



## Accepting System of Rice Intensification (SRI) by Farmers in Rainfed Lowland Paddy Area of Cambodia

**JUN TSURUI**

*Department of International Studies, Graduate School of Frontier Sciences, The University of Tokyo, Chiba, Japan*

*Email: k87641@inter.k.u-tokyo.ac.jp*

**EIJI YAMAJI**

*Department of International Studies, Graduate School of Frontier Sciences, The University of Tokyo, Chiba, Japan*

**SUK SOVANNARA**

*Centre d'Études et de Développement Agricole Cambodgien (CEDAC), Phnom Penh, Cambodia*

Received 14 July 2010

Accepted 1 September 2010

**Abstract** System of rice intensification (SRI) is an environment-friendly and sustainable rice farming practice developed in Madagascar in 1980s under irrigated condition. Unlike the Green Revolution technology, which was widely applied in many developing countries after 1960s, SRI does not require additional chemical fertilizers or agrochemicals. Recently, SRI has been diffused not only in irrigated area but also in rainfed lowland paddy in Cambodia. It is significant, if SRI is confirmed to be effective in rainfed area, where green revolution technology is ineffective. The objective of the research is to analyze acceptability of SRI by farmers in rainfed lowland paddy area and illustrate reasons for acceptance or non-acceptance. Farming practice comparison test was conducted in the rainy season of year 2008 by six volunteer farmers in three villages of Prey Nheat commune, Kong Pisei district, Kampong Speu province in Cambodia. Each of these farmers' rainfed lowland paddy plot was divided into two parts, SRI practices on one part and the traditional practice on the other. In year 2008, the farmers did not adopt all of the SRI principles but only for some. There was no significant difference between the yield of SRI and conventional practice. However, the farmers founded benefits from SRI, such as less labor and less seeds and they accepted SRI. The research indicates prospect of SRI in rainfed lowland paddy, since farmers can maintain at least the same level of yield with less resources and cost. It was also revealed that decreasing seedlings per hill has been an important motive for the farmers to change their farming practice.

**Keywords** system of rice intensification (SRI), rainfed lowland paddy, Cambodia

### INTRODUCTION

**Rainfed lowland rice:** The rainfed lowland rice is one of the rice ecosystems defined as “It is rice, usually transplanted, that is grown in leveled, banded field that are shallowly flooded by with rainwater (Mackill et al. 1996)”. In Lao PDR, Cambodia, Thailand, Nepal, and Myanmar, more than 50% of rice area is classified into rainfed lowland in year 2004-2006 (International Rice Research Institute, 2010). Bangladesh, India, and Vietnam also show high rate of rainfed lowland, which is 30-40%. In total, 32% of rice area in Asia and 30% of global rice area is rainfed lowland.

**Effect of the green revolution on the rainfed lowland paddy:** It is obvious that the green revolution contributed dramatic improvement of rice production in many developing countries after 1960s. However, it was also revealed that largest impact of green revolution is observed only in irrigated area or rainfed lands with good water control (Evenson et al., 2003). Since then, importance of improving rainfed lowland paddy was recognized.

**System of rice intensification (SRI) and its practice in rainfed lowland paddy:** System of rice intensification (SRI) is an environment-friendly and sustainable rice farming practice developed by Father Henri de Laulanié in Madagascar in 1983 under irrigated condition. Stoop et al. (2002) summarized the major elements of the SRI strategy as follows: “(1) raising seedlings in a carefully managed, garden-like nursery; (2) early transplanting of eight to 15 days old seedlings; (3) single, widely spaced transplants; (4) early and regular weeding; (5) carefully controlled water management; and (6) application of compost to the extent possible”. The SRI has been diffused to 33 countries in the world in 2008 (Uphoff, 2008a).

Even SRI is now conducted in many countries in the world, there are few articles mentioned about SRI practiced in rainfed lowland paddy. Such cases are mostly observed in South Asian countries such as India (Prasad et al., 2006; PRADAN, 2006), Sri Lanka (Namara et al., 2004), Nepal (Uprety, 2006), Myanmar (Kabir et al., 2007) and also in Cambodia (Chey, 2004). Namara et al. discuss some features of rainfed SRI that rainfed farmers are more likely to adopt SRI due to risk reduction and wage difference between rainfed and irrigated areas (Namara et al., 2004). However, there has not been much discussion about farmers’ perception on SRI and their practices in rainfed lowland paddy.

**Diffusion of SRI in Cambodia:** In Cambodia, SRI was firstly introduced by a Cambodian NGO, CEDAC (Centre d’Educat et de Développement Agricole Cambodgien), in 1999. In 2000, there were only 28 farmers from 18 villages who volunteered to test SRI. In 2007, the total number of SRI-using households reached about 82,400 across the 24 provinces/municipalities (SRI-secretariat of Cambodia, 2008).

CEDAC explains farmers that SRI consists of the following 12 principles based on SRI practiced in Madagascar. (1) Level the paddy field and provide drainage, (2) Select dense seeds for sowing without mixing them with other varieties, (3) Raise nursery beds or use dry nursery beds, (4) Select big seedlings and transplant them immediately, (5) Transplant young seedlings (seedlings younger than 15 days), (6) Transplant one to two plant(s) per hill (preferably only one), (7) Transplant seedlings at a shallow depth and keep the roots horizontal, (8) Transplant seedlings in lines, (9) Transplant seedlings 25-40 cm apart, (10) Weed at least 2-4 times a season, (11) Keep the water depth in the paddy field shallow, and (12) Apply natural fertilizer as much as possible.

Distinctive characteristic of SRI in Cambodia is that most of farmers are applying SRI in rainfed lowland paddy, where farmers were not benefited by the green revolution.

**Objective of the research:** The objective of the research is to analyze acceptability of SRI by farmers in the rainfed lowland paddy and illustrate reasons for acceptance or non-acceptance. It is important to know farmers’ perception and behavior on SRI, since it might provide a clue to improve productivity of rice and living condition of farmers in rainfed areas.

## METHODOLOGY

**Concepts:** To achieve the research objective, concepts of the research has set. These are:

- To implement the research in rainfed lowland paddies,
- To compare SRI and conventional rice farming practice in farmers’ fields (on-farm), and
- To conduct the research with farmers’ participation and strong initiatives of farmers.

**Location:** Three villages (Tboung Angk village, Samdach Ov village, and Chas village) of Prey Nheat commune, Kong Pisei district, Kampong Speu province of the Kingdom of Cambodia were selected for the participatory on-farm experiment. The villages are distributed around Latitude 11°22’N and Longitude 104°39’E. SRI has not been introduced in these villages before the year of 2008. Most of paddies in the villages are rainfed lowland.

**Period:** The experiment was implemented in the rainy season (from May to December) of year 2008. In May 2008, socialization meetings for SRI promotion were conducted in the villages. During the meeting, it was announced that a Japanese NGO (Zutto Sustainable) and CEDAC will provide technical guidance on SRI but not provide physical support such as provision of seeds, fertilizer and agrochemicals. It was observed that many farmers were interested in SRI and wanted to try SRI. Among them, two strongly motivated farmers in each village were selected as volunteer farmers for

the farming practice comparison test. Reflections of farmers on the test were obtained by a survey in March 2009.

**Situation of farm management of the volunteer farmers:** Farm management situations of the six volunteer farmers are complex and diversified as shown in Table 1.

**Table 1 Farm management of six volunteer farmers (March 2009)**

Item	Farmer A	Farmer B	Farmer C	Farmer D	Farmer E	Farmer F
Village	Chas	Chas	Tboung Angk	Tboung Angk	Samdach Ov	Samdach Ov
Size of paddy farming (ha)*	1.5	1.0	0.5	1.0	1.0	1.3
Availability of irrigation facilities	No	No	No	No	No	No
Major activity in Chamkar**	vegetable	vegetable	not in use	vegetable	vegetable	vegetable
No. of cattle	5	5	1	2	3	6
No. of hen	5	2	0	2	5	8
Non-farm income	-	vegetable dealer	construction worker	prayer in pagoda	motorbike taxi	motorbike taxi /vegetable dealer

\* Estimated by farmers. \*\* Chamkar is farm lands which are commonly used for vegetable or fruits cultivation, and cattle grazing. Source: Authors' data.

**Conventional rice farming practice:** According to the interview survey, the following conventional rice farming has been commonly practiced by the volunteer farmers. The farmers introduce compost to paddy in April. They broadcast home seed-raised traditional cultivar seeds to their nursery without raised bed in beginning of the rainy season, which is June. Then they wait for the peak of rainfall in August. When some rain is expected, they uproot seedlings from the nursery and bring them to the nearest pond or water stagnant to keep their moist. They do not transplant seedlings immediately, since they need some time to uproot and transport huge numbers of seedlings. When they receive heavy rain in August, they immediately plow their paddy and transplant seedlings. Even at the time of transplanting, the paddy soil might not be fully saturated. Since seedlings have grown to be big after two months from sowing, farmers need to cut their seedlings on the top. According to the farmers, it is necessary because seedlings cannot stand by themselves without reducing height. They cannot penetrate seedlings deeply into the soil because soil is not saturated and hard. Traditionally, farmers transplant seedlings randomly, 5-10 plants per hill, and with 15-20cm distance. Sometimes, they employ agricultural labor especially for transplanting. Normally, farmers depend only on rainfall to grow paddy. They introduce water from the nearest community pond or water stagnant in side drain of roads by portable pump, when it is necessary and possible. They provide weeding and chemical fertilizer in October or November and harvest in November or December.

**Table 2 Outline of comparison test in the rainy season of year 2008**

Item		Farmer A	Farmer B	Farmer C	Farmer D	Farmer E	Farmer F
Alignment of test plot		Same plot without levee	Same plot without levee	Same plot without levee	Separated (50 m distance)	Same plot without levee	Same plot without levee
Size of plot (a)*	CFP	14.0	8.6	6.3	11.5	3.3	2.2
	SRI	12.6	11.3	9.2	16.4	4.5	2.1
Cultivar**	CFP	Beikantam	Chhma Prum	Chhma Prum	Beikantam	Lum Ang-Khsach	Phka Mlis
	SRI	ditto	ditto	ditto	ditto	ditto	ditto
Chemical fertilizer application (kg/ha)	CFP	36	81	0	87	0	0
	SRI	40	35	0	61	0	0

\* Sizes of plots were measured by handheld Global Positioning System receiver. \*\* All of them are traditional cultivars. CFP: Conventional rice farming practice. Source: Authors' data.

**Farming practice comparison test between SRI and conventional practice:** SRI and conventional rice farming practice has been compared in rainfed lowland paddy plots of the volunteer farmers (Table 2). The farmers were instructed by NGO staff to divide a plot into two parts and cultivate rice with SRI on one part and with the conventional practice on the other. Table 1 describes outline of the comparison test designed by the farmers. It was observed that the farmers reduced amount of chemical fertilizer in both of SRI and conventional plots but more for SRI. For plots other than comparison test, they applied 117 kg/ha of chemical fertilizer in average. Three of them did not apply any amount of chemical fertilizer for SRI even NGO staff instructed to reduce amount of chemical fertilizer only to half.

## RESULTS

### Adoption of SRI principles by farmers

The volunteer farmers were instructed to follow 12 SRI principles in the comparison plot for SRI. However, it was found that they did not adopt all the principles. Table 3 shows actual SRI practices they conducted. All the farmers transplant seedling in lines and shallower. However, no farmer used raised nursery bed and transplanted young seedlings. It means that the farmers applied SRI practices selectively. In general, adoption rates of SRI principles are low in principles related to water management and nursery preparation. In the year of 2008, it was observed that water in paddies tends to dry up even farmers tried to keep water in paddies as much as possible.

**Table 3 Adoption of SRI principles in the comparison plot for SRI in the rainy season of 2008**

SRI Principles	Volunteer Farmer						Adoption rate*
	A	B	C	D	E	F	
<b>Water management</b>							
1) Level the paddy field and provide drainage	×	○	×	×	×	△	25%
2) Keep the water depth in the paddy field shallow	—	○	—	—	—	—	17%
<b>Nursery preparation</b>							
3) Raise nursery beds or use dry nursery beds	×	×	×	△	×	×	8%
4) Select dense seeds for sowing without mixing them with other varieties	○	△	△	△	○	△	67%
<b>Transplanting</b>							
5) Transplant young seedlings (seedlings younger than 15 days)	×	△	△	△	×	×	25%
6) Select big seedlings and transplant them immediately	○	△	×	△	○	△	58%
7) Transplant one to two plant(s) per hill (preferably only one)	○	△	○	△	○	○	83%
8) Transplant seedlings at a shallow depth and keep the roots horizontal	△	△	○	○	△	△	67%
9) Transplant seedlings in lines	○	○	○	○	○	○	100%
10) Transplant seedlings 25-40 cm apart	△	○	○	○	△	△	75%
<b>Fertilizing</b>							
11) Apply natural fertilizer as much as possible	○	○	○	○	○	×	83%
<b>Weeding</b>							
12) Weed at least 2-4 times a season	×	×	○	○	×	×	33%
Average	50%	63%	58%	63%	50%	38%	53%

○ adopted, △ partly adopted, × not adopted, —standing water is dried up naturally.

\* Adoption rate was calculate by giving 1 point for “adopted”, 0.5 point for “partly adopted”, and 0 point for “not adopted” to each farmers and divide total score with number of farmers. Source: Authors’ data.

According to monthly rainfall record in Kampong Speu (Latitude 11°28’N and Longitude 104°34’E) which is about 20 km northwest of the villages, there was 785 mm of rainfall in the period from August to December of the year 2008. It was higher than that of recent five year

average (from 2004 to 2008), which is 663 mm. It means that drying up of standing water in paddy is common phenomenon in the area.

## Yield

Yields of SRI and conventional practice were measured in the three comparison plots (one plot in each village) by quadrat sampling. It was confirmed that yield of SRI in year 2008 was not very different for two comparison plots (Table 4). It is noted that several farmers showed their belief for increasing yield by SRI. They said they could not get much yield by SRI because the weather was not very good in year 2008.

**Table 4 Yield in the rainy season of year 2008**

Farming Practice	Yield (ton/ha)			Average
	Farmer A	Farmer C	Farmer E	
Conventional	2.5	2.2	2.2	2.3
SRI	3.5	2.4	2.3	2.7
Increment by introducing SRI	+1.0	+0.2	+0.1	+0.4

*Source: Authors' data.*

## Farmers' impression on SRI

Farmers' impression on SRI was confirmed by semi-structured interview after completion of the first season trial. As shown in Table 5, all the farmers said at the very beginning of interview that they can reduce labor force by applying SRI even they tried SRI for the first time. It is surprising because Uphoff (2004) said "Initially, SRI methods require more labor, as they need to be learned and mastered. The first-season increase in the labor required is usually 25-50%". The farmers explained that SRI required more labor to transplant seedlings in lines but they could reduce more labor for uprooting and transporting seedlings from their nurseries. It is because they reduced number of seedlings. Another benefit of SRI is also resulted by reducing number of seedlings. The farmers saved seeds and consume them for their own consumption.

**Table 5 Farmers' impression on SRI (Benefits of SRI)**

Benefit of SRI	Farmer						Ratio (%)
	A	B	C	D	E	F	
Less labor	○	○	○	○	○	○	100
Less seeds	×	○	○	○	○	○	83
Potential for high yield	○	○	×	○	×	○	67

○ farmer reported, × farmer did not report.

*Source: Authors' data.*

## Acceptance of SRI

All the farmers admitted SRI could improve their rice farming and living condition. They agreed to continue testing SRI in the next rainy season in year 2009. In this way, SRI was accepted by the farmer. However, it is necessary to confirm whether they expand area for SRI in the next year or not. They might accept SRI since they tried it only for small area.

## **DISCUSSION**

### **Features of rainfed SRI**

Tsujimoto et al. (2009) explains situation of irrigated SRI fields in Madagascar as “Weeds were more frequently controlled at the SRI-practicing fields than at the conventional fields. This was partly because sparse transplanting of young seedlings and non-flooded conditions at the SRI-practicing fields favored weed growth and consequently required more frequent weed control in the early stage of rice growth”.

In our experiment in rainfed lowland paddy, only 2 volunteer farmers reported increment of weeds. In fact, most of the farmers did not drain water even for SRI since it is too risky for rainfed paddy. The paddies in the area were often dried up but only naturally. The farmers practiced SRI without intentional water control and this creates no difference between SRI and conventional practice as far as water management concerned. They observed many weeds not only in SRI plots but also conventional plots. With this reason, even they applied slightly wider spacing for SRI, they did not regard weeding as disadvantage of SRI.

It was also confirmed that application of more amount of compost was strongly supported by the farmers. Since they need to plow their land without full saturation of water, it is critical for them to make the soil soft as much as they can. Otherwise, they cannot plow deeply. According to an old farmer in one of the village, villagers are already reducing amount of chemical fertilizer even before they know about SRI, because they realized that application of chemical fertilizer makes the soil harder. They also said they easily lose their yield when they face drought. Investment in chemical fertilizer does not help them in this case. Moreover, they just lose their money. In the experiment, the farmers reduced amount of chemical fertilizer to a large extent. This fact shows their strong interest and curiosity in converting chemical fertilizer to compost.

### **Key SRI principle**

It is obvious that “reducing number of seedlings per hill” is the key SRI principle for the farmers. Reducing number of seedlings made the farmers save seeds and they can consume more amount of rice. Reducing number of seedlings also contributed to reduce labor, especially labor for uprooting of seedlings from nursery and hauling them to the plot for transplanting.

### **Obstacle for accepting SRI**

According to the farmers, the biggest obstacle for applying SRI is “transplanting seedlings in lines”, since it requires more time and labor. Especially it is difficult or impossible when they employ agricultural labor for transplanting. They can not educate and supervise labor for transplanting in lines.

## **CONCLUSION**

The research suggests prospect of SRI in rainfed lowland rice, since farmers can maintain yield with less resources and cost as least in small-scale trial plots. It was confirmed rainfed lowland might be very suitable for applying SRI, since SRI might not increase weeds from conventional practice in some cases.

It was also revealed that decreasing seedlings per hill has been an important motive for the farmers to apply SRI, since it can decrease input like labor and seeds. It is interesting that the rainfed lowland rice farmers are not going to intensify their farming by applying System of Rice Intensification. SRI could be extensive manner of rice farming for them.

Though some facts were revealed by the experiment, it is too early to conclude and discuss effectiveness of SRI in rainfed lowland paddy only with one year experiment. Necessity of SRI research in several consecutive years has been pointed out (Uphoff et al., 2008b). It is hoped that the

research will be continued in year 2009 by improving farmers' skill. Fortunately, all of the six farmers agreed to continue their on-farm experiment, so the experiment would be continued.

## **ACKNOWLEDGEMENTS**

The authors thank Japanese NGO Zutto Sustainable and Cambodian NGO CEDAC for allowing us to conduct research in their project area.

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