Journal of Crop and Weed 7(1):12-16 (2011)

Institutionalization of system of rice intensification (SRI) in Indonesia: socio- economic aspects

I. M. FERICHANI AND D. A. PRASETYA

Sebelas Maret University, Central Java Province, Indonesia
Joglo Tani Association, Yogyakarta, Indonesia; Faculty of Agriculture, University of Gadjah Mada, Indonesia

Received: 05.03.2011, Revised: 15.05.2011, Accepted: 30.05.2011

ABSTRACT

The research aimed to know the economic advantages and the socio-economic barriers in adopting on System of Rice Intensification (SRI). The research was carried out in Bantul and Sleman District, Yogyakarta Special Regency (DIY), Indonesia. The sampled farmers implemented SRI method to their rice fields either as a landowner or sharing system. They were involved and active in empowerment program on SRI at both districts. The rice variety that planted was Menthik Susu, a local variety in Central Java and Yogyakarta province. Economic advantages were measured to affirm that SRI had economic advantages that include variable cost (per 1000 m^2) and return cost ratio values besides environmental. SRI which had been done was pure-organic or without synthetic fertilizers and pesticides. Comparison of SRI and conventional method indicated social economic barriers on adopting process of SRI. In the process Chi-Square and Cochrant-Q tests were used. The result showed that SRI has greater return:cost (R/C) ratio value (1:1.4) and lower in variable cost than conventional method. Comparison between both value are, variable cost value for SRI:conventional is 1 : 1.4; and R/C ratio value is 4.80 : 3.16. It shows that SRI reduces variable cost by 40% and increases R/C ratio by 52%. Decreasing variable cost was influenced by cost of inputs which mostly can be produced by farmer-self, such as solid organic fertilizer and natural pesticides. The economic barriers those hampered in adoption of SRI to the people are product market, input source, capital and production mechanism. The social barriers were government policy, social organization, academic support, and training.

Key words: Adoption, institutionalization, R/C ratio, social organization, SRI, variable cost.

Since 1970, Indonesia Government tried to maximize green revolution technology. Many programme to increase rice production had been introduced nationally until 1990 era. Intensification programs (Green Revolution) had been directed to Indonesian's farmers and millions acres of rice fields. Intensification policies were the factor that had pushed increasing of synthetic pesticides which unknown before (Untung, 2006).

Reinjtjes, Haverkort and Bayer (1999) discussed about the green revolution in India which is familiar as *High External Input Agriculture* (HEIA). External input means that added maters such as synthetic pesticides and fertilizers which used to the rice field. Synthetic input application that imbalance and abundance in HEIA can emerge big effect to the ecology, economy and socio-politics.What has been introduced by HEIA under green revolution flag is so worry to environment safety, it has distributed "the bad" source to farming system and crates agriculture system as a high cost farming system. That causes a strong dependency to equipment, seed and other import inputs. On the other hand, inputs have polluted river and soil water on dangerous level of poison to the human.

Some of farmers and scientists advocates for organic farming system. Sutanto (2002) states that organic farming is a system to move nutrient and mineral from plant/cropping, compos and organic fertilizer being bio-mass of soil by mineralizing or decomposing process. Fact, organic farming provides a lot of benefit to the people by maintaining and conserving to the environment. Out of the positive news, the diffusing of those values meets some difficulties. Public policies and socio-politics so decides where do the destination of farming system as an element of economic development.

Uphoff, from Cornell University, introducing the new rice cultivating method is called System of Rice Intensification (SRI). By SRI elements, individually, crop is push to increase self produce by optimizing environment capacity. SRI has several conditions that has to be accomplished such as implementing of organic fertilizer;1-2 number of seedlings; young seedlings are transplanted at 8-12 days old; wider spacing of plants; water management; and weed and pest control (ciifad.cornell.edu, on 7th August 2010).

SRI had been tried to diffuse since year of 2000 in Indonesia and became familiar around 2005. Mostly, persons who active in diffusing SRI, introduce the SRI advantages on environment only. Such as, water efficiency, soil maintenance, consumer protection from pesticide, etc. but it needs to be proved scientifically. Moreover, the farmers need more facts on economic account.

Economic assumptions of course need to be compared with the ordinary farming method that are used by farmers under conventional system. Generally, Indonesian's farmers use synthetic fertilizers to grow their crops and pesticides to control the pests. The comparison will show whether SRI really has economic advantages or yet show lower value than conventional. Among of economics account models, one can use variable cost and R/C ratio values to see the advantages. Economic evidence will accelerate institutionalization

Email: da_prasetya@yahoo.co.id

process of SRI to the farmer communities by adopting stage of the innovation.

Beside economic facts, one needs to elaborate on adopting course. Adoption is individual process in implementing innovation (Roger, 1995). By adoption process, innovation begins to function to the people, in this case the farmers. Adoption is the early stage of institutionalization (Scott, 2001). SRI, in spite of having many advantages still needs research results on many frame, not only the advantages. Adoption of SRI will help in the empowerment program to bring it to deeper stage of institutionalization by scientific information on factors that influence. Second question draw from Yogyakarta Province conditions after empowerment program is "what are social economic barriers on adopting of SRI?"

Nee (2003) on the new institutionalism theory states that institution is system that be afforded by relation between formal and informal values, which consisted in micro (individual), middle (social organization and organizing) and macro level (government and the policy). Inconformity between formal and informal values will make disintegration in the community. Therefore, conformity of both should be supported if we need to accelerate integration process. SRI as a new technology in agriculture which has a lot of advantages should be diffused. Of course, people live in social system that constituted over informal and formal values, so the sustainability of value really depended on both. Government policy is one factor that probably influences the adoption process of SRI. In this case, government policies assumed as formal values and informal values can be represented by product market.

Feibleman (1956) states that in the deeper stage of institution material producing and the effects to the human being included physic or non-physic effects. Material produced, how to produce, how to maintain etc. are important. Producing and maintaining of crops needs some requirement such as capital, capacity and other supporting factors. Farmer's capacity or skill so supported by training, difficulties level of practice mechanism and other supporting agency, such as academic sector and social organization. We distribute those factors in two clusters as economy and social factors which probably affecting adoption process of SRI.

Based on two cores of this research on SRI diffusion barriers, we try to understand conformity between formal and informal values includes those cores. Understanding not just on SRI advantages on the other side about the barriers, indeed will clear situation to empower farmers. Fact, we still rarely meet this frame on researching about SRI. So, beside economic advantages, we need to know those barriers.

MATERIALS AND METHODS

This research was carried out at Bantul and Sleman Dictrict, Yogyakarta Special Regency (DIY), country of Indonesia. Respondents were farmers who applied SRI method to their rice fields. The data were collected by observation and interview. Variety planted on the rice field was Menthik Susu which is a local variety of rice in Central Java and Yogyakarta Province.

SRI which had been done was pure-organic or without synthetic fertilizers and pesticides. Measuring in economic advantages on SRI includes BEP and return cost ratio. R/C ratio is one of tool to measure a firm or business (Suratiyah, 2008). R is revenue and C is cost include fix and variable cost. It is different than incremental B/C ratio which use marginal assumptions from benefit and cost, such as present benefit as B and past benefit as B'. In this case, we counts R/C ratio from SRI and conventional farming method of same farmers. For example, we means that farmer (A) is now implementing SRI and previously he implemented conventional method. But, all the farmers were corporative farmers from the empowerment program at past.

Besides that, we compare variable cost between SRI and conventional method too. Variable cost in this research includes cost of fertilizers, pesticides, seeds, and labors wage. C in R/C ratio formula is total cost (TC) and R is total revenue (TR). Sukartawi (2006) states that income is total revenue minus total cost. Total cost (TC) is sum of fixed cost (FC) and variable cost (VC). P as element of revenue means is price/kg and Q is sum of harvest. Selling of the harvest is done as full-whole grain, not milling yet.

$$TC = FC + VC \quad \ldots\ldots\ldots\ldots (1)$$

$$Revenue = P \times Q \quad \ldots\ldots\ldots\ldots (2)$$

For further, sum of cost, revenue and R/C ratio are measured of each mean values by the formula below:

$$SP = \frac{\sum_{n=1}^{n} A + B + C + \ldots n}{n} \quad \ldots\ldots (3)$$

SP = mean value

N = amount of sample

A, B,.n = value of each sample in cost, revenue, BEP, and R/C ratio

Socio-economic barriers measured with Chi-Square and Cochran-Q which are non parametric statistical analysis showing the problems that farmers feel as obstacles for them. Chi-Square was used to know which one factor that most hampers (weighting) adoption process (early stage of institutionalization) of SRI base on farmer consideration. To know the kinds factors which being obstacles to farmers in adopting SRI follow prominent time factor in each of economic and social sections. The farmers were interviewed based on those factors.

Economic factors:

K_1 = Product market (PM)

K_2 = Input source (IS)

K_3 = Competition among farmers (CF)

K_4 = Capital limitations©

K_5 = Production mechanisms (PMc)

Social factors

K_1 = Social value (V)

K_2 = Social organization (SO)
K_3 = Academic support (AS)
K_4 = Training (T)
K_5 = Government policy (GP)
The Chi Square formula attached below:

$$\chi^2 = \sum_{n=1}^{k} \frac{(Oi - Ei)^2}{Ei} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Oi = Observed value
Ei = Expected value

Cochran-Q is a statistical tool that measure significantly of data on farmer choosing towards which kinds of factors that hampers institutionalization of SRI. So, each person can have more than one choice of the answer.

$$Q = \frac{(k-1)\{k \sum_{i=1}^{K} Gj^2 - (\sum_{i=1}^{n} Lj)^2\}}{k \sum_{i=1}^{n} Li - \sum_{i=1}^{n} Li^2} \quad \ldots\ldots\ldots\ldots (5)$$

The statistical assumption that is used to count social economics barriers is:
If χ^2 calculated > χ^2 table (α=0.05) (k-1), so alternative hypothesis (Ha) accepted and null hypothesis (Ho) will be rejected.

RESULTS NAD DISCUSSION

1. Economic values

Firstly, we compared cost efficiently between SRI and conventional method. Data of cost are measured not including fix cost that assumed has same value on it. Different value of cost will show on variable cost which is influenced by changing on input. Distribution on comparison showed on table 1.

Table 1: Distribution of *Variable Cost* between SRI and Conventional/1000 m^2

	VARIABLE COST	
	SRI (IDR)	**Conventional (IDR)**
1	405504	575070
2	405504	575070
3	405504	575070
4	405504	575078.46
5	314104.36	576813.19
6	356550	455400
MEAN	**382111.73**	**555416.94***

**The difference is significant at 1% level of significance*
Source: primary data analysis 2010, Currency: USD 1 = Rp.9000,00 (IDR)

Based on the table 1, SRI proved has significantly lower value than conventional. Farmers spend out amount Rp. 382.112,00 (USD 42.4) every 1000 m^2 to implement SRI. On the other hand, conventional needs Rp. 555.417,00 (USD 61.7). Cost efficiently is showed by using SRI method and this is a good parameter for farmers to apply it than the technique that usually they applied. The low cost was influenced by controlling input expenditure, such as solid and liquid organic fertilizer, natural pesticide and seed that produced by their efforts. Farmers try to produce inputs by themselves, except seed that in the early adoption accomplished by buying.

In implementing conventional method, all input requirement usually accomplished by buying from farming device-shop. Moreover the input's prices are influenced by market mechanism which can't be controlled by farmers. On the other hand, by empowerment or social learning, farmer can produce several kinds of input, such as organic fertilizers and pesticides.

R/C ratio is a method to measure the economic effectiveness of a firm, that effectiveness a unit of cost over revenue. Table 3 shows that SRI has bigger R/C ratio value than conventional. Mean of R/C ratio is 4.8 for SRI and 3.16 for conventional. Value of 4.80 meant that every a unit of cost can give back revenue 4.8 times. Bigger value assumed has bigger proper to be implemented. Farmers can see that SRI more proper than conventional that used to implement to their rice field. Table 3 also shows that average value can still be optimized for even better value.

Table 2: Comparison inputs' cost

Input	SRI (IDR)	Conventional (IDR)
Fertilizers	213650	161480
Pesticides	2855	51000
Seeds	15000	60000
SUM	**231505**	**272480**

Source: primary data analysis 2010
Currency: USD 1 = Rp.9000,00 (IDR)

Table 3: Variation of return

	SRI	Conventional
1	5078	2984
2	393	2962
3	4494	2997
4	512	2945
5	495	3588
6	523	3489
Mean	**4800**	**3161**

Source: primary data analysis 2010

2. Socio-economic barriers

a. Economic factors

Based on interviewed and analyze by Cochran-Q test, the results show that χ^2 counted > χ^2 table (α=0.05) (k-1), it is 61.09 > 9.49. Analysis show significant differences among farmers' considerations on the economic barriers that hamper them from continuously adopting SRI technology. The composition is explained in table 4.

Table 4: Distribution of economic factors

Factors	Percentage
PM	74.08
IS	18.52
CF	0.00
C	3.70
PMc	3.70
SUM	**100**

Source: primary data analysis 2010

Table 4 shows that product market (PM), input source (IS), capital limitation (c), and production mechanism (PMc) being economic factors which hamper adoption process on SRI. Farmers' assumptions of course based on their experiences. Competition among farmers (CF) not be considered as an obstacle, it showed over the percentage (0%).

Based on measuring under Chi Square test, the results show that χ^2 counted > χ^2 table (α=0.05) (k-1), it is 48 > 9.49. Analysis shows significant differences among farmers' considerations on the economic barriers that most hamper (weighting) them from continuously adopting SRI technology. Product market (80%) being the most one followed input source (20%). PM is considered as factor which is most needed to accelerate adoption on SRI. The composition is explained in table 5.

Table 5: Distribution of factors weighting

Factors	Percentage
PM	80
IS	20
CF	0
C	0
PMc	0
SUM	**100**

Source: primary data analysis 2010

b. Social factors

Based on Cochran-Q test, the results show that χ^2 counted > χ^2 table (α=0.05) (k-1), it is 52.33 > 9.49. Analysis result shows significant differences among farmers' consideration of social barriers that hamper them from continuously adopting SRI technology. The composition is explained in table 6.

Table 6: Distribution of social factors

Factors	Percentage
V	0.00
SO	19.12
AS	25.00
T	26.47
GP	29.41
SUM	**100.00**

Source: primary data analysis 2010

Table show that social organization (SO), academic support (AS), training (T), and government policy (GP) being economic factors which hamper adoption process on SRI. Farmers' assumptions of course based on their experiences. Social value not be considered as an obstacle, it showed over the percentage (0%). It means that there are no local social value hampers to adoption on SRI to farmers.

Based on measuring under Chi Square test, the results show that χ^2 counted > χ^2 table (α=0.05) (k-1), it is 14.5 > 9.49. Analysis show significant differences among farmers' considerations on the social barriers that most hamper (weighting) them from continuously adopting SRI technology. Government policy (40%) being the most one followed social organization (35%) and training (20%). GP is considered as factor which is most needed to accelerate adoption on SRI. Under GP supporting, SRI is considered by farmers will easy to be absorbed. Such supporting will emerge and strength capital, market, funding, national issues, etc. from government to success continuity adoption on SRI. The composition is explained in table 7.

Table 7: Distribution of factors weighting

Factors	Percentage
V	0
SO	35
AS	0
T	25
GP	40
SUM	**100**

Source: primary data analysis 2010

This evidence can affirms farmer to implement SRI continuously and as farmers assumption that can be told to other farmer. Through this involvement, farmer has more logically consideration on their faith.

Cost efficiently of SRI is caused applying farming inputs which can be produced by farmers themselves. Farmers' capacity of course is gained from continuous empowerment program. Empowering farmers, values/innovations can be absorbed by other from social learning process among them. Actually, several inputs such as fertilizer, pesticides and seed can accomplish under self-producing. That fact can reduces farming-variable cost. We can see from comparison above that SRI exceed emphasize organic farming may reduce variable cost upto 40 %.

Results of comparison R/C ratio among SRI and conventional is 4.8 for SRI and 3.16, or SRI increase R/C ratio to 52 %. Those values indicate that SRI has bigger proper and feasibility to be implemented under economic logic than conventional. Increasing R/C ratio value is supported by several factors such as decreasing of variable cost and pricing of harvest results. Harvest of SRI was considered as organic product, so it had higher in pricing and the selling supported by private sector.

R/C ratio value of SRI can be increased through its continued implementation in the same field. That condition achieved by increasing of soil and environment quality. Organic farming application will improve soil quality and energy cycle. Besides that, by SRI elements, methods can optimize solar energy and oxygen exceed, and reduce water requirement. That

optimizing is achieved by management on spacing of plants, number of seedlings and water management. In addition, the results prove Uphoff's argument on environmental and economic advantages of SRI.

Product market (PM), input source (IS), capital limitation (CF), and production mechanism (PMc) being economic factors which hamper adoption process on SRI. Competition among farmers © not be considered as an obstacle, it showed over the percentage (0%). Based on measuring under Chi Square test, product market (80%) being the most one followed input source (20%).

Worry over PM so clear emerges from the research. Mostly farmers put PM are caused product distributing to gain more income is most important point. Marketing decision is influencing their income. Organic product can be said as a new product inside their mind, so it is normal if they worry about how to market the harvest. Farmers often overhear that organic product has higher price than non, but real experience need to be passed to ensure their worries. Solutions to solve PM problem is influenced a lot of factors, such as government policy to strength market image and increase people conscious to life in healthy; and marketing strategy which involve private sector. Both combinations will rise bargaining position of organic rice products. Formal and informal sector creates together.

Input source is considered as second factor that most hamper process. It consist of solid and liquid organic fertilizers, natural pesticides, and seeds. Part of them still worry about input source whereas can be produced by them self. Social Factors

Results show that social organization (SO), academic support (AS), training (T), and government policy (GP) being economic factors which hamper adoption process on SRI. Social value not be considered as an obstacle, it showed over the percentage (0%). The social barriers that most hamper (weighting) them from continuously adopting SRI technology is government policy (40%) being the most one, followed social organization (35%) and training (20%).

GP clearly influences almost all development sectors. Positive support from GP will develop and accelerate those sectors, whether agriculture, forestry, industry, etc. SRI as an innovation offers values which based on farmer's experience is "new". Absorbing of the values naturally will not fast like what trainer want, be caused farmers have a lot of questions which need to be answered exceed their experience. But, the real government policy will support and strength peoples' mind, market condition and national issues. Policy in this case, not just as a jargon or slogan but created as a real program that rule or control some national program or at least territory program which will degrade to subordinate territories.

Social organization is considered as social factor caused functions of it. SO as an organization at least has several functions such as media for gather, study and even to produce, for example, farmer association. Based on those functions, functioning SO, to bring SRI values is a good solution. On the other hand, SO which is no involved in diffusing process is considered as barriers by farmers. Training as social barriers has correlation with study media. Farmers chose T hamper adoption process caused they argue that training is so rarely carried out. Farmers need more time and session to study and train under training or empowerment programs. If T often carried out and tend to grounded, it will be a supporting factor.

The results show that implementation of SRI method can reduces variable cost until 40% and increases R/C ratio until 52%. That value was gained by farmers over applying SRI elements such as applying organic farming and reducing seed need. Economically, it indicates that SRI more proper and efficient than conventional method. The economic barriers those hampers in adopting of SRI values to the people are product market, input source, capital, and production mechanism. Then, the economic factor base on farmer consideration that most hampers them to continuously adopt SRI method is product market and followed input source. The social barriers are government policy, social organization, academic support, and training. Then, the social factor base on farmer consideration that most hampers them to continuously adopt SRI method is government policy and the second biggest is social organization.

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