ISSN 1560-7607 / ISBN 978-99950-52-05-8

CAMBODIA DEVELOPMENT REVIEW

A publication of CDRI—Cambodia's leading independent development policy research institute

VOLUME 19, ISSUE 2 JUNE 2015 $4.00

CLIMATE-SMART AGRICULTURE: SYSTEM OF RICE INTENSIFICATION IN CAMBODIA

Background

Agriculture plays an important role in sustaining rural livelihoods in Cambodia, with 83 percent of rural people engaged in agricultural activities (NIS and MAFF 2014). In response to changes in climate and weather, a key feature of emerging adaptation and resilience agenda is the adoption of climate-smart agricultural practices. "Climate smart farming is agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals" (FAO 2013, 2).

Farmers prepare their land for wet season rice, Kompong Thom, May 2015

The system of rice intensification (SRI) is one such climate-smart practice, introduced by CEDAC (Centre d' Etude et de Developpement Agricole Cambodgien) in 2000. Since its development, various NGOs and government agencies have shifted their focus towards SRI, promoting it nationwide. The SRI Secretariat was set up in January 2005 under the Department of Agronomy and Agricultural Land Improvement, later changed to the General Directorate of Agriculture (Ngin 2010).

SRI is a low-water, labour-intensive organic method based on transplanting young seedlings at wide spacing. It combines a set of best practices that can increase rice yield on poor soils up to 15 tonnes per ha, reduce irrigation water requirements, and use only local inputs (Stoop, Uphoff and Kassam 2002; Uphoff 2007; Kassam, Stoop and Uphoff 2011). Original SRI practices were developed for irrigated rather than rainfed farming and involved planting single 8-12 day-old (instead of clumps of 30-35 day-old) seedlings in a 25cm x 25cm square pattern, intermittent (rather than continuous flooded) irrigation, application of organic matter, preferably compost (as opposed to reliance on external inputs), and regular weeding.

In this Issue

This article was prepared by Sam Sreymom, research associate, Environment Unit. It may be cited as Sam Sreymom. 2015. "Climate-Smart Agriculture: System of Rice Intensification in Cambodia." *Cambodia Development Review* 19(2):1-6. Phnom Penh: CDRI.

Table 1: Study sites

Agroecological area	Province	District	Commune
Tonle Sap	Kompong Chhnang	Samaki Meanchey	Thlok Vien
		Teuk Phos	Tang Krasang
	Kompong Thom	Prasat Ballangk	Sala Visai
		Stung Saen	Ou Kanthor
Lower Mekong	Prey Veng	Kanh Chriech	Chong Ampil
		Ba Phnom	Theay
	Takeo	Koh Andaet	Krapum Chhuk
		Tram Kok	Trapeang Thom Khang Cheung

Rather than a rigid set of agronomy techniques, the principles of SRI are flexible and can be modified (Uphoff 2007). Thus, the system continues evolving to suit local conditions as farmers adapt to creeping climate change, though its core principles and practices remain the same. Today's SRI practices are being adapted for rainfed (nonirrigated) farming and include direct seeding through broadcasting.

This article draws on the findings of a larger study (Sam and Ouch 2015) to identify local knowledge and SRI practices in the Tonle Sap and Lower Mekong agroecological areas. It looks at gaps in local practices and suggests ways of closing those gaps to help cope with the effects of climate change.

Method

Primary data was collected from seven focus group discussions (FGDs), eight in-depth interviews and 11 key informant interviews (KIIs) with respondents at selected study sites in Kompong Chhnang, Kompong Thom, Prey Veng and Takeo provinces (see Table 1). Secondary data consisted of qualitative information on SRI practices in the target provinces, gathered from various institutions' reports and other documents.

KIIs were held with representatives from provincial departments of agriculture (PDAs), district agricultural offices (DAOs), Ministry of Agriculture, Forestry and Fisheries, Cambodia Climate Change Alliance,[1] Cambodian Agricultural Research and Development Institute, CEDAC and climate-related projects including HARVEST[2] and PADEE.[3] FGDs involved commune chiefs, commune councillors responsible for agriculture within the commune, and the head or members of local farmer water user communities.

Key findings

Adoption of SRI practices

The extent to which SRI practices have been adopted varies according to agroecological area and socioeconomic conditions. In addition, the application of SRI principles in rainfed and irrigated systems is not distinct because farmers cannot control the amount of water on their plots due to lack of drainage. In the visited communes, some SRI principles and practices have been only partly adopted or not adopted at all (Table 2). This largely reflects farmers' integration of those practices as they adapt to specific circumstances. SRI is therefore applied differently across areas and even within the same village.

Variety selection: Farmers from the selected communes grow three varieties of rice: modern (IR 66, 504 and 85), improved traditional (Raing Chey, Phka Rumduol, Somaly and Phka Malis) and traditional (Kronhol, Neang Khon and Neang Tom). FGD participants said that farmers prefer to grow modern varieties in the early wet and dry seasons because of their market value, suitability for farm conditions, preferred eating quality, higher yields and reduce risk and disease resistance. Specifically to cope with climate variability, farmers have changed from photoperiod-sensitive late maturing to photoperiod-insensitive early maturing varieties.

1 Cambodia Climate Change Alliance provides grants to many local NGOs to work on climate change adaptation.

2 Helping Address Rural Vulnerabilities and Ecosystem Stability is funded by the United States Feed the Future and Global Climate Change initiatives.

3 The Project for Agriculture Development and Economic Empowerment, through support from International Fund for Agricultural Development, focuses on improving poor people's livelihoods by providing agricultural technologies and establishing local savings groups.

Seed and seedling preparation: Most farmers have developed their own methods to prepare seeds for broadcasting and seedlings for transplanting. Some have updated their practices as their knowledge of techniques and technologies improved through training provided by PDA/DAO and NGOs. Seed preparation depends on local conditions. Rather than applying the exact techniques from training, farmers combine some components of the recommended practices they have learned with their usual practices and local knowledge.

Field preparation: Farmers prepare rice land before planting by ploughing, harrowing and levelling their fields. Ploughing (by hand, by animal traction or mechanically) is normally done twice, or thrice for weedy fields; levelling (manual or mechanical) is done once. In practice, however, the frequency depends on ploughing techniques, planting methods and affordability.

Planting methods: Original SRI practices exclude direct sowing, yet transplanting occurs in only four of the eight communes visited. The age of the seedlings when transplanted depends on the variety and water availability. Farmers have learned that young seedlings are productive and try to use them whenever they can, water supply allowing. The decision whether to grow from transplants or seed depends on local environmental conditions and practices. Strong, healthy transplants can compete with weeds and better tolerate pest damage in early crop establishment. In some areas, farmers broadcast seed because they either cannot or do not want to spend time checking their fields. Now, due to labour shortage, some farmers have switched to broadcasting even though they know that yields are lower. Some have adopted SRI practices: selecting vigorous, young seedlings and planting them in wide rows at a low density of 1-3 seedlings per hill.

Table 2: Adoption or adaptation of SRI practices by province and commune

Practice	Details	Kg Chhnang		Kg Thom		Prey Veng		Takeo	
		Thlok Vien	Tang Krasang	Ou Kanthor	Sala Visai	Chong Ampil	Theay	Krapum Chhuk	Trapeang Thom Khang Cheung
Variety selection	High yielding	√	×	×	√	√	√	√	√
	Pest, drought and flood tolerant	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Ecosystem suited	√	√	√	√	√	√	√	√
	Market demand	√	√	√	×	√	√	√	√
Seed preparation	Seed preparation	√	√	√	√	√	√	√	√
Field preparation	Ploughing	√	√	Δ	√	Δ	Δ	Δ	√
	Harrowing	√	√	√	√	√	√	√	√
	Levelling	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Seedlings	Age of seedlings	Δ	Δ	×	Δ	×	×	×	Δ
Planting methods	Direct seeding	×	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Transplanting	Δ	Δ	×	Δ	×	×	×	Δ
Fertility management	Organic materials	Δ	Δ	×	Δ	Δ	×	×	Δ
	Inorganic fertiliser	Δ	Δ	Δ	Δ	Δ	Δ	Δ	×
Water management	Water storage	×	×	×	Δ	Δ	Δ	×	×
	Water depth	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Intermittent irrigation	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Weed management	Weeding	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ

Note: √ =fully adopted/adapted; Δ =partly adopted/adapted; x =not adopted at all.

Table 3:Factors encouraging and discouraging the use of SRI, by commune

Commune	Labour requirement	Land (No. of plots, size and distance)	Mind set and local practices	Access to water	Access to inputs	Access to market	Access to information	Rural institutions	Risk	Yield	Weeds
Thlok Vien	-/+	-	-	-		-/+	+	-/+	+	+	+
Tang Krasang	-		-	-/+	-/+		-/+		-	+	
Ou Kanthor		-	-/+	-/+	-/+	+	-/+	+	+	-	+
Sala Visai	-	-		-/+	-/+	+	-/+			+	+
Chong Ampil	-		-	-	-/+	-/+	-/+	+		-	
Theay	-			-/+	+	+	+	+	+	+	
Krapum Chhuk	-	-		-/+	-/+	-/+	-/+	+		-	
Trapeang Thom Khang Cheung	-/+	-	+	-/+	-/+		-	+		+	

Note: (-) discouraging factor; (+) encouraging factor.

Table 4: Factors encouraging and discouraging adoption of individual SRI practices

Practices	Details	Labour requirement	Land (No. of plots, size and distance)	Mindset and local practice	Access to water	Access to inputs	Access to market	Access to information	Rural institutions	Risk	Yield	Weeds
Variety selection	High yield				-/+	-/+	-/+	-/+	-/+		-/+	
	Pest, flood and drought tolerant		+	+	-/+	-/+	-/+	-/+	-/+	+		+
	Suit to local conditions		+	-/+				-/+	-/+	+		
	Market demand		-/+		+	-/+	+	-/+	-/+			
Seed preparation	Seed preparation		-/+	+	-/+		+	+		+	+	
	Nursery preparation		-/+	-/+	-/+		+	-/+			+	
Field preparation	Ploughing		-/+			-/+	+		-/+		+	+
	Harrowing					-/+	+				+	
	Levelling	-/+	-/+			-/+	+	-/+			+	+
Seedlings	Age of seedlings			-/+	-/+		+	-/+		-	+	
	Field preparation		-/+	-/+	-/+		+	-/+			+	
Planting methods	Direct seeding	+	+	-/+	-/+	+	+	+			+	-
	Transplanting	-/+	-/+	-/+	-/+		+	-/+	+		+	+
Soil improvement	Organic materials	-	-/+	-/+	-/+	-/+	+	-/+	+	+	+	
	Inorganic fertiliser		-/+	-	-/+	-/+	+	-/+	+		+	
Water management	Water storage		-/+		-/+		+	-/+	-/+	+	+	
	Water depth	-		-	-/+		+	-/+		-/+	+	
	Intermittent irrigation	-		-	-/+		+	-/+		-/+	+	
Weed management	Weeding	-/+	-/+	-/+	-/+	-/+	+	-/+	-/+	-/+	+	-/+

Note: (-) discouraging factor; (+) encouraging factor.

Farmers who broadcast use different seeding rates to those recommended in SRI depending on locality and variety. In Takeo, Prey Veng and Kompong Thom provinces, some farmers who grow IR504 conduct their own field tests to calculate how much seed is needed.

Soil fertility management: Organic matter can sustain high yields, enrich soil structure and increase water and nutrient retention. Compost is applied in five of the communes, whereas farmers in Ou Kanthor, Theay and Krapum Chhuk think it takes too long to produce good results and find it hard to transport to their distant, dispersed fields. Recommended compost application rates vary according to soil type. In practice, the amount applied is lower because farmers apply only as much as they can make or transport. If sufficient organic matter is not available or fields are too far away, chemical fertilisers may be used. After much training, some farmers have learned about different types of fertiliser, what and how much to apply to various soil types and when. Others apply excessive amounts of fertiliser without knowing how much to use in the belief they will get higher yields.

Water management: Even low-input irrigated fields are more productive than rainfed ones. A central principle of SRI is keeping the soil moist through intermittent irrigation rather than continuously saturated. The water level and watering regime (frequency and duration of flooding) is defined for each phase of rice development, though fields have to be completely level for this low-water technique to be effective. Through training provided by PDA and NGOs, farmers have a good understanding of the level of water needed for rice development. In rainfed areas, some farmers seem to apply SRI irrigation practices well, while others who do not have ponds, dykes or streams to store or drain excess rainwater find it hard to keep the required shallow level of water on their fields. In irrigated areas, where farmers commonly drain water through adjacent fields, maintaining a shallow water level can also be problematic if there is no drainage system. Also, in areas where irrigation water is charged for, farmers rarely let water flow from their fields. Most of the fields in the visited communes were reported by farmers to be uneven because they could not afford to have their fields mechanically levelled.

Weed management: When fields are not flooded continuously, weeds often grow more vigorously. Conversely, wider row spacing may allow plants to outgrow weeds in the early stages of growth. Weeding is mostly done manually, though some farmers apply herbicides. Farmers know when to start weeding and how to prevent specific weed species from taking hold.

Factors affecting adoption of SRI

The interviews and focus groups identified many factors affecting farmers' adoption of SRI. These factors are summarised in Table 3, and their effect on the take up of individual SRI practices is summarised in Table 4. Aspects that attract farmers to adopt SRI practices include:

- reduced labour requirement for transplanting, broadcasting and weeding
- suitability for small farming systems
- positive results
- positive mindset
- sufficient water
- availability of pure seeds, organic materials, fertilisers and machinery
- access to markets, technical information and rural institutions
- reduced risk
- high yield
- lower weed density.

Factors that deter farmers from adopting SRI practices are:

- labour requirement for transplanting, levelling, weeding and inspecting water level
- unsuitability for multiple or large plots
- traditional mindset and habits
- insufficient water
- lack of production inputs
- limited access to market, technical information and rural institutions
- risk associated with lower seeding rate/ transplanting density and higher weed density.

Conclusion and recommendations

SRI is a method for increasing rice productivity by improving the management of soil, water, nutrients and weeds. The findings suggest that once farmers decide to upgrade their production,

they not only adopt SRI practices but also adapt them to fit local conditions. However, farmers select only the practices they think are feasible and beneficial. Feasible means easy to implement and in keeping with local agroecological and socioeconomic conditions. This is effective in the current circumstances of rural Cambodia, where access to individual elements for agricultural adaptation to climate change is still limited.

The deciding factors most likely to encourage farmers to adopt SRI practices are higher yields and better market access. On the other hand, labour requirement and land endowment (number of plots, size and distance) are likely to deter farmers from considering SRI. Other factors can either encourage or discourage adoption of SRI.

SRI practices of variety selection (with the exception of pest/drought/flood resistant varieties), seed preparation and harrowing (field preparation) seem to have been fully adopted, whereas seedling selection, planting methods, ploughing and levelling, soil improvement, water management and weed management have been only partly adopted.

Improving the adoption of SRI in Cambodia requires urgent efforts to both bridge the gaps between ideal or recommended practices and actual implementation and address the issues contributing to those gaps. While national efforts require ongoing attention, local efforts that do not depend on external support are also important in helping farmers cope with climate variability and change. Importantly, local communities need to mobilise local resources. Collective action is therefore required to share technical information and adapted practices, facilitate access to markets and inputs, identify local water storage options and share risks and labour.

NGOs should collaborate more closely with departments involved with climate change adaptation and SRI to expand coverage of climate-smart agriculture. They should also focus more on local innovations, consider the complex technical requirements of SRI and look at adaptations for each of the main practices. Further, NGOs and the government through extension agents should provide market advice to help farmers establish links to markets themselves. Subject-matter specialists and institutions also have to be engaged in research and development. Government should not only increase the number of village agents but also mobilise local people to work together in delivering local extension services.

References

FAO (Food and Agriculture Organization). 2013. *Facing the Challenges of Climate Change and Food Security: The Role of Research Extension and Communication for Development*. Accessed Jul 2015, www.fao.org/docrep/018/i3334e/i3334e.pdf.

Kassam, Amir, Willem Stoop and Norman Uphoff. 2011. "Review of SRI Modifications in Rice Crop and Water Management and Research Issues for Making Further improvements in Agricultural and Water Productivity." *Paddy and Water Environment* 9(1): 163-180.

MOE and UNDP (Ministry of Environment and United Nations Development Programme). 2011. *Cambodia Human Development Report 2011*. Phnom Penh: UNDP.

Ngin Chhay. 2010. "Overview of SRI Application and Adoption in Cambodia." Presentation at workshop on Consolidation of SRI Experiences, Lessons and Networking, Hanoi, Vietnam, 21-22 June.

NIS and MAFF (National Institute of Statistics and Ministry of Agriculture, Forestry and Fisheries). 2014. "Census of Agriculture in Cambodia 2013: Preliminary Report." Phnom Penh: NIS and MAFF.

Sam Sreymom with Ouch Chhuong. 2015. *Agricultural Technological Practices for Climate Change Adaptation*. Working Paper Series No. 100. Phnom Penh: CDRI.

Stoop, Willem A., Norman Uphoff and Amir Kassam. 2002. "A Review of Agricultural Research Issues Raised by the System of Rice Intensification (SRI) from Madagascar: Opportunities for Improving Farming Systems for Resource-Poor Farmers." *Agricultural Systems* 71(3): 249-274.

Uphoff, Norman. 2007. "Farmer Innovations Improving the System of Rice Intensification (SRI)." *Journal of Pure and Applied Microbiology* 9(2): 57-62. Accessed 12 Jul 2014. www.future-agricultures.org/farmerfirst/files/T1a_Uphoff.pdf.