Agroland: The Agriculture Science Journal, 2015 June 2(1) :14 – 21 **ISSN : 2407 – 7585**
E–ISSN : 2407 – 7593

OPTIMIZATION OF PADY FARMING SRI METHOD (System of Rice Intensification) IN NGOMBOL PURWOREJO

Istiko Agus Wicaksono[1)], Dyah Panuntun Utami[1)], Isna Windani[1)] dan Erny[2)]

[1)] Lecturer and researcher at Department of Agribusiness, Faculty of Agriculture, University of Muhamadiyah, Purworejo.
[2)] Lecturer and researcher at Department of Agribusiness, Faculty of Agriculture, University of Tadulako, Palu.
Email: dyah_put@yahoo.com

ABSTRACT

This study is aimed to determine: 1) The income level of rice farming using SRI method in Ngombol, Purworejo, 2) The allocation of optimal resources of rice farming SRI method in Ngombol, Purworejo, and 3) the effect of changing in input and output prices to optimal resource allocation. The method used is descriptive analysis method with 20 farmers as samples/respondents and implementing interview method using questionnaires. The study was conducted in the village names Ringgit, Ngombol, Purworejo. Study sites was selected by purposive sampling considering that Ngombol is the district with the highest rice production in Purworejo and Ringgit has been long time using SRI method, since 2003. This study were applying: 1) Analysis of the actual farm income, 2) QRP (Risk Quadratic Programming) Model Analysis, and 3) Sensitivity Analysis. The analysis showed that the average production of paddy SRI system A is greater than system B, but for the average cost of system B is higher but for the income system B is smaller than A. This illustrates that SRI paddy farming systems A more advantageous compared to systems B; Optimization analysis results indicate that from the average of the actual land area of 1.81 ha of activity that appears on the optimal cropping pattern farming area system A 1.27 ha and system B at 0.54 ha. Meanwhile, the system A selected as optimal farming pattern with the highest optimal cropping patterns, The results of the optimization analysis also showed that the land and labor resources are still abundant or excessive, where as capital resources are limited. The results of the sensitivity analysis shows that increase and decrease in input prices and output prices both partially and simultaneously for 5-15% do not affect the optimal allocation of resources, but only affects the risk of SRI paddy farming. The increase of input prices is the higher risk faced by rice farmers SRI and other wise higher selling price of output become smaller risk faced by farmers.

Key Words: Optimization, Risk Quadratic Programming, SRI.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the main agricultural crop in Indonesia as a staple food source of the most Indonesian population. Paddy also a crops cultivated by most farmers in Indonesia. Indonesia on Pelita IV (government program), achieved sufficiency on rice. One of the effort is manage agricultural lands as well as possible to increase agricultural output by using Sapta Farming is proper agriculture land management, watering regularly, selecting seeds, fertilizing, pest control and plant diseases, post-harvest processing and marketing. Purworejo Goverment is one of district that implemented System of Rice Intensification (SRI) in order to increase rice production. The government of Purworejo currently has been empowering farmers using SRI methods.

This method has several advantages which can produce more bud, easier maintenance of paddy farms, the plants will be exposed to full sunlight because there is a distance between plants, seed saving and pest control. Kecamatan Ngombol is a district which has great harvested and large production in Purworejo. This district is mostly low land area that has a height at 7 meter above sea level.

Optimization in the farming refers to the determination of the best plans in achieving optimal farming pattern with the obstacles of limited resources. The common problem faced by farmers when using the SRI method is planting process takes quite long in time. Other obstacles are many farmers afraid of when using the SRI method, the crop will die attacked by pests because of the planting hole consists of only one of paddy. SRI method of paddy farming influenced by several factors of production that use should be optimal. Optimization in the using of production factors from this methods impact indirectly on the income of farmers. Farmers in managing the farm always seeks to achieve optimal conditions. Based on the background, this study will examine how to optimize resources for the paddy production using SRI method.

RESEARCH METHODOLOGY

Research Method. The basic method used is descriptive method. According to Natsir (2003), the descriptive method is a method in researching the status of human groups, an object, a condition, system of thought or a class of events in the present. Selection of study sites by purposive sampling with particular consideration since Ngombol is a district which has the highest rice production in Purworejo and the villages has been implementing the SRI method since 2003. Selection of respondents/farmers was using census method and got 20 farmers of SRI paddy and semi SRI.

Analytical Framework.

a.) According to Djuwari (2003) farm income is the difference between revenues and all expense and mathematically income written as follows:

NR = TR - TC explicit
= TR - (TFC + TVC) explicit
= Py.Y - (Px.X + TFC) explicit

where :
NR = Net Revenue or farming income (Rp)
TR = Total Revenue (USD)
TC = Total Cost (USD)
Py = Output prices
Y = Output
Px = Price input
X = Input

b.) Analysis Model QRP (Risk Quadratic Programming)

QRP Model is using in order To determine the allocation of optimal resource. This model is essentially the same as the model of Linear Programming (LP), the difference lies in the objective function in the form of squares (non-linear), while obstacle function is linear. In analysis QRP in this study was using Win QSB computer program. Within this model, the objective function created an optimal solution model using quadratic functions that including risk factors. Quadratic programming models that minimize the objective function is defined as follows (Hazel and Norton, 1986):

Minimum variant:

$V = \Sigma_j \Sigma_k x_j x_k \delta_{jk}$

With limitations/constraints:

$\Sigma c_j x_j = \bar{\lambda}$

$\Sigma a_{ij} x_j \leq b_i$; $x_j \geq 0$

Where:

V = Variance of total gross margin of farming.
x_j = j farming activities.
x_k = k-th farming activities
δ_{jk} = covariance of farm j and $\Sigma c_j x_j = \bar{\lambda}$ is a certain profit level of $\bar{\lambda}$ which has advantages over earlier.
$\Sigma a_{ij} x_j \leq b_i$ = function limitation or functional constraints of farming.
$x_j \geq 0$ = non-negative constraints.

c.) Sensitivity Analysis

To determine the optimal completion sensitivity to changes in the objective function and constraint functions means that however the price of input or output or an obstacle change without affecting the other constraints that do not affect the optimal solution, then sensitivity analysis will be done. In this study, the sensitivity analysis carried out by raising and lowering input and output prices. The selling price of the output fluctuates around 5-15%. Thus the sensitivity

analysis are classified into three phase are to increase or decrease the input price and output price 5.10 and 15 percent.

RESULTS AND DISCUSSION

Characteristics of Farmers Respondents. Characteristics of the respondent farmers in SRI method of paddy farming include farmer's age, formal education, number of dependents, owned land and farmer experience. In this study the number of respondents (farmers) are 20 people, divided into two systems, namely:

a. system A rice farming with cropping systems are all SRI method.
b. System B is rice farming partly SRI method and the other part is conventional method.

a.1. Age of Respondents

In this study characteristics of age are categorized into productive and non-productive. SRI farmers are mostly belongs to the productive age, which is the range age at 15-54 years (89.66%) and the rest are in non-productive age at > 54 years (10.34%). The youngest age in system A is 39 years and 30 years in system B. The oldest farmer in SRI system A is 62 years old and system B is 54 years old. Age of farmers of paddy SRI based on each system can be seen in the following table.

Table 1 shows that the number of paddy farmers SRI which belonged to the productive age in system are 9 farmers (90%) and one old farmer non-productive (10%), system B 7 farmers (70%) is productive age and 3 old farmer non productive (30%). Productive age is closely related to physical ability and the ability of farmers to make decisions, so that farmers can think more rationally and brave to take risks in order to increase their income.

Table 1 also shows that only a few of SRI paddy farmers who are in the age group of non-productive, it is one farmer in system A (10%) and 3 paddy farmers in System B (30%). This illustrates those farmers who have old does not take a part as decision makers in farming. They shift their responsibility of farming to children or other relatives who are considered able and willing to continue the farming.

Tabel 1. Age of Paddy Farmers SRI Method in Ngombol 2015

Age (Year)		Paddy Farmers			
		Sistem A		Sistem B	
		∑ (Person)	%	∑ (Person)	%
Productive	30-34	2	20.00	0	0
	35-39	1	10.00	0	0
	40-44	3	30.00	0	0
	45-49	2	20.00	4	40.00
	50-54	1	10.00	3	30.00
Non-Productive	>54	1	10.00	3	30.00
Total		10	100	10	100

Sumber : Primary Data Analysis, 2015.

Tabel 2. Formal Education of Paddy Farmers SRI in Ngombol, 2015

Education Level	Padi SRI Farmers			
	Sistem A		Sistem B	
	∑ (Orang)	%	∑ (Orang)	%
SD	1	10.00	5	50.00
SLTP	2	20.00	3	30.00
SLTA	6	60.00	2	20.00
Diploma/Sarjana	1	10.00	-	-
Total	10	100	10	100

Sumber : Primary Data Analysis, 2015.

a.2. Formal Education

Improvement and development of human resources of which is depend on formal education. Education is a media learning to improve knowledge, understanding attitude, capabilities and skill in this study characteristics of formal education of farmers following the general category of education in Indonesia, namely elementary, junior high and high school. SRI paddy farmers have graduated at formal education based on each system can be seen in Table 2 below.

Table 2 shows that formal education varies among paddy farmers SRI from primary school to the under graduate student. On the table shows that the educational level of most of the SRI paddy farmers graduated from high and junior school. The number of paddy farmers who had elementary school 1 farmer (System A) and 5 farmers (System B).

Based on the criteria of secondary education (junior and senior), the highest percentage in the paddy farmers in system A is 60%, while system B, the highest percentage of farmers with elementary school that is 50%. Insufficient numbers of farmers who continue their education up to secondary level due to the economic inability of farmers to go to school and farmers' lack of awareness about the importance to continue their study. The low level of formal education can lead to low motivation of farmers in finding and transferring new information relating to their farming activities, so that farmers will be learn from its experience.

a.3. Number of Dependents Family

In this study characteristic number of family divided based on criteria submitted by Tohir (1991), the number of dependents of small family (1-3 people) and the number of dependents middle (4-6). Number of family farmers can be seen in Table 3.

Table 3 shows that most of paddy farmers SRI have small number of family members are 1-3 people (80%), while the remaining 20% of paddy farmers both systems have a number of middle families between 4-6 people. Number of family is certainly reflects the economic burden (clothing, food, housing and education) to be borne by a farmer. The high number of family farmers, the greater expected income of farmers in order to fulfill the needs of all family dependents. This will affect farmers in farming decision making.

a.4. Land Area

The characteristics of the area in this study divided based on criteria submitted by Hernanto (1991), namely the small farmers (<0.5 ha), middle farmers (0.5 to 2 ha) and farmers has large land (> 2 ha).

Table 4 shows that in average SRI paddy farmers in each system have a land area on middle classified. The availability of land owned by paddy farmers SRI allows them to cultivate paddy farming with system-A (full SRI) or keep on trying farming system B. The land area cultivated by paddy farmers SRI ranged from 0.3 to 4 ha. The smallest land area owned by paddy farmers system B is 0.3 ha. Meanwhile, the largest land area owned SRI paddy farmers are owned by farmers with system-A it is 4 ha.

a.5. SRI Paddy Farming Experience

Farming experience is the period of farmers in farming activities. Experience farm belong to SRI paddy farmers by each system can be seen in the following table.

Table 5 shows the variation in experience of farming between SRI paddy farmers with systems A and B. At the level of farming experience > 10 years, SRI paddy farmers system B tend to have farming experience longer than rice farmers SRI system A. Tohir (1991) says that the longer a farmer in managing his farm, the more experience gained. The experience will certainly influence the attitudes and actions of many farmers in farming's decision making. Thus if the farmer often fail in farming then he will be more careful in the management of farming.

A.6. Farm Income Analysis

Farm income is the measure of income received by farmers from farming activities. In analyzing farm income, farmers should consider several things associated in, such as production costs, production and farm receipts. SRI paddy farmers' income is

the difference between the value of sales of production of paddy farming in system A and system B with production costs are actually incurred by the farmers in paddy farming SRI. Results of SRI paddy farm income analysis based on each system can be seen in the following table.

In farming SRI paddy, land used for SRI paddy farming in each system is mostly privately owned status, so that farmers do not pay for the rent of land. Similarly, the cost seeds, farmers also do not pay for the seeds. This is because the paddy seeds used in general is given by village or from parents/relatives. In this study, the calculated cost is temporary cost that covers cost production (organic fertilizer and pesticides) and the cost of labor outside the family as well as a fixed fee that includes the cost of depreciation of equipment.

A.7. Resource Allocation Optimization

To achieve high productivity from the application of SRI paddy farming required a concept of farming patterns and resource use (land, labor and capital) are optimal. Through optimization techniques using the quadratic risk programming, the optimal allocation of resources can be known whether in limited conditions (rare) or not by pay attention to the constraints risks exist. Based on the results of the overall study of 2 cropping, the value optimization of resources as follows:

Tabel 3. Number of Dependents Family of Paddy Farmers SRI In Ngombol in the Year of 2015

Number of Dependents Family (Person)	Petani Padi SRI			
	Sistem A		Sistem B	
	∑ (Person)	%	∑ (Person)	%
Small 1-3	8	80.00	8	80.00
Middle 4-6	2	20.00	2	20.00
Total	10	100.00	10	100.00

Sumber : Primary Data Analysis 2015.

Tabel 4. The Total Land Area of Paddy Farmers SRI in Ngombol in the Year of 2015

Total Land Area (ha)	Paddy farmers SRI			
	System A		System B	
	∑ (Person)	%	∑ (Person)	%
Small< 0,5	2	20.00	3	30.00
middle 0,5 – 2	5	50.00	7	70.00
Large> 2	3	30.00	0	0
Total	10	100.00	10	100.00

Sumber : Primary Data Analysis 2015.

Tabel 5. Sri Paddy Farming Experience in Ngombol in the Year of 2015

Farming Experience (Year)	Petani Padi SRI			
	System A		System B	
	∑ (Person)	%	∑ (Person)	%
1 – 10	9	90.00	2	20.00
11 – 20	1	10.00	3	30.00
>20	0	0	5	50.00
Total	10	100.00	10	100.00

Sumber : Primary Data Analysis, 2015.

Tabel 6. Production Cost, Receipts and Income Per Musim Tanam Petani Padi SRI di Ngombol in the Year of 2015

Detail	Paddy Farming SRI	
	System A	System B
Permanent cost (Rp)		
Depreciation tool	218.541	259.460
Temporary cost (Rp)		
Total expense of organic fertilizer	750.000	1.250.000
Total cost of Pesnab	350.000	624.845
Total cost of labour	2.378.313	2.517.923
Total Biaya (Rp)	3.696.854	4.652.228
Rerata/ petani (Rp)	369.685	465.222
Produksi (kw)		
- Production	27.3	27.6
Rerata/petani (kw)	2.73	2.76
Penerimaan (Rp)		
receipt	27.300.000	22.080.000
Rerata/petani (Rp)	2.730.000	2.208.000
Pendapatan (Rp)		
income	23.603.146	17.427.772
Rerata / petani (Rp)	2.360.314	1.742.777

Sumber : Primary Data Analysis, 2015.

Tabel 7. In Average Actual Resource and Optimal, Interval Konfidensi of SRI Paddy Farming in Ngombol in the Year of 2015

Farming Pattern	Sumberdaya											
	Land in Average (ha)				Labour in Average (HOK/ha/thn)				Capital in Average (Rp/ha/thn)			
	Akt	Opt	Interval Konfidensi 99%		Akt	Opt	Interval Konfidensi 99%		Akt	Opt	Interval Konfifdensi 99%	
			Bts Bwh	Bts Atas			Bts Bwh	Bts Atas			Bts Bwh	Bts Atas
PatternA	1,27	0,64	-0,04	0,21	70	20	-307	390	967.264	347.190	-281.017	2.215.554
PatternB	0,54	0,27	-0,24	0,42	81	27	-157	326	1.314.121	462.918	-755.857	3.384.099
Total	1,81	0,91	0,28	0,63	151	47	464	716	2.281.385	810.108	1.036.874	5.599.653

Sumber : Primary Data Analysis, 2015.
Ket : Akt : Aktual.
Opt : Optimal.

Tabel 8. Analisis of Simultaneously Input Changes to Optimal Allocation Resource on SRI Paddy Farming in Ngombol in the Year of 2015

Detail	Minimum Value Varians	Change	
		Increase/Decrease	Optimal Allocation Resource
Optimal	2.983.314		
Increase (%)			
5	3.002.084	increase	stable
10	3.005.537	increase	stable
15	3.042.080	increase	stable
Decrease (%)			
5	2.965.382	decrease	stable
10	2.948.283	decrease	stable
15	2.932.028	decrease	stable

Sumber : Analisis Data Primer, 2015.

Tabel 9. Analysis of Selling Price of Paddy SRI to The Optimal Resource Allocation on SRI Paddy Farming in Ngombol in The Year of 2015

Detail	Minimum Value Varians	Change	
		Increase/Decrease	Optimal Allocation Resource
Optimal	2.983.314		
Increase(%)			
5	2.965.382	decrease	stable
10	2.948.283	decrease	stable
15	2.932.028	decrease	stable
Decrease (%)			
5	3.002.084	increase	stable
10	3.005.537	increase	stable
15	3.042.080	increase	stable

Sumber : Primary Data Analysis, 2015.

Table 7 shows that the average actual land area of SRI paddy farm on both cropping pattern 1.81 ha and an average land area is 0.91 ha after optimized. Farming patterns that have the highest land area after optimized is a pattern of 0.64 ha. In the average the availability actual of labor is 151. The pattern of farming that has the highest labor availability after optimized is the pattern B, 27 HOK, while the average capital value is Rp. 2,281,385 and optimal value of Rp. 810 108 with the cropping pattern that has the highest capital availability after optimized is the pattern B Rp. 462 918.

A.8. Effects of Changes in input (organic fertilizer and pesnab)

Simultaneously, against Farming Optimal Income and optimal Patterns of farming Based on analysis, fluctuations of inputs prices (organic fertilizer and pesnab) simultaneously does not affect to the optimal allocation and patterns of farming, but bring impact on the value of the minimum optimal variant of gross margin. Pattern optimization illustrates that the higher percentage prices of inputs (organic fertilizers and pesticides), it will be followed by the increasing of a capital farm spend by the farmers, so that will have an effect on decreasing farmers income and the other way around, the lower price of inputs simultaneously, then the capital of farming spend will be smaller and farmers' income, and gross margin will be even greater. However, this is not bring impact to the allocation of resources and optimal farming patterns (Table 8).

A.9. Effects of Changes in Output Price to the optimal Resource Allocation of paddy SRI

The increase in output prices will certainly able to increase revenues, gross margin and income of SRI paddy farming, and otherwise if the selling price of paddy SRI down, then revenues, gross margin and income will also decline. The increase in output prices indicates the decline minimum optimal value variance of the gross margin, or in other words the risk faced by farmers will decrease and in a contrary if the selling price of the output getting low, then the risk faced by farmers will be even greater. However, the results of the sensitivity analysis shows that changes in the increase and decrease in the selling price of the output does not affect the optimal allocation of resources so it can be concluded that the change in output price used was not sensitive to the changes of optimal conditions (Table 9).

CONCLUSIONS

In average production of paddy SRI farming system A is greater than B system SRI rice farming, but for the average cost of system B larger, but the average of income for the system B is smaller than the system A. This illustrates that the farming SRI system A more profitable when compared to system B.

The results of optimization analysis shows that from the average of the actual land area is 1.81 ha the activity that appears

on the optimal cropping patterns farming system A the area is 1.27 ha and system B covering an area 0.54 ha. The selected optimal farming pattern is the highest optimal cropping patterns, the system A. The results of the optimization analysis also showed that the land resources and labor resources are still abundant or excessive, whereas capital resources is limited resources.

The results of the sensitivity analysis shows that changes in the increase and decrease in input and output prices both partially and simultaneously 5-15% do not affect to the optimal allocation of resources, but only affects the risk of SRI paddy farming. The higher input prices, the higher risk faced by paddy farmers SRI and otherwise if input prices decline, then the risk will be smaller. The higher selling price of the output, then the smaller risk faced by farmers and in contrary, decline in selling prices of output, the risks faced by farmers will be even greater.

REFERENCES

Ashari, 2010. *Peranan Nasional dalam Pembiayaan Sektor Pertanian Di Indonesia.* (Online), (http://litbang.deptan.go.id/Ind/Pdf). Diakses 11 Mei 2015.

Darmawan, 2002. *Optimasi Usahatani Rumput Laut (Euchema cottonii) Di Pulau Panjang Banten.* Tesis Ekonomi Pertanian Pasca Sarjana. Universitas Gadjah Mada. Yogyakarta.

Djuwari, 2003. *Ilmu Usahatani. Hand Out*. Jurusan Sosial Ekonomi Pertanian. Fakultas Pertanian. Universitas Gadjah Mada. Yogyakarta. (Tidak dipublikasikan).

Hazel, P.B.R And R.D. Norton, 1986. *Mathematical Programming for Economic Analysis in Agriculture.* Macmillan Company. Page 76-109.

Hernanto, F, 1989. *Ilmu Usahatani*. Penebar Swadaya. Yayasan Indonesia. Jakarta.

Mardiyati, Sri, 2004. *Optimasi Usahatani Empang Parit di Lahan Konservasi Hutan Mangrove* RPH Cikiperan BKPH Rawa Timur KPH Banyumas Barat. Tesis Ekonomi Pertanian Pasca Sarjana. Universitas Gadjah Mada Yogyakarta.

Mosher, A.T, 1984. *Menggerakkan dan Membangun Pertanian, Syarat-Syarat Pokok Pembangunan Modernisasi.* Disadur Oleh S. Krisnandi dan B.Samad. CV. Yasaguna. Jakarta.

Mubyarto, 1994. *Pengantar Ekonomi Pertanian*. Edisi Ketiga. LP3ES. Jakarta.

Nachrowi, D.N. dan Hardius, U, 2006. *Pendekatan Populer dan Praktis Ekonometrika untuk Analisis Ekonomi dan Keuangan Lembaga*. Penerbit Fakultas Ekonomi Universitas Indonesia. Jakarta.

Natsir, M, 2004. *Optimasi Pola Usahatani Lahan Kering di Kawasan Perbukitan Kebun Rakyat Kabupaten Cilacap*. Tesis Ekonomi Pertanian Pasca Sarjana. Universitas Gadjah Mada. Yogyakarta.

Siregar, 1981. *Budidaya Tanaman Padi di Indonesia*. PT. Sastra Hudaya. Bogor.

Soekartawi, 1990. *Teori Ekonomi Produksi dengan Pokok Bahasan Analisis Fungsi Cobb-Douglass.* CV Rajawali. Jakarta.

Sugeng, H.R, 2001. *Bercocok Tanam Padi*. Aneka Ilmu. Semarang.

Widarjono, Agus, 2005. *Ekonometrika : Teori dan Aplikasi untuk Ekonomi dan Bisnis.* Penerbit Ekonisia Fakultas Ekonomi UII. Yogyakarta.

Widiyanto, A, 2002. *Analisis Resiko Pilihan Pola Tanam*. Tesis Ekonomi Pertanian Pasca Sarjana. Universitas Gadjah Mada. Yogyakarta.