Research article

Improvement in Practicing System of Rice Intensification (SRI) Principles by Farmers in Rainfed Area of Cambodia

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Abstract System of rice intensification (SRI) is a rice farming practice developed in Madagascar under irrigated conditions. Recently, SRI has been diffused in rainfed paddy areas of Cambodia. Confirming the reasons for the diffusion will undoubtedly provide clues for improving rainfed agriculture unaffected by green revolution technology. In 2008, the authors introduced SRI to rainfed rice farmers in the Kampong Speu province of Cambodia. Six volunteer farmers unfamiliar with SRI techniques conducted an on-farm trial to compare conventional practices with SRI. The farmers adopted only several SRI principles, and a significant yield difference between SRI and conventional practices was absent. Even though yield did not increase dramatically, all cooperating farmers agreed to continue SRI at least in small-scale trial plots since SRI showed indications of being more efficient such as savings on the cost of seeds. In 2009, the farmers practiced SRI more rigorously following intensive training. The principle of "reducing number of seedlings per hill" was found to be the motivating factor that led to introducing SRI other principles. For example, the farmers were compelled to use younger seedlings. Conventionally, farmers grew a huge number of seedlings in a large nursery area, making it more difficult to grow young seedlings with care. SRI, and its advantage of fewer seedlings requirements, changed this practice and the farmers started using younger seedlings. As a result, yield difference between SRI and conventional practices in 2009 was larger than that in 2008. It was also observed that the farmers instituted several SRI principles in comparison plots for conventional practice, not only in SRI plots. The farmers introduced their own ideas in search of the best combination of SRI principles. Another remarkable result was that the farmers also took the initiative to introduce some SRI principles into their own non-comparison plots.

Keywords system of rice intensification, sustainable rice farming, rainfed lowland paddy, small-scale trial plot

INTRODUCTION

SRI in rainfed lowland paddy areas of Cambodia

System of rice intensification (SRI) is a rice farming practice developed by Father Henri de Laulanı´e, in Madagascar in 1983 under irrigated conditions, and was introduced into Cambodia in 1999 and disseminated by organizations such as the Centre d'Étude et de Développement Agricole

Cambodgien (CEDAC). The distinctive characteristic of SRI in Cambodia is that most farmers are practicing SRI in rainfed lowland paddy areas.

Objectives

Understanding the reasons for SRI diffusion in Cambodia has the potential of suggesting clues for improving rainfed agriculture unsupported by green revolution technology. The objectives of the research are to:

1) evaluate SRI in rainfed lowland paddy areas from the viewpoints of Cambodian farmers,
2) analyze the reasons and mechanism for farmer acceptance of SRI practices, and
3) construct a case example useful for further SRI research and development.

Framework

An on-farm experiment with participatory action research (PAR) concept was conducted for three years. PAR seeks to understand and to improve the world by changing it. Collective, self-reflective inquiry that researchers and participants undertake is the heart of the concept. This, in turn, enables better understanding of and improvement in employed practices and under local environmental conditions. The reflective process is directly linked to action, influenced by an understanding of history, culture, and local context and embedded in social relationships (Baum et al., 2006). The experiment was carried out under the earnest desire and decision making initiative of the farmers with the flexibility to change the design of the experiment. We expected the PAR concept to enable us to gain knowledge of farmer perceptions of SRI.

The experiment has been conducted since 2008 and this article reports the results of the second year of the experiment in 2009.

Results of the first-year experiment in 2008

The experiment started in 2008 with six volunteer farmers in Tboung Angk, Samdach Ov, and Chas villages of Prey Nheat commune, Kong Pisei district, Kampong Speu province in the southwest part of Cambodia. The villages are scattered in the vicinity of latitude 11°22'N and longitude 104°39'E. Results suggested potential advantages of SRI in rainfed lowland rice paddy areas since the farmers were able to maintain yields with fewer resources, at least in small-scale test plots. It was also revealed that the need for fewer seedlings per hill was an important motive for the farmers in applying SRI since seed input can be decreased. (Tsurui et al., 2010).

METHOD

All six farmers during the first year of the experiment in 2008 agreed to continue the on-farm experiment in the second year in 2009. The farmers compared SRI and conventional rice farming practices in small-scale on-farm comparison plots to evaluate SRI effectiveness. It should be noted that no seeds, fertilizer, equipment, agrochemicals, or other physical support was provided to the farmers. It was thought that such physical support might create bias in farmer decisions. Hence, the farmers were provided with technical guidance only.

RESULTS OF SMALL-SCALE COMPARISON TEST

Rainfall

Records of monthly rainfall in Kampong Speu (latitude 11°28'N, longitude104°34'E) report 733 mm of rainfall during June-December 2009, nearly 100 mm lower than a five-year average (2003-2007) of 827 mm.

Layout and size of comparison plots

Two farmers (Farmers B and F) redesignated comparison test plots to closer or larger plots from those used during the first year (see Table 1). All six farmers applied traditional cultivar for the comparison test, but two applied different cultivar for conventional practice and SRI. These farmers were interested in finding a suitable cultivar for SRI.

On average, 39 kg/ha of chemical fertilizer was applied to comparison plots for conventional practice (increased by 5 kg/ha from the first year), and 29 kg/ha was applied for SRI (increased by 6 kg/ha). It was also estimated that about 84 kg/ha (decreased for 33 kg/ha) of chemical fertilizer was applied to non-comparison plots. The farmers decided to conduct the second-year comparison test by increasing the amount of purchased chemical fertilizer slightly while at the same time reducing the amount for non-comparison plots.

Table 1 Outline of comparison test in 2009 (year 2)

Item	Plot	Farmer A	Farmer B	Farmer C	Farmer D	Farmer E	Farmer F
Test plot displacement from Year 1 (2008)		No	Yes (to nearer plot)	No	No	No	Yes (to bigger plot)
Test plot alignments		Same plot without levee	Same plot with levee	Same plot with levee	Separated (50 m distance)	Same plot with levee	Same plot with levee
Plot sizes (a)*	CFP	14.0	13.0	9.5	11.5	3.3	8.9
	SRI	12.6	4.9	3.8	16.4	4.5	20.4
Cultivar**	CFP	Chhma Prum	Champar-meas	Chhma Prum	Beikantam	Lum Ang-Khsach	Lum Ang-Khsach
	SRI	ditto	Chhma Prum	Beikantam	ditto	ditto	ditto
Chemical fertilizer application (kg/ha)	CFP	71	77	11	43	30	0
	SRI	79	61	27	6	0	0

**Size of plots was measured by handheld Global Positioning System receiver.*
***Only traditional cultivars used.*
Note: CFP: Conventional rice farming practice
Source: Authors' data

Adoption of SRI principles

It was confirmed that about 15% of practices equivalent to those of SRI had already been introduced into these farmers even before the farmers learned about SRI in 2008. In 2008, the farmers were introduced to SRI practices and instructed to follow 12 SRI principles as best as possible. However, the SRI adoption rate (ratio of applied SRI principles against total number of SRI principles which is 12) in 2008 was 53% even in small-scale comparison plots for SRI.

In 2009, the farmers were provided intensive training and strongly urged to apply the principles, especially in comparison plots for SRI. As a result, the average adoption rate of SRI principles in comparison plots for SRI increased by 76% (see Table 2). However, SRI principles related to water management were not well practiced.

Unexpectedly, the farmers introduced several SRI principles into comparison plots for conventional practice on their own initiative. In some cases, this might have happened coincidentally because the plots were located very near to SRI comparison plots. The farmers were able to provide natural fertilizer or weeding for comparison plots for conventional practice at the same time as they did for SRI plots. However, transplanting one or two seedlings per hill or other SRI principles were introduced intentionally; that is, the farmers introduced their own ideas in hopes of discovering the optimal combination of SRI principles. The adoption rate of SRI principles in comparison plots for conventional practice was 38%.

Fig. 1 shows changes in SRI adaption rate by individual farmer in the comparison plots for conventional practice. Fig. 2 shows that for SRI both sets of figures indicate that the adoption rate from the first year of the experiment increased among all farmers except farmer E. It is noted that Farmer D applied 96% of principles in the SRI plot in 2009.

Yield

NGO staff or farmers compared the yields of SRI and conventional practice in the same three plots (Farmers A, C and E) from the first year of the experiment by quadrat sampling. In the second year, yields in SRI plot were higher than conventional practice yields in Tbong Angk and Samdack Ov villages, yet the yield increase in Chas village was little. Yields of the conventional practice plots and SRI plots were at an average of 3.1 ton/ha and 3.8 ton/ha respectively.

Table 2 Adoption rate of SRI principles by the six farmers in 2009

SRI Principles	Adoption rate of the six farmers (%)			
	Before 2008	Year 2 (2009)		
		CFP	SRI	NON
Water management				
1) level the paddy field and provide drainage	33	25	50	8
2) keep the water depth in the paddy field shallow	0	17	42	8
Nursery preparation				
3) raise nursery beds or use dry nursery beds	17	25	92	25
4) select dense seeds for sowing without mixing them with other varieties	50	67	83	67
Transplanting				
5) transplant young seedlings (seedlings upto 15 days)	0	17	67	8
6) select big seedlings and transplant them immediately	0	33	92	17
7) transplant one to two plant(s) per hill (preferably only one)	0	50	92	33
8) transplant seedlings at a shallow depth and keep the roots horizontal	17	50	58	42
9) transplant seedlings in square pattern or lines	0	0	100	8
10) transplant seedlings 25-40 cm apart	17	33	83	33
Fertilizing				
11) apply natural fertilizer as much as possible	33	67	83	67
Weeding				
12) weed at least 2-4 times a season	17	75	75	0
Average	*15*	*38*	*76*	*26*

Note: CFP: comparison plot for the conventional farming practice, SRI: comparison plot for the SRI, NON: Non-comparison plot
**Adoption rate was calculated by giving 1 point for "fully adopted", 0.5 point for "partly adopted", and 0 point for "not adopted" to each farmer, and divide the total score by the number of farmers.*
Source: Authors' data

Farming practice in non-comparison plots

One remarkable result in the second year was that four farmers (Farmers A, B, C and D) started introducing some SRI principles in their own non-comparison plots without any instruction from NGO staff; that is, under their own initiative (see Fig. 3). Of special note is that they reduced the number of seedlings per hill from the previous 5-10 plants per hill to 2-4 plants per hill.

DISCUSSION

Participatory evaluation of SRI

The farmers' perception of SRI was confirmed through semi-structured interviews at the end of the first year trial. It was confirmed that the main benefit of SRI for the farmers is "reducing number of seedlings per hill".

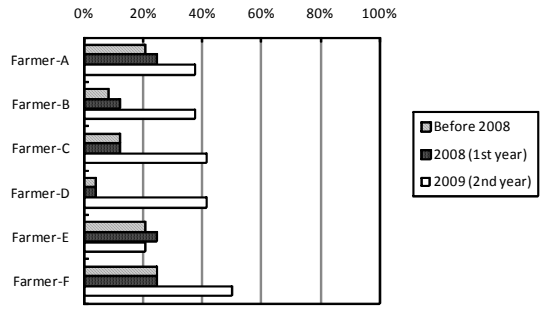


Fig. 1 SRI adoption rate in comparison plots for conventional practice

Farming practice in 2008 was assumed to be same as the practice before 2008 unless any changes were reported by the farmers.

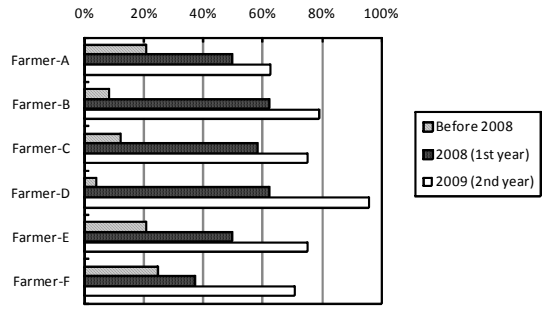
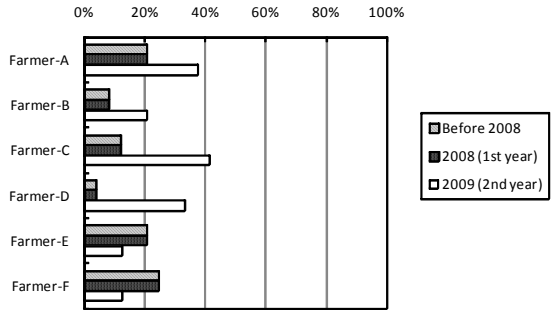


Fig. 2 SRI adoption rate in comparison plots for SRI



Farming practice in 2008 was assumed to be the same as that before 2008.

Fig. 3 SRI adoption rate in non-comparison plots

This enabled the farmers to save seed and consume more rice. The second major benefit is "reducing labor especially for uprooting". Naturally the amount of labor for uprooting could be reduced accordingly by reducing the number of seedlings. The farmers said they needed more labor for transplanting seedlings with lines, but such increment could be balanced out by reducing the labor for uprooting. The third major benefit was revealed to be "increase of yield". As expected, the farmers found larger benefit from reducing resources than increasing yield.

SRI difficulties were also confirmed. The major difficulty is "transplanting seedlings in square pattern or lines". Farmers find it difficult and time consuming to transplant seedlings in lines since they have been accustomed to random transplanting. Not owning rotary weeders, however, may very well prevent the farmers from realizing the significant benefit from line transplanting. Of special note is that no farmer introduced line transplanting in comparison plots for conventional practice though all farmers employed it in SRI plots. Probably this behavior has some symbolic meaning, showing that farmers are practicing SRI. The second major difficulty is "insufficient water". However, this complaint occurred regardless of the rice growing method. The third major difficulty is "additional weeding" and "difficulty in carrying compost from house yard to paddy by ox cart, especially if no proper road is available". Other difficulties included "difficulty in drainage" and "attitude of other villagers (villagers recognized the farmer is doing something strange)".

Finally, farmers commented that they felt (the farmers evaluated SRI as) SRI was an effective method, at least for small-scale plots, since benefits outweighed difficulties. This fact suggests improperness of evaluating SRI only by yield or economic benefit. The farmers might not always think about yield or they might not calculate economic benefit as scientists do. It must be important to include farmers' input and evaluate SRI together with farmers and from their viewpoints.

Process of introducing SRI principles

Regarding the typical process of how the farmers initiated SRI principles, two entry points were observed: "transplant one to two plant(s) per hill" and "apply natural fertilizer as much as possible". These two entry points gave impetus to the introduction of other principles. Fig. 4 and the attached explanation show the process of introducing SRI principles. Solid line arrows show relationships practiced by the farmers, and dotted line arrows indicate conceptual relationships practiced on site. "Reduce number of seedlings per hill" is clearly strongly influenced the introduction of other SRI principles.

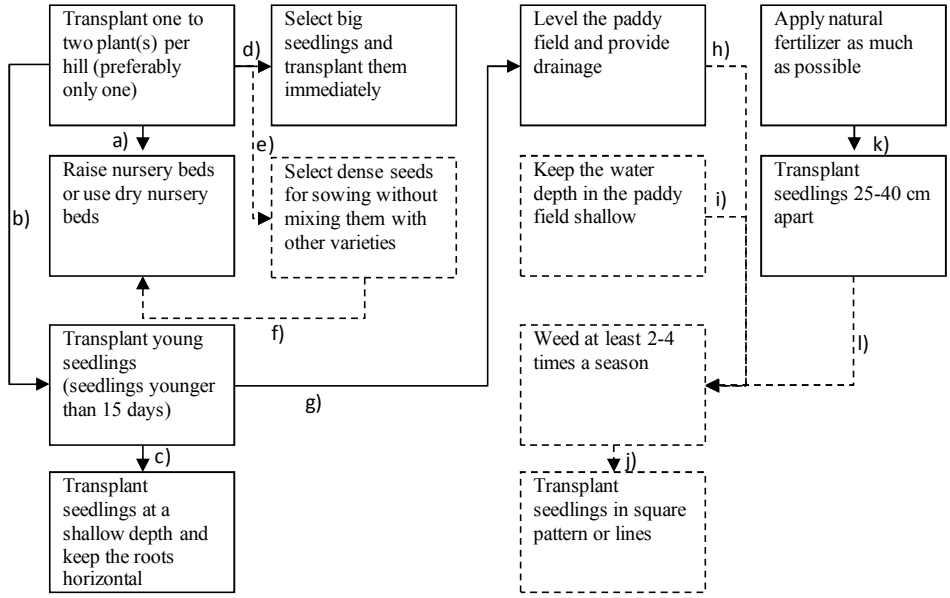


Fig. 4 Typical process of introducing SRI principles

a) Reducing number of seedlings enables introduction of raised bed nursery since a smaller area is required.
b) Reducing number of seedlings enables farmers to seed in July when rain may be infrequent. Farmers can water by watering can if the nursery is small.
c) It is possible to transplant seedlings with shallower depth, only if the seedlings are young. Old seedlings cannot support themselves if they are transplanted into shallow depth because of their weight.
d) Farmers can transplant quickly if number of seedlings are less.
e) Preparation of salt water for seeds selection becomes easier if the required number of seeds is less.
f) Improvement in germination percentage decreases mental anxiety of farmers over sparse seeding.
g) Exhaustive leveling is required to avoid submergence of young seedlings.
h) Amount of weed is increase if water is kept shallower by providing drainage.
i) Amount of weed is increase if water is kept shallower.
j) Transplanting in square pattern or lines is essential for efficient weeding with rotary weeder.
k) Transplant seedlings with wider spacing is a rational option if physical and chemical property of soil is improved by applying natural fertilizer.
l) Amount of weed cover increases if seedlings are transplanted with wider distance.

CONCLUSION

Results of the second year experiment suggest the potential advantages of SRI in rainfed lowland rice growing. Reducing resources (input) produced greater yield (output). Regardless of the type of plot, the farmers benefited. However, the SRI adoption rate remained low in non-comparison plots suggesting the possibility of some difficulty in applying SRI to larger areas. Assuming the farmers can be made to realize the full potential benefits, the researchers expect to continue the experiment and introduce SRI principles in larger plots.

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