AN ASSESSMENT OF ECOLOGICAL SYSTEM OF RICE INTENSIFICATION (SRI) IN CAMBODIA IN WET SEASON 2002

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1. Introduction

CEDAC is a Cambodian NGO founded in August 1997 with initial assistance from GRET, a French NGO. Since its creation, CEDAC has been working with farmers and other organizations in Cambodia to develop and disseminate innovations in ecological agriculture. Our program's priority has been the improvement of rice-based farming systems in rainfed lowland areas. We have been working on rice intensification since 1998, and our focus was improving soil and nutrient management practices.

It was very timely when CEDAC learned about SRI from the LEISA newsletter in December 1999 (Rabenandrasana 1999). In 2000, we received also more information on SRI from CIIFAD (Uphoff 1999 and 2000). In the wet season 2000, we integrated the elements of SRI, namely, its principles for water and plant management, into our sustainable rice intensification program.

This report summarizes the results and experiences of SRI adaptation in Cambodia since 2000, including a perspective on the future of SRI in Cambodia. This report is based on information obtained from organizations involved in SRI programs and on interviews with SRI farmers. 171 SRI farmers were interviewed by extension workers working with CEDAC, the EU-funded agricultural development project PRASAC, and the GTZ Rural Development Program.

2. SRI and Traditional/Conventional Rice Cultivation

Rice is the main staple food in Cambodia, and rice farming provides income and employment opportunity for around 65% of Cambodia's population.[1] Officially, the national average yield of rice is estimated to be between 1.65 and 1.80 tons per hectare in the wet season (MAFF 1995-2000, and FAO/WFP 1999). This is relatively low compared with other countries in the region.

Improvement of rice productivity has to be one of the main objectives of any agriculture and rural development program in Cambodia. During the last three decades, especially in the 1980s and 1990s, a lot of efforts have gone into improving traditional rice farming. These have focused on developing and diffusing recommendations for fertilizer applications and introducing improved, high-yielding varieties.

Although this approach can help farmers to increase their yields, the environmental sustainability and economic advantages of this strategy for small farmers and for Cambodia still remain an issue. Rice productivity is still relatively low compared to the growing demand for rice, while farmers' costs of production are increasing, mainly due to the costs of fertilizer and of fuel for pumping water (dry-season rice)

SRI seeks to increase rice production through improved practices for plant, water, soil and nutrient management, rather than through the use of new or purchased inputs. The main difference between SRI and the traditional/conventional system, especially in terms of water and plant management, can be explained briefly as follows.

A. Plant management

Rice plants by themselves have great natural potential to produce a lot of tillers and grain when certain associated practices are employed. This was discovered by Father Henri de Laulanié, a French priest living in Madagascar, and it can be explained in terms of scientific experimentation conducted by T. Katayama, a Japanese scientist, in the 1920s and 1930s.[2] Conventional

[1] About 85% of Cambodia's 12 million people live in rural areas, and about two-thirds of this rural population depend mainly on rice farming.

[2] The model of rice tillering developed in the 1920s and 1930s by T. Katayama was explained in the book written by Didier Moreu (GRET 1987), quoted in Rafaralahy (1999)

management practices for transplanted rice seedlings suppress this potential or ignore it, while SRI practices help farmers to capitalize upon this biological potential effectively.

B. Water management

Rice is not an aquatic plant, and its root development under flooded conditions is inhibited and ultimately reduced. A majority of the rice roots growing in flooded soil degenerate by the time of panicle initiation (Kar et al. 1974). Rice fields are traditionally maintained continuously flooded while with SRI, one avoids continuously saturated soil during the vegetative growth period. Table 1 presents the main differences between SRI and the usual system of rice cultivation.

Table 1: Differences between SRI and Common Traditional Practices in Rice Cultivation

PLANT MANAGEMENT	
SRI	Traditional
- Produce vigorous seedlings for transplanting, raising seedlings under garden-like conditions, and using low density of seed - Transplant young seedlings, 8 to 15 days - Select only vigorous seedlings for transplanting - Transplant quickly and carefully, and plant seedlings singly, one by one - Transplant with wide spacing - Roots are placed into the soil horizontally and shallow, 1-2 cm, when transplanting - Transplanting is done in a square pattern, wide spacing (25x25 cm is recommended as a starting distance) - Punctual and frequent weeding is done to improve soil aeration and to remove weed competitor; by using a rotary weeder, the weeds remain in the soil to decompose	- Seedlings are raised in fields with saturated soil conditions and high seed density - Mature seedlings, generally between 1-2 months old, are transplanted - Mixture of weak and strong seedlings used in transplanting - Forceful uprooting of seedlings from bed - Seedlings are kept in transit as much as 1-2 days before transplanting - Transplant many seedlings per clump, generally more than 5 - Roots are placed very deep into the soil - Transplanting is done with close spacing - No regular weeding is done, only when seen to be needed; weeding is considered as the removal of a rice competitor
WATER MANAGEMENT	
SRI	Traditional
- Transplant when there is no flooded water standing in the rice field; the soil should be only moist and muddy - Improve soil aeration by draining water from the rice field or by keeping the rice field from being continuously flooded and saturated during the vegetative growth phase - Rotate crops on rice fields in wet and dry seasons to improve soil aeration -	- When field is flooded or saturated, this is considered good for transplanting and for growing the rice crop - The paddies are kept inundated permanently during the entire growth cycle

C. Soil/nutrient and pest management

In addition, there is a set of improved management practices for better soil, nutrient and pest management that we are developing with farmers. Most of the ideas and techniques are based on the principles and techniques of ecological soil and pest management. They are quite compatible with what has been presented as SRI.

3. SRI Principles and Practices Recommended by CEDAC

The list of good practices in rice cultivation that we recommend to farmers can be summarized as below:

Improved seed and seedling management practices

- Select full-sized grains as seed for sowing and planting
- Prepare a raised-bed nursery, similar to vegetable bed
- Sow lower density of seed to ensure that seedlings are strong
- Select only strong seedlings for transplanting

Improved methods of uprooting and transplanting

- Uproot the seedlings gently and carefully to avoid plant and root damage
- Transplant quickly after uprooting, 15-30 minutes if possible
- Transplant carefully and with shallow rooting
- Transplant younger seedling, preferably 8 to 12 days and less than 15 days old
- Transplant fewer seedling per clump, preferably one seedling per clump
- Wide spacing and transplanting in square pattern

Improved methods in water control

- During transplanting, the field should not be flooded or only with minimal standing water
- Avoid permanent flooding of the rice field during the vegetative stage; preferably only a minimal of water should be applied to the field, just enough to meet plant needs so roots will grow deep

Improving methods of weeding

- Early and frequent weeding; preferably the first weeding should be done around 8-10 days after transplanting, and the number of weeding should be 4 if possible
- Use a rotary weeder or similar tool to ensure that soil is loosened

Improved methods in soil fertility and nutrient management

- Application of compost, preferably around 3-5 tons per ha
- Use rice straw, rice stubble and rice husk for soil improvement. returning to the soil what is harvested from the soil, especially to mulch the field
- Grow green manure and cover crops before and/or after rice

In addition, CEDAC also encourage experimentation with zero-tillage technology, rice-duck and rice-fish integration as elements of its ecological system of rice intensification program.

4. Progress of SRI Adoption/Adaptation in Cambodia in 2002

4.1. Organizations involved in SRI program

After the first successful field experimentation by cooperating farmers of CEDAC in 2000 and 2001 (CEDAC 2001, CEDAC 2002), there is growing interest among development practitioners in SRI. Organizations involved in implementing SRI program in Cambodia in 2002 were, with indication of the provinces where they worked on SRI:

- CEDAC in Prey Veng, Takeo, Kandal, and Kampong Cham
- GTZ-Rural Development Program in Kampot and Kampong Thom
- PRASAC (European Union-funded project) in Prey Veng, Takeo, Kampong Speu, and Kampong Chhnang
- ADRA in Siem Reap
- Khrom Aphiwat Phum in Battambang
- Aphiwat Strey in Battambang
- Chamroeun Cheat Khmer (CCK) in Takeo
- Khmer Farmer Association (KFA) in Kandal
- Neak Aphiwat Sahakum (NAS) in Kampong Cham
- SSC in Kampong Speu
- NTFP and CEDAC in Rattanakiri
- Padek in Prey Veng
- CRS in Svay Rieng

In addition, Oxfam/GB has also played an important role in supporting local NGOs to implement SRI in several provinces of Cambodia. With the cooperation and support from the above-mentioned organizations, especially PRASAC and GTZ, SRI has spread very fast among farmers in Cambodia.

4.2. Result of SRI adaptation/adoption by farmers

2002 is the third year of field evaluation of SRI by farmers. Farmers who tested SRI since 2000 continue to apply SRI on larger areas. In addition, increasing numbers of farmers also joined the SRI movement in 2002, especially through farmer-to-farmer extension as well as through the expansion of SRI farmer training program in new villages.

Table 1: Information SRI Adoption/Adaptation by Farmers

	2000	**2001**	**2002**
Number of farmers	28	500	3000
Number of villages	18	122	350
Number of provinces	4	7	11
Average yield (t/ha)	5.0	3.2	3.5*
Average area used for SRI (ha/family)	0.06	0.07	0.30
Total area under SRI	1.6	28.7	900

Note: *Based on the result of the survey of 171 SRI farmers

Not only is the number of farmer is increasing, but also the area used for SRI is increasing. There are two reasons for this:

- Experienced SRI farmers have more confidence in the practices, and they are now more skillful
- New SRI farmers have confidence in the technology as they saw the results from other farmers

It is important to note that there now farmers who apply SRI in all their rice cultivated areas.

With regard to yield, on average SRI farmers were able to harvest around 3.5 tons per ha. Interestingly, around 10 % of farmers are able to harvest more than 5 tons per ha. This result is similar to the pattern seen in the wet season of 2001 (see also CEDAC 2002)

Table 2: Frequency Distribution of Yields with SRI

Yield group	Frequency	Percent	Cumulative percent
Less than 1 t/ha	2	1	1
1-2 t/ ha	19	11	12
2-3 t/ha	45	26	39
3-5 t/ha	77	45	84
5-10 t/ha	28	16	100
Total	171	100	--

Source: Farmer interviews, December 2002

If compared to traditional practices, there is around 130 % increase of yield (see Section 2 with Table 1). In addition to yield increase, farmers also gain other benefits from SRI practices, such as lower expenditure on chemical fertilizer (about 50% less than than traditional), and a lesser amount of seed (around 46%). Actually, the amount of seed used is much less than indicated by farmers because all farmers said that after transplanting they still had seedling available, which implies that they used more seeds than required for actual transplanting.

Table 3: Comparison of Yield and Selected Inputs in SRI and Traditional Systems

Parameter	SRI in 2002	Traditional system in 2002
Yield (kg)	3.5	1.5
Seed (kg)	42	78
Chemical fertilizer (kg/ha)	66	133 (kg/ha)
Organic fertilizer	5-10 t/ha	No data

Source: Farmer interviews, December 2002

It is important to note that farmers still use a large amount of seeds as the majority of them did not have enough experience yet with SRI. They tend to use more seeds as they are afraid of not having enough seedlings for transplanting. As the result, there was the surplus of seedlings. According to good SRI farmers, only around 10 kg of seeds or less are needed for planting one ha.

3.3. Assessment of degree of farmer adoption of SRI of selected best practices

Based on farmer interviews, there is variation in term of adoption of SRI practices among farmers. As seen from Table 4 below show, no farmers adopted all of the recommended SRI practices. Growing green manure or other crops before the rice crop has the lowest adoption, because this practice has not been yet widely promoted by the project. In addition, growing green manure is associated with the risk of being eaten by free-grazing cows.

Transplanting of young seedlings and transplanting in rows, with exact spacing, also have very low adoption. For farmers who apply SRI in the first year, this is the most difficult practice, but for experienced SRI farmers, it is not the problem anymore.

Uprooting the seedlings carefully is also still a problem as most farmers accustomed to using a lot of force to uproot seedlings, and they beat the root to remove the soil. This practice particularly needs to be stopped.

Table 4: Degree of Farmer Adoption of Selected Recommended SRI Practices

Recommended SRI practices	Number of farmer who applied the practices	Percentage
Selecting only full grain seeds for sowing	123	72
Seedlings grown on raised bed (not flooded)	121	71
Sowing seed with lower density	148	87
Careful uprooting without damaging the roots	113	66
Uprooting only strong seedlings for transplanting	108	63
Immediate transplanting after uprooting	115	67
Shallow-rooted transplanting	164	96
Transplanting young seedling (<20 days)	73	43
In-row transplanting	75	44
Weeding	144	85
Application of compost	152	89
Good water management and control	142	83
Growing a green manure or other crop before rice	20	12

Source: Farmer interviews, December 2002

For the some of the key SRI practices, following adoptions were reported:

- The average age of the seedling is 28 days. This is much older than the <15 days recommended, so there could be some significant opportunities for further yield improvement by more complete use of SRI methods.
- The average number of seedling per clump is 1.20. This is close to the recommendation.
- The average spacing of seedlings is 25-30 cm. This is within the preferable range.

3.4. Farmer opinions and perceptions about SRI and labor input

Farmers were asked to give their perceptions and opinions on the impact of SRI on their yield, seed and labor requirements. Very interestingly, a majority of farmers claimed that with SRI, there is the decrease of labor input, which is contrary to the opinion of SRI critics. The decrease of labor input is mainly due to the decrease of labor for uprooting and transporting seedlings and for transplanting, since so many fewer plants are involved.

Table 5: Farmer Assessments of Labor Requirements with SRI

	Increase		No Change		Decrease	
	Number of responses	%	Number of Response	%	Number of Response	%
Labor input	10	7	32	22	102	71

Source: Farmer interviews, December 2002

3.6. Plan of Farmers for Implementation of SRI Program in 2003

All farmers interviewed said that they will continue to apply SRI. With regard to cultivated area, they plan to expand from 0.3 ha to around 0.6 ha. They also expect that there will be more farmers in their neighborhood who will apply SRI.

With regard to SRI practices in the next season, most farmers plan made following changes and improvements:

- Improve their nursery management
- Reduce the age of seedling
- Introduce row transplanting
- Increase the application of compost

4. Conclusion

- After 3 years of field evaluation by farmers, SRI appears to be widely accepted by an increasing number of farmers and development organizations. The field experiences under rainfed condition in 3 consecutive years have shown that with SRI, farmers are not only able to increase rice production by 2 to 3 times, but they can reduce their costs for seeds and fertilizers. Even the labor input does not pose any problem or constraint to farmers in adopting SRI.

- SRI is a gradual process of adoption or improvement of farmer practices. It takes several years for farmers before they become skillful in applying SRI practices, especially using young seedlings, row transplanting, and careful, quick transplanting.

- In order to ensure that SRI can be widely applied by farmers in Cambodia, there is a need to let farmers to have opportunities to see and/or meet other SRI farmers and to see SRI fields of other farmers. They should also have opportunities to test SRI by themselves. This would contribute to developing positive attitudes of farmers toward SRI, which is important for the success of SRI application.

- Based on the results of the SRI program from 2000 to 2002, CEDAC expected that by the end of 2003, there will be around 10,000 farmers applying SRI in Cambodia, but the actual number was probably 9,000. Still, if this growth trend continues, we expect that within 5-10 years, the majority of rice farmers in Cambodia (around 1.7 million farm households are doing rice farming) would participate in the SRI movement. Based on experience to date, the target for SRI users in 2004 is 50,000 farmers.