0.000 (p <0.01), which means that the use of land area is allocatively inefficient. With this, the agricultural extension workers should appeal to farmers to increase the use of land area for rice farming. One of them is by extensification. The inefficient use of this land area is due to the small land ownership of farmers in the study area with an average land area of 0.54 ha. Judging from the regression coefficient for land area of 0.840, which means that the elasticity of production (Ep) is between zero and one, then the elasticity of production is in the rational area. This means that it is possible to increase the area of land planted with rice which can make the use of land area allocatively efficient so that it can increase rice farming income to its maximum condition. The addition of land area of 1 m^2 will increase the income of rice farming by Rp 1,818.

These results are similar to the research of Suzana et al (2011) which states that rice farming in Bolaang Mongondow Regency is significantly influenced by land area. However, the use of the land area production factors is not allocatively efficient. With this, farmers need to increase the area of land to increase production and income of rice farming.

2.) Seed Number Allocative Efficiency

The use of input for the number of seeds in landscape IPM rice farming in Klaten Regency is considered inefficient. This is evidenced by the value of MPVx / Px obtained at 7.02 where this value is greater than 1, meaning that the use of the number of seeds is allocatively inefficient. If seen from the t test probability value, which is equal to 0.001 (p <0.01), which means that the seed input is inefficient. With this, agricultural extension workers should appeal to farmers to add superior quality seeds and apply the principle of IPM in a wider landscape to prevent pest attacks from reducing production yields. With this the use of seeds can be allocatively efficient. Judging from the seed regression coefficient of 0.156, which means that the elasticity of production (Ep) is between zero and one, the elasticity of production is in the rational area. This means that the addition of seeds can make efficient use of seeds allocatively so as to increase the income of rice farming to reach its maximum condition. The addition of 1 kg of land seeds will increase the income of rice farming by Rp 75,593.

These results are similar to those of Wibowo (2012). From the analysis of the allocative efficiency of the use of rice production factors, it shows that the allocation of seed use is 1.24 kg / ha with a yield of more than 1, so it is not allocatively efficient. In order to use rice farming seeds efficiently, it is necessary to increase the seed allocation of 59.58 kg / ha.

2. Non Landscape IPM Farmers

1.) Allocative Efficiency of Land Area

The efficiency index value (ki) of land area for Non-IPM farmers is 2.86 or more than 1. This value of ki is then analyzed by t test. Analysis of the test value of ki yields the number 0.000 (p <0.01) which means rejected, which means that the use of land area is allocatively inefficient. The average land area used by IPM farmers is 0.54 Ha. With this, in its use, agricultural extension workers appeal to farmers to use IPM farmers' land to expand extensification to get optimal income. Judging from the regression coefficient of 0.620, which means that the elasticity of production (Ep) is between zero and one, the elasticity of production is in the rational area. This means that the additional land area planted with rice can use the land to be allocatively efficient so that it can increase the income of rice farming to reach its maximum condition. Additional land area of 1 m^2 will increase farm income by Rp 1,818.

4. Factors Affecting Farm Income

Regression analysis was carried out to determine the factors that affect the income of rice farming in Klaten Regency. It can be seen from the model accuracy test, the F test, and the t test (Table 5). To explain the contents of Table 5, it can be detailed as follows:

a. Model accuracy test

The regression model analyzed for non landscape IPM rice farmers had an adjusted R^2 value of 0.741 or 74.1% (Table 5). This value indicates that the independent variables in the form of land area, seeds, organic fertilizers, inorganic fertilizers, and TKLK can explain 74.1% of the variation of the dependent variable, namely rice farming income. Meanwhile, 25.9%

of variable variation is explained by other variables not included in the model.

The regression model analyzed for non-landscape IPM rice farmers had an adjusted R^2 value of 0.598 or 59.8% (Table 5). This value shows that the independent variables in the form of land area, seeds, organic fertilizers, inorganic fertilizers, and TKLK can explain 59.8% of the variation of the dependent variable, namely rice farming income. Meanwhile, 40.2% of the variable variation is explained by other variables not included in the model.

Table 5. Results of Regression Analysis on Factors Affecting Rice Farming Income for Landscape IPM Farmers and Non-Landscape IPM Farmers

Variable	*Expected Sign*	IPM field school farmers (n=30)		Non IPM field school farmers (n=30)	
		Regression Coefficient	Significant t	Regression Coefficient	Significant t
Constant	+/-	1,151 ^{ns}	0,401	0,437 ^{ns}	0,86
lnSeedPrice	-	0,301 ^{ns}	0,352	-0,495**	0,007
lnCompostFertilizerPrice	-	-0,201 ^{ns}	0,723	2,795 ^{ns}	0,122
lnPhonskaFertilizerPrice	-	0,204 ^{ns}	0,818	-2,312 ^{ns}	0,164
lnHiredLaborWage	-	-0,653*	0,087	1,039 ^{ns}	0,308
lnRegentPesticidePrice	-	0,044 ^{ns}	0,682	0,712 ^{ns}	0,465
lnDangkePesticidePrice	-	-0,021 ^{ns}	0,830	3,787 ^{ns}	0,137
lnLandArea	+	1,043**	0,000	0,798**	0,000
F-value		12,865**		7,162**	
F significant		0,000		0,000	
Adjusted R^2		0,741		0,598	

Explanation: ^{ns} : not significant; ** : significant at α = 1%; * : significant at α = 10%

b. F test

Table 5 states that the F-count value for landscape IPM rice farmers is 12.864 and the F significance is 0.000 (p <0.01). This means that the independent variables in the form of land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages together significantly influence the dependent variable in the form of rice farming income.

The F-count value for non-landscape IPM rice farmers is 7,162 and the probability is 0,000 (p <0.01). This means that the independent variables in the form of land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages together significantly influence the dependent variable in the form of rice farming income.

c. T test

Variables that have an individually significant effect on non landscape IPM rice farmers are land area and TKLK wages. Meanwhile, the variables that have an individually significant effect on non-landscape IPM rice farmers are land area and seed price. This is similar to Desmon's (2018) research which states that land area and seed prices also have a significant effect on rice farming income.

d. F test

Table 5 states that the F-count value for non-landscape IPM rice farmers is 12.864 and the F significance is 0.000 (p <0.01). This means that the independent variables in the form of land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages together significantly influence the dependent variable in the form of rice farming income.

The F-count value for non-landscape IPM rice farmers is 7,162 and the probability is 0,000 (p <0.01). This means that the independent variables in the form of land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages together significantly influence the dependent variable in the form of rice farming income.

e. T test

Variables that have an individually significant effect on non landscape IPM rice farmers are land area and hired labor wages. Meanwhile, the variables that have an individually significant effect on non-landscape IPM rice farmers are land area and seed price. This is similar to Desmon's (2018) research which states that land area and seed prices also have a significant effect on rice farming income.

1. Constant

Based on the results of the regression analysis in Table 5, it can be seen that the landscape IPM rice farmers have a significant t value of 0.401 (p> 0.1). This indicates that the constant does not have a significant effect on the income of landscape IPM rice farming. Meanwhile, non-landscape IPM rice farmers had a significant t value of 0.860 (p> 0.1). This indicates that the constant does not have a significant effect on the income of non-landscape IPM rice farming.

2. Seed Price

The significant t value for the seed price of landscape PHT rice farmers is 0.352 (p> 0.1), which means that the individual seed price does not have a significant effect on farm income. This is because landscape IPM farmers do not all depend on one seed brand and often change the type of seed in each planting season. Meanwhile, the significant t value for the seed price of non-landscape IPM rice farmers was 0.007 ($p < 0.01$), which means that the individual seed price had a significant effect on rice farming income. The seed price regression coefficient of 0.495 means that every 1% increase in the price of seeds used will cause a decrease in farm income by 0.495%. This decrease is due to the fact that seeds are an important and always used input. Farmers will experience a decrease in farm income due to the use of fewer seeds or a decrease in the purchasing power of farmers for seeds. According to farmers, the increase in seeds is generally from Rp. 50,000 to Rp. 55,000. In addition, if the price of seeds rises, farmers buy rice seeds labeled white, which means that the first broodstock is then self-bred so that they have sufficient seeds in the changing season. In addition, farmers make an agreement with a seed selling agent in which the seedlings from the broodstock are also bought back by the agent. The quality of broodstock and chicks according to farmers will be the same. Sometimes, if the yields are good, the farmers will use the seeds. In this way, farmers save costs and can increase rice farming income or increase farming capital costs to buy production inputs

3. Compost Fertilizer Price

The significant t value for the price of landscape PHT rice farmers compost is 0.723 ($p > 0.1$), which means that the price of compost individually does not have a significant effect on farm income. Meanwhile, the significant t value for the price of landscape compost for rice farmers is 0.122 ($p > 0.1$), which means that the price of individual compost does not have a significant effect on rice farming income. This is because farmers can buy fertilizers with other trademarks in one planting season and do not depend on certain brands so that they are not too affected by the increase in the price of one type of fertilizer brand.

4. Phonska Fertilizer Price

The significant value of t for the price of phonska fertilizer for landscape PHT rice farmers is 0.818 ($p > 0.1$), which means that individual phonska fertilizer has no significant effect on farm income. Meanwhile, the significant t value for phonska fertilizer for non-IPM landscape rice farmers was 0.164 ($p > 0.1$), which means that individual phonska fertilizer had no significant effect on rice farming income. This is due to the many variations in other types of compound fertilizers as well as a mixture of various elements that can replace the type of compound fertilizer with the Phonska trademark. This condition allows farmers to choose various fertilizers to apply so that they are not affected by the increase in the price of phonska fertilizer.

5. Hired Labor Wage

The significant t value for the hired labor wages of landscape IPM rice farmers is 0.087 ($p > 0.1$), which means that individual hired labor wages have a significant effect on rice farming income. The hired labor wage regression coefficient of 0.087 means that every 1% addition of hired labor wages used will cause a decrease in farm income by 0.087%. This is because the use of HKO that is used tends to be fixed from season to season so that they have to pay the wages per HKO. If the hired labor wages increase, the expenditure for using hired labor will increase, thereby reducing rice farming income. Generally, the increase in the hired labor per HKO wage was caused by the increase in prices for daily necessities such as gasoline, diesel, rice, and so on. This increases labor costs so that farm income can decrease. Meanwhile, the significant t value for hired labor wages of non-landscape IPM rice farmers was 0.308 ($p > 0.1$), which means that individual hired labor wages did not have a significant effect on rice farming income. This is due to the behavior of non-landscape IPM farmers who replace hired labor when there is an increase in wages by inviting family members or choosing to do it themselves.

5. Regent Pesticide Price

The pesticide in question is a regent brand that is used to reduce the population of insect pests such as brown planthoppers. The significant t value for regent pesticide prices for landscape PHT rice farmers is 0.682 ($p > 0.1$), which means that the price of regent pesticides individually does not have a significant effect on rice farming income. Meanwhile, the significant t value for the price of regent pesticide for non-landscape IPM rice farmers is 0.465 ($p > 0.1$), which means that the price of regent pesticides individually does not have a significant effect on rice farming income. This condition occurs because farmers do not depend on certain brands of chemical pesticides. If the population of insect pests increases, farmers still have many choices of liquid pesticides due to the ease of purchasing access to the presence of agricultural shops in the village.

6. Dangke Pesticide Price

The solid pesticide referred to in this study is the dangke brand which is used to reduce the caterpillar population in rice plants. The significant value of t for the pesticide price for dangke rice farmers in landscape PHT is 0.830 ($p > 0.1$), which means that the price of dangke pesticide individually does not have a significant effect on rice farming income. Meanwhile, the significant t value for the price of dangke pesticide for non-landscape IPM rice farmers is 0.137 ($p > 0.1$), which means that the price of dangke pesticide individually does not have a significant effect on rice farming income. This condition occurs because farmers do not depend on certain brands of chemical pesticides. If the caterpillar pest population increases, farmers still have many choices of liquid pesticides due to the ease of purchasing access to the presence of agricultural shops in the village.

7. Land Area

The significant t value for the land area of landscape IPM rice farmers is 0.000 (p <0.01), which means that individual land area has a significant effect on farm income. The land area regression coefficient of 1.087 means that every 1% addition of planted land area will cause an increase in farm income by 1.087%. Meanwhile, the significant t value for the land area of non-landscape IPM rice farmers is 0.000 (p <0.01), which means that individual land area has a significant effect on farm income. The land area regression coefficient of 0.798 means that every 1% addition of planted land area will cause an increase in farm income by 0.798%. The increase in the area of land being planted has made it possible to plant more rice seeds so that the rice has more rice tillers. That way, the resulting production has the potential to increase, thereby increasing income. The increase in land area to be planted with rice must be accompanied by the same monitoring of farmers when they have more land area. That way, the increase in land area can increase farm income.

5. Impact of IPM Field Study on the Use of Chemical Pesticides

In this study, a regression analysis was carried out to determine the impact of IPM field study on the use of chemical pesticides in Klaten Regency, which can then be seen from the model accuracy test, F test, and t test (Table 6). To explain the contents of Table 6, it can be detailed as follows:

a. Model accuracy test

The regression model analyzed for landscape IPM rice farmers had an adjusted R^2 value of 0.608 or 60.8% (Table 6). This value shows the use of chemical pesticides in the regression model can be explained by the variable price of chemical pesticides, the ratio of pest attacks to land area, and the application of landscape IPM by 60.8%. While the remaining 39.8% is explained by other variables not included in the model. Other variables can be in the form of weather factors, natural enemies of pests (predators and parasites), and other methods of pest management.

Table 6. Results of Regression Analysis of the Impact of IPM FIELD SCHOOL on the Use of Chemical Pesticides in Rice Farming in Klaten Regency

Independent Variable	Coefficient	Significant t
Constant	206,368	0,114
Chemical Pesticide Price (Rp/ml)	-0,281*	0,098
Ratio of Pest Attack to Land Area (%)	11,894**	0,000
Dummy	-237,371**	0,003
F-value	31,483**	
F significant	0,000	
Adjusted R^2	0,608	

Explanation: ^{ns} : not significant; ** : significant at α = 1%; * : significant at α = 10%

b. F test

Table 6 states that the F-count value in the regression model is 31.483 and a significant F is 0.000 (p <0.01). Simultaneously, the use of chemical pesticides is significantly influenced by the price of chemical pesticides, the ratio of pest attack to land area, and the application of landscape IPM.

c. T test

Partial test is conducted to determine whether each independent variable affects the dependent variable. Variables that have a significant effect on income can be shown from the probability value t by comparing with α (1%; 5%; and 10%). If the probability of t is smaller than α, then this variable has a significant effect on production. The variables that have a significant effect on the OLS regression model are the price of chemical pesticides, the ratio of pest attack to land area and the dummy variable of landscape IPM. This result is similar to the research of Irham and Mariyono (2001) which states that pest attacks and the ratio of chemical pesticide prices and rice prices also significantly influence the use of chemical pesticides.

1. Chemical pesticide price

The significant value of t for the price of chemical pesticides is 0.098 (p <0.1), which means that the price of chemical pesticides individually has a significant effect on the use of chemical pesticides. Partially, ceteris paribus, if the price of chemical pesticides increases by Rp 1/ml, the use of chemical pesticides for farming will decrease by 0.281 ml.

According to the head of the farmer group, farmers often try to use chemical pesticides that are newly emerging with higher prices, such as the Sigenta brand which generally works systemically. However, this is the last choice of farmers if the population of the brown planthopper and stem borer cannot be reduced. Farmers think that by buying these pesticides and applying them with a higher dose, the farmers will be able to drastically reduce the pest population. Previously, farmers also often tested these pesticides in demonstration plots that had been arranged in such a way that farmers would understand which chemical pesticides were the most effective.

2. The ratio of pest attacks to land area

The significant t value for the ratio of pest attack to land area is 0.000 ($p < 0.01$), which means that the ratio of pest attack to land area individually has a significant effect on the use of chemical pesticides. Partially, ceteris paribus, if the ratio of pest attack to land area increases by 1%, the use of chemical pesticides for farming will increase by 11.894 ml.

Pest attack is uncertain, which happens unpredictably. To find out if there are pests, it is necessary to conduct regular land observations. This is in accordance with the principle of landscape IPM, which is weekly observations at a landscape scale not only on their own plots so that farmers become managers / experts in their own land and must collaborate intra and inter groups in one stretch as well as the local government (Ministry of Agriculture, 2017).

3. *Dummy*

The significant t value for the dummy is 0.000 ($p < 0.01$) which means that there is a significant difference in the use of chemical pesticides between farmers who follow IPM FIELD SCHOOL and do not follow IPM FIELD SCHOOL. With this, ceteris paribus, it can be seen that the use of chemical pesticides by farmers who follow IPM FIELD SCHOOL is less than farmers who do not follow IPM FIELD SCHOOL.

The concept of the use of chemical pesticides introduced in landscape IPM technology is to consider pest attacks in making decisions on the use of chemical pesticides (Untung, 1984). If there is no attack, there should be no need to use chemical pesticides because it is a waste of expense. According to farmers' information, farmers often reduce the use of chemical pesticides to control the brown planthopper pest population. This difference is possible because landscape IPM farmers are also helped by planting refugia plants so that the preservation and utilization of natural enemies through ecosystem engineering can reduce pest attacks. Apart from the brown planthopper pest, farmers still use chemical pesticides such as to reduce stem borer caterpillars, weeds, and rat pests.

Farmers are always overshadowed by various uncertain factors, both regarding the production of their crops as well as about pests and the marketing of their agricultural products. The uncertainty factor is due to the risk of failure due to weather, pest and disease attacks, and inappropriate prices. In terms of pest and disease attacks, to reduce and avoid failure, farmers tend to use chemical pesticides. The uncertainty factor is often considered by experts as the main driver of increased pesticide use (Untung, 1984). Farmers consider pesticide treatment as a kind of insurance / guarantee for the success of their farming.

IPM FIELD SCHOOL in Klaten Regency is carried out with monthly associations of each farmer group accompanied by field extension officers (PPL). With this, farmers need to be advised by field extension officers (PPL) that the application of chemical pesticides can only be done when there is a massive pest attack. In addition, it is hoped that farmers will consider pest attacks in the use of pesticides and increase the area of application of landscape IPM. Thus, it is hoped that farmers will not use pesticides when there are no pests.

CONCLUSIONS AND SUGGESTIONS

1. Conclusions

a. The factors land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, refugia flowers, and pest attacks on land area together significantly influence the rice production in landscape IPM farming, meanwhile the factors that influence the rice production in non-landscape IPM are land area, age, farmer experience, seeds, organic fertilizers, inorganic fertilizers, hired labor, and pest attacks on land area.
b. The factors land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages together significantly influence the rice farming income in landscape IPM farming, meanwhile the factors that influence the rice farming income in non-landscape IPM farming are land area, seed price, organic fertilizer price, inorganic fertilizer price, and hired labor wages.
c. The increase in the price of seeds and the wages of workers outside the family can reduce the income of rice farming. Meanwhile, the addition of land area can increase rice farming income.
d. IPM field school has an impact in the form of less use of chemical pesticides by farmers.

2. Suggestions

a. Rice farmers in Klaten Regency are advised to apply the principle of integrated landscape pest management because it can reduce the use of pesticides, which has the potential to increase rice farming income.
b. It is suggested that agricultural extention workers should urge landscape IPM rice farmers in Klaten Regency to increase the use

of planted land area and use of seeds to achieve allocative efficiency so as to increase rice farming income. Meanwhile, non-landscape IPM rice farmers should increase the area under cultivation.

c. It is recommended that agricultural extention workers provide assistance on the principles and components of landscape IPM with a longer time for farmer groups in Klaten Regency so that farmers apply chemical pesticides only when there is a massive pest attack.

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