Economic Performance of System of Rice Intensification (SRI) Project in Malang Regency, Indonesia

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ABSTRACT

The objectives of this research were to study the role and function of the SRI project, socioeconomic characteristics and agricultural production systems of the farmers, rice cultivation activities of farmers joining the SRI project, to analyze net profit and level of practice in the SRI project, correlation between the levels of practice and net profits, problems and obstacles of SRI project in the practice, and factors affecting the farmers status (still practicing SRI or quit SRI). The research instruments used were questionnaires and interviews from 110 farmers, who participated in the training of the SRI Project in 2007. Data were collected all farmers during April to June 2011.

Descriptive statistics such as mean, frequency, and percentage were used to analysis the socioeconomic characteristics, and agricultural production system of the farmers, the rice cultivation activities of farmers joining the SRI project, the net profit and the level of the farmers' practice in the SRI project, and the problems and obstacles of the SRI project in practice. Quantitative analysis such as; correlation analysis by Rank Spearman Correlation Coefficient to analyze the correlation between the level of practice and the net profit in the SRI project, and independence tests via Chi-Square statistic to analyze the relationship among socioeconomic or other factors that are independent variables and the farmers status that is a dependent variable.

The results revealed that all farmers were male, at an average age of 49 years. Most of the SRI farmers finished secondary school, while nearly half of the Q-SRI farmers finished elementary school. There were also members of an agricultural group. The results also revealed that the net profit of rice farming obtained by SRI farmers is IDR 16,045,593 per hectare. While that of Q-SRI farmers is IDR 9,321,610 per hectare. Hence, the net profit of SRI farmers is higher than Q-SRI farmers by approximately 40 percent per hectare.

The high level practices such as; seed selection with salt water, makes the seedbed before cultivating, transplant seedlings at a young age - 7 to 12 days old, transplanting one-two seeds per hole, transplanting wide spacing, and practicing of intermittent irrigation. Furthermore, the moderate level practices such as; management of land and organic fertilizer, frequency of weeding, practicing organic fertilizers, practicing Integrated Pest Management (IPM), and harvesting management. The results of the correlation between the level of practice and the net profit in SRI the project is relatively high. This implies that the higher the level of practices of the SRI project principles, the higher of the net profit.

The results indicated that the problems, and obstacles of the SRI project in practice included farmers difficulty in transplanting young seedlings, farmers difficulty of finding employment or laborers, farmers difficulty of transplanting the seeds with wide spacing, most farmers preferred to use chemical fertilizers, and the farmers difficulty to controlling pests and diseases.

The relationship among socioeconomic or other factors and farmers status revealed that age, size of rice field, labor, single or double seedling, soil organic fertilizer, farmer practices and drought had a significant relationship (P=0.000-0.050) with farmer status (SRI or Q-SRI farmers). Meanwhile, the marital status, the level of formal education, main occupation, second occupation, and land holding had no significant relationship with the farmer status.

Keywords: SRI project, net profit, the level of practice, factor affecting

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Setiyo Yuli Handono

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List of Abbreviations

BPS	*Biro Pusat Statistik* (Central Bureau of Statistic in Indonesia)
Bulog	B*adan Urusan Logistik* (National Logistic Agency in Indonesia)
DISIMP	Decentralized Irrigation System Improvement Project
IDR	Indonesian Rupiah
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
K	Potassium (fertilizer)
LP	Land Preparation
MD	Man-Day
MOL	*Mikro Organisme Lokal* (Local Microorganism)
N	Nitrogen (fertilizer)
P	Phosphorus (fertilizer)
Q-SRI farmers	Farmers who quit practicing SRI project
RTBV	Rice Tungro Baciliform Virus
RTSV	Rice Tungro Spherical Virus
SRI	System of Rice Intensification
SRI farmers	Farmers who still practicing SRI project
WASSAN	Watershed Support Service and Activities Network

Chapter 1
Introduction

1.1 Background

Rice has been widely known as a basic commodity for Indonesian people as a source of energy, and carbohydrate. The increase in rice production in Indonesia is assumed to have an amount as Indonesian population density for now or in the future. In this case, to increase the rice production the use of science and technology, through research and projects is needed to help maximize the rice production and increase the farmers' welfare.

In 2007, International Rice Research Institute (IRRI) reported that Indonesia is the third largest rice producer, and consumer in the world. As compared to other foods and cereals, rice has been the staple food for Indonesian people (above 95%) with 133 kilogram of rice being consumption per person, per year. Regarding this phenomenon, Erwidodo (2010) argues that the rice diversification failure is due to the fact that most of the Indonesian people believe that the definition of eating is eating rice, and in spite of carbohydrate needs to meet the energy requirements being fulfilled by eating other sorts of meals, Indonesian people still think they need to eat rice.

The Central Bureau of Statistics of Indonesia reported that the Indonesian population growth rate from 2005 to 2010 is estimated to reach 1.3%, 1.18% in 2011-2015, and 0.82% in 2025-2030. In addition, The National Development Planning Agency (Bappenas) Indonesia reported that the Indonesian population density is estimated to reach 450 million people in 2045. This means that referring to the fact that rice consumption per capita of the Indonesian people is 133 kilogram per year, the domestic demand of rice will be more than 61.5 million tons per year. In 2006, the total rice consumption per annum was about 30.3 million tons, while in 2030 total rice consumptions will reached around 75 million tons (Prabowo, 2007).

During 2009 to 2010, Indonesia imported 1.15 million tons of rice and 1.2 million tons of corn. In order to maintain a rice minimal stock, The Indonesian

National Logistic Department (BULOG) supplies 1.5 million tons of rice. Furthermore, in 2010 Bulog imported another 1.5 million tons of rice including 0.8 million tons from Thailand and 0.7 million tons from Vietnam to maintain the national minimum stock of rice (market operation and to alleviate the potential rise of rice commodity in domestic markets (Meylinah and Slette, 2011).

In 2010, rice was mainly grown in an area of 13.12 million hectare, with the average production being 65.98 million tons. In 2010, the Indonesian population was about 237.60 million people (Central Bureau of Statistic Indonesia, 2011). At the current rate of population growth, the Indonesian government should produce more than 100 million tons of rice by 2025 for food commodity. Thus, there is a demand as a challenging task for policy makers, researchers, and other stakeholders, to provide the targeted rice demand.

An agricultural intensification program in farming was started in 1960s, known as the green revolution. In Indonesia, this intensification program was on trial in 1937 before the Indonesian in-dependency. This program was aimed to increase rice production without changing the rural social structure. The basic assumption was that rice crop production should increase. The result of the green revolution was supported by several programs such as; rehabilitation of drainage, financial support programs, and so on (Tjondronegoro, 1990).

In 1950s, the governments efforts to increase rice production was emphasized with the land-crop expansion and the construction of irrigation systems. The expansion of farming areas was successful due to the conversion of sugar cane areas into rice crop areas. The average rice production in 1956-1960 was approximately two tons per hectare (Jatileksono, 1987). Rice “self-supporting” was the main program by the government in 1960, as the government tried to increase rice production to meet the increase in the population. The agricultural intensification program was designed to increase rice production through social counseling programs. It had five main activities (*panca usaha tani*) involving technological innovation; (1) the use of high-yield varieties, (2) the use of fertilizer, (3) integrated pest management, (4) irrigation and (5) soil management.

The Indonesian institution for agricultural research and development is The Indonesian government institution (Department of Agriculture) whose program is to increase rice production, and keep up food security, especially with the use of technological innovation. Dealing with the fact that most of the farming area in Indonesia have been classified as less fertilized lands, an environment friendly technology innovation is badly needed. One of the environment friendly technology innovations is through the System of Rice Intensification (SRI).

The SRI program is an effort to overcome the problems of less fertilized land, and to maximize rice crop productivity. In addition, SRI is a set of farming practices which have been developed continuously based on the principle of the environment friendly act, efficient inputs, and it also aims to produce rice with a large and deep root system that is better at resisting drought, storms and heavy rains. SRI is also to implement the principles of an agricultural system ability, economic, social, and environmental sustainability (Anonymous, 2010).

East Java is one of the provinces on Java Island, which is a big contribution of the rice supply in Java. According to The Central Bureau of Statistic Indonesia (2011) rice production in East Java in 2010 was 9.14 million tons. Rice production in the Malang Regency was around the last three years, increasing from 366,271 tons of dried rice in 2008 to 368,509 tons in 2009 and 416,396 tons in 2010. The head of the Agricultural Department in Ngantang sub-district of Malang, Wahadi, said that there was an increase in rice production from, 6-7 tons per hectare in 2009 to 8-9 tons per hectare in the following year.

In 2007, The Department of Agriculture Malang Regency implemented the SRI project in the Village of Clumprit (30 farmers), Kademangan (25 farmers), Kanigoro (25 farmers), Karangsuko (30 farmers), Pagelaran Sub-District, Malang Regency. In detail, there were several training lessons about the SRI project covering land preparation until harvesting. SRI projects were implemented in four villages with as many as 110 farmers. At first they were skeptical about this project as it was different than conventional methods, yet they carried it out and successfully produced rice crops with an average of 7-10 tons per hectare or even more than this with 15 tons per hectare.

However, in 2011 most of the farmers quit the SRI project, 85 farmers quit the SRI project (Q-SRI farmers). Only 25 farmers are still practicing this project (SRI farmers). These fact show that farmers have problems, and obstacles with the SRI project in the practice, and why those farmers quit the SRI project even though they already knew the advantages of this project towards the increase of rice production.

This fact certainly attracts critical questions as to what extent SRI projects contribute to a farmers welfare, and the reasons why they not practicing it any longer. This research is important to answer these issues. The following are the research questions of the study.

1. What are the roles and functions of the SRI project?
2. What are the farmers' socioeconomic characteristics, and agricultural production systems?
3. What are the farmers' rice cultivation activities in both SRI farmers and Q-SRI farmers?
4. What is the net profit, and the level of the farmers' practice in the SRI project, and the correlation between level of practice and net profit in a SRI project?
5. What are the problems and obstacles of the SRI project in the practice?
6. What are the factors affecting the farmers status (still practicing SRI or quit SRI) in a SRI project?

The formulated questions above are expected to answer the questions being raised in this research as to what extent the SRI project contributes toward farmers' economic lives in Malang Regency, Indonesia. Thus, the title for this research is "*Economic Performance of System of Rice Intensification (SRI) Project in Malang Regency, Indonesia*".

1.2 Objective and benefit of the research

1.2.1 Objective of the research

The general objective of this research is to examine the contribution of SRI projects to the economic aspect of the farmers. The general objective can be broken down to six specific objectives that would together achieve the overall goal of the research as follows;

1. To study the role and function of the SRI project,
2. To study the socioeconomic characteristics and agricultural production system of the farmers,
3. To study the rice cultivation activities of farmers joining the SRI project,
4. To analyze net profits and levels of practice in SRI projects and the correlation between the levels of practice and net profits,
5. To identify the problems, and obstacles of SRI project in the practice,
6. To study factors affecting farmer status (still practicing SRI or quit SRI).

1.2.2 Benefit of the research

The results of this study are theoretically expected to contribute to the researcher, facilitator, information providers, and interested parties in studying farmer knowledge and practice in the SRI project. In addition, the results of practical research are expected to provide significant contribution for practitioners, especially farmers, or interested parties in applying the SRI project.

The results of this study are expected to have benefits for people who do not have a basic knowledge in agribusiness management that will be able to understand some, or all of the research report. However, it is also expected to be useful to other researchers who may gain some insights in conducting further research in other ways that can use the data described in this report.

Furthermore, this research can also be used to understand the conditions of knowledge and practices of farmers in the SRI project, providing information about the role, and function of the SRI project in Indonesia. It is also useful for decision-making or policy-makers in agriculture, especially rice fields, to improve the welfare or income of farmers in the SRI project.

1.3 Scope of the research

The scope of the research focuses on three major parts; those are content of the research, research area, population of research and period of data collection.

1.3.1 Content of the research

The content of the research focuses on the following parts (1) the role and functioning of the SRI project. The role and functioning of the SRI project following the standard of SRI, (2) the socioeconomic characteristic and agricultural production systems of farmers joining in the SRI project. The focus of the topic includes gender, age, religion, marital status, education, and numbers of family, main occupation, second occupation, and status of organization, participation and position in the organization. It also emphasizes on the aspects of agricultural production systems which, include used land and hold land, and (3) the rice cultivation activities of farmers joining the SRI project. The rice cultivation activities include land preparation, seedling and transplanting, chemical and organic fertilizer application, water management, weeding, chemical and herbal pesticide application, and harvesting.

(4) Net profits and levels of practice in the SRI project, and the correlation between levels of practice and net profits. Net profit is the difference between total revenue, and total cost per hectare. The level of practice in SRI principles includes: (a) selecting seeds with salt water, (b) managing field and practicing organic fertilizers to the field, (c) planting seeds at a young age (7-15 days), (d) transplanting one or two seeds per hole, (e) setting the planting distance of 30 cms x 30 cm, (f) doing frequent weeding 3-4 times, at least three times using "*kokrok* or weeder" and doing them manually, (g) practicing organic fertilizers, (h) practicing intermittent irrigation, (i) practicing an integrated pest-disease control and (j) practicing an appropriate harvesting system. The correlation between the level of practice and net profit in the SRI Project is analyzed by correlation analysis using Rank Spearman correlation coefficient.

(5) The problems and obstacles of the SRI project in the practice. Problems and obstacles of the SRI project in the practice include: difficulty in transplanting young seedlings, difficulty finding employment or labor, difficulty in transplanting the seedling with a wide spacing, majority respondents prefer to use chemical fertilizers, difficulty in controlling pests and diseases.

(6) The factors affecting the farmer status (still practicing SRI or quit SRI). The factors affecting the farmer status include: socioeconomic factors and other factors. Socioeconomic factors such as; age, marital status, the level of formal education, the number of household members, main occupation, second occupation, total land holdings, size of paddy fields, status of the farmer organization participates, and the number of cows. Other factors such as; labor requirements, single seedling, soil organic fertilizers, the farmers practice of the SRI project, and drought. The relationship between socioeconomic, and other the factors and farmer status is analyzed by relationship analysis using independence tests via Chi-Square (χ^2), among socioeconomic or other factors that are independent variables and the farmer status that is the dependent variable.

1.3.2 Research area

The research areas (village, sub districts, regency and province) performed purposive selection for consideration: (1) village, sub district, district and province is the center of production of paddy in Malang, (2) In the area of SRI development ever undertaken. Therefore, the area of the study is conducted in four areas as follows, (a) the Clumprit Village, Pagelaran, Malang, (b) the Karangsuko Village, Pagelaran, Malang, (c) the Kademangan Village, Pagelaran, Malang, (d) the village of Kanigoro, Pagelaran Sub-District, Malang Regency, Indonesia.

1.3.3 Population of research

The population of this research are all 110 farmers who took part in the government's pilot project (SRI Project). There are 25 farmers who are still practicing the SRI Project, and 85 farmers who already quit the SRI Project.

1.3.4 Period of data collection

Data were collected all farmers who participated in SRI Project in 2007, in total 110 farmers during April to June 2011.

1.4 Definition of the terms

This sub chapter will explain some terms to avoid any misperception amongst readers. These terms are explained as follows:

1. Conventional method is the method used by farmers whom tend to use chemical fertilizers, pesticides and hybrid seeds these are relatively large compared with the SRI farmers.
2. The green revolution is a technology package comprising material components to improve high yielding varieties of two staple cereals (rice and wheat), irrigation or controlled water supply, and improved moisture utilization, chemical fertilizers, and pesticides.
3. Cash costs are costs requiring an out of pocket cash payment, an example; hired labor, fertilizer, pesticides, etc.
4. Non-cash costs are costs not requiring a cash payment every year or season (depreciation, family labor, subsidy of seeds, etc.).
5. Level of practice in the SRI project is the ability of farmers to practice the SRI project such as land preparation, seedling and transplanting, weeding, through till harvesting.
6. Organic fertilizers are naturally occurring fertilizers (e.g. compost, manure, green manure, etc.)
7. Herbal pesticides are potion of organic nature, using herbal ingredients. It has the same function as chemical pesticides, which can reduce or minimize pests and diseases. It is also as supplement the growth of plants by offering all the important nutrients.

1.5 Organization of the study

The entire study has been divided into five chapters. Chapter 1 presents an introduction. Chapter 2 describes a literature review. Chapter 3 presents the research methods, while Chapter 4 comprises of the empirical results of the research and discussion. The final chapter gives conclusions and recommendations.

Chapter 2

Literature Review

2.1 Rice situation and the SRI project in Indonesia

2.1.1 The rice situation in Indonesia

Indonesian population and area of agricultural land in Indonesia

Based on the results of the population census enumeration of 2010 (Figure 2.1), the Indonesian population was 237.56 million people; consist of 119.51 million men and 118.05 million women. Distribution of Indonesia's population is still concentrated in Java that is equal to 58 percent, followed by Sumatra Island at 21 percent. Next to the islands or other island groups in succession are as follows: Sulawesi at 7 percent; Kalimantan at 6 percent, Bali and Nusa Tenggara at 6 percent, and Maluku and Papua at 3 percent (BPS, 2010).

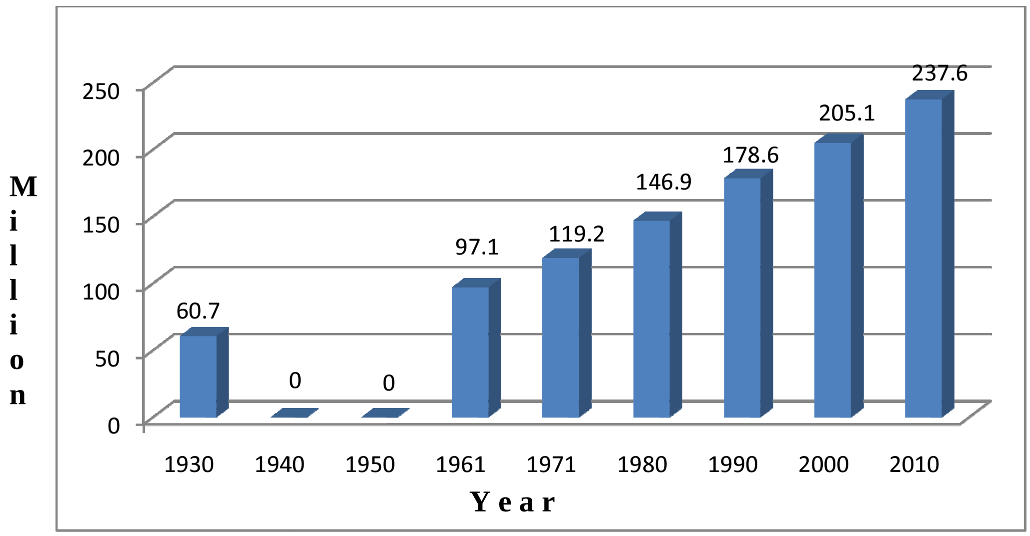

Figure 2.1 Data of Indonesia's population by year
Source: BPS, 2010

Figure 2.1 shows that Indonesia's population continues to grow. When the Dutch entered the 1930 census the population was 60.7 million people nationwide. In 1961, the first population census, after Indonesia became independent, the total was a population of 97.1 million people. In 1971 Indonesia's population was 119.2 million people, in 1980 it was as many as 146.9 million people, in 1990 it was 178.6 million people, in 2000 was 205.1 million people, and in 2010 it stood at 237.6 million people.

Nationally, the sex ratio of Indonesia's population amounted to 101, which means the total male population was one percent more than the number of females, or for every 100 women there were 101 men. The sex ratios are largest in the province of Papua, which is equal to 113 and the smallest is found in West Nusa Tenggara Province which is 94.

West Java, East Java and Central Java are the top three provinces with the most populous, which respectively amounted to 43.02 million people, 37.48 million people and 32.38 million people. Province of North Sumatra is the most populated area outside Java, with as many as 12.99 million people.

The total area of Indonesia is approximately 1.91 million km^2, meaning the average population density of Indonesia is 124 people per km^2. Provincial the highest population density is in the Province of DKI Jakarta, which amounts to 14.44 thousand people per km^2. Meanwhile, the province's most low-level population density is the Province of West Papua, that is equal to 8 people per km^2.

Further regarding the harvested area, productivity, production of Rice in Indonesia are presented in Table 2.1

Table 2.1 Harvested area, productivity, production of rice in Indonesia

Year	Type of crop	Harvested area (ha)	Productivity (ton/ha)	Production (ton)
2004	Paddy	11,922,974	4.536	54,088,468
2005	Paddy	11,839,060	4.574	54,151,097
2006	Paddy	11,786,430	4.620	54,454,937
2007	Paddy	12,147,637	4.705	57,157,435
2008	Paddy	12,327,425	4.894	60,325,925
2009	Paddy	12,883,576	4.999	64,398,890
2010	Paddy	13,118,120	5.030	65,980,670
Growth Rate(%/year)		1.80	1.97	3.80

Source: BPS, 2011

Table 2.1 shows that 7 years based on the highest of the area harvested in 2010 with an amount of 13.12 million hectare, which means that every year there is a trend increase in the area harvested. Later in production, total production was also at its in 2010 amounting to 65.98 million tons, while the smallest number in 2004 amounted to 54.09 million tons, it also shows a trend of increased production aspects.

Consumption of rice in Indonesia

According Raswa, E (2006) in his article titled "Rice Consumption Data" states that: A number of agricultural circles questioned the national rice consumption data (Indonesia) per year. They urged the Central Bureau of Statistics reexamine the data. According to the Chairman of the Advisory Council of the Organization of the Indonesian Farmers Association, Siswono Husodo, data for 139 kilograms of rice consumption per capita per year is too big.

Based on his research of rice consumption it averaged only 125-130 kilograms per capita per year. As a result of consumption per capita being too large, the number of national rice consumption swelled to 30.6 million tones. Thus, said Siswono, rice production could not close the lack thereof. And with the consumption of 125-130 kilograms of rice per person per year, the national rice consumption is only 27.5 to 28.6 million tons per year.

According to the Chairman of Contact Farmers and Fishermen Mainstay, Winarno Tohir, a re-calculation should be carried out between BPS, the Ministry of Agriculture, and agricultural practitioners. Director General of Food Crops Agriculture Department, Sutarto Alimoeso admitted to routinely providing input to the Central Bureau of Statistic (CBS) about the revision of this consumption data. "Continues to do an evaluation," said Sutarto. Actually has a valid method of calculating the consumption of rice. But this method needs to be repaired under the conditions there.

Projected rice production in 2001 refers to the forecast figures Connecticut, further projections in 2002-2004 using the rate of production growth rate of 1% per year. This growth figure is the range of fluctuations in rice production that occurred in the last 5 years (between -3.3 to +3.3 percent) with a declining trend, and considering the unavailability of sources of new growth for rice production, either from raw land fields, cropping intensity, and productivity. The unavailability of production incentives that ensure farmers' income, intense competition with imported rice, and the increasingly limited land and water resources, an obstacle facing efforts to increase rice production.

Projected availability of rice, that is ready to be consumed, is reduced domestic production of seed / seedlings and yield losses (Table 2.2), then converted to the rice with a conversion factor of 0.65.

Table 2.2 Production and availability of rice for consumption

Year	Production (ton)	Needs Seeds (ton)	Loss (ton)	Availability for consumption	
				Rice (ton)	Equivalent rice (Ton)
2001	50,096,486	1,252,412	2,254,342	46,589,732	30,283,326
2002	50,597,451	1,264,936	2,276,885	47,055,630	30,586,159
2003	51,103,425	1,277,586	2,299,654	47,526,185	30,892,021
2004	51,614,460	1,290,361	2,322,651	48,001,448	31,200,941

Source: Ministry of Agriculture Republic of Indonesia, 2011

Table 2.2 shows that the availability of rice for consumption is expected to rise only about 1 percent per year from 30.3 million tons in 2001 to 31.2 million tons in 2004.

Projection import/ export of rice in Indonesia

In this study the volume of import / export of rice are a residual in the balance sheet and in rice production needs. By comparing the availability and demand projections (Table 2.3) can be viewed any surplus or deficit over a period of four years (2001-2004). If the deficit is needed for import the difference is, on the contrary if there is a surplus there is potential for exporting.

Table 2.3 Balancing demand and availability of rice for consumption (2001 to 2004)

Year	Requirement (ton)	Production available (ton)	Deficit (import) (ton)
2001	32,771,264	30,283,326	2,487,920
2002	33,073,152	30,586,159	2,486,993
2003	33,372,463	30,892,021	2,480,442
2004	33,669,384	31,200,941	2,468,443

Source: Ministry of Agriculture Republic of Indonesia, 2011

Table 2.3 above represents an estimate of the deficit when the nominal volume is quite large, although it tends to decrease slightly, from 2.49 million tons in 2001 to 2.47 million tons in 2004. This deficit condition makes the domestic rice market sensitive to fluctuations in domestic rice production, it is also sensitive to changes in climate and other natural conditions.

2.1.2 SRI project in Indonesia

The System of Rice Intensification (SRI), developed by Laulanié, in the 1980s in Madagascar, offers unprecedented opportunities for improving rice production in a variety of situations around the world, not just by increments but, by multiples. The SRI, developed in Madagascar with the help of Malagasy farmers, involves reduced water applications, including the adoption of Alternate Wet and Dry Irrigation (AWDI) as a part of a new strategy of rice intensification, growing rice under mostly aerobic soil conditions (Uphoff, 2004 and Van der Hoek et al., 2001).

Uphoff (2005) reveal that SRI system changes a number of practices that farmers have used for centuries, even millennia, to grow irrigated rice. However, it should be understood that the SRI is more than these practices. It is the concepts, ideas and principles preceding and justifying the practices that are the crux of SRI. The alternative methods are manifestations of a different way of thinking about and pursuing agricultural production. Conventional practice (Non SRI) and SRI practice is presented in Table 2.4 (Uphoff, 2005).

Table 2.4 Conventional practice (Non SRI) and SRI practice

Conventional practice (Non SRI)	SRI practice
Transplant older seedlings, 20-30 days old, or even 40-60 days old in traditional practice	Transplant young seedlings, 8-12 days old, and certainly less than 15 days old, to preserve subsequent growth potential
Transplant seedlings in clumps of plants and fairly densely, 50-150 plants m2	Transplant seedlings singly, one per hill, and in a square pattern, 25x25cm, or wider if or when the soil is more fertile[1]
Maintain paddy soil continuously flooded, with standing water throughout the growth cycle	Keep paddy soil moist, but not continuously saturated, so that mostly aerobic soil conditions prevail
Use water to control weeds, supplemented by hand weeding or use of herbicides	Control weeds with frequent weeding by a mechanical hand weeder (rotating hoe or cono weeder) that also aerates the soil
Use chemical fertilizers to enhance soil nutrient supply	Apply as much organic matter to the soil as possible; can use chemical fertilizer,

Source: Uphoff, 2005

1 Also, transplant seedlings quickly – getting them replanted within 15-30 minutes after removal from their nursery; shallow – only 1-2 cm deep; and gently – taking care to minimize any trauma to the roots, and not plunging the seedlings down vertically into the soil, which inverts the roots tips so that they point upwards and their resumption of growth is delayed while their tips reorient downward.

Uphoff (2008) wrote “The SRI as a System of Agricultural Innovation”: The basic concepts of SRI can be summarized as follows:

1. Use young seedlings to preserve mature plants, growth potential, although direct seeding is becoming an option with SRI.
2. Avoid trauma to the roots – transplant quickly, shallow (1-2 cm), with no inversion of seedlings, root tips that will delay the plants, resumption of growth after transplanting.
3. Give plants optimal wider spacing – *one plant per hill* and in *square pattern* so as to achieve, the border effect for the whole field.
4. Keep paddy soil sufficiently moist but not continuously flooded, mostly aerobic, and not saturated. This concept has been adapted for rice-growing in rainfed, unirrigated areas, with considerable success.
5. Actively aerate the soil as much as possible, using a rotary hoe or *conoweeder* to control weeds.
6. Enhance soil organic matter as much as possible by applying compost, mulch, manure, etc. Chemical fertilizers can be used with SRI, but the best results have come from organic soil amendments.

The first three practices stimulate plant growth, while the latter three practices purposefully enhance the growth and health of plant roots and soil biota. Another beneficial practice is gained from that of use SRI, such as selecting of most suitable varieties, using good seed selection, possibly also doing seed priming and seedbed polarizations or using raised beds (Culman et al., 2006).

Therefore, rice seedlings, when transplanted at a very young stage, can easily absorb the transplanting shock and can still maintain their ability to grow to their full potential. Like plants, soil is also considered living — full of live, with microbes thriving on and in it. The activities of these huge numbers of microorganisms make the soil a living body. Rather than being a store house, it is virtually a living-machine that produces nutrients for plants depending on the way it is managed, and depending on the energy that is supplied to it.

Generally, composts and manures are considered the primary source of such energy, and the amount, the time allowed, and the type of the organic materials, that are supplied to the soil, have a large influence on the overall activities and the population of these huge numbers of microorganisms.

Contrary to what people general understand, these organic materials are provided to the soil not as a supply of nutrients to the plants but rather, as a source of nutrients and carbon to the microorganisms. It is generally believed that microorganisms cannot uptake carbon, which is essential for their survival, from air, and no synthetic fertilizers contain carbon at all. The supply of organic nitrogen through green manures also influences (positively) the population of microorganisms that cannot a fix atmospheric nitrogen (Kabir, 2006).

The principles of SRI

The principles that have determined SRI practices are (Kabir, 2006):

1. Rice is not an aquatic plant:

Rice has been growing over centuries under submerged conditions. There was a general belief that rice plants grow better under saturated conditions. This is strengthened when it is seen that rice plants develop aerenchyma (air pockets) in their roots when it grows under submerged conditions.

2. Rice plants loose some of their growth potential when transplanted at an older age:

SRI capitalizes upon an in-built pattern of physiological development in rice which was first identified by a Japanese scientist named T. Katayama before World War II, when he found while studying the growth and development of cereal plants, that these plants produce their tillers in a sequential order (Katayama, 1951; Uphoff, 2002). Later Father Henri de Laulanié, during his work in Madagascar in 1960s-1980s, observed that a plant's ability to produce tillers was reduced gradually with the age of the seedlings when transplanted, with younger seedlings producing a larger number of tillers. He found that rice seedlings transplanted before the fourth *phyllochron* - a physiological development unit of plant growth, the time interval during which one or more phytomers (units of tiller, leaf and root) develop — produced the highest number of tillers. Therefore, to exploit the maximum potential for tillering, rice seedlings need to be transplanted before the beginning of the fourth phyllochron, usually when they are around 10-15 days old. This difference is based on the management of the seedlings. Under better management conditions, 10-day-old seedlings could reach such a stage.

3. Enough spacing to grow fully:

Rice seedlings, when planted earlier, need enough space to express their full potential in terms of growth of leaves, tillers and roots. Enough space, along with other favorable conditions, allow the plants roots to grow profusely both vertically in deeper parts of the soil and horizontally to cover a larger area, and when roots are spread to a larger volume of soil, they tap more nutrients, which results in the development of larger plants with a larger numbers of tillers and grains.

4. Careful transplanting:

Transplanting shock associated with uprooting, transportation, and transplanting is an important stress to rice seedlings; therefore, they need to be handled very carefully. Seedlings when they get affected lose their potential to grow fuller, and perhaps this is one reason why, when they are transplanted in usual ways, they are not seen to produce as many tillers as when using SRI.

5. Specific soil amendment practices to facilitate the growth and development of microorganisms:

The supply and the availability of nutrients, in the soil is mainly determined by how it is managed. Specific soil management practices include providing alternate oxidized and reduced conditions to the soil so that both aerobic and anaerobic microorganisms can grow, and die, in alternating conditions and their continuous decomposition supplies nutrients to the soil, as mentioned earlier. This would be maintained by alternate flooding and drying.

Specific soil management can also supply adequate amounts of organic material so that, it improves the nutrient supply for microbes. Studies conducted with sugarcane in Brazil indicate that non-leguminous plants, of which rice is one, when grown without chemical nitrogen, can a fix 150-200 kilogram of nitrogen per hectare (Uphoff, 2002). For example, increases in water-extractable organic P of between 185 and 1900% were reported following the air drying of temperate pasture soils (Turner and Haygarth, 2001).

All these dynamics can make the application of chemical fertilizers unnecessary if there are unavailable reserves of nutrients in the soil that can be mobilized or mineralized, as a result of the work of microorganisms. Another important finding, which is again contrary to the general belief, is that plants can grow satisfactorily with much lower concentrations of nutrients than have previously been thought to be necessary provided and that the limited supply is constantly available over time rather than at a few points in time (Primavesi, 1994, and Uphoff, 2002).

Abeysiriwardena D.S.d.Z., Weerakoon W.M.W. & Wickramasinghe W.M.A.D.B. (2009) wrote "System of Rice Intensification (SRI) As a Method of Stand Establishment in Rice": The range of stand establishment methods in rice with placing SRI in its proper position in the range and their associated seed rates based on the utilization of tillering capacity and special features are presented in Figure 2.2. Furthermore, in one extreme end of the range of stand establishment methods in rice, rice crop is allowed to have only the main culm of the rice plant with the maximum number of mother culms or panicles per unit land area (uni culm approach). The practical implication of this extreme method of stand establishment is that it saves cost on labor and weed control at the expense of seed paddy while obtaining profitable yields.

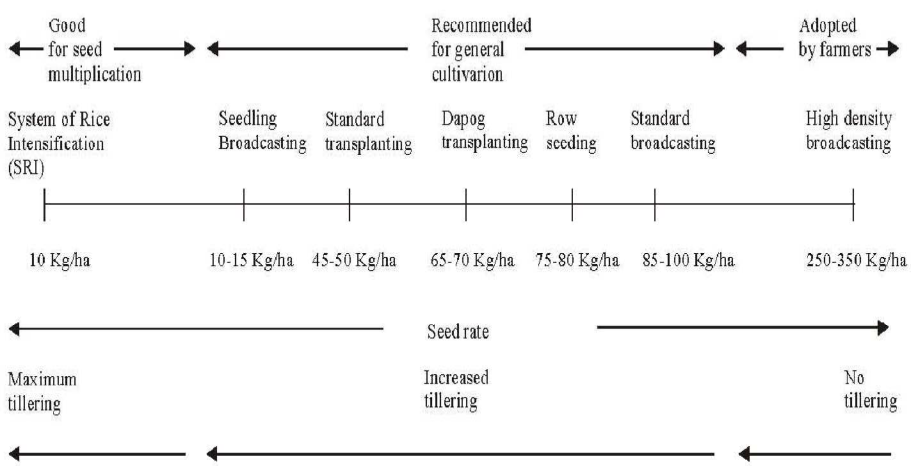

Figure. 2.2 Range of stand establishment methods with their associated seed rates and special features in rice cultivation

Source: Abeysiriwardena et al, 2009

Each of the stand establishment methods while having its own advantages and disadvantages is associated with a specific set of management practices unique to each method depending on the tillering requirement to maximize grain yield. All the stand establishment methods including SRI ultimately end up with the same grain yield through making autonomous adjustments among yield components if properly managed. SRI was not capable of giving extraordinary high grain yield or at least a significantly higher grain yield than that of properly managed conventional methods on area basis. However, its grain yield level on seed basis was comparatively very high owing to its low seed rate. SRI could be considered as one of the two extreme ends in the range of stand establishment method in rice (Abeysiriwardena et al, 2009).

Kabir (2006) wrote; Adaptation and Adoption of the System of Rice Intensification (SRI), soil is considered a store-house of nutrients essential for the growth and development of rice plant, and over time after growing rice for many years, the capacity of this store gradually declines as rice plants, on a continual basis for growing year after year, take up needed nutrients from it. Therefore, the store needs to be filled up with those appropriate types and amounts of nutrients that have been taken up to make sure that new rice crops have enough nutrients for their production. This is a zero-sum view, where the system is not regarded itself contributing to its own operation, and able to replenish its capacities. It is a view dependent on outside (exogenous) interventions.

Additionally, in this view, rice varieties, either local or improved, are considered to possess a given yield ceiling or a barrier, which is the virtual limit for expressing their genetic potential; even with more inputs and/or better environmental conditions, no variety has a capacity to cross such barrier. Generally, such limits are higher in the modern varieties, being artificially raised through conventional plant breeding of genetic modification, than in the local varieties. The creation of modern varieties such as high-yielding varieties (HYVs) or hybrid varieties with their higher yield target, require that more nutrients be supplied to the soil from external sources, since the amount available in the soil is not considered enough to meet their demand. To meet such huge demands, farmers usually opt for synthetic fertilizers as they are less costly (especially when subsidized) and easily available and, as well as being more convenient to use. Especially on large-scale operations (Kabir, 2006).

Therefore, the cultivation of these modern varieties is always dependent on fossil-fuel-based synthetic fertilizers and later, after the emergence of pest insects and diseases, which are eradicated by synthetic pesticides - mostly insecticides and herbicides. The overall consequences of this concept of growing rice, especially how it is making impacts - both positive and negatives - to the lives of the farming communities, the environments, and ecosystems (Kabir, 2006).

The System of Rice Intensification (SRI) is one of the rice farming methods which focuses on the management of soil, plant, and water through community empowerment, which is based on local wisdom leading to environment friendly programs. SRI develops rice farming activities which consider the establishment of better plant growth, especially starting from the root system as it is different from traditional methods (Berkelaar, 2001).

WASSAN (2006) argued that there are essential components in the SRI methods which are as follows:

1) Wider spacing between plants, suggesting that there must be sufficient spare-space between one plant and another, so that air and light can get through the plant leading to its full potential, growth in terms of growth of the plant root system, enabling it to absorb more nutritions, and finally this condition will result in the development of larger plants with larger tillers and grains.
2) The use of fewer seedlings as a consequence of wide spacing among the plants. This method is also useful in reducing costs.
3) Showing that it could alleviate shock in earlier transplanting, so as to avoid the density and increase plant production with more tillers, rods, and maximum growth of the plants.
4) The use of less water, rice plants are not the kind of watery plants that require a lot of water. They only need 1-3 cm of water.
5) Use the weeds as the organic.
6) Applying organic fertilizer to enrich the microorganisms in the soil, which enable the fixing the soil structure.

In 1999, SRI was firstly implemented in Indonesia, in the Sukamandi Village, West Java. Through this method, the rice production increased twice compared with the conventional method. During the dry season the total production of rice is 6.2 ton/ha and 8.2 ton/ha during the rainy season. However, when this method was applied in China and the Philippines, the results showed that there was no significant different between SRI and the conventional method. Therefore, some experts still question the result of SRI implementation in Madagascar (Uphoff and Sato, 2007).

The study conducted by Rakhmi (2008) revealed that the implementation of SRI in rice farming activities in Binuang Saiyo has been successful. Another study by Richardson (2010) in East Java suggested that the implementation of SRI could produce 7-8 ton/ha of rice. This production is 5 tons more than the traditional farming method.

The failure towards SRI implementation is due to the fact that the implementation, or farming activities, tend to contradict with conventional ones. In other words, the SRI method is against the myth and farmer’s tradition. Some examples are as follows:

(1) Commonly the transplanting process applied when the seedling age is 20-30 days with massive clumps and water in the whole season.

(2) SRI strongly recommends the use of organic fertilizer which is unfortunately unaffordable for farmers, because it is improving the soil structure, and helping to prevent topsoil erosion. However most farmers prefer the use of chemical fertilizers.

(3) Planting one seedling in one hole/hill, with younger seedlings is quite difficult for farmers to do as it requires them to do it rather quickly.

(4) Systems of intermittent watering in irrigation areas is still difficult to implement because irrigation systems by farmers for crop land is usually carried out based on the schedule on the basis of days (10 days, 2 weeks, or even 1 month in dry season).

(5) Process of land drying in irrigation areas especially flat areas is still difficult to adopt.

In addition, Gani et.al (2002) in his article “SRI in Indonesia” also reveals several problems which farmers meet during implementing SRI, such as:

(1) Irrigation management, and scheduled water control are hard to adopt by farmers. As a result, soil aeration increases and generally farmers are not aware of it.

(2) The higher labor costs.

(3) Technical problems.

(4) Pest and disease problems, an example; mice, grasshoppers, and others which easily attack the young plants after the transplanting.

Uphoff and Sato (2007) conducted an experiment between SRI and non-SRI method in Nusa Tenggara with an average area 0.5 ha. Table 2.5 shows the result of their experiment:

Table 2.5 Comparison between SRI and non-SRI implementation

Practices	SRI methods under DISIMP	Conventional methods (irrigated)
Land Preparation (LP)	2 times: 1st LP for plowing, and 2nd LP for puddling and leveling No standing water after 2nd LP	2 times: 1st LP for plowing, and 2nd LP for puddling and leveling Keep standing water after 2nd LP
Seed		
➢ Quality	80-100% certified seed	20-40% certified seed
➢ Quantity	Planting @ 5-8 kg/ha	Planting @ 30-50 kg/ha, or Direct seeding @ 60-100 kg/ha
➢ Seedling age	8-12 days at planting	21-30 days at planting
Transplanting		
➢ Seedling no.	1 seedling in each hill. 1-2 cm deep	3-5 seedling in each hill
➢ Spacing	30cm x 30cm (standard) with regular distance	15 to 20 cm spacing at random intervals
Irrigation		
➢ Vegetative growth stage	Intermittent irrigation with wet-dry cycle. Little standing water (± 2 cm) in wet period.	Continuous irrigation keeping 5-10 cm deep standing water
➢ Reproductive stage	Continuous irrigation, keeping 2-5 cm of standing water.	Continuous irrigation keeping 5-10 cm deep standing water
Weeding		
➢ Method	Rotary weeder, weeding tools, or manual weeding	Weeding tools, or manual weeding
➢ Frequency	2-3 times during vegetative growth stage	1-2 times during vegetative growth stage
Fertilizer use		
➢ Type	Chemical fertilizer plus organic inputs	Chemical fertilizer
➢ Amount	Recommend 150 kg/ha of urea (nitrogen) and 100 kg/ha phosphorus fertilizer	Follow guideline of district agriculture office

Source: Uphoff and Sato, 2007

SRI methods are expected, indeed intended, to be adapted to local conditions, so that the best possible growing conditions are created for the rice plants and for the soil organisms that interact with them. According to DISIMP (Decentralized Irrigation System Improvement Project) experience, some adjustments have been made in the original SRI practices, e.g., most Eastern Indonesian farmers continue to use some chemical fertilizer, but they are usually reducing its application. They have found most farmers are reluctant to give up fertilizer entirely, and many do not have access to enough biomass or to enough labor to convert it into compost. So some accommodation is necessary. They anticipate that there is still considerable room for making further productivity improvements since not all of the SRI practices that have been validated by factorial trials are being used by farmers in DISIMP (Uphoff and Sato, 2007).

2.1.3 The effect of the practice of SRI project

The previous study about the effect of the SRI method has been studied by Mediana (2010) revealing three important things as follows:

(a) The effect toward productivity, shows that the increasing of production and productivity.

(b) The effect towards the use of input (water, seed etc) for rice production in which generally the implementation of SRI is much more focused on the efficiency of input. It could be seen from the intermittent irrigation system being used in SRI.

(c) The increasing of the farmer's income as a result of increasing production compared to traditional methods.

In addition, Kunia (2009) found that there are at least four main reasons of SRI is recommended to be implemented in Indonesia. First, SRI has been found to increase rice crop productivity above the average national rice production. Second, it also shows the efficiency of water usage up to 40 percent. The use of seeds could also be saved, up to 80 percent so that it could reduce cost production.

Thirdly, it could make soil more fertilized and sustain the land production. Fourthly, this method is known to be environment friendly since it (a) mitigates the presence of smoke pollution as a result of less dried rice stalks burning which can reduce gas emission CO_2, (b) mitigates methanol gas emission produced by anaerobe reduction process and standing water, (c) mitigates emission CO_2 and methanol CH_4 which could decrease the production of green house gas emission, which is highly related to global warming, (d) focuses on waste recycle as one of SRI principles so that waste load can be minimized or even avoided, (e) limits the application of agrochemical matters so that chemical environmental pollution can be avoided, and (f) SRI-produced rice can be classified as healthy rice as the method minimize the use of chemical fertilizers and synthetic pesticide.

The application of SRI methods, which is used by most of Indonesian farmers brings positive and negative effects. Based on Andrina's explanation (2009) that the lack of organic fertilizer is the constraint of the development of SRI, because the farmers are not able to produce compost fertilizer for the whole farmland. If it is analyzed from a economically aspect, the SRI method can increase the total cost because, it also includes labor costs. The total cost will also increase more if the compost fertilizer price is also included. If the total cost is higher the total profit will be reduced.

Finally, the SRI is technically more efficient compared to the conventional model. However, economically, using SRI method is lower than the conventional method. It is based on the research done by Rachmiyanti (2009), it is stated that total revenue from total cost of the farmer using SRI is lower than the conventional method.

2.2 Theoretical background

2.2.1 Fixed, variable, and total costs

Kay et al., (2008) examined the cost associated with owning a fixed input are called fixed cost. Fixed cost do not change as the level of production changes by definition there need not be any fixed inputs changes. By definition there need not be any fixed inputs owned in the long run, so fixed cost exist only in the short run and are equal to zero in the long run. Total fixed cost (TFC) is the summation of the several types of fixed costs. Computing the average annual TFC for a fixed input requires finding the average annual depreciation and interest costs, among others.

Fixed cost can be expressed as an average cost per unit of output. Average fixed cost (AFC) is found using the equation AFC = TFC : output, where output is measured in physical units such as bushels, bales, or hundredweights. Acres or hours are often used as the measure of output for machinery even though they are not units of production. By definition, TFC is a fixed or constant value, so AFC will decline continuously as output increases (Kay et al., 2008).

The first thing to check is fixed costs, such as machinery and building depreciation, interest and general farm overhead costs. If they are high relative to the farm size and value of production, steps should be taken to reduce those which will have little or no effect on the level of production. Reducing fixed costs may be difficult and require some time, but all current and new investments and their related fixed costs should be carefully scrutinized. If the fixed and overhead costs appear satisfactory, check the economic efficiency measures for excessive variable costs (Kay, 1986).

Variable cost are those over which the manager has control at a given time. They can be increased or decreased at the manager's discretion and will increase as production in increased. Item such as feed, fertilizer, seed, pesticides, fuel, and livestock health expenses are examples of variable cost. Total variable cost (TVC) can be found by summing the individual variable cost, each of which is equal to the quantity of the input purchased times its price. Average variable cost (AVC) is calculated from the equation AVC = TVC : output, where output again is measured in physical units. Average variable cost may be increasing, constant, or decreasing, depending on the underlying production function and the output level (Kay et al., 2008).

Total cost (TC) is the sum of total fixed cost and total variable cost (TC = TFC + TVC). In the short run, it will increase only as TVC increases, because TFC is a constant value. Average total cost (ATC) can be found by one of two methods. For a given output level, it is equal to AFC + AVC. It can also be calculated from the equation ATC = TC : output, which will give the same result. Average total cost will typically be decreasing at low output levels, because AFC is decreasing rapidly and AVC may decreasing also level (Kay et al., 2008).

Opportunity cost is an economic concept and not a cost that can be found in an accountant's ledger. However, it is an important and basic concept that needs to be considered when making managerial decisions. Opportunity cost is based on the fact that every input or resources has an alternative use even if the alternative is nonuse. Once an input is committed to a particular use, it is no longer available for any other alternative, and the income from the alternative must be foregone (Kay and Edwards, 1994).

Opportunity cost can be defined one of two ways; first, the value of the product not produced because an input was used for another purpose, or second, the income that would have been received if the input had been used in its most profitable alternative use. The later definition is perhaps the more common. Either of these definitions of opportunity cost should be kept in mind as a manager makes decisions on inputs use. The real cost of an input may not be its purchase price. Its real cost, or its *opportunity cost,* in any one use is the income it would have earned in its next best alternative use. If this is greater than the income expected from the planned use of the input, the manager should reconsider the decision. The alternative appears to be a more profitable use of the input (Kay and Edwards, 1994).

2.2.2 Revenue

An income statement should include all business revenue earned during the accounting period but no other revenue. The problem is one of determining when revenue should be recognized; that is, in what accounting period it was earned. This problem is further compounded because revenue can be either cash or noncash. When revenue is received in the form of cash for a commodity produced and sold within the same accounting period, recognition is easy and straightforward. However, revenue should also be recognized whenever an agricultural commodity is ready for sale (Kay et al., 2012).

When an inventory or account receivable is recognized as revenue, it is noncash revenue at that time, but something for which a cash payment typically will be received at a later date. However, payment may sometimes be received in the form of goods or services instead of cash. This noncash payment should be treated in the same manner as a cash payment. The value of feed or livestock received in payment for custom work should be included in revenue, because a commodity was received in lieu of cash (Kay et al., 2012). Total revenue is the income received from the total physical product; same as total value product (Kay and Edwards, 1994).

Kay et al., (2012) examined depreciation is often defined as the annual loss in value due to use, wear, tear, age, and technical obsolescence. It is both a business expense that reduces annual profit and a reduction in the value of the asset.

What types of asset would be depreciated? To be depreciable, an asset must have the following characteristics:

1. A useful life of more than one year.
2. A determinable useful life but not an unlimited life.
3. A use in a business for the depreciation to be a *business* expense (loss in value on a personal automobile or personal residence is not a business expense).

Example of depreciable assets on a farm or ranch would be vehicles, machinery, equipment, buildings, fences, livestock and irrigation wells, and purchased breeding livestock. Land is not a depreciable asset, because it has an unlimited life. However, some improvements to land, such as drainage tile, can be depreciated (Kay et al., 2012).

2.2.3 Net farm income

Profitability is concerned with the size of the business. Size is measured by the value of the resources used to produce the profit. A business can show a profit but have a poor profitability rating if this profit is small to the size of the business. For example, two farms with the same net farm income are not equally profitable if one used twice as much land, labor, and capital as the other produce that profit. Profitability is measure of the efficiency of the business in using its resources to produce profit or net farm income (Kay et al., 2012).

Net farm income is the amount by which revenue exceeds expenses, plus any gain or loss on the sale of capital assets. It can also be thought of as the amount available to provide a return to the operator for the unpaid labor, management, and equity capital used to produce that net farm income (Kay et al., 2012). Net farm income is the difference between total revenue and total expenses, including gain or loss on the sale of all capital assets; also the return to owner equity, unpaid labor, and management (Kay and Edwards, 1994).

Profit is the monetary value computed as net relative to the size of business or the resources used to produce the profit (Kay, 1986). The profit level and profitability ratios were estimated using gross margin and return to management (Kay, 1981).

Profit or return to management, the estimated profit is found by subtracting total expenses from total revenue. If a charge for management has not been included in the budget, this value should be considered the return to management. Management is an economic cost and should be recognized on an economic budget either as a specific expense or as part of the residual net return or loss (Kay and Edwards, 1994).

2.2.4 Farmer participation and farmer income

Hung-Hao and Richard (2009), claimed that farmers were improved an understanding of the interactions between the farm business and the farm household, particularly relative to decisions to participate in the Conservation Reserve Program (CRP), the largest U. S. agro-environmental program targeting land use. Importantly, they found that in order to explain participation in CRP, farmers must also account for the correlation between the decisions of farm operators and their spouses to work off the farm and the decision to participate in CRP.

Moreover, by extending these results, farmers also demonstrate that these three decisions interact with socio-economic characteristics of the farm and farm household to affect the well-being of farm households, as measured by farm household income, and its variability among farm households with common characteristics Participating in CRP depends on characteristics of the farm, the farm operator (including age, experience, and risk attitudes), land quality, and local economic conditions. There are also differences in participation by major ERS production regions. Off-farm work decisions by the farm operator and spouse are related to many of these same factors, although the direction and magnitude of some of the effects are different. All three decisions are affected by participation in other Federal farm programs (Hung-Hao and Richard, 2009).

Participation in CRP (Conservation Reserve Program) was affected by state and local programs for farmland retention, etc. Policy implications of these results are elaborated in the text. It is not surprising that many of the same factors that affect the decisions to participate in CRP (Conservation Reserve Program) and to work off the farm also affect both farm household incomes and its variability compared with farm households in which the other farms and households characteristics are similar. After controlling for the endogeneity between these decisions and farm household income, they found that participation in CRP and off-farm work by both the operator and the spouses increased the average household income, but they decreased the variability of household income across households with other similar characteristics (Hung-Hao and Richard, 2009).

2.2.5 Relationships between farmers and the environment

Lynch and Lovell (2003) carried out their study on voluntary farmland preservation programmes in the USA. Under these programmes, government entities purchase the development rights of the farm. The fact that larger farms are more likely to participate in this scheme would be influenced by the fact that the cost of purchasing developing rights per hectare is less for larger farms than smaller farms. Wilson (1997) was looking at the effect of farm size on participatory behaviour in a local Environmentally Sensitive Area (ESA) scheme in the Cambrian Mountains, UK. Farms in this area are non-intensively farmed. This means that larger farms will be expected to make pretty much the same management changes as smaller farms, but will receive higher ESA payments for participating.

The quality of the soil on a farm is closely linked to the productivity of the farm, as well as the habitat types on the farm. Hynes *et al.* (2008) found that farmers having good soil types were less likely to participate in REPS (Rural Environmental Protection Scheme) than to participate. This finding indicates that more productive farms are less likely to participate in REPS than less productive farms. Dupraz *et al.* (2003) showed that farmers in the Walloon region of Belgium were less likely to participate in agri-environmental schemes if they had highly productive soil and climate conditions on their farms. The Belgian farmers were also more likely to participate in the scheme if they had low yielding meadows.

Morris and Potter (1994) separated farmers who participated in agri-environmental schemes into passive and active scheme participants. Economic variables like income support are negatively linked to the likelihood of farmers being active adopters of agri-environmental schemes and demographic variables, like levels of environmental awareness, are positively linked to farmers being active adopters of a scheme. For REPS to be deemed successful as an agri-environmental scheme, it needs to attract a high number of active participants because they are most likely to take their role as primary scheme agents seriously.

2.2.6 Factor affecting concept

All of the decisions in Table 2.6 are made by the farm-household. It is, therefore, important to consider them all when deliberating sustainability issues. While identifying factors affecting sustainability, it may be good to recall the various dimensions of the sustainability concept: sustainability includes not only the environmental dimension but also the economic and social dimensions.

Table 2.6 What farmers have to make decisions in the medium term

Production Oriented: 1. What to produce 2. How to produce 3. How much to produce 4. When to produce 5. Where to produce
Resource-Use Oriented: 1. How family labor should be used for farm activities, non-farm and off-farm activities 2. How much hired labor is required for farm activities and non-farm activities 3. Acquisition of inputs 4. Renting in, renting out of land resources
Investment oriented: 1. Where and how the farmer could invest his savings safely and profitably 2. Investments in direct means of production
Liquidity oriented: 1. How much cash is required by the farm-household for consumption, school fees, taxation, marketing, etc. 2. Whether credit is required and, if so, how much, for what purposes, how to obtain it 3. Cash-management decision
Process, marketing oriented: 1. How much of what production should be processed on the farm and marketed 2. When to market what production, and where 3. Storage decisions
Community oriented: 1. Participation in a farmers' organization 2. Increasing status in the community 3. What the community expects from the farm-household in terms of production, time, etc

Source: FAO, 1990

What are good agricultural practices from a sustainability point of view depends partly on local conditions. In order to exemplify such practices, the following list compiled by Seppänen and Korkman et al. was presented (Seppänen, 1999; Korkman et al., 1993):

1. Cultivation planning and monitoring

   An annual, appropriate cultivation plan for the whole farm is made. Measures carried out on each parcel are recorded, including nutrient inputs amounts. Results from soil analysis are included in the plan.

2. Fertilizer and pesticide use

   The appropriate amounts of nitrogen, phosphorus and pesticides vary greatly depending on the productive potential of soil.

3. Headland and filter strips

   Buffers zones, filter strips and headlines are left next to waterways to prevent soil, nutrients and other substances from leaching out of arable fields into surface water.

4. Plant cover outside the growing season

   Fields are covered with plants in the wintertime to reduce nutrient leakage.

5. Reduced tillage

   If no plant cover is used, autumn ploughing can be replaced by direct sowing, stubble cultivation or spring ploughing.

6. Stocking densities

   It is somewhat difficult to generalize what should be considered maximum stocking densities, depending on the agroecological system in question (for examples, see Baldock and Beaufoy 1993, p. 30-31). Pork and poultry production tends to be intensive and less sustainable than cattle or sheep production. However, good agricultural practices require not using livestock densities above a certain ceiling. In Finland this ceiling is defined as 1.5 LU/ha (Pirttijärvi et al., 1995).

7. Storage and application of manure

   Manure must be appropriately stored and ploughed into the field when spread and alternatively injected or placed under the soil in order to avoid ammonia losses.

8. Nature and landscape management

   Biodiversity as well as diversity in the landscape should be taken care of, and possible valuable habitats should be preserved or restored.

2.3 Related research

Madagascar farmers plant rice in the bottom of valleys and terraced on hillsides or newly cleaned upland using the SRI methods, and the seed varieties largely unchanged for several generations. Because of the importance of rice for rural incomes, employment and food security, the intensification of rice production becomes mainly focused in the development of Madagascar for many years (Bareth and Dorosh, 1996).

Through a combination of good practices from the beginning of time planting, spacing of seedlings, regularly weeding, and management of water, the roots can grow well. SRI can also produce more rice compared to the previous method. Besides, SRI does not need chemical fertilizers, pesticides, or new seed varieties, also high results seem to be sustained and have been developed since 2000 in field trials in Bangladesh, Cambodia, China, Indonesia, Philippines and Sri Lanka (Stoop et al. 2002).

Gupta *et al.* (1985) examined the economics of paddy cultivation on different size groups of Haryana. It was observed that the use of human labor generally declined with an increase in farm size, while that of mechanical labor increased. The share of fixed costs in the total cost of cultivation was higher on larger farms than that on smaller farms. Use of yield augmenting inputs and yield per hectare increased with the increase in farm size, and so did the return over variable costs.

Pergade (1986) studied the economics of rice cultivation in different land situations for both local and high-yielding varieties (HYV). The cost of production (per quintal) in upland region for local and HYV rice was Rs. 130 and Rs. 88.81 respectively. The cost of production in midland region for local variety during *rabi* and *kharif* seasons was Rs. 143.81 and Rs. 134.42 respectively. For HYV's the same trend was observed but the difference in cost between the two seasons was much more in case of low land paddy. The cost of production was the highest in summer in the case of local variety because of high total costs. In the case of HYV, the cost was less in *kharif*, which was due to the low costs of inputs. The gross income received from local varieties in upland was higher than the income received from the other two types of land, and returns were higher in *rabi* (Rs. 1,420.85) than that in *kharif* (Rs.1,305).

Thiruvenkatachari *et al.* (1991) analysed the economics of groundnut production in rainfed area (Tamil Nadu). The study showed that costA contributed 61.05 per cent to the total cost (cost C) in case of marginal farmers, where as it was 77.27 per cent in the case of big farmers. The net returns over cost C was Rs. 1674, Rs. 2371 and Rs.2313 in the case of marginal, small and big farmers respectively. It was reported that groundnut production was profitable under rainfed areas of Tamil Nadu.

Nagaraj (1993) analysed the economics of cropping system In Tungabhadra project commanded area. He reported that the cost of cultivation (cost C) for paddy was higher for middle reach (Rs. 12,605) when compared to that for head reach (Rs. 12,138) farmers. The gross returns, and the net returns were Rs. 26,170 and Rs. 14,031 for head reach and Rs. 24,291 and Rs. 13,685 for middle reach respectively. Whereas the returns for rupee of expenditure in paddy production was Rs. 2.16 for head reach and Rs. 1.93 for middle reach farmers.

Thimmappa (1994) indicated that the cost of cultivation increased with an increase in was found to be more in the case of transplanted paddy (4185 kg/ha) than that in the direct sown paddy (3590 kg/ha). However, net returns were more for direct sown paddy (Rs. 6500/ha) than for the transplanted paddy (Rs. 5375/ha). In spite of the low yield level direct sown paddy proved to be more profitable as it reduced the requirement of resource and cost of cultivation.

Pouchepparadjou *et al.* (2005) examined the economics of paddy cultivation of IPM adopted and non-adopted farms of Union Territory of Pondicherry. It was observed that the IPM adopted farms generated net returns worth of Rs. 5,208 per acre as against Rs. 4,147 per acre net returns of non-adopted farms, which was 26 per cent higher than the non adopted farms.

Radha and Chowdry (2005) studied the cost of seed production as well as commercial production of cotton and compared the costs and returns of seed production and commercial production of cotton in Kurnool district of Andhra Pradesh. The cost of cultivation was very high in seed production of cotton (Rs. 74,412/acre) compared to commercial production of cotton (Rs. 26,461/acre). Human labour, manures and fertilizers cost, plant protection chemical cost and rent for leased in land formed major components of total cost in seed production of cotton whereas human labour, plant protection chemicals cost, manures and fertilizers cost and rent for leased in land formed major components of total cost in commercial production of cotton.

According to Rakotomalala (1997), 62 percent of the additional labor in SRI is required for weeding and 17 percent for planting. Preparation of land, especially land managed for drainage, also takes time to check the water level. Even the additional labor costs in SRI are much higher than traditional methods. Furthermore, according to Joelibarison (2001) he mentioned that there is an increase in profit of about 113%. Although SRI has clear benefits to the farmers. However, for the development and implementation of SRI, intensive counseling is still required. Through education and training for farmers it is expected that rice productivity will increase, so their revenue will increase as well.

According to Van den Ban and Hawkins (1999), participation has different terms for different people, as in the following: (1) the cooperative attitude of farmers in the implementation of the education program, such as attending counseling, suggesting new methods for their farming, asking questions to others, (2) organize outreach activities by farmers' groups, such as the meeting about the extension to give a speech, managing the classroom, making demonstrations, publishing a newspaper written by educators and researchers to farmers, (3) provide information needed to plan effective counseling programs, (4) farmers and their representatives to participate in the organization of counseling services to make decisions about purpose, group, target message and methods, and in evaluation.

Gani et.al (2002) wrote an article titled: “ The SRI in Indonesia: difficulties that have been faced in disseminating SRI methods” which are:

1) Irrigation management and water control are not easy to maintain. As a result, the optimal effects from increased soil aeration were often not realized.
2) Labor requirements are higher than with the traditional practice.
3) Many constraints limit the use of younger, single seedlings.
4) Some pests and diseases attacked younger seedlings more after transplanting.
5) It is not easy to handle, and cultivate a tiny single seedling, at least until farmers gain the skill, and confidence in this method.
6) Farmers are afraid of running greater risks with younger and single seedlings.
7) Improvement of soil organic matter is often difficult in situations like in Java where farmers often do not own the land that they cultivate. They consequently, hesitate to invest in improving the soil, even when they know that there will be benefits from this, even in the short run.
8) Because not all farmers understand the ICM (Integrated Chemical management) methodology equally well, and there are always some variations in bio-physical conditions, in which there are many differences among villages in how completely and how well they applied these methods. Not all farmers/ villages utilized the main components completely. This means that there is still a scope for further improvement of yields.

Chapter 3

Research Method

This chapter discusses the methods used in this research. This includes research area, data and data collection, and data analysis.

3.1 Research area

The location determination of this research was chosen purposively in Karangsuko, Clumprit, Kanigoro, Kademangan Village, Pagelaran Sub District, Malang Regency, East Java Province, Indonesia (Figure 3.3) as follow:

1. The locations are the center of the production areas of rice in Malang Regency, Indonesia (Figure 3.1).
2. The SRI program was firstly implemented in Clumprit, Karangsuko, Kademangan, Kanigoro Village, Malang Regency in 2007 by the Department of Agriculture, Indonesia (Figure 3.2).
3. Farmers began to apply the principals of SRI in their fields after joining the training of the SRI Project in 2007.

Figure 3.1: Malang Regency, East Java Province, Indonesia
Source: Anonymous, 2011

Figure 3.2: Village of research, Malang Regency, Indonesia
Source: Anonymous, 2011

3.2 Data and data collection

Data used in this research are both secondary data, and primary data. Details are describes in the following sub-sections.

3.2.1 Secondary data

Secondary data related to SRI in Indonesia, theory cost and return analysis, and related research in economic performance of SRI project were collected from achieves of Agricultural Department, Malang Regency and East Java Province, and documents published by the Central Bureau of Statistic, Indonesia and Minister of Agriculture Republic of Indonesia. Secondary data also obtained from literature, including journals, text books, e-books, public documents, government publications, and others (magazines, newspapers).

3.2.2 Primary data

Primary data in this research consist of population and tools for data collection. Details are describes in the following sub-sections.

1) Population

Populations of this research are all farmers who participated in SRI Training Project in 2007. In total, there are 110 farmers. Interviewing key informants who are experts is one method for identifying problems. Number of key informants are 15 peoples.

(1) Farmers

The respondents (farmers) are divided into two categories; 1) farmers who are still practicing SRI (SRI farmers), and 2) farmers who have quit practicing SRI (Q-SRI farmers). There are 25 SRI farmers and 85 Q-SRI farmers. The details of these respondents (SRI and Q-SRI farmers) are presented in Figure 3.3.

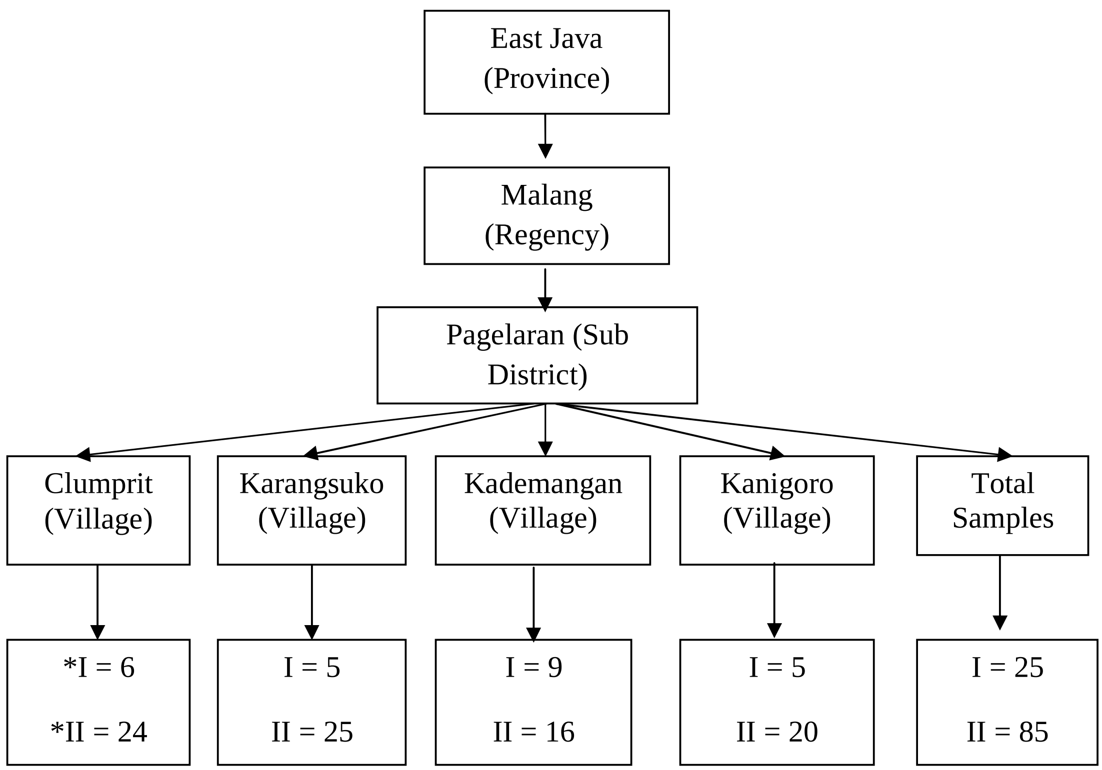

Figure 3.3: Research location and the number of the respondent
Note: * I = SRI farmers
II = Q-SRI farmers

For the farmers who are still practicing SRI Project (SRI farmers), there are 9 farmers from Kademangan Village, this number is higher than that from other villages. While there are 6 farmers, 5 farmers, and 5 farmers from Clumprit, Karangsuko, and Kanigoro Village, respectively. However farmers who have quit practicing the SRI Project (Q-SRI farmers) are different. There are 25 farmers from Karangsuko Village higher than other villages. There are 24 farmers, 16 farmers, and 20 farmers for Clumprit, Kademangan, and Kanigoro Village, respectively.

A crop year is the time period from one harvest to the next, varying according to the commodity. Most of farmers (almost 60%) planted two or three rice crops in a year. The data used in this research based on a crop year of farmers during November 2010 until February 2011 or one season of rice cultivation.

(2) Key Informants

Key informants chosen in this study were based on their ability and strategic role in the SRI project. The chosen key informants are the leaders of the farmers groups, innovative farmers, the head of villages, facilitators and motivators in the SRI project. The number of key informants are presented in Table 3.1

Table 3.1 List of key informants based on the location and type of informant

No.	Type	Key informants	Location
1.	Head of farmer group	1. Mr. Rasat 2. Mr. Bisri 3. Mr. Misiadi 4. Mr. Tubi	Clumprit, Karangsuko, Kademangan, Kanigoro
		5. Secretary of farmer group	Clumprit, Karangsuko, Kademangan, Kanigoro
2.	Head of village	6. Head village of Clumprit 7. Head Village of Kademangan 8. Head village of Kanigoro 9. Head village of Karangsuko	Clumprit, Karangsuko, Kademangan, Kanigoro
		Secretary of Clumprit 11. Secretary of Kademangan 12. Secretary of Kanigoro 13. Secretary of Karangsuko village	Clumprit, Karangsuko, Kademangan, Kanigoro
3.	Extension Officers (facilitator and motivator)	14. Mr. Kunto (Extension officer)	Pagelaran
		15. Mr. Sugeng (Extension Officer)	Pagelaran

2) Tools for data collection

Tools for data collection consist of structured questionnaire and semi-structured questionnaire. Details are presented below.

(1) Structured questionnaire

Structured questionnaire was constructed to gather information from 110 farmers (respondents). Interviews were conducted by spreading questionnaires and getting answers from respondents and then processed to an appropriate form related to the research. The questionnaire included the questions about the farmers' socioeconomic characteristics, the level of SRI farming processes practiced by the farmers (from land preparation to the harvest time), the reasons why farmers quit practice SRI, and other questions relating to the research. Details of the structured questionnaire are in appendix 1.

(2) Semi-structured questionnaire

Semi-structured questionnaires was constructed to collect information through in-depth interviews, by giving direct questions to the key informants who are able to give detailed information related to the research objectives. Details of the semi-structured questionnaire are in appendix 2.

3.3 Data analysis

This research used both descriptive and quantitative analysis. Details are presented below.

3.3.1 Descriptive analysis

This analysis used descriptive statistic such as mean, frequency, and percentage to examine the following aspect.

(1) The socioeconomic characteristic of farmers, and production system used by farmers.

(2) Rice cultivation activities of farmers joining the SRI project.

(3) Net profit and the level of practices in the SRI project.

Details analysis of net profit and level of practices are described.

1) Net profit

To analyze net profit, costs and returns analysis was used. Net profit can be obtained from total revenue, and total costs as follows:

(1) Total revenue

Total revenue is the total of output times the price of output. Total revenue can be calculated as follows:

TR = P x Q

Whereas: TR = Total Revenue (IDR per hectare)

P = Price (IDR/kg), price of rice per kg

Q = Quantity (kg), quantity of rice per hectare

(2) Total cost

Total costs in this research included total variable costs, total fixed costs. Total variable cost include the cost of chemical fertilizer, organic fertilizer, chemical pesticides, compost, labor, seed, irrigation fees, and opportunity cost. Total fixed cost includes land rent and depreciation. Then, total cost can be calculated as follows:

TC = TFC + TVC

Whereas: TC = Total Cost (IDR per hectare)

TFC = Total Fixed Cost (IDR per hectare)

TVC = Total Variable Cost (IDR per hectare)

Opportunity costs are useful when evaluating the cost and benefits of choices. It is often is expressed in non-monetary terms. Opportunity cost is expressed in *relative prices*. That is to say, the price of one choice relative to the price of another. Opportunity costs can be calculated as follows:

OC = TVC * (I / T)

Whereas: OC = Opportunity Cost (IDR per hectare)

TVC = Total Variable Cost (IDR per hectare)

I = Interest per year (time deposit) equal to 6.75 %

T = Time for one year (365 days)

Depreciation is a non cash cost that reflects a loss in value from age, wear, and obsolescence. Since most depreciation is caused by age and obsolescence and is not affected very much by annual use, it is considered a fixed cost once the machine is purchased.

Annual depreciation can be estimated using the straight-line, declining balance, or sum-of-the-year's digits methods. Depreciation can be calculated as follows:

$$\mathbf{D = (C - SV) / OL}$$

Whereas: D = Depreciation

C = Cost of machine or tools of cultivation

SV = Salvage Value, can be estimated as a percent of the new list price of a similar machine or tools of cultivation

OL = Ownership Life

(3) Net profit

Net profit is the difference between total revenue and total cost. Net profit can be calculated as follows:

$$\boldsymbol{\pi} = \mathbf{TR - TC}$$

Whereas: π = Net Profit (IDR per hectare)

TR = Total Revenue (IDR per hectare)

TC = Total Cost (IDR per hectare)

2) Level of practices

To examine the level of practice in SRI project likert scale was used. There were 5 categories of levels of practices, namely 5 = very high, 4 = high, 3 = moderate, 2 = low, 1 = very low (Table 3.2). Interpretation of the practice level was undertaken using mid-point as shown below.

Table 3.2 Level of practices of the SRI farmers

Farmer practice in SRI project	Level of practices
1. Seeds selection with salt water.	5= Farmer use salt, water and egg (until the eggs float) 4= Farmer use salt, water, without egg 3= Farmer use little salt, and water 2= Farmer just use water 1= Farmer not use salt and water
2. Manage of land and organic fertilizer.	5= available ditch and quantity of organic fertilizer 7.1-10 tons per hectare. 4= available ditch and quantity of organic fertilizer 5.5-7 tons per hectare. 3= available ditch and quantity of organic fertilizer 2.1-5.4 tons per hectare. 2=not available ditch and quantity of organic fertilizer 1-2 tons per hectare. 1=not available ditch and quantity of organic fertilizer less than 1 tons per hectare
3. Make the seedbed before cultivating.	5= 90-100% certified seed, seedlings @ 5-6 kg/ha 4= 70-89% certified seed, seedlings @ 7-9 kg/ha 3=55-69% certified seed, seedlings @ 10-12 kg/ha 2=40-54% certified seed, seedlings @ 13-15 kg/ha 1=less than 40% certified seed, seedlings @ more than 15 kg/ha
4. Transplanting seedlings at a young age - 7 to 12 days old.	5=seedlings age 8-9 days at planting 4=seedlings age 10-11 days at planting 3=seedlings age 12-15 days at planting 2=seedlings age 16-20days at planting 1=seedlings age more than 20 days at planting
5. Transplanting one seed per hole.	5= one seed per hole 4= mix one or two seeds per hole 3= 2 seeds per hole 2= 2-3 seeds per hole 1= more than 3 seeds per hole
6. Transplanting wide spacing, 30cm x 30cm with regular distance.	5= 30cm x 30cm (standard) with regular distance 4= 30cm x 25cm with regular distance 3= 25cm x 25cm with regular distance 2= 20cm x 25cm with regular distance 1= 20cm x 20cm with regular distance
7. Frequency weeding in farmer's land.	5= 4-5 times during vegetative growth stage 4= 3-4 times during vegetative growth stage 3= 2-3 times during vegetative growth stage 2= 1-2 times during vegetative growth stage 1= 0-1 times during vegetative growth stage
8. Practicing organic fertilizers.	5= 8,000-10,000 kg organic fertilizer per hectare 4= 6,000-7,900 kg organic fertilizer per hectare 3= 4,500-5,900 kg organic fertilizer per hectare 2= 2,000-4,400 kg organic fertilizer per hectare 1= less than 2,000 kg organic fertilizer per hectare

Table 3.2 (Continued)

Farmer practice in SRI project	Level of practices
9. Practicing the intermittent irrigation with wet-dry cycle, and little standing water (± 2 cm) in wet period	5= Intermittent irrigation with wet-dry cycle. Little standing water (± 2 cm) in wet period (Vegetative growth stage) 4= Intermittent irrigation with wet-dry cycle. Standing water (2 - 4 cm) in wet period (Vegetative growth stage) 3= Intermittent irrigation with wet-dry cycle. Little standing water (4 - 5cm) in wet period (Vegetative growth stage) 2= Intermittent irrigation with wet-dry cycle. Little standing water (more than 5 cm) in wet period (Vegetative growth stage) 1= Did not intermittent irrigation with wet-dry cycle. Continuous irrigation keeping 5-10 cm deep standing water (Vegetative growth stage)
10. Practicing Integrated Pest Management (IPM) by utilizing the available natural resources (organic matter or natural)	5= 90-100 % use organic matter or natural 4= 70-89 % use organic matter or natural 3= 55-69 % use organic matter or natural 2= 40-54 % use organic matter or natural 1= less than 40 % use organic matter or natural
11. Harvesting management	5= 90-100 % follow standard harvesting management (harvested when the grains have a moisture content of around 25%) 4= 70-89 % follow standard harvesting management 3=55-69 % follow standard harvesting management 2=40-54 % follow standard harvesting management 1= less than 40 % follow standard harvesting management

Average ($\bar{X}$)	**Categories of level of practices in SRI project**
4.50-5.00	Very high level of practice
3.50-4.49	High level of practice
2.50-3.49	Moderate level of practice
1.50-2.49	Low level of practice
1.00-1.49	Very low level of practice

3) Production constraints

To examine the level of production constraint in SRI project, likert scale was also used and the same analysis to the level of practices was conducted.

3.3.2 Quantitative analysis

To test the following hypothesis, quantitative analysis were used.

1. The SRI farmer's profit is higher than Q-SRI
2. The level of practice of SRI has a positive relationship to the net profit
3. There are problems that obstruct the SRI project practice
4. There are farmers' socioeconomic characteristics and other factors that have a relationship with the farmer status (SRI and Q-SRI farmers)

1) Using t-statistic to analyse the relationship between the level of practice in SRI (X) and net profit from rice farming (Y). t-statistic and correlation (r) can be formulated as follows:

$$t = r\left[\frac{n-2}{1-r^2}\right]^{1/2}$$

$$r, r_{xy} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]\left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$

$$r_{xy} = \frac{S_{xy}}{S_x S_y}$$

The steps of hypothesis testing are done as follows:

(a) Determining the hypothesis, Ho: $\rho = 0$, Ha : $\rho \neq 0$,

(b) Setting α or type I error (Significance Level) at $\alpha = 0.05$,

(c) Computing t – statistic and r with application software,

(d) Computing P-value with application software, and

(e) Concluding if P-value $\leq \alpha$, it implies that the alternative hypothesis of correlation between of X and Y is accepted. Then, If P-value $> \alpha$, it implies that the null hypothesis of no correlation between of X and Y is accepted

2) Using Chi-Square statistic (χ^2) to analyse the relationship between farmers' socioeconomic characteristics and other factors of SRI Project that are independent variables, and farmer status (SRI farmers and Q-SRI farmers) that are dependent variable (Figure 3.4). χ^2-Statistic can be formulated as follows:

$$\chi^2 = \sum\sum\frac{(Oij - Eij)^2}{Eij}$$

In which Oij is observed value and Eij is expected value.

The steps of hypothesis testing are done as follows

(a) Determining the hypothesis, Ho: There is no relationship between two variables. (Dependent variable is not affected by independent variables), Ha: There is relationship between two variables, (Dependent variable is affected by independent variables),

(b) Setting α or type I error (Significance Level) at $\alpha = 0.05$,

(c) Computing χ^2–statistic with application software,

(d) Computing P-value with application software,

(e) Concluding: If P-value $\leq \alpha$, alternative hypothesis is accepted implying that there is relationship between two variables. If P-value $> \alpha$, null hypothesis is accepted implying that there is no relationship between two variables.

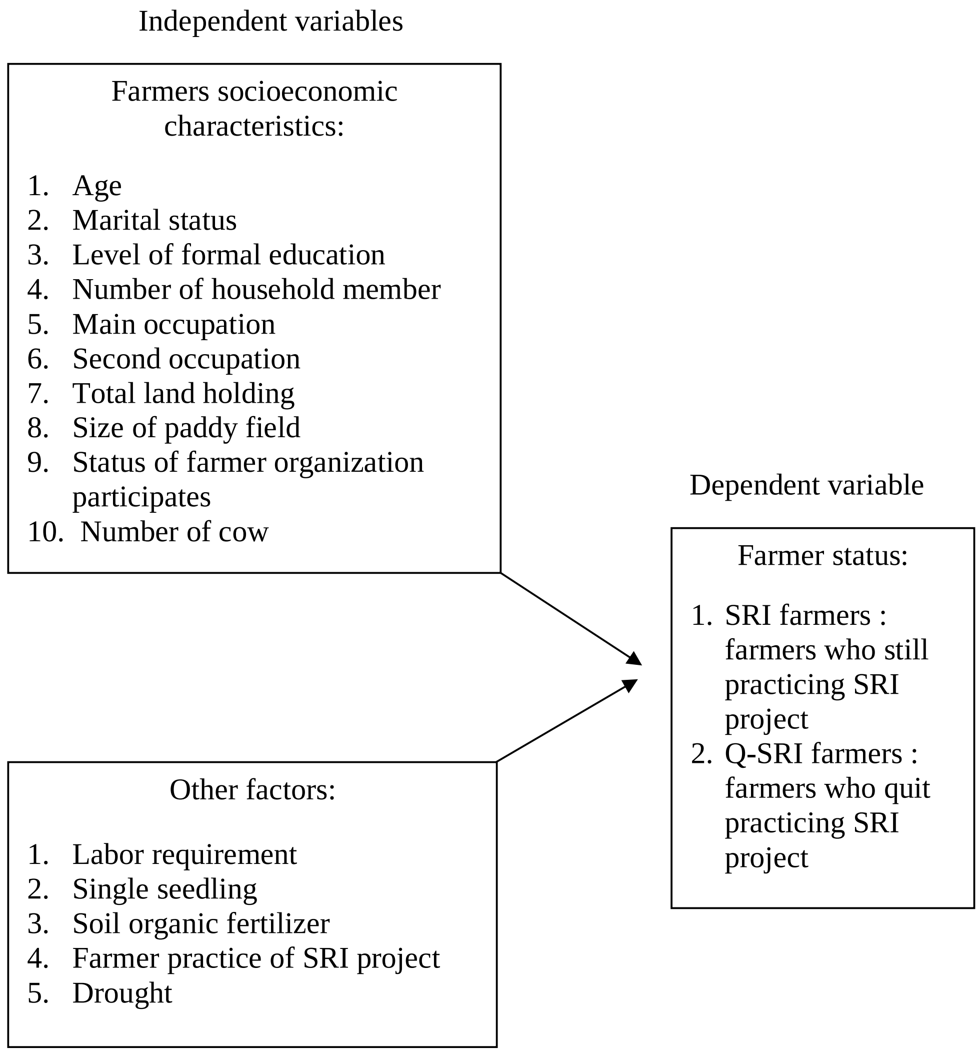

Figure 3.4 The relationship between socioeconomic characteristics and other factors, and farmer status

Chapter 4

Results and Discussion

This chapter focuses on the results of the economic performance of the SRI project in Malang Regency, and the results corresponding to each research objective on there are: (1) the roles and functions of the SRI project, (2) Socioeconomic characteristics and agricultural production system of the farmers, (3) Rice cultivation activities of farmers joining the SRI project, (4) Net profits and the level of practice the SRI project, and the correlation between level of practice and net profit, (5) Problems and obstacles of the SRI project in the practice, (6) Factors affecting farmer status (still practicing SRI or quit SRI).

4.1 Roles and functions of the SRI project

This section explains the roles and functions of the SRI project obtained some key informants. The results are presented in Table 4.1

Table 4.1 Summary of the results from interviews with key informants on the roles of functions of the SRI project

No.	Key informants	Roles and functions of the SRI project
1.	Rasat (farmer groups leader)	- As land fertilizers. Based on principally the SRI project is emphasized on the use of organic fertilizers, from animal waste and compost. Because of soil that has enough organic matter, the soil has good biological, chemistry and physics soil aspect. - As an economic enhancer, the function to improve the farmers' economics. Fertile and good land may improve the crops, since the land is suitable for rice farming that determines the growth of the crops. - As production input savers, saving to use production inputs efficient, from the seeds, chemical fertilizers, and chemical pesticides
2.	Misiadi (farmer groups leader)	1. As input saving. It may be efficient use of inputs, example: for seeds only need 7 kg in one hectare. 2. As a crops enhancers. It increase rice yield. Before adopt this project, the yield was 4-6 tons/hectare, but it became 7-10 tons/hectare after adopt this SRI project. 3. As friendly-environment agriculture, important for agriculture, since it minimize use chemical materials, and increase use natural materials or natural enemies.

Table 4.1 (Continued)

No	Key informants	Roles and functions of the SRI project
3.	Bisri (farmer groups leader)	1. As land fertilizers, serving to fertilize land. It is due to the fact that the SRI project often uses organic fertilizers, such as petroganik, bokashi or other organic fertilizers. 2. As income enhancers because it increases income than traditional method. 3. As an input savers, often called "*System Rodok Irit* or SRI" (efficient system). Principally, it can save seeds, chemical fertilizer, and water, except weed.
4.	Kurtubi (farmer groups leader)	1. As income enhancer because, it increase rice production. 2. As land improver, since this project make the land more fertile and healthy because use manure or bokashi. 3. As sustainable agriculture, because this project improve the land fertility, yields simultaneously, and it did not destroy environment or surroundings.
5.	Kunto (agricultural extension officer)	1. As enhancer in the soil ecological aspect, from soil physic, chemical and biological aspects, so that the soil can be simultaneously and sustainably used. 2. As enhancer in the economic aspect, it improves incomes, and reaching 15 tons/hectare. 3. As a saver for agricultural production inputs, saving all inputs of agricultural productions.
6.	Sugeng (farm supervisor)	1. Possessing accuracy and efficiency in production inputs of rice farming because SRI project having emphasis in the use of inputs that is not excessive. 2. Possessing economic prospects because it increase income and increase quantity and quality rice production. 3. Possessing sustainable land ecology to improve the land ecology, chemical, and biological aspects, so that the land may be simultaneously and sustainably used.

Based on in-depth interviews, it can be concluded that there are three roles and functions of the SRI project, firstly this project played a role as a yield enhancement of rice more than so conventional methods. Secondly, it functions as an input saving, from use water, seeds, and others. Thirdly, it served to realize the sustainable agriculture in order to recover land fertility or to maintain the sustainability of field productivity, since the emphasis of this project use natural pesticides and fertilizers known as environmentally friendly.

4.1.1 Increasing rice yield

The role as the crop yields or rice productivity enhancer is to increase the farmers' incomes. One hectare of land in the SRI project may, on average, result in 7 to 10 tons, even 12 to 14 tons if the land is properly processed. As Rasat (leader of the farmer group) said: 'that practicing of SRI project of rice productivity at average may reach 10 to 14 tons even 15 tons/hectare, where at average this production was 6-8 tons/hectare when applying the traditional method, and other farmers applying the SRI also get benefits'.

The economic calculations of conventional methods, the costs to process one hectare about IDR 6 millions with the rice production about 5 tons rice, and the farmer gets a benefit of about IDR 6.2 millions. If the SRI method is applied, the farmer can get a benefit of about IDR 13.2 millions. Therefore, if rice production is made three times a year, the farmer who practices the SRI method may receive more benefits.

Kunto (Agricultural Extension Officer) also suggested that the SRI project played out as an income enhancer (rice production increases), showing that input efficiency, and supporting a sustainable agriculture (leading to natural or organic agriculture). According to Kunto, this project in Malang Regency is still continued. It has become a priority of the Food Agricultural Department, intended to realize self- sufficiency in rice and granary in Malang Regency.

4.1.2 Input saving

Moreover, the secondary role of the SRI is as an input saving, such as use seeds, water, and chemical fertilizers. In one hectare the seed needed is about 7-10 kg in the SRI method and in traditional methods the seeds needed were 40-60 kg/hectare. It means that the efficiency in seed is more than 70% using the SRI method. Then the use of water is also more efficient by about 40-50% less than in traditional methods. Efficiency is also reached in the use of chemical fertilizers and pesticides.

Hari statement that the SRI is beneficial since it served as an input saving, from seed, water, chemical fertilizers, pesticides and others, so that a relatively some input may result in a better benefit, compared with a conventional method. It is also get by other farmers applying the SRI that it may save some inputs, and as a result the SRI is also called as "*Sistem Rodok Irit*" or Saving/ Efficient System.

Misiadi stated that the SRI project may save the input from water, seeds, and using chemical fertilizers by more than 20-30%. The saving of water is important because conventional rice farming needs a lot of water, so it may be in conflict among farmers. Whereas, in the SRI, conflicts may be avoided because rice does not consume a lot of water. Seeds could also be saved; Misiadi said that one hectare in this project needed about 5 to 6 kg of seeds because single widely spaced transplanting were 30 x 30 cm and one seed per hole.

4.1.3 Environment sustainability

Moreover, the SRI pattern could also recover the soil fertility and keep the sustainability of field productivity. It means that this pattern served as a sustainable agricultural realizer**,** and the sustainable will be better. This pattern was also environmentally friendly since the minimum use of pesticides, chemical fertilizers, insecticides and various toxics.

Sugeng (a farmers supervisor, in Malang Regency) suggested that the SRI principally is an efficient and effective method of rice farming; the land processing with ditches, one or two seeds per hole, chemical fertilizers and pesticides were minimally used. Even in the SRI project the farmers were trained to make environmentally friendly pesticides and to make solid (manure, compost, *bokashi*) or natural fertilizers.

Moreover, the SRI project leads to organic agriculture, and to minimalize application of chemical fertilizers and pesticides, and also to optimize bokashi, manures, natural enemies, natural pesticieds and others. Hopefully, the SRI project can make farmers aware of the importance of SRI and realize a environmentally friendly and sustainable agriculture. On the basis of the above discussion, it can be concluded that naturally the roles and functions of the SRI project can run well if applied according to the existing manual. If the SRI project runs well and sustainably is applied, it can be a good economic performance for the farmers.

4.2 Socioeconomic characteristics and agricultural production system of the farmers

4.2.1 Socioeconomic characteristics of the farmers

Socioeconomic characteristics of the farmers (respondents) include gender, age, religion, marital status, education, and numbers of family, main occupation, second occupation, and status of organization, participation and position in the organization. The characteristics of SRI farmers and Q-SRI farmers are presented in Table 4.2

Table 4.2 The socioeconomic characteristics of the farmers

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. Gender				
- Male	25	100.00	85	100.00
2. Age (years)				
- < 30	-	-	3	3.53
- 30 – 45	7	28.00	26	30.59
- 46 – 60	15	60.00	38	44.70
- > 60	3	12.00	18	21.18
3. Religion				
- Muslim	25	100.00	85	100.00
4. Marital status				
- Single	-	-	1	1.18
- Married	25	100.00	84	98.82
5. Education				
- No school	-	-	1	1.18
- Elementary school	7	28.00	41	48.23
- Junior high school	5	20.00	21	24.71
- Senior high school	11	44.00	17	20.00
- Diploma or university	2	8.00	5	5.88
6. Family members (person)				
- < 3	1	4.00	3	3.53
- 3 – 4	18	72.00	56	65.88
- 5 – 6	5	20.00	22	25.88
- > 6	1	4.00	4	4.71
7. Main occupation				
- Rice farmer	21	84.00	71	83.53
- Other profession	4	16.00	14	16.47

Table 4.2 (Continued)

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
8. Second occupation				
- Rice farmer	4	16.00	14	16.47
- Other profession	21	84.00	71	83.53
9. Participation in farmer organization				
- Yes (active)	25	100.00	82	96.47
- No (passive)	-	-	3	3.53
10. Participating organization				
- Farmer group	15	60.00	82	96.47
- Association of farmer group	3	12.00	1	1.18
- Farmer group and association of farmer group	7	28.00	2	2.35
11. Status of farmer organization participate				
- Leader (management in farmer or association of farmer group)	10	40.00	3	3.53
- Member (in group or association of farmer group)	15	60.00	82	96.47

Table 4.2 shows that all the SRI or Q-SRI farmers are all male where most ages are 40-60 years old, 60.00% for SRI farmers and 44.70% for Q-SRI farmers. Moreover, all respondents are Muslims. Most SRI and Q-SRI farmers have family members of 3-4 persons (72.00% and 65.88%). Concerning with the education level, 44.00% of SRI farmers finished from senior high school and 48.23% of Q-SRI farmers finished from elementary schools.

About main occupation, most respondents work in rice farming where 84.00% and 83.53% for SRI and Q-SRI farmers, respectively. It difference with second occupation, most respondents work in agricultural sector or other profession where 84.00% for SRI farmers and 83.53% for Q-SRI farmers. Thus, the majority farmer work in the rice and non rice farming sector, the government should give attention intensively in the agricultural sector from infrastructure, agricultural inputs, training of human resources, and guaranteed prices of agricultural products, so that farmers will get welfare.

Dealing with the farmers' status in organizations, it was shown that most farmers were active in organizations (100.00% for SRI and 96.47% for Q-SRI). Farmers participate in farmer group organization (60.00% for SRI and 96.47% for Q-SRI). In terms of SRI Farmer's position in the organization, the majority farmers are members of farmer group (60.00% for SRI and 96.47% for Q-SRI).

4.2.2 Agricultural production system of the farmers

This section focuses on land holding, land using and the quantity of livestock (Table 4.3).

Table 4.3 Agricultural production system (land holding, land using, and quantity of livestock)

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. Average land holding (ha)				
- Own	0.51	49.04	0.61	69.00
- Rent	0.11	10.58	0.16	18.00
- Other	0.42	40.38	0.12	13.00
- Total land holding	1.04	100.00	0.89	100.00
2. Average land use (ha)				
- Rice	0.68	65.39	0.51	57.30
- Maize	0.05	4.81	0.12	13.48
- Vegetables	0.15	14.42	0.01	1.12
- Sugar cane	0.13	12.50	0.21	23.60
- Others	0.03	2.88	0.04	4.50
- Total land using	1.04	100.00	0.89	100.00
3. Average the quantity of livestock (head)				
- Cow	1.48	7.17	0.84	7.97
- Buffalo	0.12	0.58	0.01	0.09
- Goat/sheep	0.64	3.10	0.19	1.80
- Chicken	4.28	20.74	5.68	53.89
- Duck	14.12	68.41	3.82	36.24
- Total of livestock	20.64	100.00	10.54	100.00

Table 4.3 shows that most respondents owned their lands (49.04% and 69.00% for the SRI and Q-SRI farmers, respectively). Furthermore, 65.39% of the SRI farmers and 57.30% of the Q-SRI farmers used their land for rice farming. It

shows that the most of farmers have the same tendency to use their land to plant rice. In the quantity of livestock, a large quantity of livestock possessed by the SRI farmers is ducks (68.41%), and most for the Q-SRI farmers is chicken (53.89%).

Based on the data, although in the rice research site is commonly cultivated, the number of cows is only 7.17% for SRI farmers, and 7.97% for Q-SRI farmers as compared to the number of other livestock such as chicken or ducks. This is caused by the fact that some farmers earn their living from farming and also from raising chicken and ducks, where the chicken and ducks are easier to sell in this area than cows. It is also because it needs a long time to get benefit from raising cows.

Moreover, the detailed data on the number of farmers, planting size, and planting methods, either mono- or mix-cropping, are presented in Table 4.4. Mono cropping is plant cultivation with the same type of plant in a year and mix-cropping is plant cultivation with various types of plant in a year or in an area; two or more different types of plants are cultivated.

Table 4.4 Type of cropping practiced by farmers

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
Mono cropping	16	64.00	61	71.76
Mixed cropping	9	36.00	24	28.24

The results of the research show that most farmers used their land in a mono-cropping system (64.00% and 71.76% for SRI and Q-SRI farmers, respectively). It implies that either the SRI or Q-SRI farmers tended to manage their land in a mono-cropping method. The reason they applied the mono-cropping method is because it is easy and practical, and they also tended to plant rice in a one year period, although it is susceptible to pest attack such us *planthopper* and *rats*, and moreover it destroys soil fertility in the long time, it makes rice productivity not optimum.

Table 4.4 shows that the number of farmers used their land in mix cropping were 36.00% for SRI farmers and 28.24% for Q-SRI farmers. In addition, they have reasons to plant mixed cropping such as; to balance input and get soil nutrients, to keep down weeds insect, and pests, to resist climate extremes (wet, dry, hot), to suppress plant diseases, to increase overall productivity, and to use scarce resources to the fullest degree.

4.3 Rice cultivation activities of farmers joining the SRI project

Rice cultivation activities of the SRI and the Q-SRI farmers such as; land preparation, seedling and transplanting, chemical fertilizer application, organic fertilizer application, water management (irrigation), weeding, chemical and herbal pesticides application, and harvesting. The SRI farmers cultivated rice based on the SRI principles, while the Q-SRI farmers cultivated rice based on traditional methods. Table 4.5 shows the differences between SRI and Q-SRI farmers in rice farming.

Table 4.5 The differences between SRI and Q-SRI farmers in activities of rice cultivation

No.	Cultivation activities	SRI farmers	Q-SRI farmers
1.	Land Preparation	- Using organic fertilizer as the basic fertilizer. - Using ditches on drainage at the side or middle of each field.	- Using chemical fertilizer as the basic fertilizer. - Not available ditches on drainage at the middle or around of each field.
2.	Seedling and transplanting	- Seeds selected with water and salt. - Seeds put in the house terrace or a tray that provided with planting media. - Seeds planted at the age of 7-15 days. - One or two seeds per hole. - Seeds planted to a depth of 2-3cm.	- Seeds not selected with water and salt. - Seeds sowed in the field. - Seeds planted at the age of 20-30 days - Three or four seedling per hole. - Seeds planted to a depth of ≥ 5cm.
3.	Irrigation	- Intermittent irrigation is applied on irrigation system.	- Field is irrigated continuously with height 5-7 cm during 60 days.
4.	The application of chemical fertilizer	- Minimized the use of chemical fertilizers, on average 150 kg/hectare. - Applied the chemical fertilizers twice on average.	- Applied a lot of chemical fertilizer, approximately 400 kg/hectare on average. - Applied more chemical fertilizer, approximately 3-4 times from planting to harvesting.
5.	The application of organic fertilizer	- Organic fertilizer applied approximately 2,425 kg per hectare. - Organic fertilizer applied	- Organic fertilizer applied approximately 117 kg per hectare. - Organic fertilizer applied

Table 4.5 (Continued)

No.	Cultivation activities	SRI farmers	Q-SRI farmers
		approximately 2-3 times on average.	approximately 2 times on average, but some case is unapplied.
6.	Weeding	- Cleared the weeds of 3-4 times. - It needs more labor for weeding.	- Cleared the weeds of 2-3 times - It needs less labor for weeding.
7.	Pesticides Application	- It uses natural pesticides such as *Tithonia diversifolia*.	- It uses chemical pesticides.

Table 4.5 shows the differences between SRI and Q-SRI farmers in activities of rice cultivation such as; land preparation, seedling and planting, irrigation, the application of chemical fertilizer, the application of organic fertilizer, weeding, and pesticides application. Aspects of seedling or transplanting are very different in activities of rice cultivation. Whereas, SRI farmers: single planting of young seedlings (7-14 days after seeding). On the contrary, Q-SRI farmers practice more than 2 seedlings of old seedlings (20-30 days after seeding).

Irrigation activities, SRI farmers use intermittent irrigation systems, and Q-SRI farmers use irrigated continuously with the height of water 5-7 cm during 60 days. Pesticides application, SRI farmers use natural pesticides, and Q-SRI farmers use chemical pesticides. Table 3.6 shows that SRI farmers tend to practice the organic farming because minimize chemical fertilizers and maximize organic fertilizers such as; *bokashi*, compost, and others (petroganic fertilizer).

Description of each cultivation activities of SRI and Q-SRI farmers, including percentages, averages and others be presented each sub chapter.

4.3.1 Land preparation

Rice farming both SRI and Q-SRI farmers includes land preparation before planting, puddling, built ditch, mix organic, total of organic or chemical fertilizer, ploughing, labor use and approach of land preparation are presented Table 4.6

Table 4.6 Land preparation

List	SRI farmers Number (N=25)	SRI farmers %	Q-SRI farmers Number (N=85)	Q-SRI farmers %
1. Land preparation before planting				
- Yes	25	100.00	85	100.00
2. Puddling				
- Transplanting	-	-	44	51.76
- Before transplanting	25	100.00	9	10.59
- Others	-	-	32	37.65
3. Farmer built ditch or drainage				
- Yes	25	100.00	15	17.65
- No	-	-	70	82.35
4. Ploughing				
- No	25	100.00	85	100.00
Continued Table 4.6				
5. Labor use for land preparation (MD/ha)				
- Family labor	9	29.03	6.75	26.04
- Hired labor	22	70.97	19.17	73.96
6. Approach of land preparation				
- Tractors	21	84.00	76	89.41
- Cows	4	16.00	9	10.59

Table 4.6 shows that all the SRI and Q-SRI farmers do land preparation before planting. All of the SRI farmers make puddling before transplanting, and 51.76% of Q-SRI farmers make puddling when transplanting. All of the SRI farmers and 17.65% of Q-SRI farmers built ditch or drainage. All of the SRI farmers and the Q-SRI farmers practice ploughing.

Similarly, man-day average per hectare for land preparation, SRI farmers need 22 man-day/ha (70.97%) from hired labor for land preparation. Q-SRI farmers need 19.17 man-day/ha (73.96%) from hired labor for land preparation. SRI farmers (84.00%) and Q-SRI farmers (89.41%) approach of land preparation by tractor.

4.3.2 Seedling and transplanting

Activities of rice cultivation especially seedling and transplanting, such as; number of seeds per hole, age of seedlings transplanting, farmer cutting the roots and shoots before transplanting, depth of transplanting, farmer using certified seeds, type or variety of seeds, price of seeds per kilogram, and quality of seeds. Activities of seedling and transplanting are presented in Table 4.7 Seedlings and transplanting

Table 4.7 Seedling and transplanting

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. The number of seed per hole				
- 1 seed	10	40.00	3	33.53
- 2 seeds	15	60.00	12	14.12
- > 2 seeds	-	-	70	82.35
2. Age of seedling transplanting				
- 7 – 12 days	25	100.00	-	-
- 25-30 days	-	-	85	100
3. farmer cuts the root and shoot before transplanting				
- Yes	-	-	21	24.71
- No	25	100.00	64	75.29
4. Depth of transplanting				
- 0-2 cm	25	100.00	65	76.47
- 2-6 cm	-	-	20	23.53
5. Farmer uses certified seed				
- Yes	24	96.00	71	83.53
- No	1	4.00	14	16.47
6. Type/variety of seed				
- Ciherang	14	56.00	43	50.59
- Cibogor	3	12.00	22	25.88
- Hibrida	4	16.00	5	5.88
- Others (IR 64)	4	16.00	15	17.65
7. Price of seed/kg (IDR)				
- 0 – 6,000	17	68.00	61	71.76
- 6,100 - 10,000	7	28.00	23	27.06
- 10,100- 20,000	-	-	1	1.18
- > 20,000	1	4.00	-	-
8. Quality of seed				
- Moderate	12	48.00	39	45.88
- Good	13	52.00	46	54.12

Table 4.7 shows that most of the SRI farmers (60%) transplanted 2 seeds per hole, and most of Q-SRI farmers (82.35%) transplanting more than 2 seeds per hole. All of the SRI farmers transplant seedlings at a young age - 7 to 12 days old. All of the Q-SRI farmers transplant seedlings at a young age - 25 to 30 days old. All of SRI farmers and 75.29% of Q-SRI farmers did not cut the roots and shoots before transplanting. All of the SRI farmers and 76.47 of the Q-SRI farmers transplant seedlings at a depth about 0-2 cm.

Most of the SRI farmers (56.00%) and the Q-SRI farmers (50.59%) practiced “*Ciherang*” (type or variety of seed). Furthermore, most of the SRI farmers (68.00%) and the Q-SRI farmers (71.76%) have a price of seeds per kilogram of around IDR 0 – IDR 6,000.00. Most of the SRI farmers (52.00%) and the Q-SRI farmers (54.12%) have a good quality of seeds. It is implied that the SRI and the Q-SRI farmers show a tend relatively, such as; age of seeds, price of seeds, and quality of seeds.

4.3.3 Application of chemical fertilizer

Activities of rice cultivation, especially chemical fertilizer application, such as; application of chemical fertilizer, frequency of chemical fertilizer application, quantity of chemical fertilizer application, price of chemical fertilizer, concerned factors when using chemical fertilizer, and the problems of chemical fertilizer. Activities of chemical fertilizer are presented in Table 4.8

Table 4.8 Application of chemical fertilizer

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. Application of chemical fertilizer				
- Yes	21	84.00	81	95.29
- No	4	16.00	4	4.71
2. Frequency of chemical fertilizer application				
- 2 times	10	47.62	3	3.70
- 3 times	11	52.38	53	65.43
- 4 times	-	-	25	30.86
3. Average quantity of chemical fertilizer application(kg/ha)				
- N (Nitrogen)	159		410.08	
- P (Phosphorus)	164		322.61	
- K (Potassium)	121		177.90	
- Others (KCl)	47		72.89	
4. AveragePrice of chemical fertilizer (IDR/kg)				
- N	1,692.00		1,696.47	
- P	2,384.00		2,387.06	
- K	1,624.00		1,506.47	
- Others (KCl)	560.00		592.35	

Table 4.8 (Continued)

List	SRI farmers Number (N=25)	%	Q-SRI farmers Number (N=85)	%
5. Concerned factor when using chemical fertilizer following				
- extension officer recommendation	14	66.67	3	3.70
- Price chemical fertilizer	18	85.71	68	83.95
- Soil fertility	6	28.57	59	72.84
- Own personal experience	17	80.95	73	90.12
6. Having problem of chemical fertilizer application				
- Yes	16	76.19	74	91.36

Table 4.8 shows that most of the SRI farmers (84.00%) and the Q-SRI farmers (95.29%) practiced chemical fertilizer. Q-SRI farmers (65.88%) practiced using chemical fertilizer at a higher level than SRI farmers (52.00%) at a frequency on (3 times more). SRI farmers practiced the use chemical fertilizer around 159 kilogram per hectare, while Q-SRI farmers were around 410.08 kilogram per hectare. It is implied that SRI farmers were lower than Q-SRI farmers (amount of chemical fertilizer). The price of chemical fertilizer nitrogen (*urea*) of SRI farmers is around IDR 1,692.00 while Q-SRI farmers is around 1,696.47.

SRI farmers (66.67%) while only 3.70% of Q-SRI farmers practiced chemical fertilizer as a suitable from the extension officer recommendation. SRI farmers (85.71%) and Q-SRI farmers (83.95%) practice chemical fertilizer as suitable market price for fertilizer. SRI farmers (76.10%) and Q-SRI farmers (91.36%) have problems with chemical fertilizers. The problems of chemical fertilizer application such as: scarcity of chemical fertilizers, the high price of chemical fertilizers, and others.

Based on these descriptions, it is concluded that the Q-SRI farmers prefer using chemical fertilizers, viewed from the use of Nitrogen (*urea*), Phosphorus (*Phonzka*), and other chemical fertilizers with the total amount of 1000 kg/ha or more than 1 ton per hectare. Whereas the high usage gives a negative effect on the soil and the soil becomes infertile because it contains a minimum amount of organic matter, it becomes acidic and hard. This condition causes the soil to not be able to provide the rice with enough nutritions. The solutions are to practice the SRI project which trying to minimalist the application of chemical fertilizers, and to encourage the application of organic fertilizers.

4.3.4 Application of organic fertilizers

Activities of rice cultivation especially organic fertilizer application, such as; application of organic fertilizer, frequency of organic fertilizer, quantity of organic fertilizer, price of organic fertilizer, concerned factor when using organic fertilizer, and problem of organic fertilizer. Activities of organic fertilizer are presented in Table 4.9

Table 4.9 Application of organic fertilizer

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. Application of organic fertilizer				
- Yes	25	100.00	26	30.59
- No	-	-	59	69.41
2. Frequency of organic fertilizer application				
- 1 times	-	-	10	11.76
- 2 times	15	60.00	16	18.82
- 3 times	10	40.00	-	-
3. Quantity of organic fertilizer (kg/ha)				
- Bokashi	1,992.00		63.18	
- Petroganik	103.60		26.06	
4. Price of organic fertilizer (IDR/kg)				
- Bokashi	302.00		295.45	
- Petroganik	1,064.29		1,126.67	
5. Concerned factor when using organic fertilizer following				
- extension officer recommendation	22	88.00	12	46.15
- Price chemical fertilizer	16	64.00	20	76.92
- Soil fertility	18	72.00	17	65.38
- Own personal experience	21	84.00	15	57.69
6. Having problem of organic fertilizer application				
- Yes	14	56.00	20	84.71

Table 4.9 shows that all of the SRI farmers and 30.59% of the Q-SRI farmers practice organic fertilizer. SRI farmers (60%) practice of organic fertilizer is higher than Q-SRI farmers (18.82%) at a frequency of 2 times. SRI farmers practice organic fertilization (*bokashi*) of around 1,992.00 kilogram per hectare, while Q-SRI farmers are around 63.18 kilogram per hectare. It is imply that SRI farmers usage is

higher than Q-SRI farmers (amount of organic fertilizer). The price of organic fertilizer (*bokashi*) of the SRI farmers around IDR 302.

SRI farmers (88.00%) and only 46.15% of Q-SRI farmers practice organic fertilizer in line with the extension officers recommendations. SRI farmers (64.00%) and Q-SRI farmers (76.92%) practice organic fertilizer as suitable market price for fertilizer. SRI farmers (56.00%) and Q-SRI farmers (84.71%) have problems of organic fertilizer.

It is implied that SRI farmers practice organic fertilizers at a higher level than Q-SRI farmers. It proves that SRI farmers started leaning towards organic agriculture, since they tried to minimalist the application of chemical fertilizers. Organic fertilizers prove to be able to continually improve the soil fertility, so the productivity in rice production will be optimum and continuously. In addition, applying organic fertilizers sustains, a high level of productivity.

4. 3.5 Water management

Activities of water management or irrigation application, such as; usage of irrigation systems, time for using irrigation such as; seedling establishment, tillering, booting, flowering, filling, and ripening, and the usage of irrigation problems. Activities of the use of irrigation in rice farming is presented in Table 4.10

Table 4.10 The use of irrigation in rice farming

List	SRI farmers		Q-SRI farmers	
	Number (N=25)	%	Number (N=85)	%
1. Using irrigation system				
- Yes	18	72.00	69	81.18
- No	7	28.00	16	18.82
2. Time for using Irrigation				
- Seedling establishment/ on transplanting	18	100.00	69	100.00
- Tillering	18	100.00	65	94.20
- Booting	16	88.89	66	95.65
- Flowering	15	83.33	68	98.55
- Filling	17	94.44	56	81.16
- Ripening	14	77.78	40	57.97
3. Using irrigation problem				
- Yes	3	12.00	18	21.18
- No	22	88.00	67	78.82

Table 4.10 shows that 72.00% of SRI farmers and 81.18% of Q-SRI farmers use irrigation. All of SRI farmers and Q-SRI farmers practice irrigation for seedling or transplanting. All of SRI and 94.20% of Q-SRI farmers practice irrigation for tillering. Most of SRI the farmers (88.89%) and 95.65% of the Q-SRI farmers practice irrigation for booting. 88% of the SRI farmers and 78.82% of the Q-SRI farmers have no problem in the practice of irrigation.

Based on the results or survey, watering process between the SRI and Q-SRI farmers is generally the same. But there are some differences:

a) The SRI farmers: when the rice reaches the age of 1-8 days after planting, the condition of water in the field is not too much, about 1-2 cm above the land level. For the Q-SRI farmers: the flooding (5-7 cm above land level) during 60 days.
b) The SRI farmers: 9-10 days after planted, the rice is flooded with the height water at 2-3 cm above the land level for one night in order to make the first weeding stage easier. Q-SRI farmers always flood their fields.
c) SRI farmers: after weeding, the field is redried off after the rice reached 18 days after planted. The Q-SRI farmers: the field is still flooded.
d) SRI farmers: after flowering, the field is the flooded to the height of 1-2 cm above land level, and this condition is maintained up to the rice in condition (± 15-20 days before harvested). The field is redried off. Q-SRI farmers: when the rice reaches 60 days after planting, the field is redried off.

Based on the results, it is concluded that SRI farmers need less water than Q-SRI farmers. Then SRI farmers practice an intermittent irrigation pattern, but Q-SRI farmers always flood their field during the 60 days.

4.3.6 Weeding

Activities of weeding, such as; apply weeding, frequency of farmer weeding application, use of herbicides for weed control, problems of weed control, types of labor for weed control, and labor quantity for weed control. Activities of weeding is presented in Table 4.11

Table 4.11 Weeding or weed control

List	SRI Farmers		Q-SRI Farmers	
	Number (N=25)	%	Number (N=85)	%
1. Apply of weeding				
- Yes	25	100.00	85	100.00
2. Frequency of farmer weeding application				
- 1 times	-	-	18	21.18
- 2 times	-	-	26	30.59
- 3 times	6	24.00	37	43.53
- 4 times	16	64.00	4	4.71
- >4 times	3	12.00	-	-
3. Use herbicides for weed control	2	8.00	71	83.53
4. Problem of weed control				
- Yes	16	64.00	73	85.88
- No	9	36.00	12	14.12
5. Type of labor for weed control				
- Family labor	25	100.00	85	100.00
- Hire labor	16	64.00	56	65.88
6. Average of labor quantity for weed control (man-day/ha)				
- Family labor	4.44		2.21	
- Hired labor	58.96		23.69	

Table 4.11 shows that all of SRI and Q-SRI farmers practice weeding or weed control. SRI farmers (64%) practice weeding higher than Q-SRI farmers (4.71%) for frequency of farmer weeding applications (4 times per season). SRI farmers practice of herbicides is around 8.00%, while Q-SRI farmers is around 83.53%. It is imply that Q-SRI farmers are higher than SRI farmers (usage of herbicides). SRI farmers (64.00%) and 85.88% of Q-SRI farmers have problem of organic fertilizer. SRI farmers (64.00%) and Q-SRI farmers (65.88%) practice weeding by hired labor for weed control.

The use of herbicides has a negative effect namely eradicating worms, where worms have a function to fertilize the soil. If there are no worms in the soil, it will become infertile, and the rice production is not optimum. On the weeding activities, farmer use of self-made tools called weeders or "*kokrok* (Javanese)". Which are made from bamboo where it is formed like a brush. The bush consists of nails for the function of uprooting the grasses. But it should be applied carefully in order to avoid destroying the rice plants. Besides, the farmers also weed their field manually.

4.3.7 Application of chemical pesticides

Pest and diseases are a serious problem in rice cultivation. To control the existence of pest and diseases, both SRI and Q-SRI farmers practice chemical pesticides on rice farms. However, the frequencies and amounts are different for each method. Activities of rice cultivation especially chemical pesticides application, such as; pesticide application, pesticides application frequency, and labor quantity for chemical pesticides application. Activities of the use of pesticide in pest management is presented in Table 4.12

Table 4.12 The use of pesticide in pest management

List	SRI Farmers		Q-SRI Farmers	
	Number (N=25)	%	Number (N=85)	%
1. Pesticide application				
- Yes	21	84.00	85	100
- No	4	16.00	-	-
2. Pesticide application frequency				
- 1 time	10	47.62	-	-
- 2 times	6	28.57	27	31.76
- 3 times	5	23.81	31	36.47
- 4 times	-	-	27	31.76
3. Average of labor quantity for chemical pesticide application (man-day/ha)				
- Family labor	2.96		2.11	
- Hired labor	5.04		5.48	

Table 4.12 shows that most of the SRI farmers (84%) and all of the Q-SRI farmers pesticides application. Q-SRI farmers (36.47%) are higher than SRI farmers (20%) for pesticides application frequency (3 times per season). SRI farmers use of labor quantity for chemical pesticides application is around 5.04 man-day from hired labor, and Q-SRI farmers use of labor quantity for chemical pesticides application around 5.48 man-day per hectare from hired labor. It is imply that the Q-SRI farmers cost of pesticides, expenses for the Q-SRI farmers is confirmed higher than the SRI farmers. The Q-SRI farmers expenses for pesticides as 255,776.20 IDR/ha, while SRI farmers is 101,070.10 IDR/ha. Since the SRI farmers have a lower cost for pesticides expenses, the revenue and profit will be higher than the Q-SRI farmers.

4.3.8 Application of herbal pesticides

Herbal pesticides which commonly are used by farmers are Local Microorganism (MOL) and *pahitan* leaves (*Tithonia diversifolia*). MOL is used as a catalyst to make fluid organic fertilizers and materials for herbal pesticides and may solve elements of soil macro and micro nutrients, serving to help plants grow and to improve the ecosystems health including preventing pests and diseases. Activities of herbal pesticides application, such as; herbal pesticides application, frequency of farmer apply natural pesticide, labor quantity for herbal pesticide application. Activities of herbal pesticide use in pest management is presented in Table 4.13

Table 4.13 Herbal pesticide use in pest management

List	SRI Farmers		Q-SRI Farmers	
	Number (N=25)	%	Number (N=85)	%
1. Application of herbal pesticide				
- Yes	25	100	7	8.24
- No	-	-	78	91.76
2. Frequency of farmer apply natural pesticide(person)				
- 1 time	2	8.00	3	3.53
- 2 times	5	20.00	4	4.71
- 3 times	8	32.00	-	-
- 4 times	10	40.00	-	-
3. Average of labor quantity for herbal pesticide application (man-day/ha)				
- Family labor	3.31		2.21	
- Hired labor	5.84		3.48	

Table 4.13 shows that all of the SRI farmers and 8.24% of the Q-SRI farmers practice herbal pesticides. Q-SRI farmers (4.71%) practice of herbal pesticide (2 times per season) is lower than SRI farmers (40%) at a frequency of 4 times per season. The type of herbal pesticides used by farmers are fruits MOL, leaf MOL, and others. It is imply that most of Q-SRI farmers didn't use the herbal pesticides since they had used chemical pesticides. They thought that herbal pesticides were not important and needed, because of the effect of herbal pesticides was less effective to annihilate pests and diseases.

4.3.9 Harvesting and post-harvesting

The age of plants harvested is influenced by the varieties, but is ranging from 100-120 days from the planting time. An activity of harvesting, in the SRI method, is usually done by hired labors consisting of a team with members of 10 people or more.

The wage system is call the *bawon* system, by giving wages in the form of rice with the proportion of 1:8. If the rice production is 10 tons, 8,75 tons belong to the owners, and the rest, 1.25 tons is given to the labors as the wage for harvesting.

In a conventional agriculture, the harvesting method is divided into two, namely the *bawon* and *tebasan* systems. The *tebasan* system is one of harvesting methods full of risk, since bargaining activities are made before the rice is ready to harvest. Therefore, farmers are unable to predict the amount of production which is conversed into the amount of money they will receive. The benefit of this system is that when harvest fails or the price of rice decreases, the buyer will get less not the farmers. On other hand, when the price of rice increases, the farmers would not enjoy the increase in price.

4.4 Net profit and level of practice in SRI project, and the correlation between level of practice and net profit

4.4.1 Net profit of rice farming in SRI project

The discussion about cost and return of rice farming in the SRI project is divided into two parts such as; the cost and return of rice farming for SRI farmers and Q-SRI farmers. Components of total cost, total revenue and net profit be explained within each sub chapter.

1) Net profit of rice farming for the SRI farmers

The results of the research revealed that farmers did not record and calculate cost and return of rice farming because they feel is not necessary. However, in rice farming it is necessary to know costs, revenues, and profits. This analysis is divided in to three parts; total cost (total variable cost, and total fixed cost), total revenue (rice production, and rice price), and net profit. Analysis of the cost and return of rice farming for the SRI farmers is presented in Table 4.14.

Table 4.14 Cost and return of rice farming for the SRI farmers in 2010

Unit: IDR/ha

List	Cash		Non cash		Total	
	IDR	%	IDR	%	IDR	%
A. Total Variable Cost	8,005,387.18	73.62	1,462,001.19	13.44	9,467,388.37	87.06
1. Chemical fertilizer	936,069.96	8.61	-	-	936,069.96	8.61
2. Organic fertilizer	224,595.85	2.07	-	-	224,595.85	2.07
3. Chemical pesticides	219,091.70	2.01	-	-	219,091.70	2.01
4. Organic pesticides	211,262.77	1.94	-	-	211,262.77	1.94
5. Compost	838,219.78	7.71	-	-	838,219.78	7.71
6. Labor	5,576,147.12	51.28	858,947.74	7.90	6,435,094.86	59.18
7. Seed	-	-	85,427.55	0.79	85,427.55	0.79
8. Irrigation fee	-	-	300,000.00	2.76	300,000.00	2.76
9. Opportunity cost	-	-	217,625.90	2.00	217,625.90	2.00
B. Total Fixed Cost	740,000.00	6.81	666,666.67	6.13	1,406,666.67	12.94
1. Land rent	740,000.00	6.81	-	-	740,000.00	6.81
2. Depreciation	-	-	666,666.67	6.13	666,666.67	6.13
C. Total Cost	8,745,387.18	80.42	2,128,667.85	19.58	10,874,055.03	100.00
Yield (kg/ha)					8,293.61	
Price (IDR/kg)					3,245.83	
D. Total Revenue					26,919,648.15	
E. Net Return					17,452,259.78	
F. Net Profit					16,045,593.11	
G. Net profit (IDR/kg)					1,934.69	

Table 4.14 shows that the total cost of the SRI farmers is IDR 10,874,055.83 per hectare. The total variable cost and total fixed cost are 87.06% and 12.94% of total cost. Labor costs are the highest (59.18%) of total costs. Next, the chemical fertilizer cost is the second highest (8.61%) of total cost. Conversely, the seed cost is the lowest cost (0.79%) of total the cost. Likewise, the organic pesticides cost is the second lowest (1.94%) of total cost. Furthermore, other cost such as; organic fertilizer (2.07%), chemical pesticides (2.01%), compost (7.71%), irrigation fee (2.76%), and opportunity costs (2%) are moderate relatively. Similarly, land rent cost and depreciation costs are 6.81% and 6.13% of the total cost.

Labor cost is the highest cost in rice farming because, SRI farmers need a lot of steps in the process of cultivation; it includes land preparation, transplanting, weeding, harvesting and others. This indicator implies that rice farming in SRI Project (SRI farmers) is more labor intensive than Q-SRI farmers.

Table 4.14 shows that total revenue of SRI farmers is IDR 26,919,648.15 per hectare. Furthermore, yield obtained is more than 8.29 ton/ha for SRI farmers. Rice's price is IDR 3,245.83 per kilogram. In addition, net return and net profit are IDR 16,045,593.11 and IDR 17,452,259.78. The last, net profit of rice per kilogram is IDR 1,934.69.

2) Net profit of rice farming for the Q-SRI farmers

Analysis of the cost and return of rice farming for the Q-SRI farmers is presented in Table 4.15 shows that the cost and return of rice farming including total costs (total variable cost, and total fixed cost), total revenue (rice production, and rice price), and net profit. In addition, net profit is the difference between total revenue and total cost.

Table 4.15 Cost and return of rice farming for the Q-SRI farmers in 2010

Unit: IDR/ha

List	Cash		Non cash		Total	
	IDR	%	IDR	%	IDR	%
A. Total Variable Cost	6,655,459.34	70.01	1,477,237.14	15.54	8,132,696.48	85.54
1. Chemical fertilizer	1,885,144.13	19.83	-	-	1,885,144.13	19.83
2. Organic fertilizer	470.59	0.00	-	-	470.59	0.00
3. Chemical pesticides	261,023.26	2.75	-	-	261,023.26	2.75
4. Organic pesticides	6,600.00	0.07	-	-	6,600.00	0.07
5. Compost	71,096.08	0.75	-	-	71,096.08	0.75
6. Labor	4,431,125.28	46.61	728,073.04	7.66	5,159,198.32	54.27
7. Seed	-	-	268,235.90	2.82	268,235.90	2.82
8. Irrigation fee	-	-	300,000.00	3.16	300,000.00	3.16
9. Opportunity cost	-	-	180,928.21	1.90	180,928.21	1.90

Table 4.15 (Continued)

List	Cash		Non cash		Total	
	IDR	%	IDR		IDR	%
B. Total Fixed Cost	818,823.53	8.61	555,555.56	5.84	1,374,379.09	14.46
1. Land rent	818,823.53	8.61	-	-	818,823.53	8.61
2. Depreciation	-	-	555,555.56	5.84	555,555.56	5.84
C. Total Cost	7,474,282.87	78.62	2,032,792.70	21.38	9,507,075.57	100
Yield (kg/ha)					5,993.40	
Price (IDR/kg)					3,141.57	
D. Total Revenue					18,828,685.64	
E. Net Return					10,695,989.16	
F. Net Profit					9,321,610.07	
G. Net profit (IDR/kg)					1,555.31	

Table 4.15 shows that the total cost of Q-SRI farmers is IDR 9,507,075.57 per hectare. The total variable costs and total fixed costs are 85.54% and 14.46% of total costs. The labor cost is the highest cost (54.27%) of total costs. Furthermore, the chemical fertilizer cost is the second highest cost (19.83%) of total costs. Conversely, the organic fertilizer cost is the lowest cost (0.00%) of total costs. Likewise, the organic pesticides cost is the second lowest (0.07%) of total costs. Other cost such as; seeds (2.82%), chemical pesticides (2.75%), compost (0.75%), irrigation fees (3.16%), and opportunity costs (1.90%) are moderate relatively. Similarly, land rent costs and depreciation costs are 8.61% and 5.84% of total costs.

Table 4.15 shows that the total revenue of Q-SRI farmers is IDR 18,828,685.64 per hectare. Yield obtain is more than 8.29 ton/ha for Q-SRI farmers. Rice price is IDR 3,141.57 per kilogram. Furthermore, net return and net profit are IDR 10,695,989.16 and IDR 9,321,610.07. Net profit (dry rice per kilogram) is IDR 1,555.31.

Table 4.16 shows that SRI farmers are better than Q-SRI farmers. The SRI methods have multiple benefits. The quantity of seeds used for cultivation through this method is considerably less. Furthermore, expenditure levels of SRI farmers is lower than Q-SRI farmers. It is presented in Table 4.16

Table 4.16 Difference in cost and return between SRI and Q-SRI farmers in 2010

Unit: IDR/ha

List	SRI Farmers		Q-SRI Farmers		Difference	
	IDR	%	IDR	%	IDR	%
A. Total Variable Cost	9,467,388.37	87.06	8,132,696.48	85.54	1,334,691.89	14.10
1. Chemical fertilizer	936,069.96	8.61	1,885,144.13	19.83	-949,074.17	-101.39
2. Organic fertilizer	224,595.85	2.07	470.59	0.00	224,125.26	99.79
3. Chemical pesticides	219,091.70	2.01	261,023.26	2.75	-41,931.56	-19.14
4. Organic pesticides	211,262.77	1.94	6,600.00	0.07	204,662.77	96.88
5. Compost	838,219.78	7.71	71,096.08	0.75	767,123.70	91.52
6. Labor	6,435,094.86	59.18	5,159,198.32	54.27	1,275,896.54	19.83
7. Seed	85,427.55	0.79	268,235.90	2.82	-182,808.35	-213.99
8. Irrigation fee	300,000.00	2.76	300,000.00	3.16	0.00	0.00
9. Opportunity cost	217,625.90	2.00	180,928.21	1.90	36,697.69	16.86
B. Total Fixed Cost	1,406,666.67	12.94	1,374,379.09	14.46	32,287.58	2.30
1. Land rent	740,000.00	6.81	818,823.53	8.61	-78,823.53	-10.65
2. Depreciation	666,666.67	6.13	555,555.56	5.84	111,111.11	16.67
C. Total Cost	10,874,055.03	100.00	9,507,075.57	100.00	1,366,979.46	12.57
Yield (kg/ha)	8,293.61		5,993.40		2,300.21	27.73
Price (IDR/kg)	3,245.83		3,141.57		104.26	3.21
D. Total Revenue	26,919,648.15		18,828,685.64		8,090,962.51	30.06
E. Net Return	17,452,259.78		10,695,989.16		6,756,270.62	38.71
F. Net Profit	16,045,593.11		9,321,610.07		6,723,983.04	41.91
G. Net profit (IDR/kg)	1,934.69		1,555.31		379.38	19.61

Comparison of total costs between SRI farmers and Q-SRI farmers found that SRI farmers are higher (12.57%) than Q-SRI farmers. Table 4.16 shows that several cost of SRI farmers are higher than Q-SRI farmers, such as; organic fertilizer (99.79%), organic pesticides (96.88%), compost (91.52%), labor (19.83%), and opportunity costs (16.86%). The high cost of labor for the SRI farmers for weeding. Labor requirement (weeding) of SRI farmers (59 man-days per hectare) higher than Q-SRI farmers (23 man-days per hectare).

Table 4.16 also shows that several costs of SRI farmers are lower than Q-SRI farmers, such as; seed (213.99%), chemical fertilizers (101.39%), and chemical pesticides (19.14%). In addition, the seed requirements of SRI farmers (6-10 kilogram per hectare) lower than Q-SRI farmers (50-70 kilogram per hectare). The fact that there is a drastic reduction in seed. Likewise, chemical fertilizer requirements of the SRI fertilizer (313 kilogram per hectare) is lower than Q-SRI farmers (532 kilogram per hectare).

Table 4.16 revealed that the yield of the SRI farmers higher than the Q-SRI farmers by around 27.73% per hectare. Net profit of the SRI farmers is higher than the Q-SRI farmers by around 41.91 percent per hectare. Likewise, net return of SRI farmers is higher than Q-SRI farmers by around 38.71% per hectare. The total revenue of SRI farmers is higher than Q-SRI farmers by around 30.06% per hectare. Moreover, net profit (IDR per kilogram) of SRI farmers is higher than Q-SRI farmers by around 19.61%. These results imply that rice productivity of SRI farmers is higher than Q-SRI farmers, and SRI project (SRI farmer) better yield performance than conventional methods (Q-SRI farmers). It can be concluded that the SRI project is a more efficient at production and yields obtained are higher by practicing improved technology.

4.4.2 Level of practice in SRI project

In general, the level of practice in SRI principles includes: (1) selecting seeds with salt water, (2) managing fields and practicing organic fertilizers to the field, (3) planting seeds at a young age (7-15 days), (4) transplanting one or two seeds per hole, (5) setting the planting distance at 30 cm x 30 cm, (6) frequent weedings 3-4 times, at least three times using "*kokrok* or weeder" and doing of manually, (7) practicing organic fertilizers, (8) practicing intermittent irrigation, (9) practicing an integrated pest-diseases control and (10) practicing an appropriate harvesting system. The level of rice farming practice of the SRI farmers is presented in Table 4.17

Table 4.17 The level of rice farming practice score of the SRI farmers

Farmer practice in SRI project	Average score ($\bar{X}$)	Level of practice
1. Seeds selection with salt water.	4.16	High
2. Manage of land and organic fertilizer.	2.60	Moderate
3. Make the seedbed before cultivating.	3.52	High
4. Transplant seedlings at a young age - 7 to 12 days old.	3.56	High
5. Transplanting one seed per hole.	3.68	High
6. Transplanting wide spacing, 30cm x 30cm with regular distance.	3.84	High
7. Frequency weeding in farmer's land.	2.72	Moderate
8. Practicing organic fertilizers.	2.60	Moderate
9. Practicing the intermittent irrigation with wet-dry cycle, and little standing water (± 2 cm) in wet period	3.68	High
10. Practicing Integrated Pest Management (IPM) by utilizing the available natural resources (organic matter or natural)	3.28	Moderate
11. Harvesting management	3.32	Moderate

Based on data analysis found two categories the level of practice (SRI farmers) such as; moderate (2.50-3.49) and high (3.50-4.49) level of practice. The high level of practice such as; seeds selection with salt water, make the seedbed before cultivating, transplant seedlings at young age - 7 to 12 days old, transplanting one-two seeds per hole, transplanting using wide spacing, and practicing the intermittent irrigation. Furthermore, the moderate level of practice such as; manage of land and organic fertilizers, frequency of weeding, practicing organic fertilizers, practicing Integrated Pest Management (IPM), and harvesting management.

Table 4.17 shows that SRI farmers have the high level (3.50-4.49) of rice farming practice in the SRI project such as; seed selection with salt water, making the seedbed before cultivating, transplant seedlings at a young age (7 to 12 days old), transplanting one seed per hole, transplanting with a wider spacing 30 cm x 30 cm with regular distance, and practicing the intermittent irrigation with a wet-dry cycle, and little standing water (± 2 cm) in the wet period.

Seed selection with salt water means that the SRI farmers selected seeds in a water and salt solution using an indicator i.e; if an egg entered into the solution floats, then the solution can separate good and bad seeds. If the seeds are drowned, they are good, and can be seeded. After the seeds are selected in the solution, they are then washed with clean water and rinsed well, then soaked in water for about 24 hours or until an embryo appears. On the basis of the research results, it is shown that most SRI farmers applied this selection method, and its applicability is high (4.16).

Manage of land and organic fertilizers means that the SRI farmers management of land (using plows) and practiced organic fertilization before transplanting. A good land management is plowed using tractors or cows (*ngeluku*) and the land leveling is made using *debog* (banana stalk) or other tools until no water puddles are found. In each land compartment a ditch is made. Before transplanting, organic fertilizers are used on the land with the standard amount of 7-10 tons per hectare, since organic matter contains in their land (the SRI farmers) is less than 3%. If they practice them according to the given standard, the level of the practice is very high. Based on the research results, it is known that not all SRI farmers practiced them in line with the standard given by the field elucidation staff, for instance they merely gave organic fertilizers to their land at about 1-2 tons per hectare. Therefore, on average the SRI farmers showed a moderate practice level of 2.60 in management of their land and the practice of organic fertilizers.

Making the seedbed before cultivating means that the SRI farmers made seedlings in trays or house terraces before planting the seeds. A standardized need for seeds is 6-10 kg/ha. In making a seedling, the following principles are practiced. The thickness of the planting media in the seedlings is 1cm to 1.5 cm functioning to facilitate the planting process and the media consist of a mixture of *bokashi* (organic fertilizer) so that the seeds are easy to grow. Each morning and afternoon the seeds should be watered and the place of the seedling should get direct sun. It is known that most of the SRI farmers make the seedbed before cultivating, and its applicability is high (3.52)

Transplant seedlings at a young age (7 to 12 days old). Based on the research, on average, the SRI farmers planted young seeds (the age of 7-12 days old or maximum 15 days old). It is different with a conventional transplanting system where the age of the seed is 23-30 days old. Table 4.17 shows that the level of its practice is moderate (3.18).

Transplanting one seed per hole**.** Means that the farmers or the laborers planted one or two seeds in each hole. The seeds are shallowly placed, with a depth of 2-3 cm, shifting in a horizontal movement (forming the L letter), instead of being pressed into the soil at a depth of 4-6 cm. The rice roots form the U letter so that the roots have difficulty growing. Moreover, such a horizontal movement, forming the L letter, facilitates the roots to spread and look for optimum nutrients, organic matter, oxygen, and sun. The rice plants therefore will optimally grow. The research suggested that SRI farmers showed that the level of this practice is high (3.68).

Transplanting with a spacing of 30 cm x 30 cm with regular distance means that the farmers or laborers planting the seeds with a wide spacing of around 25 cm x 25 cm or 30 cm x 30 cm or 35 cm x 35 cm. Such a wide spacing helps to improve the amount of rice offspring, and facilitates the photosynthesis processes, to insure the availability of nutrients or organic matter. Table 4.17 shows that the SRI farmers showed a high practice of transplanting wide spacing with a value of 3.84.

Frequency weeding in farmer's land means that the SRI farmers needed 3-4 weeding times during a rice planting season. The results showed that they weeded their rice 2-4 times, once in ten days. There were few farmers weeding 4 times for cost saving reasons. Their level of practice concerning weeding is moderate, with a value of 2.72.

Practicing organic fertilizers. SRI farmers practice of organic fertilizers was about 10 tons per hectare in line with the standard application in the SRI project. Moreover, the farmers also used leave or fruit fertilizers naturally known as leaves and fruits MOL (Local Micro Organism). Table 4.17 shows that the level of its practice was moderate (2.60)

Practicing the intermittent irrigation with a wet-dry cycle, and little standing water (± 2 cm) in the wet period means that the SRI farmers practiced an intermittent irrigation with a wet-dry system. It is different from the Q-SRI farmers, or a conventional method, that continually inundates the field for 60-70 days after planting. Table 4.17 shows that the SRI farmers showed a high practice of practicing the intermittent irrigation with a value of 3.68.

Practicing Integrated Pest Management (IPM) by utilizing the available natural resources (organic matter or natural). Means that the SRI farmers practiced Integrated Pest Management (IPM). It is one of the approaches to controlling pests and diseases comprehensively, in that it not only relies on chemical substances but, also on an organically-combined approach, for instance, by using *pahitan* leaves (*Tithonia diversifolia*) to prevent caterpillars or using natural enemies such as owl to prevent rat pests. From the research results, the SRI farmers showed a high practice in this respect, with a value of 3.28.

Harvesting management means that the SRI farmers managed their harvesting activities according to the existing standard, for example, by applying certain criteria, whether the age of the rice is in line with the variety, whether the variety has a short or normal age, in terms of color, whether the color of the rice is yellow and the grain is hard enough. If the rice is harvested to early its yield is bad, if too late the grains will drop off resulting in a reduced yield. From Table 4.17 it is shown that the level of practice by the SRI farmers in this respect is high (3.32). However, the technology adopted either by the SRI or the Q-SRI farmers is manual. Therefore, effective technology mechanization should be adopted in the future. So as to save laborers and to minimalist the loss of rice grains.

4.4.3 The correlation between level of practice and net profit

There is a correlation between the level of practice and the net profit with the level of significance of 0.01 (r = 0.73) (Table 4.18). This correlation is relatively high, meaning that the higher the level of practice (in the SRI project) the higher the net profit also from the rice farming in the SRI project.

Table 4.18 Correlations between level of practice and net profit

			Practice (X)	Net Profit (Y)
Spearman's rho	Practice _X	Correlation Coefficient	1.000	.730(**)
		Sig. (2-tailed)	.	.000
		N	25	25
	Net Profit _Y	Correlation Coefficient	.730(**)	1.000
		Sig. (2-tailed)	.000	.
		N	25	25

The results of the calculation showed that the level of significance between the level of practice and the net profit in rice framing in the SRI project is relatively high. This implies that the higher the level of practice of the SRI project principles, the higher the positive correlation with the net profit. If the level of practice in the SRI project principles in the land preparation, seed preparation, planting, weeding, up to the harvesting is high, so then is the net profit from the rice farming.

It is necessary to note that a positive correlation between the level of practice of the rice cultivation in the SRI project and the net profit deals with the Field Extension Officer, and the chair of the farmers groups that motivates to improve the practice of the SRI method. Although there were some obstacles the farmers or the Extension Officer faced, at the end the farmers could carry out the program and got an economic profit. The Extension Officers were able to motivate the conventional farmers to do the SRI project.

The calculation of the rank spearmen's correlation is presented in appendix 3. Referring to the research hypothesis that the higher the level of practice the farmers made in the SRI project the higher their net profit. The results of the analysis is relevant with the hypothesis. The correlation between the levels of practice of the SRI farmers and the net profits from the rice farming showed a spearmen rank correlation coefficient (r) of 0.730 from the total 25 respondents, and this suggests that the correlation between the two variables is completely significant ($p=0.000$). This is reinforced by the findings in the field that the SRI farmers really wanted to improve their net profits, by practicing the SRI principles accurately in the hope that their rice production would be optimum and they will get a economic benefit as maximum as possible.

Therefore, the positive correlation between the two variables, the level of farmers' practice and net profits is empirically proved. Although some SRI farmers suffered from a financial loss in their rice cultivation due to rat attack, in general the application of the SRI project is beneficial for them.

On the basis of the results of interviews with the leaders of the farmers groups, farmers figures, and also the extension officers, ways to succeed the SRI project are through training and guidance, motivation, direction, and physical assistance (e.g. seeds, tractors, and others), including a persuasive approach by the extension officers to the farmers, especially those who once got the SRI training. Although in fact some of the people joining in the training quitted practicing the SRI, the extension officers always gave them training on anything the farmers needed.

4.5 Problems and obstacles of SRI project in the practice

Problems and obstacles of farmers in doing the SRI project included difficulty in transplanting young seedlings, difficulty to finding employment or labor, difficulty in transplanting the seeds with wide spacing, the majority of respondents prefer to use chemical fertilizers, difficulty in controlling pests and diseases. The summary of the problems and obstacles of the SRI project is presented in Table 4.19

Table 4.19 The problems and obstacles of SRI project in the practice

No.	Problems and obstacles	Indicators	Percentage of farmers	
			SRI (N=25)	Q-SRI (N=85)
1.	Difficulty to transplanting young seedlings.	• A lot of energy and efforts to transplanting young seedlings. • The high risk to transplanting young seedlings.	48.00	98.82
2.	Difficulty to finding employment or farm labor.	• Productive labors, with the ages of 18-40 years, looking for jobs in other villages. • The unavailability of labors is also due to the interaction between the land owners, land hirer, and workers.	52.00	96.47
3.	Difficulty to transplanting the seedling with wide spacing, and one-two seeds per hole.	• Farmers prefer to transplanting rice by conventional methods. • Some labors complained that transplanting the seeds with wide spacing, and transplanting one-two seeds per hole makes they get backaches.	40.00	90.59
4.	The majority of farmers prefer to use chemical fertilizers.	• Farmers prefer chemical fertilizer because practice, effect direct and simple. • The effect of organic fertilizer long time	44.00	94.12

Table 4.19 (Continued)

No.	Problems and obstacles	Indicators	Percentage of farmers	
			SRI (N=25)	Q-SRI (N=85)
5.	Difficulty to controlling pests and diseases.	• Difficulty to reduce pest and disease problems. • Difficult to integrated pest management	48.00	91.76

Table 4.19 shows that most of the Q-SRI farmers (98.82%) and 48.00% of the SRI farmers faced difficulties in transplanting young seedlings. SRI farmers (52%) and Q-SRI farmers (96.47%) had difficulty in finding employment or farm labor. Moreover, 40.00% of SRI farmers and most of the Q-SRI farmers (90.59%) had difficulty in transplanting the seedlings with a wide spacing, and one or two seeds per hole. Most of Q-SRI farmers (94.12%) prefer to use chemical fertilizer, on the contrary, 44% of the SRI farmers are still using chemical fertilizers. The last, 48.00% of the SRI farmers, and most of the Q-SRI farmers (91.76%) had difficulty in controlling pest and disease. For a detailed explain per problems and obstacles on the next discussion.

1. Difficulty to transplanting young seedlings

One of key success of the SRI project is to plant young seeds, at the age of 7-15 days. If farmers plant older seeds – 3, 4, 5 or 6 weeks – they will lose same potency in producing a large amount of plant offspring. The way to plant young seeds is that when the seeds are pulled under the soil, the movement should be shifted forming the L letter in order to reduce the tension of the plant roots and to facilitate the plants continuation of growth.

It is one of the obstacles the laborers experienced since they are used to planting seeds conventionally by pulling them into the soil at a depth of 4-6 cm. And planting such young seeds is a special obstacles form the laborers.

One of the reasons to plant young seeds by shifting movement is that the growth of the plant roots will be good, since the rice plant roots grow from their tips. If the tips lead upward, they should change their position in the soil in order to make the tips lead downward before continued growing. This needs a lot of energy and effort from the small roots which are still weak after being planted, especially if the roots are dry due to late planting. It is a high risk transplanting young seeds.

Based on the results of in-depth interviews, most farmers who quitted practicing the SRI reasoned that they had difficulties in planting activities, especially in finding laborers ready to plant young seeds. If the laborers are ready, there is a consequence, it needs a lot of funds. It is this problem that caused some farmers to quit the SRI.

2. Difficulty to finding employment or farm labor

Concerning the availability of laborers in the research site, it was found that in the rice planting season, it was difficult to get laborers, since all farmers planted rice simultaneously. Even some farmers hired laborers from other villages. Moreover, the planting area is very wide, but the availability is relatively fixed, due to most laborers age above 40 years. Productive laborers, with the ages of 18-40 years are more likely to look for jobs in other villages, as cigarettes factory workers, drivers, and others, even workers in foreign countries.

The unavailability of labor is also due to the interaction between the land owners and land hirers (*pengedok*) and workers. If the owners have many brothers or sisters or friends whose professions are farmers, there is not be difficulty in finding laborers. Usually land owners also have good relationships with land hirers, since they are key people who manage the farming from land preparation to harvesting activities. The relationship among the land hirers themselves is very good, so that they manage lands one after another. There are respondents who have got fixed workers so that they do not have any difficulty in managing their lands. It is these respondents who have a good economic condition.

3. Difficulty to transplanting the seeds with wide spacing

Planting rice using a wide or regular distance, one of the methods is to use a string tied in sticks placed between each side of the field with the distance of 25 cm – 30 cm, or 40 cm or even 50 cm if the land is fertile or well managed. The lines should be signed (or tied) at the same interval in order to adapt to the width of the row so that the uniform distance may be convenience while weeding. A brush-like form made of bamboo with a removable space or distance may also be used.

Another alternative is by using a specific harrow to mark a surface in a square pattern function to plant seeds in the intersection of the lines. Some farmers said that this special harrow is better than string. It turns out that some farmers have difficulty in practicing this model.

Some farmers also said that in the conventional method no measurement is practiced, and the planting activities are quicker. Furthermore, some labors complained that transplanting the seeds with wide spacing, and transplanting one-two seeds per hole gives them a backache and is difficult to reach, so it is impractical and complicated.

4. The majority of respondents prefer to use chemical fertilizers

Based on the results of research and in-depth interviews, it was found that the amount of chemical fertilizers practiced by Q-SRI farmer was relatively high. They still relied on chemical fertilizers to solve their agricultural problems. As the extension officer said, the need for chemical fertilizers, especially urea was still high, at average the non SRI farmers at least needed 500 kg/ha, even some farmers, almost 1 tons/ha.

Rasat (leader of farmer group) explained that the Q-SRI farmers still relied on chemical fertilizers to make their lands fertile and to accelerate their plants, especially rice plants that are consided too hard to handle. Plants, especially rice not only needs Nitrogen (*Urea*) but also NPK, Phonzka, SP36 and others.

The quantity of the use of organic fertilizers was still low, as the farmers tended to know the results immediately. Therefore, chemical fertilizers are considered to quickly solve their problems, i.e. their plants are quick to grow well and last longer than organic fertilizers. The matter is that the characteristic of organic fertilizers is to give a long term impact for land recovery. And the extension officers have encouraged the use of these organic fertilizers to keep the soil fertile.

From the observation in the field, it was found out that farmers had difficulty in practicing the SRI method because they still relied on chemical fertilizers, and little organic fertilizers are used, even this SRI approach leads farmers to make use of organic fertilizers.

5. Difficulty to controlling pests and diseases

Pests and diseases are the biggest problems for rice farmers. The main disease is *beureum* caused by virus RTBV (*Rice Tungro Baciliform Virus*) or RTSV (*Rice Tungro Spherical Virus*) with the vector of *planthopper* carrier. The symptoms of rice attacked by the virus are that the plants cannot grow well, their leaves are yellow to orange and spotted brown.

The factors influencing the growth and development of this *tungro* diseases are among others the availability of inoculums sources (plants attacked), vectors (infectors), sensitive variety, supporting environment, wind speed and simultaneous planting.

Based on the in-depth interviews, it was shown that the attack of the pests and diseases to the rice plants because the farmers in the farming are considered to invite them, even to make them stay and grow well and this degrades the quality of the field itself. If this happens, the field will dry out and cannot be used anymore.

Moreover, planting rice made at different times among fields causes the green *planthopper* vector carrying the *beureum* disease survives and spreads viruses in the next planting season. Unwise application of pesticides and chemical fertilizers may kill natural enemies that should be able to control pests existing in the agricultural fields. One way to control the pests and diseases is by reducing the use of chemical pesticides and fertilizers, so that natural enemies are not killed and pests can be annihilated.

Besides plant rotation using other commodities, suppressing and even cutting the life cycle of pests that carry the vector of *beureum* disease is necessary. Another positive effect of the plant rotation is that the soil will not be so fatigued and is slow to recovered. A Simultaneous planting is other good choice to control the green *planthopper* and to help prevent the spread virus *tungro*. Based on these research results, it can be explained that pests and diseases are problems and obstacles the farmers faced in practicing the SRI methods, because of the SRI principle is to encourage the use of organic fertilizers, natural enemies and minimalist the use of chemical pesticides.

Production constraints

The farmers face various constraints, such as drought, lack of soil fertility, shortage of land, disease and pests, lack of improved input, market or price, lack of capital, long distance to market place, etc. For detailed information, see table 4.20.

Table 4.20 Level of production constraints in rice farming

List	SRI farmers (N=25)		Q-SRI farmers (N=85)	
	Average	Level of constraints	Average	Level of constraints
1.Drought	4.32	High	4.25	High
2. Lack of soil fertility	4.24	High	3.92	High
3. Shortage of land	4.44	High	3.58	High
4. Disease and pests	4.20	High	4.20	High
5. Lack of improved inputs	3.80	High	3.47	Moderate
6. Seasonality of market	4.32	High	4.23	High
7. lack of capital	4.75	Very high	4.52	Very high
8. Uncertainty in tenure systems	2.84	Moderate	2.85	Moderate
9. Long distance to market places	3.75	High	4.14	High
10. Poor crop storage	3.48	Moderate	3.11	Moderate
11. Weeds	4.40	High	4.14	High
12. Unknown reason (climate)	3.72	High	3.66	High

Factors of production constrains is divided in to five levels such as; very high, high, moderate, low, and very low. Table 4.20 shows that three levels of production constraint in rice farming, such as; very high, high, and moderate level. Very high level, only the lack of capital. Moderate level on the uncertainty in tenure system and poor crop storage. Most of production constraint are high level, such as; drought, lack of soil fertility, shortage of land, disease and pests, lack of improved inputs, seasonality of market, long distance to market places, weeds, and climate (unknown reason).

SRI farmer have high levels of constraint such as drought, lack of soil fertility, shortage of land, disease and pests, lack of improved inputs, seasonality of market, long distance to market places, weeds, and climate, score average 4.32, 4.24, 4.44, 4.20, 3.80, 4.32, 3.75, 4.40, and 3.72 respectively. Q-SRI farmer have high level of constraint such as drought, lack of soil fertility, shortage of land, disease and pests, seasonality of market, long distance to market places, weeds, and climate, score average 4.25, 3.92, 3.58, 4.20, 4.23, 4.14, 4.14, and 3.66 respectively.

Both of type of farmers have very high problem are lack of capital, whereas average score 4.75, and 4.52 for SRI farmer, and Q-SRI farmer respectively. Most of the SRI and the Q-SRI farmers said that capital is very important because it meets their needs such as; farm inputs (seed; farm tools, implements and equipment; pesticides, fertilizer and herbicides; and to hire labor, etc), transportation, harvesting, and others.

SRI farmers and Q-SRI farmers said that drought is an important factor that influences their rice production because drought can be caused by plant stress, an example; secondary rachis branch abortion and resulted in a reduction in spikelet's number per panicle. In addition, drought can reduce in grain weight. Furthermore, they said that seasonality of market is an very important factor that influence on their rice production.

In addition, SRI farmers and Q-SRI farmers said that pests and diseases are an important factor that influenced their rice production. Different techniques used to solve problems of pest and diseases. The SRI farmers use natural enemies (predator) and herbal pesticides (for instance using *Tithonia diversifolia* to eradicate caterpillars), whereas the Q-SRI farmers use chemical pesticides or other chemical substances. The effective methods of handling pests and diseases will give high yields.

4.6 Factor affecting farmer status (still practicing or quit SRI)

This section focuses on the factors affecting farmer status (still practicing SRI or quit SRI). Table 4.21 reveals that age, size of rice field, labor, single or double seedling, soil organic content, farmer practice and drought had a significant relationship with farmer status (still practicing or quit SRI). Meanwhile, the marital status, the level of formal education, number of household members, main occupation, secondary occupation, land holding, and the status of farmers joining in organizations had not significant relationship with farmer status. Each factor that has a significant relationship with farmer status is presented in Table 4.21 below.

Table 4.21 The relationship between socioeconomic and other factors and farmer status

Factor	χ^2-Value	P-Value
A. Socioeconomic factors		
1. Age (≤49 year, >49 year)	4.193	0.041*
2. Marital status	0.297	0.586^{NS}
3. The level of formal education (1:1-4, 2:5-7)	3.585	0.058^{NS}
4. Family member (≤4 person, >4 person)	0.406	0.524^{NS}
5. Main occupation (Rice Farmers, Others)	0.003	0.955^{NS}
6. Second occupation (Rice Farmers, Others)	0.003	0.955^{NS}
7. Total land holding (≤0.92 ha, >0.92 ha)	1.279	0.258^{NS}
8. Size of paddy field (≤0.6 ha, >0.6 ha)	4.359	0.037*
9. Status of farmer organization participate	0.606	0.436^{NS}
10. The number of cow (≤3 head, >3 head)	1.090	0.297^{NS}
B. Other factors		
11. Labor requirement (≤233 Man-Day (MD), >233 MD) per hectare	4.396	0.036*
12. Single seedlings (≤2seeds, >2seeds) per hole	104.525	0.000**
13. Soil organic fertilizer (≤ 1 times, >1 times) per season	54.448	0.000**
14. Farmer practice of SRI Project (≤moderate, >moderate)	10.524	0.001**
15. Drought (low, high)	4.352	0.037*

** significantly at α=0.01; * significantly at α=0.05; NS: non significant

1. The relationship between age and farmer status

There was a relationship between age and farmer status with α = 0.05 level of significance of 0.05 (P = 0.041) (as shown in Table 4.22). Because of the P-value of ≤ α, the alternative hypothesis is accepted, implying that there was a relationship between the two variables. A cross tabulation between the farmer status and age is shown in Table 4.22.

Table 4.22 Cross tabulation between age and farmer status

List			Age		Total
			≤49 year	>49 year	
Type of farmers	SRI	Count	17	8	25
		Expected count	12.5	12.5	25.0
		% within type of farmers	68.0%	32.0%	100.0%
	Q-SRI	Count	38	47	85
		Expected count	42.5	42.5	85.0
		% within type of farmers	44.7%	55.3%	100.0%
Total		Count	55	55	110
		Expected count	55.0	55.0	110.0
		% within type of farmers	50.0%	50.0%	100.0%

Table 4.22 shows that 68% of farmers with the age of ≤ 49 years are those were still practicing the SRI. Furthermore, 55.3% farmers with the age of >49 years have quit practicing the SRI. It shows that younger farmers preferred to practice the SRI, whereas the older farmers quit practicing the SRI.

Based on the empirical result, it was shown that age is one of the factors that made farmers quit using the SRI. Moreover, age also caused some implications for the practice of the SRI. First, in SRI Project (SRI farmers) is more labor intensive than Q-SRI farmers, also needs more energy, especially physical and financial resources, from land preparation, planting, weeding and others. It means that the older the farmer, the lower their physical strength. As a result, relatively older farmers tend to quit practicing the SRI.

Secondly, the SRI model is more complicated than a conventional model. Older farmers tend to object to practicing the SRI, and to quit its application. Thirdly, older farmers tend to return to their old culture (conventional model), it is difficult to change their old habits to the SRI project. So that, they tend to quit practicing the SRI project.

2. The relationship between size of paddy field and farmer status

There was a relationship between the size of paddy field and the farmer status with the significance level of 0.05 (P = 0.037). This showed that there is a significant relationship between the two variables. A cross tabulation between the size of paddy field and the farmer status is presented on Table 4.23.

Table 4.23 Cross tabulation between size of paddy field and farmer status

List			Size of Paddy Field		Total
			≤0.6 Ha	>0.6 Ha	
Type of farmers	SRI	Count	12	13	25
		Expected count	16.4	8.6	25.0
		% within type of farmers	48.0%	52.0%	100.0%
	Q-SRI	Count	60	25	85
		Expected count	55.6	29.4	85.0
		% within type of farmers	70.6%	29.4%	100.0%
Total		Count	72	38	110
		Expected count	72.0	38.0	110.0
		% within type of farmers	65.5%	34.5%	100.0%

Table 4.23 shows that there were 52% of SRI farmers who have paddy field wider than 0.6 hectare and are still practicing SRI. Besides, 70.6% farmers with paddy fields less than and equal with 0.6 hectare were those who quit practicing the SRI. It suggests that the farmers whose paddy field is relatively wide tend to continue practicing the SRI. However, those with relative small sized paddy fields tended to quit practicing the SRI.

The fact that farmers who have paddy fields less than and equal to with 0.6 hectares tended to quit practicing the SRI because they thought such narrow fields would only yield a small income. So, they try to increase incomes by working in another sectors, such as in agricultural sector, coolies, retailer and others.

Whereas, farmers with wide paddy fields more than 0.6 hectare, they get optimum benefits from their fields. They would manage their fields well in order to get the best results. One of their efforts to improve the results is to practice the SRI optimally. So, implementation of SRI will improve their production. While farmers with relatively small paddy fields tended to quit practicing the SRI.

3. The relationship between the need for labors and farmer status

Statistically, we found that there was relationship between the need for labor and farmer status at significance level of 0.05 (P = 0.036). This result shows that relationship between these two variables was strong. Cross tabulation of the result is presented in Table 4.24

Table 4.24 Cross tabulation between the need for labor and farmer status

List			Labor requirement		Total
			≤ 233 MD	>233 MD	
Type of farmers	SRI	Count	10	15	25
		Expected count	14.5	10.5	25.0
		% within type of farmers	40.0%	60.0%	100.0%
	Q-SRI	Count	54	31	85
		Expected count	49.5	35.5	85.0
		% within type of farmers	63.5%	36.5%	100.0%
Total		Count	64	46	110
		Expected count	64.0	46.0	110.0
		% within Type of farmers	58.2%	41.8%	100.0%

Table 4.24 shows that 60% of the SRI farmers need more than 233 MD per hectare in practicing rice farming with SRI. Meanwhile, 63.5% of farmers with need for man day less than and equal to 233 MD were those who quit practicing the SRI. It suggests that the farmers whose need for labor is relatively high tend to continue practicing the SRI. However, those with relative lower needs labor tended to quit practicing the SRI.

Based on the results it can be concluded that practicing the SRI method needed more man day because farmers have to spend more money for wages. This means that the total production cost of rice will increase. It is one of the reasons why farmers quit practicing the SRI.

4. The relationship between single seedlings and farmer status

Statistically, we found that there was a relationship between single seedlings (planting more than one seeds) and the farmer status at significance level of 0.01 (P = 0.000). This result shows that the relationship between these two variables was very strong. Cross tabulation of the result is presented in Table 4.25

Table 4.25 Cross tabulation between single seedlings farmer status

List			Single seedlings		Total
			≤2 seeds	>2 seeds	
Type of farmers	SRI	Count	25	0	25
		Expected count	5.9	19.1	25.0
		% within type of farmers	100.0%	.0%	100.0%
	Q-SRI	Count	1	84	85
		Expected count	20.1	64.9	85.0
		% within type of farmers	1.2%	98.8%	100.0%
Total		Count	26	84	110
		Expected count	26.0	84.0	110.0
		% within type of farmers	23.6%	76.4%	100.0%

Table 4.25 shows that all of the SRI farmers planted no more than 2 seeds in per hole. 98.8% of farmers planted more than 2 seeds that quit practicing the SRI. It implies that farmers planting single or double seeds were those practicing the SRI, however those who planted more than 2 seeds per hole tended to quit practicing the SRI. Transplanting one seed per hole caused farmers to quit practicing the SRI because it was difficult to do, and needs higher costs and was contrary to their habits.

5. The relationship between organic fertilizer materials and farmer status

Statistically, we found that there was a relationship between organic fertilizer materials and farmer status at a significance level of 0.01 (P = 0.000). This result shows that the relationship between these two variables was strong. Cross tabulation of the result is presented in Table 4.26

Tabel 4.26 Cross tabulation between organic fertilizer materials and farmer status

List			Soil organic matter		Total
			≤1 time	>2 times	
Type of farmers	SRI	Count	0	25	25
		Expected count	15.7	9.3	25.0
		% within type of farmers	.0%	100.0%	100.0%
	Q-SRI	Count	69	16	85
		Expected count	53.3	31.7	85.0
		% within type of farmers	81.2%	18.8%	100.0%
Total		Count	69	41	110
		Expected count	69.0	41.0	110.0
		% within type of farmers	62.7%	37.3%	100.0%

Table 4.26 shows that 100% of SRI farmers use organic fertilizers more than twice per season. While, 81.2% of Q-SRI farmers practiced organic fertilizer less than, and equal to one time during cultivation period. The results imply that the SRI farmers practiced much more organic fertilizer during cultivation. In addition, Q-SRI farmers tended not to use organic fertilizer, rather to use chemical fertilizers in high amounts.

The use of organic fertilizers was one of reasons why the farmers quit practicing the SRI. They thought that organic fertilizers on plants will not give a direct effect on plants, while practicing chemical fertilizers may give bigger effects on their cultivation.

6. The relationship between farmer practice and farmer status

Statistically, we found that there was relationship between farmer practices and farmer status at a significance level of 0.01 (P = 0.001). This result shows that the relationship between these two variables was strong. Cross tabulation of the result is presented in Table 4.27

Table 4.27 Cross tabulation between farmer practice and farmer status

List			farmer practice ≤ 3 (moderate)	farmer practice >3 (moderate)	Total
Type of farmers	SRI	Count	0	25	25
		Expected count	6.1	18.9	25.0
		% within type of farmers	.0%	100.0%	100.0%
	Q-SRI	Count	58	27	85
		Expected count	64.1	20.9	85.0
		% within type of farmers	68.2%	31.8%	100.0%
Total		Count	83	27	110
		Expected count	83.0	27.0	110.0
		% within type of farmers	75.5%	24.5%	100.0%

Table 4.27 shows that all of the SRI farmers have relatively high levels of practice in SRI principle were those who were still practicing the SRI. However, 68.2% of the Q-SRI farmers with a relatively low level of practice were those who quit practicing the SRI. It implies that the farmers possessing a relatively higher level of practice SRI principles tend to practice the SRI.

Therefore, the practice in SRI principle is one of factors that influenced farmers to continue or quit practicing the SRI. For example, some farmers have understood the SRI principle well or well enough, from land preparation until harvesting, but some of them are still confused about meeting or had difficulties in practicing it. So that, they preferred using old methods and quit practicing the SRI project.

7. The relationship between other reasons (drought) and farmer status

Statistically, we found that there was a relationship between other reasons (drought), and farmer status at a significance level of 0.01 (P = 0.001). This result shows that the relationship between these two variables was strong. Cross tabulation of the result is presented in Table 4.28

Table 4.28 Cross tabulation between other reasons (drought) and farmer status

List			Drought		Total
			Low	High	
Type of farmers	SRI	Count	11	14	25
		Expected count	15.5	9.5	25.0
		% within type of farmers	44.0%	56.0%	100.0%
	Q-SRI	Count	57	28	85
		Expected count	52.5	32.5	85.0
		% within type of farmers	67.1%	32.9%	100.0%
Total		Count	68	42	110
		Expected count	68.0	42.0	110.0
		% within type of farmers	61.8%	38.2%	100.0%

Table 4.28 shows that 56% of the SRI farmers possessing other reasons (drought) that may have highly influenced the practicing of the SRI were those who practiced the SRI. This result implies that if there was drought it might influence the farmers who quitted practicing the SRI project.

Based on the empirical result, it was shown that drought is one of the factors that made farmers quit using the SRI. Most of the Q-SRI farmers believed that rice is an aquatic plant and grows best in standing water. Contrary, to this most of the SRI farmers believe that rice is not an aquatic plant; it can survive in water but does not thrive under reduced oxygen levels. Furthermore, under SRI paddy fields are not flooded but kept moist during vegetative phase. As a result, drought caused some Q-SRI farmers to quit practicing the SRI.

Chapter 5
Conclusions and Recommendations

This chapter begins with the study conclusions where the research objectives and fact findings are summarized. Based on the fact findings, recommendations are then best part.

5.1 Conclusions

The main objectives of this research were to: 1) Study the role and function of the SRI project; 2) Study socioeconomic characteristics and agricultural production systems of the farmers; 3) Study rice cultivation activities of farmers joining the SRI project; 4) Analyze net profit and level of practice in the SRI project, correlation between the levels of practice and net profits; 5) Analyze problems and obstacles of SRI project in the practice, and 6) Investigate and measure the main factors affecting the farmers status (still practicing SRI or quit SRI). Data were collected all farmers who participated in SRI Project in 2007, in total 110 farmers during April to June 2011. This study used both descriptive and quantitative analysis. In descriptive statistic used to describe (1) the socioeconomic characteristic of farmers, and production system used by farmers, (2) rice cultivation activities of farmers joining the SRI project, (3) net profit and the level of practices in the SRI project. In quantitative analysis, t-statistic were used to describe the relationship between the level of practice in SRI and net profit from rice farming. The relationship between farmers' socioeconomic characteristics and other factors of SRI Project that are independent variables, and farmer status (SRI farmers and Q-SRI farmers) that are dependent variable calculated by Chi-Square statistic (χ^2).

The results revealed as follows.

1. There are three roles and functions of the SRI project. First, increasing rice yield, means that practice of SRI on rice farming is able to enhance productivity compared with the conventional method. Second, input saving, minimizing input used, such as water, seeds and others. Third, environment sustainability, practicing this method will help to recover soil fertility, and maintain the sustainability of field production.
2. Concerning the socio-economic characteristics of farmers, either SRI or Q-SRI farmers, the different percentages are shown on an education level, where most of the SRI farmers (44.00%) finished secondary schools, while most of the Q-SRI farmers (48.23%) finished elementary schools. Other characteristics showed almost the same percentage. Based on the result about agricultural production system shows that most farmers owned their own land (49.04% and 69.00% for the SRI and Q-SRI farmers, respectively). Furthermore, 65.39% of the SRI farmers and 57.30% of the Q-SRI farmers used their land for rice farming. It shows that the most of the farmers have the same tendency to use their land to plant rice.
3. Rice cultivation activities of SRI and Q-SRI farmers such as; land preparation, seedling and transplanting, application of chemical fertilizer, application of organic fertilizer, water management (irrigation), weeding, chemical and herbal pesticides application, and harvesting. The SRI farmers cultivate rice based on the SRI principles, while the Q-SRI farmers cultivate rice based on the conventional method.
4. Net profit of rice farming obtained by SRI farmers is IDR 16,045,593 per hectare per season. While that Q-SRI farmers is IDR 9,321,610 per hectare per season. So that net profit of SRI farmers higher than Q-SRI farmers around 41.91% per hectare. Based on data analysis found two categories the level of practice (SRI farmers) such as; moderate (2.50-3.49) and high (3.50-4.49) level of practice. The high level of practice such as; seeds selection with salt water, making the seedbed before cultivating, transplanting seedlings at a young age - 7 to 12 days old, transplanting one-two seeds per hole,

transplanting wide spacing, and practicing the intermittent irrigation. Furthermore, the correlation between the level of practice in SRI and the net profit from rice farming in the SRI project, using the Spearmen Correlation Coefficient (r) is 0.730. It means that the higher the level of practice the SRI project, the higher the net profit from the rice farming.

5. Problems and obstacles of farmers in using the SRI project, such as; most of Q-SRI farmers (98.82%) and 48.00% of SRI farmers had difficulty in transplanting young seedlings. SRI farmers (52%) and Q-SRI farmers (96.47%) had difficulty in finding employment or farm labor. Moreover, 40.00% of the SRI farmers and most of the Q-SRI farmers (90.59%) had difficulty in transplanting the seedlings with a wide spacing, and one or two seeds per hole. Most of the Q-SRI farmers (94.12%) preferred using chemical fertilizer, on the contrary, 44% of the SRI farmers are still using chemical fertilizers. Lastly, 48.00% of SRI farmers and most of the Q-SRI farmers (91.76%) had difficulty in controlling pests and diseases.

   SRI farmer have high levels of constraint such as drought, lack of soil fertility, shortage of land, disease and pests, lack of improved inputs, seasonality of market, long distance to market places, weeds, and climate, score average 4.32, 4.24, 4.44, 4.20, 3.80, 4.32, 3.75, 4.40, and 3.72 respectively. Q-SRI farmer have high level of constraint such as drought, lack of soil fertility, shortage of land, disease and pests, seasonality of market, long distance to market places, weeds, and climate, score average 4.25, 3.92, 3.58, 4.20, 4.23, 4.14, 4.14, and 3.66 respectively. Both of type of farmers have very high problem are lack of capital, whereas average score 4.75, and 4.52 for SRI farmer and Q-SRI farmer respectively.

6. Based on the quantitative analysis using Chi-Square statistic (χ^2) it is shown that age, size of rice field, labor, single or double seedling, soil organic content, farmer practice and drought had a significant relationship with farmer status (still practicing or quit SRI). Meanwhile, the marital status, the level of formal education, number of household members, main occupation, secondary occupation, land holding, and the status of farmers joining in organizations have not significant relationship with farmer status.

5.2 Recommendations

Based on the results presented in this thesis, a contribution to evaluation of improved intensive SRI project in Malang Regency was made.

5.2.1 Recommendations to SRI farmers

1. SRI farmers to continue practicing SRI, and efforts to disseminate their experiences to other farmers, to influence farmers who not yet practicing SRI to practice SRI.
2. SRI farmers have problem lack adequate capital resources to invest on improved rice farming, such as purchasing organic fertilizer, herbal pesticides, and others. Moreover, SRI farmers recommended using bank or the existing credit services to expand their farms.
3. SRI farmers should increase revenue or income, such as; reduce cost of chemical fertilizers or herbicides. Furthermore, SRI farmers or farmer group creates of organic fertilizer or herbal pesticides. In addition, SRI farmers get multiple benefits such as increase income, local creativity will increase, and environmental sustainability.

5.2.2 Recommendations to Q-SRI farmers

1. Q-SRI farmers should re-practice of SRI project remembering SRI project able to increase of net profit or income, and environmental sustainability.
2. Q-SRI farmers have problem lack adequate capital resources to invest on improved rice farming, such as purchasing organic fertilizer, herbal pesticides, and others. Moreover, SRI farmers recommended using bank or the existing credit services to expand their farms.
3. Q-SRI farmers should not bored and complained to practice SRI, and always tried to practice it, they can sharing and learning to SRI farmers, though many problems and obstacles such as difficulty in transplanting young seedlings, finding employment or farm labor, transplanting the seedlings with a wide spacing, and one or two seeds per hole, controlling pests and diseases, and others.

5.2.3 Recommendations to the government

1. The policy implication of findings in this study is that government should give support, such as intensive training about principle of SRI (transplanting young seedlings, transplanting the seedlings with a wide spacing, and one or two seeds per hole), simplify access to credit, prevention and treatment of pests and diseases.
2. Government should give support to extension officers do training, counseling for all farmers, specific to farmers, such as; older farmers, farmers who own or have small land areas, farmers who continue low-level practices of SRI and others.
3. Government should develop a policy or promotion of SRI. Incentives for growing SRI project in the form of subsidy for equipment, manure, organic pesticides etc. may help in the promotion of SRI. This policy to improve in SRI project for expanding in area SRI project, and increasing the number of farmers to practice the SRI project.

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APPENDIX

Appendix 1. Questionnaire

QN No.:..……………………
Village:.……………………..
Sub district/ Regency: Pagelaran / Malang
Province/Country: East Java/ Indonesia
Date of Interview:………………………
Name of Interviewer:………………………

Questionnaire for Farmers
"Economic Performance of SRI Project in Malang Regency Indonesia"

Farmers Address & Phone :….………………………………………………

I. 1) The socioeconomic characteristic of the farmers who join in SRI Project.

1. Name of farmer :……………………………………………… **SOC 01**
2. Status in family : 1. Husband
   2. Wife
   3. Child
   4. Other
3. Gender : 1. Female **SOC 02**
   2. Male
4. Age : ……………… Years Old **SOC 03**
5. Religion : 1. Islam **SOC 04**
   2. Hindu
   3. Buddha
   4. Catholic
   5. Christian
   6. Others:………………………..
6. Marital Status : 1. Single **SOC 05**
   2. Married
   3. Separated
7. The level of formal education of farmers : **SOC 06**
   a. Illiterate
   b. No formal education
   c. Primary school
   d. Secondary school
   e. Senior high school
   f. Diploma
   g. Bachelor degree

8. Family members (including the respondent)

Classify by (year)	Total (People)	Number of passive members in rice farming activity	Number of active members in rice farming activity
1. < 8	…….. **SOC 07**	**SOC 12**	**SOC 16**
2. 8 – 14	…….. **SOC 08**	**SOC 13**	**SOC 17**
3. 15 – 65	…….. **SOC 09**	**SOC 14**	**SOC 18**
4. > 65	………**SOC 10**	**SOC 15**	**SOC 19**
5. Total	…….. **SOC 11**		

9. Status of main occupation **SOC 20**
   1) Rice farmer
   2) Government services
   3) Employee
   4) Employer
   5) Others:………………………………

10. Do you have second occupation? **SOC 21**
    1) Yes
    2) No

11. If you have second occupation, please mention. **SOC 22**
    1) Rice farmer
    2) Other profession

12. Land holding
    1) Total land holding :……………………………. Ha **SOC 23**
    2) Owner :……………………………. Ha **SOC 24**
    3) Rent :……………………………. Ha **SOC 25**
    4) Other :……………………………. Ha **SOC 26**

13. Land using

Types of crops	Land used per crop (in ha)
a. Rice (Paddy)	……………………….. **SOC 27**
b. Maize (corn)	……………………….. **SOC 28**
c. Vegetables	……………………….. **SOC 29**
d. Cassava, Yam	……………………….. **SOC 30**
e. Soybean	……………………….. **SOC 31**
f. Sugar cane	……………………….. **SOC 32**
g. Others (specify)	……………………….. **SOC 33**

14. The number of livestock
    a. Cow : ... ...head **SOC 34**
    b. Buffalo : ... ... head **SOC 35**
    c. Goat : ... ... head **SOC 36**
    d. Lamb : ... ... head **SOC 37**
    e. Chicken (hens/roster): ... ... head **SOC 38**
15. Status of farmer organization being participated **SOC 39**
    1) Yes
    2) No
16. If yes, what organization is it? :
    1) Farmer Group **SOC 40**
    2) Association of farmer group **SOC 41**
    3) Others:……………………………. **SOC 42**
17. Position in the organization:
    1) Head/director **SOC 43**
    2) Member **SOC 44**
    3) Others:……………………………. **SOC 45**

I. 2) The agricultural production systems of the farmers joining SRI Project.

1. Do you practice mixed crop farming activity? **APS 01**
   a. Yes
   b. No
2. If your answer to question 1 is "yes", what is the advantage of being a mixed farmer, according to your view?

Advantage	5	4	3	2	1	*0	Code
a. To minimize risk of crop failures							**APS 02**
b. To use cattle manure as fertilizers							**APS 03**
c. To diversify household income source							**APS 04**
d. For cultural reasons							**APS 05**
e. The easiness of the area for combined farming							**APS 06**
f. to use animal as plow power							**APS 07**
g. To use animal as to carry out farming product							**APS 08**
h. Others (specify)							**APS 09**

* 0 = No idea; 1 = Disagree definitely; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Agree completely

3. How do you explain productivity of rice farming recently? **APS 10**
   a. Increasing
   b. Decreasing
   c. No change
4. On the basis of your evaluation, what happens to your soil fertility in your farm land? **APS 11**
   a. Increasing
   b. Decreasing
   c. No change
5. If your answer to question 4 is "Decreasing", what is the main reason/s? (1 for least important factors, and 5 for highly important factors)

Factors	**Measure**						**Code**
	5	**4**	**3**	**2**	**1**	**0**	
a. Soil erosion							**APS 12**
b. Continuous cropping							**APS 13**
c. No use of fertilizers							**APS 14**
d. Poor management							**APS 15**
e. disorganized plowing							**APS 16**
f. Poor varieties deplete soil fertility							**APS 17**
g. Commercial fertilizers weaken soil's natural fertility							**APS 18**
h. Crop residues completely removed for other purposes							**APS 19**
i. Continuous mono cropping							**APS 20**
j. Cultivation of marginal lands							**APS 21**
k. Unidentified reason							**APS 22**
l. others:…………………….							**APS 23**

6. According to your view, which of the following production constraints play significant role in limiting the returns you would obtain from rice farming?

Factors	**Measure**						**Code**
	5	**4**	**3**	**2**	**1**	**0**	
a. Drought							**APS 24**
b. Lack of soil fertility							**APS 25**
c. Shortage of land							**APS 26**
d. Disease and pests							**APS 27**
e. Lack of improved inputs							**APS 28**
f. Seasonality of market							**APS 29**
g. Lack of capital							**APS 30**
h. Uncertainty in tenure systems							**APS 31**
i. farming land in remote area (far from							**APS 32**

market place)							
j. Poor crop storage							**APS 33**
k. Weeds							**APS 34**
l. Unknown reason							**APS 35**
m. others							**APS 36**

Note: 0 : Unimportant 1 : Quite unimportant
2 : Less important 3 : Neutral
4 : Important 5 : Very important

II. The rice farming activities of farmers participating in SRI Project.

2.1 Land preparation

1. Do you prepare land before transplanting? **RF 01**
   1) Yes
   2) No
2. When do you do puddling? **RF 02**
   1) on the day of transplanting,
   2) before transplanting
   3) Others…
3. Do you know level of your soil fertility? **RF 03**
   1) Yes
   2) No
4. Do you mix between organic fertilizer and chemical fertilizer? **RF 04**
   1) Yes
   2) No
5. If yes then what and how much…(per ha) ?
   Organic Matter =....................ton/ha **RF 05**
   Nitrogen =....................kg/ha **RF 06**
   Phosphor =....................kg/ha **RF 07**
   Kalium =....................kg/ha **RF 08**
   Others…….. =....................kg/ha **RF 09**
6. Do you prepare land for SRI Project? **RF 10**
   1) Yes
   2) No
7. In that case, do you follow similar practice like conventional rice land preparation? **RF 11**
   1) Yes
   2) No
8. Do you do deep ploughing? **RF 12**
   1) Yes
   2) No
9. Who does land preparation?

a. yourself **RF 13**
b. your family **RF 14**
c. hired labor **RF 15**

10. What approach do you use to do land preparation?
    1. tractors **RF 16**
    2. cows **RF 17**
    3. hoe **RF 18**
    4. others……… **RF 19**

2.2 Seedling and Transplanting

1. Seed-bed: How much seed is for one hole?
   1) 1 seed **ST 01**
   2) 2 seed **ST 02**
   3) more 1 seed **ST 03**
2. Age of seedling at transplanting? (day?)
   1. 7-12 day **ST 04**
   2. 25-30 day **ST 05**
   3. 31-40 day **ST 06**
   4. 45 day and more **ST 07**
3. How do you pull seedling?
   1. Putting water before pulling **ST 08**
   2. doing as conventional practice **ST 09**
   3. not specific **ST 10**
4. Do you cut root and shoot before transplanting? **ST 11**
   1. Yes
   2. No
5. Depth of transplanting
   1. 0 – 5 cm. **ST 12**
   2. 6-10 cm. **ST 13**
   3. >10cm. **ST 14**
7. Do you use certified seed? **ST 15**
   1) Yes
   2) No
8. What type/variety of seed you use (2010)?
   1) Hybrid **ST 16**
   2) IR 64 **ST 17**
   3) Intani **ST 18**
   4) Others (specify)…………………… **ST 19**
9. How the price of seed/kg (2010)? **ST 20**

10. What do you think about the quality of seed that you have been purchased?

1. Bad **ST 21**
2. Moderate **ST 22**
3. Good **ST 23**
4. Others… **ST 24**

2.3 Fertilizer

1. Do you start to apply chemical fertilizer **FZ 01**
   1) Yes
   2) No
2. How many time you use chemical fertilizer? **FZ 02**
3. Do you use organic fertilizer **FZ 03**
4. How many time you use fertilizer organic? **FZ 04**
5. Do you have problem in using fertilizer? **FZ 05**
   1) Yes
   2) No
6. Which kind of fertilizer do you use?
   1) Chemical fertilizer **FZ 06**
   2) Organic fertilizer **FZ 07**
7. Do you purchase fertilizer (chemical and organic)? **FZ 08**
   1) Yes
   2) No
8. Do you apply compost
   1) During land preparation (1.Yes, 2.No) **FZ 09**
   2) During transplanting (1.Yes, 2.No) **FZ 10**
   3) After transplanting (1.Yes, 2.No) **FZ 11**

16. What type of fertilizers do you use and at what rate?

Type of fertilizers	**Rates (Kg/ha)**	**Code**
a. Nitrogen (*Urea*)		**FZ 12**
b. NPK		**FZ 13**
c. KCl		**FZ 14**
d. Other …………		**FZ 15**
e……….		**FZ 16**

17. How much is the price of chemical fertilizer?

Type of chemical fertilizers	**Price (Rp/100kg)**	**Code**
a. Nitrogen (*Urea*)		**FZ 17**
b. NPK		**FZ 18**

c. KCl		**FZ 19**
d. Other :…………		**FZ 20**

18. What is the basis for determining the rate of chemical fertilizers being used?

Describes	**Yes**	**No**	**Code**
a. Recommendation from extension workers			**FZ 21**
b. Market price for fertilizers			**FZ 22**
c. Soil fertility extent			**FZ 23**
d. Based on own personal experience			**FZ 24**
e. Other (please specify)			**FZ 25**

19. Do you use organic fertilizers? **FZ 26**
    1) Yes
    2) No
20. If your answer to question 20 is "yes", what type of organic fertilizers do you use and at what rate?

Type of organic fertilizers	**Rates (Kg/ha)**	**Code**
a. Farm yard manure		**FZ 27**
b. Green manure		**FZ 28**
c. Compost		**FZ 29**
d. Bio organic		**FZ 26**
e. Others:……….		**FZ 37**

21. How much is the price of organic fertilizer?

Type of fertilizers	**Price (Rp/100kg)**	**Note**	**Code**
a. Farm yard manure			**FZ 38**
b. Green manure			**FZ 39**
c. Compost			**FZ 40**
d. Bio organic			**FZ 41**
e. Others:……….			

22. What is the basis for determining the rate of organic fertilizers being used?

Describes	**Yes**	**No**	**Code**
a. Recommendation from extension workers			**FZ 42**
b. Market price for organic fertilizers			**FZ 43**
c. Soil fertility extent			**FZ 44**
d. Based on own personal experience			**FZ 45**

f. Other (please specify)			**FZ 46**

23. Do you use organic fertility management practices (farm yard manure, crop rotation, green manure, compost, etc)? **FZ 45**
    1) Yes
    2) No
24. If your answer to question 24 above is yes, what types of organic fertility management do you usually practice?

Describes	Yes	No	Code
a. Farm yard manure			**FZ 45**
b. Green manure			**FZ 46**
c. Crop rotation			**FZ 47**
d. Use of compost			**FZ 48**
g. Crop residue management			**FZ 49**
h. Intercropping			**FZ 50**
i. Other:……………………			**FZ 51**

2.4 Irrigation

2.4.1 Irrigation Schedule (specific) Non SRI

Determinants	**Rank**	
Crop Growth stage	**Shallow irrigation (2-3 cm depth)**	**Completely flooded (> 5cm depth)**
Seedling establishment stage (at transplanting)	**IR 01**	**IR 07**
Tillering stage	**IR 02**	**IR 08**
Booting stage	**IR 03**	**IR 09**
Flowering stage	**IR 04**	**IR 10**
Grain filling stage	**IR 05**	**IR 11**
Ripening stage	**IR 06**	**IR 12**

2.4.2 Irrigation SRI

1. Do you implement the irrigation system of SRI? **IR 13**
   1) Yes
   2) No

2. Do you apply intermitted irrigation (scheduled irrigation) **IR 14**
   1) Yes
   2) No

3. Do you drain the rice land after flooding **IR 15**
   1) Yes

2) No

4. Do you do irrigation when cracks develop in soil? **IR 16**
   1) Yes
   2) No

5. Do you follow intermitted irrigation for whole crop period? **IR 17**
   1) Yes
   2) No

6. Any problem in practicing intermitted irrigation? **IR 18**
   1) Yes
   2) No

7. Any problem in practicing conventional irrigation? **IR 19**
   1) Yes
   2) No

2.5 Weeding

1. Do you prepare of pre-planting activities as part of weed managements? **WD 01**
   1) Yes
   2) No

2. How do you do it? (Method)

   ____

   ____

3. Why do you use only this method; any advantage?

   ____

   ____

4. Do you have different type of weed management (alternative option)?

   ____

   ____

5. When do you start to weed?

   ____

   ____

6. How many times do you weed in one planting season?

   ____

   ____

7. Do you use Herbicides? **WD 02**

1) Yes
2) No

8. If yes then when (crop growth stage)?

____

____

9. In SRI method do you have more weed problem? **WD 03**
    1) Yes
    2) No

10. If yes then how do you manage? (herbicides/ manual)

____

____

11. How many times weeding is required in SRI plot?

____

____

2.6 Pesticide use in pest management (Integrated Pest Management/ IPM)

Name of Pesticide	Source				Cost	Dosage
	Gover. (1)	Private (2)	Farmer group (3)	Others (4)		
1. Curakron	Pe 01	Pe 02	Pe 03	Pe 04	Pe 05	Pe 06
2. Gandasil B	Pe 07	Pe 08	Pe 09	Pe 10	Pe 11	Pe 12
3. MOL	Pe 13	Pe 14	Pe 15	Pe 16	Pe 17	Pe 18
4. Others	Pe 19	Pe 20	Pe 21	Pe 22	Pe 23	Pe 24

Family labor and hired labor

Describe	Family labor			Hired Labor		
	No. of worker	**Hours/day**	**Wages/day**	**No. of worker**	**Hours/day**	**Wages/day**
1. Land preparation						
2. Transplanting/seedling						
3. Weeding						
4. Fertilizing						
5. Application of pesticide						
6. Irrigation						
7. Harvesting						
8. Transportation						
9. TOTAL						

III. The net profit from rice farming and the practice of farmers participating in SRI Project

3.1 Net profit rice farming

Item	Unit	Quantity	Unit Price (Rupiah)	Total Value (Rupiah)	Code
A. Total Revenue=Price x Product					
1. Product (rice or paddy)	Kg				**NP01**
2. By-Product (rice straw)	Kg				**NP02**
B.1 Fix cost (cash)					
1. Family labor	Person				NP03
2. Insurance					NP04
3. Others…...					NP05
C.1 Variable cost (cash)					
1. Fertilizer (NPK)	Kg				NP06
2. Fertilizer (Organic)	Kg				NP07
3. Pesticides	Rupiah				NP08
4. Compost	Kg				NP09
5. Hired labor (land preparation, planting, harvesting)	Man-day				NP10
7. Others					NP11
C.2 Variable cost (non cash)					
1. Manure					NP12
2. Seed	Kg				NP13
3. Irrigation fee	Rupiah				NP14
5. Others					NP15

Total Cost= Fix Cost (cash & non cash)+ Var. Cost (cash & non cash)					**NP16**
Net Profit= Total Revenue – Total Cost					**NP17**
Net Profit= A – (B + C)					

List of farm machine/instrument/ housing

No	**List**	**Purchasing/ constructing value (Rp)**	**Expected life (year)**	**Contributing to rice farming (%)**	**Code**
1	Housing				FM 01
2	Big tractor				FM 02
3	Small tractor				FM 03
4	Water pump				FM 04
5	Others…				FM 05

3.2 The practice of farmers participating in SRI Project

Farmer practice in SRI Model	Score					code	Note
	1	2	3	4	5		
a. Do you select the seeds with salt water?						PC-1	
b. Do you manage to use organic fertilizer before transplanting your seed on your land?						PC-2	
c. How do you make the seedbed before transplanting?						PC-3	
d. Do you transplant the seeds at a young age (7-12 days)?						PC-4	
e. Do you transplant one seed in each hole?						PC-5	
f. Do you transplant with spacing 30cm x 30cm with regular distance?						PC-6	
g. Do you often do weeding in your land? How many times is it? What equipment is used; with a rotary weeder, or weeding tools, or manual weeding?						PC-7	
h. How much organic fertilizers and chemical fertilizers are being used (the volume is in ton (1000kg)?						PC-8	
i. Do you apply the intermittent irrigation with wet-dry cycle, and little standing water (± 2 cm) in wet period?						PC-9	
j. Do you implement Integrated Pest Management (IPM) by utilizing the available natural resources (organic matter or natural)?						PC-10	
k. How do you manage the harvest? Including technology, and drying system?						PC-11	

Note: 1. Very Low; 2. Low; 3. Moderate; 4. High; 5. Very High

IV. The problems and obstacle of SRI project in the practice.

2. What are the obstacles and problems in practicing SRI project?
3. Can you explain each of these problems or obstacles?
4. Are there any problems related to institution aspect, personal, rice production, labor, extension officer, land, season, etc in practicing SRI?
5. Can you describe each of these problems?
6. What do you hope about farmers m
7. ore prosperous and well established in the farm?
7. Do you have problem in seedling aspect? **PO 01**

    a) Yes

    b) No

8. Do you have problem in labor skills in transplanting seeds? **PO 02**.

    a) Yes

    b) No

9. Do you have problem in practicing wide spacing practices when transplanting?

    a) Yes **PO 03**

    b) No

10. Do you have problem about flooded land. **PO 04**

    a) Yes

    b) No

11. Do you have problem about using organic fertilizer? **PO05**

    a) Yes

    b) No

12. Do you have problem in pest and disease management aspect?

    PO06

    a) Yes

    b) .No

Appendix 2. Guidelines Interviews with Key Informants

I. Type Core/ outstanding farmers

1. How does SRI function in the practice?
2. What are the obstacles and problems of SRI project in the practice?
3. In what conditions encouraging some farmers still participate in SRI project?
4. What factors discouraging some farmers quit SRI project?
5. Complains and admiring from farmer about SRI project?

II. Type Head of farmer group

1. What is the relation between farmer group and SRI project in the practice?
2. Overall knowledge of farmers about SRI project?
3. Do the farmers strictly follow the knowledge of SRI project, when practicing?
4. If not, why not?
5. Complains and admiring from farmer about SRI project?

III. Type Head of village

1. How the relation between Local Government at village level and SRI project?
2. Do you know the overall farmer lively hood?
3. If you know, can you explain?
4. Is SRI project has significant contribution in this village for economic growth in your village?
5. if yes, please explain?

IV. Type Extension Officers

1. What are the role and function of the SRI project?
2. What are the continuity of the SRI model in the practice?
3. How extension officers improve the farmer knowledge and practice in SRI project?
4. What form of government support (budget, extension, training, etc)?
5. What the problems and obstacle of SRI project?

Appendix 3. Analyze correlation between level of practice and net profit from rice farming in SRI Project

No.	Practice (X)	Net profit (Y) (IDR/Ha)	RX	RY	d_i	d_i^2
1	39	16,641,833	11	15	-4	16
2	42	17,705,100	5	14	-9	81
3	35	15,888,143	16	16	0	0
4	42	20,280,200	5	8	-3	9
5	33	11,833,200	18	19	-1	1
6	46	39,608,000	3	1	2	4
7	47	19,596,800	1	9	-8	64
8	41	18,545,333	7	11	-4	16
9	40	14,756,000	10	17	-7	49
10	47	25,059,000	1	3	-2	4
11	41	17,836,000	7	13	-6	36
12	27	6,126,923	24	24	0	0
13	36	12,506,000	14	18	-4	16
14	28	7,077,400	23	23	0	0
15	29	10,866,300	22	21	1	1
16	45	26,460,000	4	2	2	4
17	32	9,393,067	19	22	-3	9
18	27	5,987,692	24	25	-1	1
19	30	11,119,600	20	20	0	0
20	34	21,865,000	17	6	11	121
21	38	23,835,000	12	4	8	64
22	36	20,618,667	14	7	7	49
23	41	18,447,500	7	12	-5	25
24	38	23,106,333	12	5	7	49
25	30	19,222,500	20	10	10	100
						719

$$r_s = \rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

$$\sum d_i^2 = 719$$

n=25

$$r_s = \rho = 1 - 0.276$$

$$r_s = \rho = 0.724$$

r value in table (n=25) = 0.47

$$T = r_s\sqrt{\frac{N-2}{1-r_s^2}} = 5.032 \text{ and } t_{table\ 0.05\ (df=n-2)} = 1.714$$

VITAE

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List of publication

Handono, Setiyo Yuli., Charernjiratragul, Somboon., and Mustadjab, Moch. Muslich. 2013, The Economic Performance of SRI Project in Malang District, Indonesia. Journal of Agrise, Volume XIV, No.1.