LAO PEOPLE'S DEMOCRATIC REPUBLIC

Peace-Independence-Democracy-Unity-Prosperity

Diversified Farming Promotion Project
for SRI Farmers in Luangprabang Province
JICA Partnership Program

Guideline on Luangprabang SRI

September 2018

Project Team of PAFO/DAFO Luangprabang
and
Pro-net 21

Guideline on Luangprabang SRI

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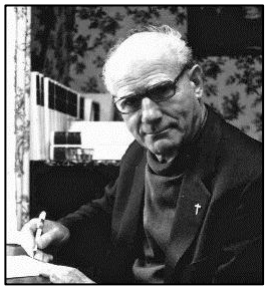
Part A

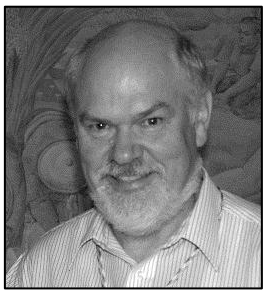
Outline of SRI in Laos

1. What is SRI?



In recent years the groundbreaking method of rice cultivation known as SRI has drawn global attention. SRI is a method of rice cultivation that was synthesized in 1983 by Father Henri de Laulanié, S.J, who had come to Madagascar, after decades of study and experimentation. When he made it public, he called it the System of Rice Intensification (SRI).

SRI became known throughout the world thanks to the efforts over many years of Professor Norman Thomas Uphoff of Cornell University's International Institute for Food, Agriculture and Development (CIIFAD).



If Fr. Laulanié was the birth parent of SRI, then Prof. Uphoff was the parent that raised it.

The modern-day challenges we face on a global scale are in the background of this growing interest in SRI. Along with the growing demand for food that accompanies worldwide population growth, the production environment for agricultural products is insufficient-- a severe food shortage on a global scale is anticipated in the near future. It can be said that there is an urgent need to work towards increasing food production, and this need is a global one. Beginning back in the late 1960s, the "green revolution" saved Asia from a food crisis by dramatically increasing the rice yield per plant.

Since the green revolution, many developing countries have constructed irrigation systems in addition to using improved varieties of rice, and they have increased inputs such as water and fertilizer, but in recent years the rice yield per unit of area (unit crop) has peaked.

With the scarcity of resources and escalation of prices, many countries will be forced to limit fertilizer usage which could result in lower yields. In addition to this, there are regions where the chemical fertilizers and other agrochemicals that have accompanied the green revolution have damaged the soil and the environment. Indeed, there is now some doubt about the very concept of increasing rice production through the application of vast amounts of resources.

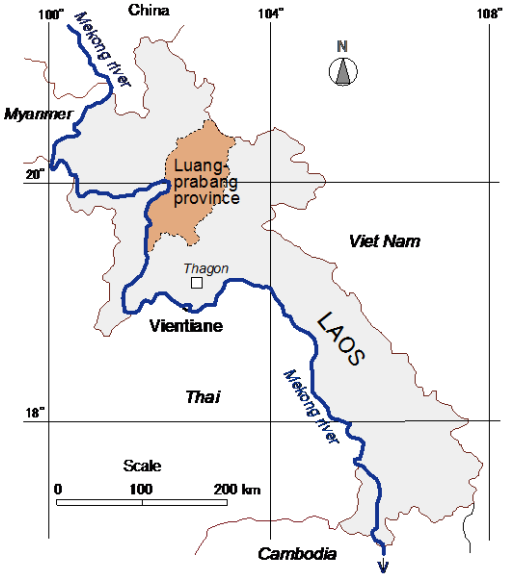
Due to the background mentioned above, SRI has drawn attention because it is a method of rice production which can increase yields while decreasing the use of resources such as fertilizer, agrochemicals, water and seed rice. In the regions that have introduced SRI, yields in the area of 1.5 times those of conventional cultivation are achieved, and as high as nearly 2 times the yields in some cases.

Also, with conventional rice cultivation, the surfaces of the fields are flooded for long periods of time. This results in the deoxidization of the surface soil which causes the formation and release of greenhouse gasses (methane). With SRI, irrigation is periodically stopped, allowing the

surface of the rice fields to dry out. This increases the amount of nitrous oxide and dramatically reduces the production of methane gas. So, not only does SRI reduce the amount of fertilizer and other agrochemicals needed, it contributes to improvement of the global environment.

2. Initiation of SRI in Laos

2.1 Formation of SRI Project



In Laos, SRI was introduced first in 2001 by international NGO, the Austrialian affiliate of Oxfam. However, the progress of expansion of SRI was still very limited as of 2007.

The Lao National Agriculture Research Center (NARC) sponsored a number of on-farm trials with SRI during the dry season 2001/02 and the rainy season 2002. According to its final report on these results, NARC concluded that "the likelihood of disseminating SRI throughout Laos is extremely slim." The reasons given for this dismissal of SRI were: (i) It is impossible to perform intermittent irrigation according to a set schedule during the rainy season; (ii) The irrigation systems of Laos were designed to irrigate from plot to plot, so managing water for individual farm plots is difficult; (iii) To be suitable for SRI, the land must be very fertile, or, if not, then extremely large amounts of fertilizers must be applied to boost the soil's fertility, and considering the current situation in Laos, this is not realistic; (iv) In particular, large-scale application of organic fertilizers is difficult.

Because of this report, the government's agriculture agencies did not engage in extending SRI activities until the Department of Irrigation began working with SRI in the 2006/07 dry season.

In May 2006, Mr. Kazuyuki Shimazaki, team leader for the Northern Community-Managed Irrigation Sector Project (NCMI) financed by ADB, received a report on SRI experience in Indonesia from Mr. Shuichi Sato (Nippon Koei). He discussed the possibility of SRI promotion with the project director for NCMI, Mr. Phaythoune Phomvixay, who was tremendously interested and decided to start performing trials of SRI under NCMI in Sainyabuli and Luanaprabang provinces at 12 sites (0.36 ha in total) from the 2006/07 dry season cropping.

In parallel with the trials by NCMI, Mr. Shimazaki arranged to promote a SRI extension project through a Japanese NPO with which he was active, (Pro-net 21), getting technical and small-fund assistance from the JICA Partnership Program.

The ensuing SRI extension program with JICA assistance was promoted by Mr. Shimazaki continuously for the next 11 years in 3 phases as follows.

SRI Phase-1 Project:	Livelihood Improvement Project for the Rural Poor in Laos with Increase of Rice Production by Adopting Low-Input Rice Farming Technology 'SRI' (System of Rice Intensification) *(September 2007 – June 2010)*
SRI Phase-2 Project:	SRI Extension Project in Luangprabang Province *(October 2010 – Septmber 2013)*
SRI Phase-3 Project:	Diversified Farming Promotion Project for SRI Farmers in

2.2 Strategy to Implement these Projects

The objective of these SRI projects was to increase the number of SRI farmers who can manage SRI paddy cultivation through capacity-building so that their increased productivity can be self-sustainable after the project is completed.

The Government offices responsible for SRI promotion have been the PAFO (Provincial Agricultural and Forestry Office) and the DAFO (District Agricultural and Forestry Office) through field SRI extension activities. All extension workers are attached to the DAFO, so proper understanding and cooperation from high officials of both the PAFO and DAFO are the key for success of SRI promotion.

Financial support from the JICA Partnership Program (the contracted amounts with NPO Pro-net 21) are as follows.

- SRI Phase-1 Project (3 years): ~ Yen 9 million (US$ 77,000)
- SRI Phase-2 Project (3 years): ~Yen 9 million (US$ 100,000)
- SRI Phase-3 Project (5 years): ~ Yen 33 million (US$ 330,000)
- Total amount (11 years): ~ Yen 51 million (US$ 507,000)

In response to the resources available, the allocation of budget to cover the necessary activities was set as follows.

- Training costs for PAFO and DAFO staff by NPO experts (direct costs only);
- Office equipment and running costs of the PAFO Luangprabang SRI office;
- Field visit allowance for the Project Manager and staff of the SRI office;
- Motorbike fuel support for DAFO extension workers;
- Meeting costs of the Project Steering Committee (PSC) in Luangprabang, the DAFO feedback meetings at PAFO, and the Village feedback meetings at each project village;
- Training costs for management of the Animal Revolving Fund (ARF) established in the 3rd phase, and for village veterinary workers;
- Provision of animal vaccines, medicines and a refrigerator to each village.

It should be noted that such limited financial support from JICA sustained over 11 years seems to have strengthened the sense of ownership of the PAFO/DAFO Luangprabang to promote SRI extension effectively by generating their own ideas.

2.3 SRI Phase-1 Project

2.3.1 Outline of the Project

The objective of the project was to confirm the possibility of promoting SRI in Laos, to achieve real effects from SRI (yields and broader benefits), to determine SRI' sacceptability and difficulty for farmers, and to get know-how for the future SRI dissemination in Laos. The project site selected for the pilot activities was 7 effective irrigation schemes (Tha Ngone, Nam Xouang, Houay Yang Noi, Nam Pieng, Nam Pa, Pak Pa & Ban Sing) in 3 provinces. The field trials of SRI were done for 5 cropping seasons from the 2007-08 dry season to the 2009-10 dry season.

Under the project, the original targets of increased SRI area and number of SRI farmers was

achieved as shown in the table below. The unit yields of SRI paddy were satisfactory level.

Performance of the SRI Phase-1 Project

Cropping Season (S)	SRI Farmers (HH)	Harvested Area (ha)	Unit Yield (ton/ha)
2007-08 dry season	22	3.7	3.42 - 5.48
2008 wet season	56	8.1	3.78 - 4.20
2008-09 dry season	94	27.6	3.85 – 4.35
2009 wet season	212	71.6	3.83 – 5.58
2009-10 dry season	420	141.4	3.80 – 4.34
Cumulative numbers	724	252.4	3.41 – 5.58

Thus the possibility ofpromoting SRI in Laos was demonstrated. However, the SRI paddy yields and benefits, and the acceptability of SRI by farmers, were highly variable by location. We could recognize the importance of proper site selection, and the necessity of intensive SRI training for PAFO/DAFO officials, especially DAFO extension workers.



2.3.2 Lessons learned from the SRI Phase-1 Project

- Under the project, SRI area and SRI farmers were increased from zero to 141 ha and to 420 households within 3 years.
- The possibility of SRI promotion was confirmed through farmers' acceptance.
- PAFO and DAFO staff and extension workers should understand the value of SRI and actively cooperate and support SRI promotion. Their understanding and effort are crucial for successful extension of SRI. Thus, repeated SRI training would be necessary.
- When introducing SRI to a new area, Organic SRI is difficult for farmers to accept at first, while Basic SRI (which includes both organic and inorganic fertilization) is acceptable by farmers, although it needs some modification.

2.3.3 Impact of the Phase-1 Project

In response to the good performance of SRI trials under the project, in September 2008 the Lao Ministry of Agriculture and Forestry (MAF) issued a "top down" decision to promote SRI to the Provincial Agriculture and Forestry Offices (PAFOs) across the country. Despite their good intentions, however, SRI extension was not as successful as expected in most of the provinces due to insufficient provision of proper technical SRI guidance to the PAFO/DAFO staff as well as to farmers.

Among 17 provinces, the SRI extension effort by MAF was most properly accepted by officials

and farmers in Luangprabang province. PAFO Luangprabang started SRI promotion from the 2008-09 dry season. In this province, SRI methodology was extended to 1,270 ha in 2009-10. This accounted for 35% of all the rice area in Laos that was cultivated with SRI methods (3,625 hectares), and it made Luangprabang the most active SRI province out of all 17 provinces.

The reason why Luangprabang province became the most developed province in Laos in terms of SRI extension are as follows:

(1) Luangprabang's terrain is mountainous. Rice fields occupy a mere 0.7% (12,600 ha) of the province's total land area. The livelihoods of many farmers are dependent on this limited rice field area, so getting higher yields from limited land is a priority for them.

(2) The province's rice production self-sufficiency is only 70%, so its households want to increase this proportion by any amount possible.

(3) As a UNESCO World Heritage Site, tourists are flocking in greater and greater numbers to Luangprabang, and given the rising population, an increase in the demand for rice is expected. This is why increased rice production has become a priority policy for the Provincial government.

2.4 SRI Phase-2 Project

2.4.1 Objective and Scope of the Project

This project was formulated so as to concentrate project activities in Luangprabang Province because of the considerations mentioned above.

The aim of the project was to expand SRI practice in a self-sustainable manner in the PAFO Luangprabang. The project sites (21 in total) were selected in 7 districts: Luangprabang, Xienguen, Nane, Nambak, Ngoi, Chomphet, and PakOu. During the project period, 5 cropping seasons of SRI practice were conducted, from the 2010-11 dry season to the 2012-13 dry season.

2.4.2 Action by PAFO/DAFO

To manage the SRI project, PAFO Luangprabang appointed Mr. Anousack Khatthiyalath as the Project Director. The project was successfully implemented under PAFO's strong initiative in collaboration with concerned members of PAFO, DAFO, and Pro-net 21.

The PAFO Luangprabang approached the extension of SRI at various levels as follows.

- Provincial level: Division of Irrigation and the Agriculture Extension Service under PAFO,
- District level: District Agriculture and Forestry Offices (DAFOs) in the 12 districts, and
- Village level: agriculture extension assistant staff (87 as of June 2010).

The latter, the agriculture extension assistants assigned about 5 to 10 persons per district office, were located so that there is a technical assistant stationed at a central village within a cluster of 5 to 10 villages. From the central village, he/she works to encourage the adoption of SRI practices in the surrounding 5-10 villages. This is a new approach.

These extension staff are mostly young, inexperienced graduates from the agriculture schools, but given the sincerity with which they pursue their extension activities, they are very popular with the villagers. Through diligent communication with villagers who have hitherto struggled to understand and apply SRI, these extension staff have helped the government to earn the

people's trust. From the perspective of the Provincial government, since these extension staff will eventually be responsible for the agriculture and forestry centers which are part of the government's upcoming policy, the cultivation of these human resources is a high-priority issue.

To introduce SRI in areas having no experience on SRI, careful selection of pioneer farmers and full support for them was indispensable. Recommended procedures for SRI dissemination in such areas were as follows. SRI training for farmers was be done by SRI experts, experienced NGOs, and trained extension workers. Support by local government was quite effective.

1. To conduct SRI guidance and training to local extension workers by SRI experts.
2. To conduct general SRI guidance to farmers in the villages, and to select candidates to serve as SRI pioneer farmers (SPFs).
3. To conduct intensive SRI training to these SPFs just before the start of cropping season.
4. To provide seeds, fertilizers, and rotary weeder to SPFs.
5. To continue monitoring and guidance to SPFs for the whole cropping season.
6. To use SPFs' own paddy fields as a demonstration farm to show SRI to other farmers.
7. To use active SPFs as SRI extension workers in the area for SRI dissemination.

In the project, detailed SRI technical assessment for all project farmers was done and SRI farmers could get valuable information how to practice each element of SRI. Then reflecting the actual practice of SRI by farmers, the previous SRI Technical Manual (on Basic SRI) was revised to serve as the Luangprabang SRI Technical Manual.

In the final meeting of the project in September 2013, Mr. Anousack stated his ideas for successful SRI extension as below. These valuable comments were taken into account in the design of the next phase of the SRI project, Phase-3.

1. Under PAFO's mentoring, DAFO should be responsible to encourage and promote extension volunteers to become permanent staff of DAFO.
2. The SRI extension coordinator must be the head of the DAFO who can respond on SRI extension.
3. DAFO yearly plan should include clear target numbers for SRI extension.

4. DAFO extension staff should prepare and submit yearly reports and evaluations of activities.
5. Extension volunteers should always stay in their villages and practice SRI with farmers, so that SRI expansion becomes more effective. If they have worked in the village with success and vthe illage becomes a model village, there should be a position for them on the government staff.
6. Model farmers should recognized and rewarded by providing certificates and equipment that is suitable for them.
7. To diversify SRI paddy farming with animal rearing, legume crops should be planted in rice paddies for improving the soil.
8. To improve the compost that farmers are making, the use of animal manure and of bioextracts for soil improvement should be encouraged.
9. Farmers should be encouraged to complement and improve their rice cultivation by engaging in animal raising (pigs, chickens) to improve their soil fertility and to improve their yields by use of animal dung as organic fertilizer.
10. Irrigation schemes should be maintained in effective condition and with good operation through proper maintenance and management by water user groups (related to the irrigation law)
11. Field staff and farmers should be trained on rice disease prevention, pest control, and how to identify diseases that may happen on rice.
12. Land preparation should be done as scheduled so as to avoid having to use old seedlings for transplanting (they should be younger than 14 days of age). If famers do not own a hand tractor, having proper contact with a tractor owner is important.
13. Focus project and model village on SRI should be promoted to be the core of SRI dissemination.
    - Irrigation schemes with a large SRI area will become a focus project, where the quality of SRI rice is expected to improve. This will be attractive to rice buyer/market, by using a uniform rice variety and by applying SRI techniques, expecting a reliable yield of 5-6 ton/ha,.
    - Focus project should have SRI farmers who can produce a high quality seeds.
    - Focus project must have staff and 2 volunteers at village level to supervise planting–raising techniques and they have a service room in each village.

2.4.3 Performance of the Phase-2 Project

Continuous SRI experience is an indicator for sustainability. Among the 21 irrigation schemes, 9 schemes were selected as being the most active and experienced SRI schemes. Their continuity and sustainability of SRI practice was as follows.

- 271 households (43%) had continued SRI more than 4 crop seasons;
- 407 households (64%) had practiced SRI more than 3 crop seasons; and
- 211 households (33%) had practiced SRI more than 7 crop seasons since the 2006-07 dry season.

The results of SRI cultivation under the project are summarized below, comparing with non-

SRI cultivation observed in the neighboring paddy fields.

Comparison of SRI and Non-SRI Performace under the SRI Phase-2 Project

Cropping Season	SRI cultivation				Non-SRI cultivation			
	Farmers (HH)	Area (ha)	Yield (ton/ha)	Income ('000 Kip /ha)	Farmers (HH)	Area (ha)	Yield (ton/ha)	Income ('000 Kip /ha)
2011 WS	569	305	4.34	8,668	21	6.0	2.68	5,613
11-12 DS	312	197	3.82	6,060	18	4.3	2.44	4,189
2012 WS	471	281	4.84	8,900	21	9.7	2.86	6,291
12-13 DS	353	205	4.44	8,756	10	4.4	2,76	5,808
Average			4.36	8,096			2.69	5,475
SRI % increase			62%	48%				

2.4.4 Lessons Learned from the Phase-2 Project

- The SRI technical guidelines in Phase-1 (Basic SRI) were modified to "Luangprabang SRI" so as to meet the local conditions and to be more acceptable by SRI farmers.
- The yields of SRI were 57% to 69% higher than for non-SRI production.
- The net incomes of SRI were 41% to 54 higher than for non-SRI production.
- PAFO Luangprabang arranged that DAFO extension workers stay in villages to cooperate with and support SRI farmers. This policy was effective to activate the SRI extension system and to encourage SRI farmers to sustain their SRI activities.

2.5 SRI Phase-3 Project

2.5.1 Objective and Scope of the Project

The main objective of the third phase of the project was to promote diversified farming (SRI paddy farming together with livestock & upland crops) for SRI farmer groups to move toward sustainable and profitable diversified farming, as well as to make SRI production more stable. The project site is was 12 villages in 5 districts of Luangprabang province below.

- Nan district (5): Phonh, Nakheun, Dontoum, Symoungkhoun, and Nampak
- Xiengun district (4): Phonsai, Thinkeo, Ber 10, and Tadkacham
- Luangprabang district (1): Phavieng
- Nambak district (1): Namkha
- Ngoi district (1): Muangxeun

For smooth implementation of the project, PAFO Luangprabang set up the SRI project office and appointed Mr. Sonchanh Vansavath as the Project Manager. Owing to this PAFO arrangement, project management and monitoring activities became more efficient. Appreciating the lessons learned during Phase-2 of the project, many important actions have been continued in Phase-3 project. Main actions performed are as explained below.

2.5.2 Action to keep good coordination

From the beginning of the project, Mr. Sonchanh has coordinated with key officials in PAFO and DAFO for every step of project activities. Further the following were arranged regularly so that the high officials will understand the real site situation and farmers' performance.

- Project coordination meeting,
- DAFO feedback meeting, and
- Village feedback meeting held at each project village

MAF Minister visited SRI village in May 2016

2.5.3 Action to train PAFO/DAFO staff

At the initial stage of this phase of the project, many training programs were conducted for PAFO/DAFO officials and extension workers Pro-net 21 experts.

- Lecture on Luangprabang SRI in May 2014.
- Agro-economic survey in May 2014.
- Training on IPM (Integrated Pest Management) at each village in March-April 2015.
- Training on organic agriculture at each village in January 2015.
- Training on animal revolving fund (ARF) at each village in November 2015.

Further, in response to a strong request raised in the Village Feedback Meeting, special training for the village veterinary workers (VVWs) was conducted on 24 to 25 May 2018.

2.5.4 Action to raise the capacity of DAFO extension workers

As we learned during the Phase-2 project, DAFO extension workers staying in villages play a key role in raising farmers' capacity to accept new techniques, to practice SRI sustainably, and to be more active in responding to new ideas. When the project started, DAFO appointed a total of 25 agricultural extension workers (14 DAFO staff and 11 assistant extension workers) to assist. This meant that 2 extension workers stay in each project village. Each extension worker covers 20-30 SRI farmers. Technical training for DAFO extension workers was conducted at the beginning of the project.

DAFO extension workers are obliged to visit SRI farmers often and to monitor SRI farming activities covering the full cropping season (from nursery for seedlings to harvesting). DAFO extension workers submit monthly reports to the SRI Project Office so the Project Manager can grasp the detailed performance in each project village and among farmers.

To raise the capacity of DAFO extension workers, a DAFO Staff Feedback Meeting was held 3 times (May 2015, December 2015, and February 2016) to exchange their real experiences and problems at site, and to discuss how to better the situation. Such feedback meetings are quite effective to raise the capacity of extension workers and keep their minds on their job.

2.5.5 Action to raise the capacity of SRI farmers

In addition to the regular SRI guidance by DAFO extension workers staying in the village, a Village Feedback Meeting (VFM) was conducted periodically for the purpose of discussing the performance of SRI cropping, to consider various issues, and to plan for the next cropping season.

The meeting was held at each SRI village with an attendance of PAFO/DAFO key officials and staff as well as SRI farmers. Also in these meetings, excellent SRI farmers were awarded with certificates.

The first VFM was held in June 2016, and the fifth VFM was held in May 2018. The VFMs were quite productive and encouraged SRI farmers to better their SRI farming activities and to consider new ideas. Further, the meetings have been a good opportunity to know the actual performance of SRI farmers by the PAFO/DAFO officials.

Furthermore, in response to a request from SRI farmers, the study tour was conducted for farmers to learn from the most active SRI farmers and groups.

2.5.6 Action for Annual Revolving Fund (ARF)

The PAFO SRI project office and DAFO staff have managed the ARF in a proper manner from the beginning of this third project to date, including (i) forming 12 SRI farmer groups for ARF in each village, selecting five model farmers per village, (ii) establishing rules and a management system of ARF, (iii) establishing ARF committee in each village, (iv) contracting an ARF loan with each model farmer under the ARF committee, and (v) supporting famers to procure animals, etc.

The SRI project office provided the animal vaccines and medicines and a refrigerator to each ARF committee. The village veterinary workers (VVWs) have effectively used and managed such medical materials. The VVWs of each village have reported to PAFO monthly the record of purchases, use, and stock of each vaccine and medicine.

From the 1st group of ARF until now (4th group of ARF) in each village, it has been very good performance to return the full amount of each loan with 5% interest by the loan maturity date, and to continue animal-raising activities (100% achievement). During the 1st year, some SRI farmers could not get sufficient profit from raising animals due to the death of animals by disease. However, they returned the full amount of the loan plus 5% interest from other income sources by selling upland crops. These are a great performance ever.

The farmers have understood well the effects of use of animal dung as organic ferlilizer in their paddy fields to increase their paddy yields.

2.5.7 Performance of SRI cropping

The performance of SRI farming for 8 cropping seasons from the 2013-14 dry season to the 2017 wet season were as follow (average of 12 project villages)

Trend of SRI Cropping for the Dry Season in the SRI Phase-3 Project

Item	2013-14 DS	2014-15 DS	2015-16 DS	2016-17 DS	Increase
SRI Farmers (HH)	385	567	744	844	219%
SRI Area (ha)	267	340	418	463	173%
Production (tons)	1342	1820	1820	2449	182%
Unit Yield (ton/ha)	5.03	5.36	4.35	5.30	105%

Trend of SRI Cropping for the Wet Season in SRI Phase-3 Project

Item	2014 WS	2015 WS	2016 WS	2017 WS	Increase
SRI Farmers (HH)	621	716	850	788	127%
SRI Area (ha)	356	433	466	497	140%
Production (tons)	1871	2233	2217	2587	138%
Unit Yield (ton/ha)	5.26	5.16	4.75	5.21	99%

The number of SRI farmers and SRI area has been increasing steadily in both the wet season and in the dry seasong. On 25-27 January 2016, severe cold weather besieged Luangprabang province, and young seedlings were damaged. Furthermore, unusually heavy rainfall happened in August 2017 and caused much flooding. Certain SRI paddy area were damaged, especially in Phavieng village. If such bad weather had not happened, SRI paddy yield would have been much higher.

2.5.8 Lessons Learned from the SRI Phase-3 Project

- Luangprabang SRI method was fully applied in the project, and the numbers of SRI farmers, SRI area, and SRI production were all much increased. This is demonstration that Luangprabang SRI method is acceptable by farmers.
- SRI production obtains yield of 5-6 tons per hectare reliably.
- To raise SRI yields still more, it is important to encourage SRI farmers to use better rice seeds, to share hand tractors properly, and to improve their irrigation systems and management.
- PAFO/DAFO's full involvement to support SRI farmers is quite effective and key to establishing self-sustainable SRI farmers.
- SRI farmers seem to wake-up to their potential ability. Their successful use of the ARF is one of the proofs of this.
- ARF is successful until now and should continue indefinitely. Use of animal dung for paddy fields will improve paddy soil, and consequently raise paddy yields further.

3. Technical Issues

3.1 General

During the implementation of a series of SRI projects from Phase-1 to Phase-3, SRI technique has been modified so as to meet the local conditions (soil, topography, plot size, availability of irrigation water, etc) and to be acceptable to famers. In reality, SRI farmers have generated their own ideas realistically so as to adjust SRI techniques to meet their own paddy fields. This is the background for why the "Basic SRI" introduced in Phase-1 project was modified to "Luangprabang SRI" in Phase-2 and -3 project.

3.2 Basic SRI

When the SRI extension program was started under mutual cooperation by PAFO Luangprabang and Pro-net 21, it was concluded that if "using organic fertilizer" was an indispensable condition for SRI, it would be very difficult for most farmers to accept it. Therefore, the strategy was decided to promote SRI in Luangprabang by a stepwise approach that started from Basic SRI first, and then promoted Organic SRI gradually when and as experienced SRI farmers can accept it.

Elements for Basic SRI are as follows.

(1) Transplant young seedlings (younger than 14-day age);
(2) Careful transplanting of one (1) seedling per hill to avoid damage to seedling roots;
(3) Transplant in a square with wider hill spacing (25 cm to 30 cm);
(4) Intermittent irrigation (alternate wet and dry soil conditions)

3.3 Luangprabang SRI

"Luangprabang SRI" is an accepted SRI method by the farmers in Luangprabang province through project experience. Luangprabang SRI has potential to be broadly applied in other northern mountainous provinces in Lao PDR, where there are similar natural, social and economic conditions. In other words, Luangprabang SRI is a Lao version of SRI which increases

yields, taking advantage of conventional rice farming methods in a more economic and safe way. The biggest advantage is that it is easy for farmers to apply.

Luangprabang SRI is not an incongruous technology for the farmers. It takes advantage of conventional farming methods such as i) controlling weeds by keeping some standing water, and ii) almost no application of chemical fertilizer and pesticides.

The main concepts of Luangprabang SRI are as follows:

(1) Use of high-quality rice seeds as much as possible;
(2) Transplant young seedlings (same as Basic SRI);
(3) Transplant one to three (1 to 3) seedlings per hill;
(4) Transplant in square pattern and with wider hill spacing (same as Basic SRI);
(5) Keep shallow standing water for 1 month after transplanting. Then, intermittent irrigation (alternate wetting and drying) will continue until 20 days before harvest;
(6) Weeding by rotary weeder at 3 to 4 times within 2 months after transplanting, achieving aeration in paddy soils at same time; and
(7) Inputs of more organic fertilizer (including as much animal dung as possible).

Through Luangprabang SRI practice in the wet season, farmers can ensure the amount of rice needed for family consumption, as well as having some excess for selling. Then during the dry season when water is limited, paddy fields can be transferred to vegetable cultivation for cash income. Rotational farming with the wet season rice and the dry season vegetables will prevent disease damages, and the double rice cropping with Luangprabang SRI can be done in small irrigation schemes where the irrigation water is enough in the dry season.

One of the key elements of SRI is “Reduce inputs of chemical fertilizer and increase organic fertilizer.” However, the differences in actual fertilizer inputs are very large between farmers as well as between villages. In order to find the most suitable and proper amounts of inputs and best application methods, monitoring and analysis should be continued.

3.4 Actual SRI Practices by SRI Farmers

After guidance on SRI, all SRI farmers have understood the key concepts of SRI and the Guidelines for Luangprabang SRI. However, in reality, they often cannot follow part of the SRI guidelines, sometimes due to poor local physical conditions (land and water) as well as farmers’ mindsets fearing low yields if they plant many fewer seedlings or if they do not keep paddies flooded.

According to interviews of SRI farmers in the 2015 rainy season, we come to know about the actual performance of SRI practices. Ratios of achievement by farmers compared to the SRI technique guidelines are shown in the table below.

Ratio of performance of SRI farming technique by SRI farmers

	SRI farming technique (guideline)	Ratio of achievement
1	Good seed selection using (salt) water	93%
2	Proper preparation of nursery bed	94%
3	Use of grid-marking using tools or lines for transplanting	100%
4	Use of young seedlings (≤ 15 days) for transplanting	49%
5	Less number of seedlings per hill (≤ 3) for transplanting	89%
6	Wider hill spacing (≥ 25 cm) for transplanting	80%
7	Weeding practices (one or more times)	94%
8	Application of organic materials to the soil	97%

9	Less use of agrochemicals	100%
10	Practice of AWD (alternate wetting and drying)	94%

The difficulty for many farmers to transplant younger seedlings (≤ 15 days) has been caused mainly by their lack of hand tractor or of access to such implement. This situation causes the delay of land preparation timing beyond farmers' expectation.

It is important to apply the guideline not strictly, but flexibly from a viewpoint of farmer's acceptability from time to time.

4. Evaluation of the Project

At the final Project Steering Committee Meeting for the SRI Phase-3 Project held at Luangprabang PAFO on Septermber 6th, 2018, Xayaphanh LASY, head of PAFO, issued the following Certificate of Commendation to Pro-net 21, dated August 20th 2018.

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For Pro-net 21:

The Japanese NPO "Pro-net 21" (resident expert: Mr. Kazuyuki Shimazaki) introduced SRI paddy farming in Laos in 2007, and has continued to extend SRI to date with the assistance of the JICA Partnership Program. The respective phases of this work have been:

Phase-1: SRI Extension Pilot Project (2007.11～2010.6)

Phase-2: SRI Extension Project in Luangprabang Province (2010.10～2013.9)

Phase-3: Diversified Farming Promotion Project for SRI Farmers in Luangprabang Province (2013.12～2018.11)

Concerning the Phase-3 project commenced in 2014, owing to the excellent cooperation among the PAFO, Pro-net 21, and JICA, the SRI extension under these projects has been great. SRI has truly taken root in Luangprabang Province. Production of SRI paddy has greatly increased by obtaining 5 to 6 tons per hectare of SRI paddy yields steadily, and production of rice in the province has been much increased.

During the project, PAFO and DAFO staff, especially the agricultural extension workers, learned a lot, and their capacity has been significantly raised. Furthermore, many SRI farmers have become self-sustainable and more cooperative among themselves. Successful implementation of Animal Revolving Fund under famers' own management under Phase-3 of the project is one evidence of farmers' increased capacity-building.

Pro-net 21 has performed the key role to make a successful series of SRI extension projects with the excellent cooperation of PAFO.

Therefore, hereby PAFO would like to declare the special appreciation to Pro-net 21 for this long-term effort and excellent mutual cooperation with PAFO, so as to establish stable and sustainable SRI farming in the province.

Sincerely yours,

Luangprabang Provincial Agriculture and Forestry Office (PAFO)
Director. Xayaphanh LASY

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Part B
Technical Guideline on Luangprabang SRI

Contents

1. Introduction to SRI

1.1 General

The System of Rice Intensification, known as SRI, is an innovation in rice production systems by raising productivity of the land, labor, water and capital. SRI is a set of modified practices for managing rice plants and the soil, water and nutrients. SRI can produce more paddy yield with less external inputs. Furthermore, SRI is environment-friendly. SRI method can be adopted to any type of rice variety (local variety, HYV, hybrid variety). SRI is an innovation that is constituted entirely of knowledge, but not depending on external inputs and materials.

SRI is a concept consisting of the following practices.

- Transplant young seedlings.
- Transplant single seedling at a hill with utmost care for seed roots.
- Transplant at wider spacing.
- Less use of chemicals (fertilizer, pesticide, insecticide, herbicide).

Less water use by applying wet-dry cycle of soil moisture.

- Transplant young seedlings.
- Transplant single seedling at a hill with utmost care for seed roots.
- Transplant at wider spacing.
- Less use of chemicals (fertilizer, pesticide, insecticide, herbicide).

The SRI concept is nowadays applying to other crops (wheat, sugarcane, millet). SRI is in progress by evolving and ramifying.

1.2 Benefits and Impacts of SRI

SRI methods have the following benefits and impacts, in general, compared to conventional methods of paddy cultivation:

- To increase paddy yields usually by 20-50% and sometimes 100% or more;
- To reduce required seeds for transplanting by 60-80%;
- To reduce use of chemical fertilizers and agrichemicals;
- To reduce irrigation water by 25-50%;
- To reduce production costs usually by 10-20%; and
- With increased output and reduced costs, farmers' net income is increased.

1.3 Key Elements of SRI

(1) Young seedlings

The seedling for transplanting by SRI should be young less than 14 days old after seeding (nursling seedling)*, preferably 8-12 days old. When the seedling is transplanted carefully it grows healthily and generates more number of tillers. It can achieve the potential of giving higher yield.

(2) Careful transplanting of single seedlings

The transplanting of single seedlings should be done quickly after the seedlings are removed from the nursery bed, and carefully putting the seedling (keeping soil and seed sac attached to the root) in very shallow (1-2 cm). This will set back their resumption of growth. Careful handling of seedlings avoids trauma to the roots, with little or no interruption of plant growth and no 'transplant shock'.

(3) Wider square spacing

Transplanting should be in a square pattern with spacing of at least 25 x 25 cm distances between rows and hills. As SRI practices build up soil fertility, through root exudation and additions of organic matter to the soil, sparser planting will give higher productivity. It is counterintuitive that reducing plant populations by as much as 80-90% can give higher yield, but this is the result, provided that the other SRI practices are also followed. The higher yield with reduce population results from the increase in panicle-bearing primary tillers per unit area, and also more filled grains per panicle, as well as usually higher grain weight

(4) Aerobic soil conditions

Using nursling seedling is the single most important contributor to higher SRI yields, but the second most important is keeping the paddy soil moist but not continuously saturated. This avoids the suffocation and degeneration of rice plant roots and also supports more abundant and diverse populations of aerobic soil organisms that provide multiple benefits to the plants. This can be done by alternate wetting and drying (AWD) with cycles ranging from 6 to 14 days. The operative principle is to provide both roots and soil biota with optimizing amounts of both water and oxygen. The result is larger and deeper root growth which gives rice plants more resilience to adverse climatic conditions, such as drought, storms or extreme temperatures.

(5) Active soil aeration

Not flooding fields is conducive to passive soil aeration, letting biological processes improve soil structure and functioning. Beyond this, SRI promotes mechanical measures to aerate the soil. When paddy fields are not kept continuously flooded, weed growth becomes a greater problem. SRI results depend substantially on maintaining mostly aerobic soil conditions. Good soil aeration can be obtained through biological means through the activity of the soil biota. Instead of weeding and throwing the weeds outside the plot, there are several advantages of turning the weeds into the soil by using a rotary weeder. This will cause advantages of (a) the soil gets aerated, and (b) the weeds get decomposed in the soil and turn into organic matter. Due to this the roots and the plant grow healthily and higher yields can be achieved.

(6) Use of organic manures

SRI practices give better results to the extent that the soil is well-supplied with organic matter. When organic matter is added, the microorganisms in the soil multiply manifold and bring nutrients into available form and are made available to them as and when they are needed. It is possible to increase organic matter production and N fixation through the use of high-biomass legumes as cover crops in rotation, also returning as much of the crop residue as

possible to cover the soil surface and/or add organic matter into the soil. This practice has been an integral part of Conservation Agriculture, and it is believed that SRI systems could also benefit from it

1.4 Type of SRI

SRI will be defined technically by key practices (menu) mentioned in section 1, but not a fixed package to be followed strictly. Even though only a part of key practices is adopted, it can be considered as SRI as far as SRI effects appear.

SRI can be categorized as the following types.

- Basic SRI: Same menu as originally proposed by Fr. Henri de Laulanié in 1983, or to transplant single young seedlings at wider spacing and to apply intermittent irrigation. Chemical fertilizer is used, but occasionally some organic matters are used to improve soil structure.
- Organic SRI: Similar menu as Basic SRI, but no chemical fertilizers use. Necessary to apply organic materials, compost or manure, to improve soil fertility and to enhance biological activity. This is the most preferable and ideal SRI.
- Partial SRI: This is a type of SRI to apply a part of menu of SRI, though SRI effects will be decreased. It will be caused by farmer's preference and/or local conditions. For example, a set of practices to transplant "not young" seedlings at wider spacing is considered as a partial SRI. Rainfed SRI will be categorized as a partial SRI due to difficulty to control soil moisture.

For easy acceptance of SRI by local farmers, it is proposed to employ a gradual approach to start from the basic SRI or the partial SRI and then to grade up to the organic SRI. Each practice of SRI can be adjusted flexibly by farmer as explained in Part 2 so as to meet with site conditions, availability of local resources, and farmers' preference.

2. Technical Guideline

2.1 Selection of Suitable Location for SRI

Success of SRI by pioneer farmers at a new area is quite important. Paddy fields of pioneer SRI farmers are a show window functioning as demonstration plot for SRI. At the initial stage to introduce SRI, priority for site selection should be given to suitable area for SRI such as leveled plots, convenient to irrigate and drain, and fertile soil.

The site conditions hamper to generate enough SRI effects are, in general, as follows:

- Saline or alkali soil area.
- Strong acid soils area (pH is below 4.0).
- Inclined plot.
- Newly leveled plot without topsoil.
- Poor drainage area due to high groundwater table.

- Humid climate area without dry season.
- Very cool area during transplanting period.

Some social and political conditions may cause difficulty for sustainable SRI practices. They are:

- Tenant farmer.
- Location where side job opportunities for farmers are ample.
- Location where local government agricultural office is against SRI.
- Location where agricultural extension office is not function.

2.2. Procedure for Dissemination of SRI

To introduce SRI in areas without experience on SRI, careful selection of pioneer farmers and full support for them are indispensable. Recommended procedures for SRI dissemination in such areas are as follows. SRI training for farmers will be done by SRI experts, experienced NGOs, and trained extension workers. Support by local government is quite effective.

1. To conduct SRI guidance and training to local Extension workers by SRI experts.
2. To conduct general SRI guidance to farmers at villages, and to select candidates of SRI pioneer farmers (SPFs).
3. To conduct intensive SRI training to SPFs just before the start of cropping season.
4. To provide seeds, fertilizers and rotary weeder to SPFs.
5. To continue monitoring and guidance to SPFs for the whole cropping season.
6. To use SPFs' paddy fields as a demonstration farm to show SRI to other farmers.
7. To use active SPFs as SRI extension workers in the area for SRI dissemination.

SRI Guidance to Extension Workers

General Guidance on SRI

Intensive Training on SRI

2.3 Nursery Bed

There are two methods of nursery bed preparation. Preparation of nursery bed at the corner of main paddy fields is common practice and suitable for larger land holding farmers. Nursery preparation by portable tray developed in Indonesia is suitable for smaller land holding farmers.

(1) Nursery Bed in Paddy Fields

The proposed nursery bed is 1.2 m wide. The length can vary depending on the need and space available. Seed requirement is 5 kg/ha for transplanting single seedling per hill, and 10 kg/ha for double seedling per hill. Depending upon the convenience, a single bed or several smaller beds can be prepared. As the roots of 6-12 day old seedling would grow up to 15 cm, it is recommended to prepare raised nursery beds of 15 cm high.

Nursery bed is prepared in this manner by using FYM (farm yard manure).

1st layer: 3 cm thick well decomposed FYM
2nd layer: 4 cm soil
3rd layer: 3 cm thick well decomposed FYM
4th layer: 5 cm soil

All these layers should be thoroughly mixed. Make a channel around the nursery bed.
To prevent the wet soil dropping down the bed should be made secure on all sides with wooden planks, bamboos or any other suitable material. FYM helps in easy presentation of roots. The plants that are grown in well decomposed manure gain resistance to diseases.

(2) Nursery Tray

In case that paddy area by farmer is not large (less than 0.3 ha per farm household), it is recommended to use tray for nursery preparation. Tray is either plastic flat tray available in the local market or bamboo flat basket made by farmers. On a tray, put banana leaf and then put soil-FYM mixture (50% each) at 4 cm depth. If rack for tray is prepared, nursery management becomes easy and finally quality of seedlings will be better. On the rack, cover sheet should be placed to avoid rainfall. This method will help farmers easy for transplanting work at the main paddy field by transport tray directly to the field.

2.4 Seed Selection, Soaking, and Broadcasting

Young, 6-12 day seedlings should be transplanted in SRI method. Best SRI effects can be obtained when transplant 8 days seedlings. Age of seedling should never be over 15 days.
The nursery should be prepared with utmost care.

(1) Selecting good seeds

To select good seeds for seeding, salt water will be used. Salt should be put into water in a bucket until an egg in a bucket is raised to the surface. Submerged seeds only should be used for seeding.
However, if salt is not available or too expensive for farmers, good seed selection by water without salt is applicable.

(2) Germinating the seed

Soak the paddy seed for 12 hours. Then transfer the soaked seed into a gunny bag or make a heap and cover it with gunny clothe. Leave it for 24 hours. At this time the seed germinates. You can observe the white root or radical emerges from the seed. This seed is used for sowing on the nursery bed. Never delay after germination for sowing. If delay, the roots grow and get matter together making it difficult to sow the seeds with wider spacing.

(3) Broadcasting the seed

To ensure uniform broadcasting, make the seed into 4 equal parts. Broadcast each part separately one after the other. Two seeds should be separated by a distance of length of one seed. It is better to broadcast the seeds in the evenings.

(4) Covering the seed

Cover the seed with a thin layer of well decomposed FYM or dry soil. Even paddy straw can be used for this purpose, if the straw is healthy without disease in the previous cropping season.
The seed is protected from direct sunshine and rainfall. It also must protect from being eaten away by birds and ants. When straw is used as a layer it should be removed after the appearance of the shoots.

(5) Watering the beds

Depending upon the need, watered the bed daily in the morning and evening.
The water should be gently sprinkled over the bed. When pots are used for watering, use one hand to break the force of the water. The nursery can be watered by letting in water into the canal surrounding the nursery bed.

2.5 Preparation of Main Field

(1) Plowing and puddling

Land preparation for SRI is the same as for conventional method. But for SRI, no standing water allowed.

(2) Ditch in a lot

For smooth implementation of intermittent irrigation, digging field ditches inside a lot is recommended. If lot size is big, additional ditch should be dig at 5 or 10 m interval. These ditches will function as small channel to flow down excess water and can keep paddy field dry for SRI.

(3) Small bund in a lot

If the lot surface is uneven, water would be stagnating at lower part and higher part will dried up. It is recommended to make a small bund in a lot to separate the higher part and lower part to improve the elevation gap for better water management.

(4) Marking for transplanting position

Location of hill for SRI transplanting should be at regular position. Use of grid marker is necessary.
Rake marker will be made by wood or bamboo.
Rolling marker suitable for large lot is made by iron.
Interval of marking is 30 cm x 30 cm as a standard. But marking at 25 cm x 25 cm spacing is also common practice.
Spacing of marking is flexible depending on site conditions and farmers preference.

If marking is difficult under soft soil?

Take a rope and tie a knot or a stick at every 30 or 25 cm (same as planting interval). Using this rope as guide, transplant one row after the other. For the rows to be straight, it is ideal that a rope is tied along the length of the field and the marker is drawn along the rope. Tie a rope as guide a marker again along the rope.

Rake Marker

2.6 Transplantation

(1) Special Care

Young seedlings, less than 15 days after seeding, are recommended to transplant in SRI method. Utmost care should be taken from taking seedling from nursery bed to transplant without experiencing any 'shock'. The seedling should not be damaged either during or uprooting or transplanting in the main field.

(2) Transportation of seedlings to the main filed

In SRI method, the seedlings would be very small. So a metal sheet is pushed 10 cm below the nursery and lifted on to the plate. This means that the seedlings along with the soil are taken on to the sheet. This can be transported to the main field on the metal sheet itself or transferred into a wicker basket. When the nursery is raised in plastic trays or banana trunk leaves, they can be transported along with them.

(3) Field condition before transplantation

The main paddy field should be wet condition but no standing water. If necessary, light irrigation can be provided before the transplantation.

Five (5) days after transplantation, light irrigation should be provided. Day of light irrigation will differ by soil condition.

(4) Number of seedling per hill

Single seedling per hill is recommended as a standard. However, if there is any doubt regarding the survival of plant, then two (2) or three (3) seedlings per hill can be transplanted. Transplantation of more than three (3) seedlings per hill is not recommended from a viewpoint of cost and labor.

It should be noted that the total paddy yields in a lot is almost the same among the transplantation of single, two, and three seedlings per hill.

(5) Placing of seedlings

For SRI transplanting, seedlings should be placed at intersection point carefully on paddy surface at shallow position (less than 1.5 cm deep) with the roots forming a 'L' shape. After placing of a seedling at right position, soil should be covered on extended root by fingers.

2.7 Weed Management

(1) Advantage to use weeder

As there is no standing water in SRI method periodically, weeds would be more.
Instead of manual weeding to throw weeds outside a plot, use of weeder has several advantages. They are: (a) to control weeds , (b) to turn weeds into the soil to be useful as organic manure, (c) to aerate soil and roots are exposed to air, (d) to grow diverse micro organisms in the soil which make nutrients available to the plant.

(2) Timing of weeding

The first weeding should be done by using weeder within 7 days after transplantation even though weeds are still not appeared much. This earlier weeding practice can remarkably reduce the quantity of weeds later on. After the first weeding, another weeding (2 to 3 times) would be necessary at about 10 to 15 days interval during the vegetative growth stage of paddy. Timing of weeding should be decided following the schedule of irrigation so as to practice at few days after irrigation supply when dried soil becomes soft after irrigation.

(3) Type of weeder

There are two types of weeders commonly used.

Manual weeder: Simple and cheap weeder of local made. Weeding work is harder than rotary weeder.

Rotary weeder: weeding and soil mixing can be done and recommended for SRI.

(4) Design of rotary weeder

Weeding by weeder requires labor. Weeding for one (1) ha of paddy can be done by a person traveling a distance of more than 30 km. So a weeder should be efficient in its function and easy to use so as to reduce the drudgery on labor.

The recommended weeder should fulfill the following requirements.

- To arrange to clean the mud that gets stuck to the teeth.
- To be low cost and easy to be prepared locally.
- To be light weight and durable.
- To reduce the walking distance.

2.8 Water Management

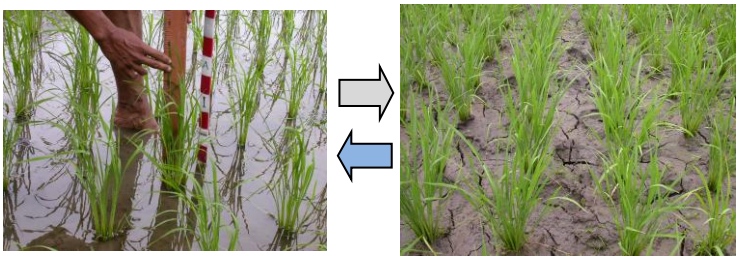
Water management for SRI is an intermittent irrigation or AWD (alternate wetting and drying). Intermittent irrigation should be introduced. In general, it is recommended to started intermittent irrigation at three (3) to four (4) weeks after transplanting, in general. After the panicle initiation stage until maturity, shallow standing water should be maintained on the field. The water in the paddy field is to be drained from 20 days before harvest. However these practices will differ by local soil conditions. The SRI plots should have secured water resources so as to irrigate the field when required. The cycle of wetting and drying period will be decided by on-farm trials. The cycle should flexibly be adjusted based on soil, field and environment conditions.

Procedure to determine the wetting-drying cycle will be as follows (recommended by IRRI).

1. Properly plug (or seal) all holes (or cracks) in the paddy bunds.
2. Apply irrigation water to a depth of about 3-5 cm in the paddy field, then stopped.
3. Observe how long (duration) will the ponded take to subside or disappear in the paddy. Record the time as T(1).
4. When ponded water has disappeared, observe how long it will take until the soil develop small shallow cracks. Record the time as T(2).
5. Irrigation interval = T(1) + T(2)

   This interval may be used as a guide when the next irrigation may be applied.
6. To ensure that the rice plant is not stressed, the level of the perched water table should not be allowed to lower beyond the effective root zone, which is in general about 15 cm below the ground surface.

Until the farmers gain the confidence in intermittent irrigation method for SRI, few alternative methods can be followed. For example, instead to wait until the paddy soil surface develops hairline cracks, start with lesser intervals and slowly increase the gap between the two irrigations.



Observation well in a paddy lot

Observation well

To ensure that the rice plant is not stressed, the level of the water table should not go below 15 cm from ground surface. Installation of a simple observation well (10-12 cm dia., 50 cm long PVC pipe) at the corner of paddy lot is recommended to determine when to irrigate again.

2.9 Pest & Disease Management

Wider spacing and use of organic manures for SRI results in healthy growth of the plants and incidence of the pests and diseases is naturally low.

According to research in 2005-06 in Vietnam, occurrence of four major disease/pests (Sheath blight, Leaf blight, Small leaf folder, Brown plant hopper) for SRI paddy compared with conventional cultivation paddy was 45% in the spring season cropping and 29% in the summer season cropping.

Though SRI paddy has more resistance against disease/pests compared with conventional, type of disease/pests to be affected has no difference. When disease/pests occur, it is recommended to take immediate action to eliminate them based on advice of local extension officer and, if necessary, information from “Rice Knowledge Bank of IRRI” < http://www.knowledgebank.irri.org/rice.htm>.

The uniqueness of organic SRI lies in not using the chemical pesticides. The pests can be managed by using some organic concoctions (MOL: microorganism local) either as a preventive measure or as and when needed. Each country has some ideas to prepare MOL.

“Amrit Jalam” developed in India is one of such MOL.

Preparation of Amrit Jalam (India)

Materials required:

- Cow urine - one (1) liter
- Cow dung - one (1) kilogram
- Jaggery (tree sap from coconut) - 250 gram
- Water (chlorine free) - 10 liter

Preparation and Use:

Mix all the above materials in a plastic container or an earthen pot. Let them ferment for 24 hours. Dilute this with water in the ratio of 1:10. Filter the solution using a fine cloth. This can be used for spraying. Amrit Jalam can be stored for a period of 30 days. However it has to be stirred daily. When urea is used, the plants grow succulently and or easily susceptible to pests and diseases. When Amrit Jalam is sprayed, it not only gives nitrogen to the plants but also repels harmful insects and micro organisms.

2.10 Soil Fertility Management

The organic matter is the food for the soil microorganisms. When the soil is alive with micro-organisms, then the nutrients needed for the plant would be in readily available form. When soil is rich with microorganisms then the plant grows healthily, develops resistance to pests and diseases and yields higher. Thus methods of improving the soil fertility should be taken up.
Application of farm yard manure/compost (10-20 ton/ha) and/or green manure is recommended. Quality of compost to be purchased should be checked carefully.

Farmer training for compost making

Compost making practice

Charcoaled rice husk making

2.11 Harvesting

Harvesting is the process of collecting the mature rice crop from the field. Paddy harvesting activity includes cutting, stacking, handling, threshing, cleaning, and hauling. It is important to apply good harvesting methods to be able to (1) maximize grain yield, and (2) minimize grain damage and quality deterioration.

Harvesting can be done manually using sickles and knives, or mechanically with the use of threshers or combine harvesters. Regardless of the method, good grain quality should be preserved during harvest operations, and harvest losses are kept to minimum.

Key actions for proper harvesting are:

- To harvest at the right time with the right moisture content;
- To avoid delays in threshing after harvesting;
- To use proper machine settings when using a threshing machine;
- To clean the grains properly after threshing; and,
- To dry the grains immediately after threshing