3 Years Experience of SRI *(System of Rice Intensification)* under SSIMP-DISIMP in Eastern Indonesia

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1. Introduction

The System of Rice Intensification (SRI) is an innovative paddy cultivation method attaining high paddy yields with lower resource utilization of such inputs as water and fertilizer. In recommending simple changes in cultivation practices only, such as planting single younger seedling at wider spacing, with intermittent irrigation without impounding, the SRI method sounds 'too good to be true'. However, increasing evidences from field tests and practices are suggesting that SRI is as productive and as beneficial as claimed (Uphoff, 2004). Though the SRI method has already produced remarkable results in many countries, it is still not well known yet.

Since 2002, SRI method has been tested and demonstrated in irrigation schemes of the ex-Small Scale Irrigation Management Project (SSIMP-I to-III) and the SSIMP's current successor Decentralized Irrigation System Improvement Project in Eastern Region of Indonesia (DISIMP = SSIMP-IV) financed by the Japan Bank for International Cooperation (JBIC).

In order to contribute to a better understanding of SRI, this report presents general introductory information on the SRI method and reviews field level practices based on experiences in SSIMP-DISIMP areas from 2002 to 2005. It will be followed in the future by a more detailed review and assessment of possible approaches to extending the SRI methodologies more widely within SSIMP-DISIMP areas as well as in other irrigation settings, including implications for irrigation organization and management.

2. Outline of SRI

2.1 General

SRI was developed initially during the 1980s by French priest, Fr. Henri de Laulanié, S.J., posted in Madagascar in 1961. The name of SRI "systeme de riziculture intensive" first appeared in his paper in the journal *Tropicultura* in 1993. SRI became popular in the world through the efforts of Norman Uphoff (Director of Cornell International Institute for Food, Agriculture and Development). In 1997, Uphoff made a presentation on SRI in Indonesia, which was the first opportunity to present SRI outside Madagascar. In 1999, SRI was first practiced in China and Indonesia. Today great results of SRI practice have been confirmed in about 20 countries with paddy yields under SRI averaging in the 7-10 t/ha range.

Paddy yields of SRI reported from 12 countries are shown below.

Table-1 Paddy Yields of SRI Comparing with (Non SRI) by Country (Uphoff 2004)

Country	Yield t/ha	Country	Yield t/ha	Country	Yield t/ha	Country	Yield t/ha
Bangladesh	6.3 (4.9)	Cambodia	4.8 (2.7)	China	12.4 (10.9)	Cuba	7.4 (4.3)
India	8.0 (4.0)	Indonesia	7.4 (5.0)	Madagascar	7.2 (2.6)	Myanmar	5.4 (2.0)
Nepal	8.5 (4.2)	Philippines	6.0 (3.0)	Sierra Leone	5.3 (2.5)	Sri Lanka	7.8 (3.6)

2.2 Basic SRI Concepts

The basic concepts that characterize SRI are: (i) a unique transplanting method using a single young seedling with wide spacing, and (ii) water management by intermittent irrigation (no impounding)..

(1) Transplanting method:

In order to create healthy and strong transplanted seedlings with multiple tillers of 30 to 50 per seedling and having larger and more numerous panicles, the following practices are recommended:

- Transplant seedlings at a younger age (before 14 days after seeding) i.e., using only 2 or 2.5 leaves, which preserves the original seeds nourishment potential by around 40-50%, and thereby optimizes the potential for tillering and root growth;
- Transplant a single seedling at each location; and

- Widen the spatial interval of transplanting (30 cm x 30 cm or more) to provide room for profuse root and tiller growth by allowing the plant to monopolize the soil fertility and sunshine energy.

(2) Water management:

Apply intermittent irrigation periodically to keep the soil both moist and aerated periodically at least during the vegetative growth period. Aeration of soil allows aerobic and anaerobic bacteria an opportunity to contribute to plant growth. Consequently the growing paddy is durable against wind and pests, and irrigation demand decreases by about 40% on the average.

In addition to the basic concept above, provision of organic matter (compost) to the soil has been recommended to help achieve sustainable SRI cultivation practices. This can be any decomposed biomass, including rice straw or weeds.

2.3 Research on Young Seedling and it's Mechanized Transplanting in Japan

The key of success of SRI is (a) transplanting of young seedlings and (b) intermittent irrigation. In Japan, since 1970s a lot of filed tests and research on young seedlings have been done from a view points to reduce labor and costs for nursery preparation and transplanting of paddy.

Definition of rice seedlings is as follows:

Table-2 Definition of Rice Seedlings in Japan

	Nursling	Young	Middle	Matured
Number of leaf (age)	1.5 - 2.5	3.0 - 3.5	4.5 - 5.0	5.5 – 6.5
Height of seedling (cm)	7 - 9	10 - 13	13 - 15	15 - 18
Remaining nutrition in albumen (%)	± 50%	< 10%	0	0
Days after seeding (days)	5 - 7	20 - 22	33 - 35	45 - 50

Remarks: Name of Nursling Seedlings was defined by the Ministry of Agriculture of Japan in 1990

Research on characteristics of nursery seedlings was initiated in 1940 and was continued by 1990. Results of research on nursery seedlings in Japan can prove that the SRI practice is a correct way to maximize the power of plant development to achieve great yield and quality of rice.

2.4 General Results Associated with SRI

Benefits

Paddy yields and quality of grain can be raised by as a consequence of the inter-linked SRI outcomes by increased tillering, greater root growth, increased grain filling, and higher grain quality and greater grain weight (Uphoff, 2004):

Water requirements with SRI are usually reduced by about half since paddies are not kept flooded during the entire crop cycle. Water is much reduced during the vegetative growth phase, and only a minimum of water is kept on the field during the reproductive phase. The need to economize water use will become increasingly important in the agricultural sector.

Other benefits with SRI would be as follows (Uphoff, 2004):

- Reduced lodging.
- Fewer pest and disease attacks and reduced expenditures for agro-chemicals
- Seed savings
- Reduced need to purchase new seeds
- No need for chemical fertilizers
- Lower rice production costs.
- Increased factor productivity
- Profitability
- Reduced risks

Problems

There are conceivable adverse impacts linked to SRI implementation. These are:

(1) Proper and efficient water management requires increased labor burden: Careful gate control is necessary to maintain the desirable wet condition in the plot. If the farm is so designed for plot-to-plot irrigation, controlled overspill into the next plot may require additional works. Also the onset of heavy rainfall may require a special response if it occurs during the drying period of the wet and dry irrigation cycle.

(2) Weeding requires increased labor burden: Alternating wet and dry periods in plots creates better conditions for grass and weed growth as well. More intensive weeding operations are necessary.

(3) Production of organic fertilizer requires additional labor inputs: The organic fertilizer made of stalks will prevent soil depletion with some additional compost. The productions of such fertilizer require additional labor inputs.

From an alternative perspective, however, the above increased labor requirements cited above also have a positive impact by generating much needed job opportunities in rural areas. In particular, the production of organic fertilizer has the potential to create new livelihoods in rural areas where SRI is spreading and being widely practiced.

3. SRI in Indonesia

In 1999, the Agency for Agricultural Research and Development (AARD) began to test and evaluate SRI at its rice center in Sukamandi, West Java. It was reported that the result of paddy yields was 6.2 t/ha compared with a control yield of 4.1 t/ha. In the next wet season, the SRI average was 8.2 t/ha, with one plot reaching 9.2 t/ha (Gani, A., 2004).

In 2002-2004, the Ministry of Agriculture has promoted a new program "Improvement of Farm Intensification Quality (PMI)" for 200 locations (one in each Kabupaten) in 29 provinces, aiming to increase farmer's income and strengthen farmer group activities. The scope of works of the program consisted of: (i) provision of farm inputs, hand tractors, and farming capital as a revolving credit fund to the farmer groups, and (ii) introduction of new farming technology under the Integrated Crop Management and Development Program (PTT) which included the SRI method as a core technology. PMI was implemented at the 200 locations (500 ha each). The PTT involving full support of farm inputs was only carried out within the same locations above for 5 ha each. The final report on PMI has not been submitted yet. However, according to interviews with staff involved in implementing PTT in South Sulawesi and in NTB, the results from SRI have not lived up to expectations due to an insufficiency of technical guidance to farmers. In fact, this PTT program had been done without any coordination with local extension offices in the related locations.

In West Java, SRI was first practiced in 2000 by leading agronomist/farmers in Kabupaten Ciamis, West Java. By the effort of the group, planting area of SRI has been expanded steadily in West Java province. In 2004, the total area of SRI has reached to 402 ha (3,000 farmers). Furthermore, the whole of the SRI area in West Java has used organic manures (no chemical fertilizer use) for SRI by farmers. In other areas in Java, SRI is still limited to small scale.

In the eastern region of Indonesia, the consultants of SSIMP-DISIMP (JBIC Loan) have promoted the introduction of SRI cultivation from 2002 as explained in Section 4.

Table-2 shows rice cultivation method with comparison of SRI and Non SRI in Indonesia and Japan for reference.

Table-2 Comparison of Rice Cultivation Method

Description	Conventional		SRI or BST Japan	
	Indonesia	Japan	SRI	NST
Transplanting method	Manual	Mechanized	Manual	Mechanized
Seedling				
a. Days after seeding (day)	25 - 30	21	8 - 14	5 - 7
b. Number of leaves (no.)	5	3 - 4	2.0 – 2.5	1.5 – 2.0
c. Height of seedling (cm)	25 - 30	12 - 15	10 - 12	7 - 9
Number of seedlings by location (no.)	4 - 5	4 - 5	1	3 - 4
Spacing				
a. Row (cm)	25	30	30	30
b. Line (cm)	20	18	30	18
c. Density of seedlings (nos/m^2)	20.0	18.5	11.1	18.5
Water management	Ponding	Intermittent	Intermittent	Intermittent
Unit yield of paddy* (t/ha)	4 - 5	7 - 9	7 - 9	7 - 9

Note: * = Dried un-husked rice (moisture content 14%)

4. SRI under DISIMP

4.1 General

Starting in 2002, DISIMP has introduced SRI as a substantive measure help promote irrigation improvements and strengthening of farmer groups. The first locations were selected at the Awo Weir Irrigation scheme (SSIMP-II) in South Sulawesi, with a trial plot of 0.2 ha, and the Tiu Kulit Dam Irrigation scheme (SSIMP-I) in West Nusa Tenggara, with a trial plot of 1.5 ha. During the 2004/05 cropping season, the SRI trial areas have expanded to 327.4 ha in South Sulawesi, and to 34.5 ha in West Nusa Tenggara. These areas are continuing to expand to cover a greater area and more irrigation schemes.

The adapted SRI practices and conditions in DISIMP schemes are as follows;

Farm plot:	Plot-to-plot irrigation farm within DISIMP scheme areas;
Variety of rice:	IR-64, Ciliwung, Ciherang and Membramo;
Transplanting method:	Single planting of young seedling (8-14 days after seeding) with a wide spacing of 30 cm x 30 cm;
Water management:	Intermittent irrigation without standing water. Wet-dry cycle is different by location reflecting soil type, shape and size of lot, rainfall, and availability of irrigation water;
Land preparation:	Several common practices have been adopted for puddling and leveling in the plot. Small ditches are dug by farmers along the ridges and center of their plots, thereby helping to facilitate smooth irrigation and drainage as well as more efficient intermittent irrigation;
Fertilization:	Organic material has not been applied yet and chemical fertilizers continue to be utilized; and
Weeding:	Weeding is conducted two (2) to three (3) times per crop season.

Table-3 shows an actual SRI practice performed in DISIMP schemes for the 2004/05 copping season;

Table-3 SRI Practice in DISIMP Schemes for 2004/05 Cropping Season

DISIMP Irrigation Scheme	Transplanting		Water Management		Weeding	Fertilizer Application (kg/ha)				
	Seedling (day)	Spacing (cm)	Moist (day)	Dry (day)	(times)	Urea	TSP	KCL	ZA	Total
South Sulawesi										
1 Awo	10-13	30 x 30	7	4	3	200	50	50	50	350
2 Salomekko	10	30 x 30	10	3	3	250	0	0	50	300
3 Kelara Karalloe	10-14	30 x 30	10	3	2	175	62	50	50	337
4 Kiru Kiru	10	30 x 30	10	3	3	200	75	50	75	400
5 Sadang	9-10	30 x 30	10	3	2-3	225	60	50	50	385
6 Lanrae	10	30 x 30	10	3	3	200	75	50	75	400
West Nusa Tenggara										
1 Tiu Kulit	8-12	30 x 30	6	12	2	210	83	0	0	293
2 Batu Bulan	8-12	30 x 30	5-6	10-13	2	150	80	0	0	230
3 Mamak	8-12	30 x 30	4	6	2	200	50	0	0	250
4 Jurang Sate Hulu	8-12	30 x 30	3	7	3	250	100	25	100	475
5 Jurang Baru	8-12	30 x 30	3	7	3	250	100	25	100	475

Note: Fertilizer: TSP=Triple Super Phosphate, KCL=Kalium Chloride , ZA=Ammonium Sulphate

4.2 Results of SRI Practice

The paddy yields (dried un-husked rice) by the SRI practice in SSIMP-DISIMP areas are as shown in the table below.

Table-4 Average Paddy Yield with SRI and without SRI in DISIMP Schemes

DISIMP Irrigation Scheme		SRI Area		Cropping Season	Variety of Rice	Paddy Yield (t/ha)		
		Area (ha)	Farmers			SRI	Non SRI	Ratio
South Sulawesi (Sulsel)								
1	Awo-1	0.20	3	DS 02/03	Ciliwung	7.15	4.35	164%
	Awo-2	5.00	18	DS 04/05	Ciliwung	7.40	4.25	174%
2	Salomekko-1	0.20	1	DS 02/03	Ciliwung	7.92	3.32	239%
	Salomekko-2	5.00	7	WS 2004	Ciliwung	7.28	4.31	169%
	Salomekko-3	5.00	10	DS 04/05	Ciliwung	7.87	4.09	192%
3	Kelara Karalloe-1	4.30	6	WS 03/04	Membramo	8.76	5.18	169%
	Kelara Karalloe-2	2.00	1	DS 2004	Membramo	8.18	4.17	196%
	Kelara Karalloe-3	217.90	145	WS 04/05	Membramo	9.56	4.79	200%
4	Kiru Kiru-1	1.00	1	WS 03/04	Ciliwung	8.76	3.19	275%
	Kiru Kiru-2	1.00	1	WS 04/05	Ciliwung	8.00	4.15	193%
5	Sadang-1	5.00	12	WS 2004	Ciliwung	8.11	4.55	178%
	Sadang-2	77.79	106	DS 04/05	Ciliwung	10.39	5.55	187%
9	Lanrae-1	3.00	4	WS 04/05	Ciliwung	8.00	4.80	167%
Total/Weighted average		327.39	314			9.60	4.93	195%
West Nusa Tenggara (NTB)								
1	Tiu Kulit-1	1.50	2	WS 02/03	IR-64	7.84	5.43	144%
	Tiu Kulit-2	2.62	10	WS 04/05	Ciherang	9.57	4.77	201%
2	Muer-1	1.50	6	WS 02/03	IR-64	7.85	4.97	158%
3	Batu Bulan-1	0.16	1	DS 2003	IR-64	8.93	4.97	180%
	Batu Bulan-2	0.32	1	WS 03/04	IR-64	9.63	4.60	209%
	Batu Bulan-3	0.16	1	DS 2004	IR-64	8.53	4.80	178%
	Batu Bulan-4	11.38	42	WS 04/05	Ciherang	8.99	5.03	179%
5	Mamak-1	7.40	14	WS 04/05	Ciherang	8.82	3.56	248%
6	Jurang Sate-1	4.37	11	WS 04/05	Ciherang	8.63	6.77	128%
7	Jurang Baru-1	5.06	12	WS 04/05	Ciherang	6.78	5.07	134%
Total/Weighted average		34.47	100			8.53	4.93	173%
Grand Total/Weighted average		361.86	414			9.50	4.93	193%

Note: WS= Wet Season, DS=Dry Season
* = Dried un-husked rice (moisture content 14%)

It should be noted that in the two provinces where SRI was initially introduced under DISIMP, the yield figures for farmers using SRI are very similar as are the cross province lower yield figures where SRI is not practiced. Thus the merits of SRI appear to be almost the same in different parts of Indonesia. Since the yield increments under SRI averaged 4.67 t/ha in South Sulawesi and 4.52 t/ha in West Nusa Tenggara, the average enhancement of rice productivity was more than 90%.

The increase in the area under SRI in Indonesia has been rapid. At present in the DISIMP scheme areas where SRI has been introduced, farmers are taking their own initiative to introduce SRI on their own fields after observing the results in the trial areas. SRI provides a strong incentive for farmers and stimulates active local participation in agricultural and irrigation improvements.

The yield-enhancing results of the SRI cultivation method have been highly successful, achieving an average paddy yield of 9.60 t/ha in South Sulawesi province, and 8.53 t/ha in West Nusa Tenggara province. The average increase in productivity to a level of 9.5 t/ha is 93% higher than rice paddy yields in adjacent irrigated fields where SRI is not being practiced. Furthermore, under the SRI method, farm production costs have decreased by about 20% and irrigation water demand at the on-farm level has decreased by about 40%. Therefore, SRI method can be said to be a successful innovative "**Water saving - Cost saving - High yielding method**".

The next stage of development for SRI within DISIMP is to expand to larger contiguous areas.

5. Lessons Learned on SRI under DISIMP

5.1 General

- SRI method can offer high paddy yield with less production costs (seeds, fertilizers, chemicals) as well as water saving.
- Labor burden increases by SRI, but farmers can overcome due to strong incentive of high productivity of paddy cultivation.
- Without use of organic fertilizers (reduced chemical fertilizer only) high yield of paddy can be

obtained without problem. The use of organic fertilizers is preferable, but not the "Must" for SRI. If use of organic fertilizers is the must, expansion of SRI is limited in the future.

- SRI is water saving attaining about 40% reduction in quantity in lot (variable by soil and filed conditions) due to intermittent irrigation. However, farmers will never agree to dry up their field without reliable water source. Therefore, introduction of SRI should be in irrigation area of relatively good conditions such as upstream of the system.
- For successful introduction of SRI, involvement of local government offices as well as experts (consultant) is necessary for technical support and advice.

5.2 For the Future Extension of SRI

(1) At present, detail of SRI practices has been determined through trial and error in each location. Systematic research on SRI activities should be done by experts or project basis on the following key issues:

- Fertilizer application program (type, quantity and timing by variety and soil),
- Intermittent irrigation method (wet-dry interval by soil type and filed conditions),
- Water management method for one tertiary system
- System planning and design suitable for intermittent irrigation, and
- Weeding method and tools (to develop good and cheap weeding tools).

(2) Government program to promote SRI should be considered including:

- To establish a national level information network for SRI,
- To conduct systematic training program of SRI including organic fertilizer preparation,
- To promote program for farmers to provide animals to facilitate the production of organic fertilizers (compost), and
- To insert SRI training program including demonstration farms in to the scope of works for all irrigation projects to generate real benefits for farmers and to strengthen farmers' group activities.