III. INTRODUCTION OF ORGANIC RICE FARMING WITH SYSTEM OF RICE INTENSIFICATION (SRI) IN INDONESIA

3.1. Background

World population growth, expected to reach more than eight billion by 2006, will cause problems in food as well as water supplies. From earth’s yearly precipitation of 110,000 km$^3$, about 70,000 km$^3$ (60 percent) returns to the atmosphere again through evapotranspiration process from forests and other natural ecosystems, cropland and other land surfaces. This portion of water is called “green water”. The remaining part of about 40,000 km$^3$ (40 percent), which is called “blue water”, becomes potential water resources for agriculture, industries, domestic and other uses. About 6,780 km$^3$ (54 percent) of the accessible blue water necessary for human life is utilized various purposes, and about 70 percent of that is for irrigated farming (Horie 2002; Yajima 2002). The rapid population growth and industrial development have caused water shortage which is worsening from year to year. For example, 31 countries mainly in Asia and Africa, are suffering an absolute lack of water. As a consequence this scarcity of water has resulted in serious food shortage and other catastrophes especially in the developing countries (Yajima 2002).

Rice has long been very important for dietary source of human life. This commodity is vital to fulfilling human food needs, especially in Asia where the population is very high and per capita available arable land very low (Fresco, 2003). Rice cultivation has been an integral part of the culture in large parts of Asia for centuries. It is not only a staple food, but also a key ingredient of the region’s culture. Growing paddy rice has been the central livelihood strategy and is in the blood of most of Asian farmers (Rijsberman 2004). There are two major challenges involving rice in Asia. The first is ensuring the ability of nations to meet their national and household food security needs with a declining natural resource base particularly regarding to water and land. The second is the eradication of extreme poverty and hunger. This is because rice is so central to the lives of most Asians that any solution to global poverty and hunger must include research that helps poor Asian farmers earn a decent, reliable income by growing
rice that is affordable to poor consumers (Cantrell 2004). Although the global rice production has so far been able to meet population demands, a big question has already arisen on its sustainability. Appropriate action has to be taken in the near future in order to solve the problem (Nguyen & Ferrero 2006).

Water scarcity and increasing rice production are two major challenges in the efforts of overcoming the food shortage especially in Asia regions in the near future. According to Barker et al. (2004), irrigation consumes approximately 80 percent of developed water resources in the developing countries. Paddy fields account for approximately 50 percent of the irrigated area in Asia. It is assumed that a great deal of water could be saved in traditional paddy rice production. The major challenge for paddy rice farmers to increase their productivity is how to grow more rice with less water. Some scientists of Consultative group on International Agricultural Research (CGIAR) are currently engaged in a long-term assessment of the potential to achieve this. This group has also recognized the high priority of growing more food, including paddy rice, with less water. Growing more rice with much less water is necessary and possible (Rijsberman, 2004). In line with these efforts, the General Assembly of the United Nation declared 2004 as the International Year of Rice with the slogan “Rice is Life”, which is an extraordinary focus for a single crop to acquire such international recognition. This dedication to a single crop is unprecedented. It acknowledges the significance of rice as the staple food and a healthy source of grain for the majority of the developing world, and links its production and ecosystem management to broader issues of global food security, poverty alleviation, environmental conservation and the protection of biodiversity (Fresco 2003; Sato 2005).

A good opportunity to produce more rice with less water was opened when a new method of rice cultivation was introduced in the 1980s by the use of System of Rice Intensification (SRI) developed originally in Madagascar. It is claimed that “SRI is a methodology that can contribute to food security by increasing rice yields to about twice the present world average, virtually without the need of improved seeds or chemical inputs” as presented by Norman Uphoff, director of the Cornell International Institute for Food, Agriculture and
Development (CIIFAD), in his keynote on “The System of Rice Intensification (SRI) and its Relevance for Food Security and Natural Resource Management in Southeast Asia” (TROZ, 2002). It has been tested in China, India, Indonesia, the Philippines, Sri Lanka and Bangladesh with positive results (Berkelaar 2006).

This paper presents the results of field observation in Indonesia, including District of Sukabumi, about the practice of SRI done by farmers. Despite the successfulness of the SRI in rice production as claimed in many countries stated above, there is still a big question about the sustainability of this system when practiced in large scale.

3.2. System of Rice Intensification

3.2.1. Development of SRI

SRI system was developed in Madagascar during the 1980s after two decades of observation and experimentation conducted by Laulanie. In the beginning of its development, SRI received criticisms from either practitioners or scientists. The practices recommended by SRI is somewhat counterintuitive, since it challenges assumptions and practices that have been applied for hundreds or even thousands of years by traditional rice farmers in Asia. No external inputs are necessary for a farmer to benefit from SRI. The methods should work with any seeds that are now being used. No purchase of new seeds or the use of new high-yielding varieties (HYV) is required, although some of the highest yields obtained using SRI have been from the HYVs of paddy.

The SRI offers many insights into ways that production can be increased efficiently and water saved by managing rice crops with more attention to biology and agro-ecology. The changes in practice that differentiate SRI cultivation from standard rice culture were initially all that was focused on, especially on using of seeds, fertilizer and water. SRI is better understood as a set of principles. The validity of SRI concepts and methods has been seen now in 42 countries including Indonesia. The governments in China, India, Indonesia, Cambodia, and Vietnam, where two-thirds of the world’s rice is produced, have come to accept and promote these alternative methods based on their own evaluations and experience.
Based on that situation the controversy that has accompanied SRI should begin subsiding (Uphoff et al. 2011).

According to Kassam et al. (2011), SRI is a production system based on alternative understandings of rice agro-ecology and on alterations in the practices for crop, soil, water, nutrient, and pest management. Under most of the circumstances evaluated thus far, SRI can raise the productivity of land, water, seeds, capital, and labor used for irrigated rice production. This method is taking root on an international scale, moving far beyond its origin in Madagascar.

3.2.2. Principles of SRI

Basically, the concept of SRI comprises certain management practices for intensive and efficient paddy rice cultivation. The management practices involve transplanting method and management of soil, nutrient and water which provide better rice plants conditions, particularly in the root zone. This method is different from the traditional one with constant field flooding that has been practiced by Asian farmers for thousands of years. It should be noted that paddy is not aquatic plant but it needs water more in the right time.

Four principles of SRI in paddy cultivation are: (1) Early transplanting of seedlings, i.e., between 10 and 15 days old when the first two leaves have emerged from the initial tiller or stalk, (2) Seedlings are planted singly rather in clumps in order that individual plants have room to spread and to send down roots, (3) Seedlings are planted in a wide spacing square pattern with plenty of space between them to grow and easy weeding (at least 25 x 25 cm), and (4) Periodically intermittent irrigation in order that the soil are both moist and aerated at least during the vegetative growth period, where aerated soil provides aerobic and anaerobic bacteria an opportunity to contribute to plant growth. These four practices are different from those traditionally practiced by farmers so far.

There are two other practices that are very beneficial and not controversial when using SRI since they have been long recognized as valuables for crops. The two practices are weeding and fertilizing. At least two or three weeding are recommended, in which, the first weeding should be done ten to twelve days after transplanting and the second weeding within fourteen days. Another one or two
weeding can significantly increase the yield. Fertilizing in SRI method applied in Madagascar initially used chemical fertilizers especially on the very poor soils. Due to some constraints, the recommendation on fertilizing switched to the use of compost, with even better results were observed. Compost adds nutrient to the soil slowly and can also contribute to a better soil structure.

By applying the SRI practices properly, it is claimed that rice plants have many more tillers, greater root development, and more grains per panicle. Hence, SRI methods have at least doubled the yields of any variety of rice that has been tried. However, farmers have to have an open mind to adopt new methods and a willingness to experiment. It might take some years to get confidence that these methods could consistently raise production so substantially.

3.2.3. Field Experiments of SRI in Indonesia

In Indonesia, the SRI methods was first tested and evaluated by Agency for Agricultural Research and Development (AARD) in 1999 at its rice center in Sukamandi, West Java (DISIMP 2006). An average yield of 8.2 t/ha in wet season was reported, with one plot reaching 9.2 t/ha. The experiments on SRI was then continued throughout Indonesia by either governmental or NGO institutions. A brief history about SRI in Indonesia is summarized in the following paragraphs.

The application of SRI in paddy cultivation by farmers in Indonesia was mostly still in experiment scales. Due to some reasons, technically and/or non-technically, only a few farmers had already been convinced to practice it professionally as a new promising method of rice farming to increase rice production. In West Java, SRI was first practiced in 2000 by some curious agronomists/farmers (NGOs) in the District of Ciamis. Since then, the planting area of SRI had expanded steadily and the total area reached 570 ha (3,000 farmers). The whole of the SRI area had used organic manures provided by farmers and no chemical fertilizer was use. SRI training for farmers from every district in West Java had been conducted since 2002 in Bandung (capital city of West Java) as part of PU’s program to strengthen the WUAs (Water User Associations).
During the years of 2002 through 2004, the Ministry of Agriculture promoted a new program called “Improvement of Farm Intensification Quality (PMI)” for 200 locations (one in each district) in 29 provinces. The objectives were to increase farmer’s incomes and strengthening farmer group activities. This program included the introduction of SRI method as a core technology, under the Integrated Crop Management and Development Program (PTT). The SRI method was also tested in some parts of outside Java, such as Sumatera and in the Eastern Indonesia (South Sulawesi, West Nusa Tenggara, Central Sulawesi, etc) (DISIMP, 2006).

The results of paddy yields from the experiments conducted by the coordination of NGOs or governmental projects varied from area to area but higher than those of the traditional ones. Table 3.1 summarizes the data obtained for paddy yields using SRI method at various locations in Indonesia. The variability of the paddy yield data shown in the table might be due to the differences of soil conditions, irrigation scheme, climate, etc.

Table 3.1. Data of yields experimental rice farming using SRI method at various locations in Indonesia

<table>
<thead>
<tr>
<th>Province</th>
<th>SRI Area (ha)</th>
<th>Farmers</th>
<th>Average Yield (ton/ha of Harvest-dry Rice)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td></td>
<td>SRI</td>
</tr>
<tr>
<td>West Java</td>
<td>570.00</td>
<td>3000</td>
<td>13.7</td>
</tr>
<tr>
<td>South Sulawesi</td>
<td>502.28</td>
<td>508</td>
<td>7.79</td>
</tr>
<tr>
<td>West Nusa Tenggara</td>
<td>311.32</td>
<td>791</td>
<td>6.55</td>
</tr>
<tr>
<td>Central Sulawesi</td>
<td>555.00</td>
<td>555</td>
<td>7.10</td>
</tr>
</tbody>
</table>

Note: Data was arranged from various sources (Sutarmin et al. 2005; DISIMP 2006)

There are two methods of calculating the paddy yield. First, the yield is calculated based on the weight of the actual paddy harvested divided by the actual land plot area. Second, the yield is calculated based on a certain area of plants locally called “ubinan”, i.e., a square area having 2.5 m x 2.5 m in size. The yield is then converted to ton per hectare. Usually yield calculated using the second method is
higher than that of the first one. It is not clear, however, which method is used in the calculation of yields presented in Table 3.1.

3.3. Sustainability of Organic Rice Farming

3.3.1. Practice of SRI by Individual Farmers

The SRI practices for paddy cultivation now being recommended to farmers in Indonesia, particularly in West Java, can be categorized as organic rice farming. No chemical fertilizers are used; instead, manures and biomass are used either in its natural condition, or in the forms of compost or bokashi. The main reason of using organic fertilizers is “cheaper”, readily available and environmentally friendly. Organic fertilizers are also claimed as having the effect of improving soil condition including soil structure.

So far, the experiments on SRI involving farmers in West Java were conducted under the supervision and coordination of NGOs or governmental institutions, i.e., a project type of activity. The results, as depicted previously in Table 3.1, indicate a very promising way in increasing rice production at least two folds as compared to that of the traditional one. The experiments were mostly conducted in small plots or pieces of paddy fields, or in small scales. Farmers involved in the activity were mostly those having long experience in paddy cultivation. With those conditions, the SRI principles were easily and appropriately applied, including water management as one of the important factors in the success of this method. Table 3.2 shows an example of the result of an experiment using demonstration plots in the District of Garut, West Java.

Table 3.2. Result of demonstration plot test of SRI in the District of Garut (2003)

<table>
<thead>
<tr>
<th>Demonstrators</th>
<th>Location (Village)</th>
<th>Area (m²)</th>
<th>Variety</th>
<th>Planting Space (cm)</th>
<th>Age (days)</th>
<th>“Ubinan” (kg/14 m²)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>Ngamplangsari</td>
<td>1400</td>
<td>Widas</td>
<td>25 x 25</td>
<td>110</td>
<td>15.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Tatang</td>
<td>Mekarmukti</td>
<td>1400</td>
<td>Ciherang</td>
<td>25 x 25</td>
<td>115</td>
<td>24.0</td>
<td>16.8</td>
</tr>
<tr>
<td>Anggung D.</td>
<td>Simagalih</td>
<td>1400</td>
<td>Sarinah</td>
<td>27 x 27</td>
<td>120</td>
<td>25.0</td>
<td>17.5</td>
</tr>
<tr>
<td>Ibu Munir</td>
<td>Panembong</td>
<td>1400</td>
<td>Sarinah</td>
<td>30 x 30</td>
<td>115</td>
<td>22.0</td>
<td>15.4</td>
</tr>
</tbody>
</table>

Source: DSDAP 2003 in Sutarmin et al. 2005
What happen if this SRI method is fully adopted by farmers as a promising “new” technology in terms of sustainable rice production? Has SRI method proven to be reliable and sustainable? Are the infrastructures required for this system ready? How long does it take to convince the majority, if not all, of traditional farmers that this method really works? There are still many questions to answer regarding the success story of SRI.

A case study was conducted using in-depth interview with a prominent farmer (Sirajuddin March 18 2006, personal communication) in Desa Cibadak, District of Sukabumi, West Java. This farmer is the leader of “Sekarmukti” farmer group, attended SRI training in Bandung and has practiced the SRI method for two years. This means that he has already experienced four times (seasons) in applying the method in his 0.25 ha paddy field and has determined to use totally the SRI method. So far, only a few (10 out of 70) of the members of his group has applied the method exactly as recommended. The others has not been convinced totally or not fully applied as recommended. The yields obtained fluctuated among the individuals and from season to season, ranging from 6.5 to 8.5 ton/ha. Although it is still premature to make a final conclusion about the success of the SRI method, at least this fact indicates a “sign” that the method promisingly works. The question is: would rice intensification using this method be sustainable particularly if applied in much larger scales?

3.3.2. Sustainability

Many scientists are still uncertain and even skeptical about the high yields of rice production that can be obtained by the SRI method. However, some data and information have been published about the improved yields of experimental rice production using this method in many countries such as China, Cuba, India, Indonesia, the Philippines, Sri Lanka, Bangladesh, etc. Systematic evaluation has not been done thoroughly by agronomists or soil scientists, but some explanations based on the scientific literature involve: (a) biological nitrogen fixation by free-living bacteria and other microbes around the roots, (b) plants can grow very well with extremely low concentration of nutrients as long as those nutrients are supplied evenly and consistently over time, and (c) plants with
extensive root growth have better access to whatever nutrients exist in the soil (Berkelaar 2006). Supposedly that the SRI method has been proven good scientifically and farmers are convinced to adopt it, the next question would be how to apply this method efficiently and effectively (or even economically) in large scales?

Farmers applying this method in Sukabumi, also those in other locations in Indonesia, found that they had to spend more in labors compared to that of the traditional method. This was true when dealing with organic fertilizers, which were bulky in volume. This meant that they had to spend more in labors in the preparation, production, and application of the organic fertilizers. However, the problem of the production cost increase so far still could be compensated by the price of the organic rice. In the early time of the 2000s, the local price of milled organic rice (up to 5000 rupiahs/kg) was higher than that of the non-organic one (an average of 2500 rupiahs/kg). The price was constantly climbing up afterwards.

It is no doubt that farmers would enthusiastically adopt this method considering its promising success. Changing from one method particularly from the traditional one to another, however, is not a simple matter and takes time. It includes not only technical but also economical and social or psychological aspects of the farmer’s life. Farmers need to see the facts that the method really works, i.e., seeing is believing. In terms of sustainability, it also includes physical and environmental aspects of the soil conditions.

Figure 3.1 shows various factors involved in the sustainability of organic farming in general, including the SRI method in rice intensification that might be considered. In small scale, the requirement of organic fertilizers can be fulfilled by the farmers themselves using local sources. This is what happens now when the number of farmers applying SRI method is still limited. What would happen, in term of sustainability, if the majority of the farmers in Indonesia adopt the system? How much organic fertilizers and land conditions required in order to apply the cultivation method fully as recommended by SRI. In relation to the efficient water management, is a new irrigation system and land consolidation needed in Indonesia? What new scenarios are needed in the agricultural systems to facilitate the “revolution” of the paddy cultivation?
3.3.4. Land conditions and water management

In Indonesia, paddy fields can be divided into two types of agricultural land, i.e., hilly lands with terrace system (uplands) and low flat lands (lowlands). Usually the sizes of blocks or plots of paddy fields in the uplands are smaller than those in the lowlands. One block of paddy field is bordered by narrow dikes. The sizes or areas of the blocks are not uniform, depending on ownership and topography of the region. The majority of farmers in Indonesia are small farmers with an average of less than 1 ha land. In Java Island, the average ownership of paddy field is 0.2 ha/HH (Hutapea & Mashar 2006). In terms of irrigation system, there are three types of paddy field with technical, semi-technical and rain-fed irrigation systems. With technical and semi-technical irrigation, water is available almost every planting season.

Paddy fields in Sukabumi, where the case study was conducted, are of the first type with the maximum size of block is around 0.25 ha. The irrigation system
is mostly of technical system and water is available throughout the year. The irrigation pattern is block to block and water is kept at relatively high level to flood the paddy field as usually applied for traditional system of cultivation. That is why farmers can plant rice two to three times a year if they want to.

The farmer who practices the SRI method in this area (Sirajuddin March 18, 2006, personal communication) has no major problem in the management of water as recommended, i.e., using intermittent water management system. This is because the number of farmers applying the method is still limited. The problem may arise when the number of the SRI farmers increase, say, the majority of farmers in a watershed has adopted the method but the irrigation scheme is still block to block. It would be difficult to manage the irrigation water if the farmers in one area do not cultivate rice simultaneously, or, two different cultivation methods of rice are practiced in the same area of irrigation scheme. So, a new land consolidation with new irrigation system might be required in order that farmers could independently manage their irrigation water for whatever cultivation method they use with no conflict of interest. The latter is a very sensitive matter and can create serious problem if not wisely managed.

3.3.4. Sources of organic fertilizers

Organic fertilizers are used in SRI method due the historical reason of lack of chemical fertilizers in the country where it was invented and the theory that organic fertilizers can improve soil conditions. Although it is slow, the organic matter can improve the soil structure and provide soil nutrient through the activity of microorganisms. It was then that the organic farming became the essence of the SRI system.

Again, the farmer practicing the SRI method fully as recommended has no problem with the provision of organic fertilizers. According to the SRI method, about 5 to 10 ton/ha of compost is required depending on the soil condition. Farmers can purchase the organic fertilizers in the form of compost or bokashi. Or, they can produce the organic fertilizers by themselves using manures of animals, mixed with organic wastes from the local vegetable and fruits market, and other kinds of biomasses. These can be obtained for free, except for transportation cost.
Due to the limited number of the SRI farmers, no competition in obtaining manures as one component of the organic fertilizers has occurred among the farmers. This is true especially for those farmers who also own or rear animals such as poultry, seep, goat, buffalo, cow, etc. Those who do not have animals can purchase manures from the local poultry, dairy, or cattle farms, if any.

The condition described above was the case of individual SRI farmers (non-project) in a village in Sukabumi. As long as the number of farmers is still limited, then there is no problem with the sustainability of organic farming in this area, or other areas Indonesia with the same agro-climatic conditions. But then again, what would happen if the majority of farmers in a certain watershed adopt the SRI method? Could it be sustainable? The answer might be “yes” if the major conditions, i.e., good water management and availability of organic matter sources, could be guaranteed. Of course, in-depth economic analysis of this farming system, as well as environmental analysis, is required in the near future.

### 3.4. Conclusion

The SRI method in rice cultivation is a promising solution for the global food problem we are facing, especially in Asian countries. However, evaluation still has to be done in order to make sure about the dependability and sustainability of the system. If the method itself has been proven scientifically, the next question would be the sustainability of the system to be applied by farmers improving the rice production, more importantly, to alleviate poverty of the farmer community in general. For Indonesian case, including the District of Sukabumi, the followings are suggested in order that the SRI method can be practiced by farmers in sustainable way: (1) In-depth study or research in soil ecology has to be conducted in the near future regarding the sustainability of the organic farming, (2) A mixed farming system of food crops and animals should be developed to ensure the sources organic matters for use of organic fertilizers, (3) Organic fertilizers industry of compost or bokashi might be needed for efficient and economic uses by farmers, (4) New land consolidation and irrigation system might be needed, and (5) Economic analysis for profitable organic rice farming.