Summary from Conference Reports

E. C. M. Fernandes and Norman Uphoff, Cornell University

Most SRI experience is very recent. Three years ago, the only country where SRI was known and was being practiced was Madagascar. At this conference in April 2001, there were reports from 17 countries on SRI experimentation and often extension, from:

- **China** in East Asia,
- **Indonesia, Philippines, Cambodia, Laos, Thailand** and **Myanmar** in Southeast Asia,
- **Bangladesh, Sri Lanka, India** and **Nepal** in South Asia,
- **The Gambia, Madagascar** and **Sierra Leone** in Africa, and
- **Cuba, Peru** and the **U.S.** in the Western Hemisphere.

It is understandable that most of these countries are from Asia since about 90% of the world's rice is grown in that region. Most of the reports give evidence of quite positive results from SRI methods; however, several do not show the expected effects.

As most of the knowledge about SRI is quite recent, conclusions about it must remain for now provisional, pending more years of experience and wider utilization of SRI in a greater variety of circumstances. The initial results are, however, mostly very positive and give reason to suggest that more countries and more farmers should have an opportunity to evaluate SRI for themselves.

Constituent Practices

As confirmed by the reports from the various countries, the set of practices that can give much increased rice yields when they are combined includes:

- Careful transplanting of young seedlings — with just two leaves, usually less than 15 days old and preferably 8-12 days old;[1]
- Planting 1 seedling per hill, though under some soil conditions, 2 seedlings may produce better than single seedlings;
- Avoiding soil saturation of the field during the vegetative growth phase, either by applying only small amounts of water daily, or by alternately flooding and draining/drying the field;
- Early and frequent weeding that aerates the soil as it removes weeds; and
- Application of compost.

This last practice, which promotes nutrient cycling and soil biological activity, reduces nutrient mining from the farm. In the short run, however, it may be considered as a means to improve yields beyond what the other practices can achieve rather than as being a required part of SRI.

Advantages

Numerous benefits associated with SRI practices were reported in the papers, the most important being an increase in **total factor productivity**. Specific advantages reported included:

- **Increased yields** — higher production of rice per unit of land.
- **Increased returns to labor** — although more labor is usually required with SRI, at least when first practices, there is greater productivity per day or per hour of work. There were several reports that SRI can be **labor saving** once farmers have mastered its techniques.
- **Water saving** — less water is generally used with SRI practices, an important consideration whenever water is not abundant; with higher production achieved, the productivity per unit of water applied becomes greater.
- **Improvement of soil quality** — greater root growth contributes to better soil quality as does the application of organic sources of nutrients.

[1] *However, if prevailing temperatures are colder, as in Nepal, "young plants" can be a few days older than 15 days because biologically they are less mature than plants grown in a warmer climate.*

- **No requirement of external inputs** — there are increased returns per unit of capital invested to the extent that purchased inputs are unnecessary while output increases.
- **Reduced requirement of seeds** — 5-10 kg/ha of seed are used rather than 5-10 times this amount with usual practice.
- **Lowered cost of production** — contributing to higher income for farmers.
- **Accessibility for smaller and poorer farmers** — since no purchase of agrochemicals is needed; the only capital requirement is a rotary weeder.
- **Better food quality** — associated with reduced or no application of agrochemicals to the crop.
- **Environmental benefits** — resulting from reduced demands for water and less or no use of agrochemicals that can affect both ecological and human health.[2]

Disadvantages

These include:

- **Requirement of good water control**, to be able to apply small amounts of water on a regular basis rather than maintain continuous flooding of fields, or to practice alternate wetting and drying throughout the growth period. Farmers who do not have such control or reliable access to water will get less or little benefit from SRI practices.
- **Requirement of more labor**, at least in the first year or two, as skills are learned for using the SRI practices quickly and confidently. This can be a barrier to adoption, even for poor households that are relatively more endowed with labor. These must use their available labor power to earn daily income, even if this is less than they could get by investing their labor in SRI methods.
- **Requirement of greater skill** on the part of farmers, expecting them to do their own trials and evaluations to adapt SRI practices to their own conditions for best effect. This can be considered as a benefit with SRI, however, rather than just as a cost.

[2]*No research has been done on reduction of greenhouse gas emissions with SRI practices, but when paddies are not kept continuously flooded, methane productioin should be reduced. Rice paddies are a major source of methane. With alternate wetting and drying of paddies, production of nitrous oxide could increase due to increased nitrification and denitrification. Nitrous oxide is more powerful as a greenhouse gas than methane. However, if inorganic N is not being applied in large amounts to rice fields, the amount of N to be converted to* NO_2 *is less. More field data are required for drawing any conclusions about this.*

Review of Reports

- **Yields:** Three-fourths of the cases confirmed that there is a significant **yield advantage** with SRI practices. Average yields up to 8 t/ha or at least 20-50% increases were usually reported. Table 1 summarizes yield reports and gives simple arithmetic averages. The super-yields reported from Madagascar have not been obtained elsewhere, but some farmers in Cambodia and Sri Lanka have come close to these. Interestingly, often with SRI methods, higher yields have been obtained on farmers' fields than on research stations. This is something worth investigating.

  There were a number of reports of yields over 10 t/ha. We should identify and quantify the driving factors that give such results. Clearly some varieties give better yield responses to SRI methods than do others. It may be that 120-140 day varieties respond most productively, but more evaluation is needed on this. Yields are most often best at 35x35 cm spacing, though the best spacing will always vary according to soil quality and rice plant type. Very wide spacing, e.g., 50x50 cm, is not recommended to begin with, and 25x25 cm is probably best to start off, evaluating alternative spacings as soil quality improves. With poor soil, 20x20cm may give best results.
- **Labor:** An increased requirement of labor was widely reported, though three country reports mentioned the possibility of less labor being needed over time. Extra labor is most needed in land preparation (leveling), transplanting, and weeding.
- **Water:** Almost all of the reports agreed that there can be water savings with SRI methods.
- **External inputs:** There was most variation on this factor in the reports, as in some countries, farmers are finding they can get increased yields without using any chemical fertilizer or insecticides or other agrochemicals, while in other countries, chemical fertilizer is being used with SRI, and often with good results. *Not using external inputs should be seen more as an opportunity than as a requirement with SRI.*[3]
- **Soil and roots:** Unfortunately, little information on soil chemical and physical properties (especially texture) was contained in the reports, which makes interpreting crop responses to SRI management practices more difficult. For example, there are conflict-

[3] *The question was raised whether heavy use of N fertilizer with SRI might have an adverse effect on effective tillering through some impact on root development. This should be examined through systematic research.*

ing results on the beneficial effect of drying the soil until it cracks before rewetting it. Soil characteristics surely play a role in this. Soil biology is probably the key to the synergy that is seen with SRI practices, but this remains a hypothesis to be evaluated. There is little information on native soil fertility, and nutrient balance budgets should be constructed to understand soil dynamics over time with SRI management.

- **Seeds:** There was wide agreement on the possibilities for significant savings on seed requirements as plant populations can be greatly reduced with good effect when using SRI practices.
- **Food and environmental impacts:** There is a desire in some countries to use SRI methods as a way to produce healthier food and to reduce adverse impacts on the environment, including production of methane gas from flooded paddies.
- **Socio-economic analysis:** More work needs to be done on the economics of SRI, particularly on costs of production and net income improvements possible. Several country reports had data on this that were very encouraging, but more systematic information is needed. Also, how readily the poor can use SRI methods needs to be studied. A study in Madagascar found that the poorest households adopted SRI less than better-off ones (which in Madagascar are still not very well-off) because of their need to earn income daily during the cultivation season.

Data Needs

The information reported from various countries represented a wide range of experience. It will be helpful if future reports provide better descriptions of trial plots or farmers' field — who did what where? There is still huge variability in results, so there should be adequate replication of trials to provide more robust results and better estimates of variability.

Particularly we would like to know what is special about the sites where much higher yields than usual are achieved. Basic site data such as GPS coordinates, elevation, soil and climate information would be invaluable for developing a more systematic understanding of the variable SRI responses across sites.

While researchers appreciate the reports from NGOs and farmers, they would like to see more standardization of reporting across regions so that inferences and conclusions can be more reliably drawn. SRI experience to date suggests that these methods offer an unusual opportunity for 'win-win' outcomes in agriculture. But to have confidence in this, there is need for more and more detailed reports on the use and results of SRI as well as the yields for best-recommended practice based on local research, e.g., the Chinese SRI trials with hybrid rice varieties.

Since this was the first international meeting to report and share results, it was still more exploratory than conclusive. It is hoped that within a year or two with more experimentation and more communication of information, a broader and deeper understanding of SRI — its opportunities and its limitations — can be achieved and disseminated.

Summary of Data from Conference Reports

It was not possible to get complete or always comparable data from all of the countries. What appears in Table 1 is a compilation of data extracted from the various country, NGO and research reports that follow in these proceedings. The data have been put into parallel format to provide an overview what the presently available data on SRI show. Simple arithmetic averages are shown for those countries where more experience with SRI has been accumulated and the reports give enough data to indicate approximate yield levels.

As often as possible, comparable or control measurements of yield are shown in the middle column whenever these were provided in the report. Comparisons with national averages are usually too gross to be very meaningful, so we show in the middle column only yield data that the persons making the report considered to be valid standards for comparison. As the same criteria would have been used for both numbers, relative comparisons (ratios) should be reasonably valid even if there are questions about the absolute numbers.

The unweighted average for all the comparison/control yield figures is 3.9 t/ha, which is very close to the current world average for rice production. The average for all the SRI yields reported is 6. 8 t/ha, and the average of highest reported yields is 10.5 t/ha. Figure 1 on page 39 was constructed from the data in Table 1 to give an overview of the variations reported.

Table 1. Summary data from conference reports on SRI and comparison yields

	Season[1]	No. of Farmers (F) or Trials (T)	Reported Average SRI Yield (t/ha)	Compar-ison/ Control Yield (t/ha)	Highest SRI Yield (t/ha)	Comments
BANGLADESH						
CARE	D2000	F (29)	6.53	5.0	NR	Kishorganj district
"	D2001	F (99)	6.25	5.0	7.2	"
Dept. of Agric. Exten.	D2000	F (53)	7.5	5.0	9.5	"
"	D2001	F (80)	7.5	5.0	NR	"
BRRI	D2000	Trials	5.4	4.4	NR	Comilla station
"	W2000	Trials	NSD	NR	NR	Gazipur HQ
"	D2001	Trials	NSD	NR	NR	"
BRAC	D2001	T (10 acres)	5.9	4.7	NR	Own fields
Syngenta	W2000	T (0.2 acre)	5.25	NR	5.61	"
"	W2001	T (0.2 acre)	5.7	NR	6.15	"
Average			**6.3**	**4.8**	**7.1**	
CAMBODIA						
CEDAC	W2000	F (28)	5.0	2.0	13.7	
"	W2001	F (393)	3.4	2.0	14.0	Bad drought year
"	W2001	F (6)	6.0	4.0	10.00	Recessional cultivation
Average			**4.8**	**2.7**	**12.9**	
CHINA						
Nanjing Agric. Univ.	1999	Trials	9.7	NR	10.5	Used 50% less water
CNHRRDC	w2001	Trials	NR	NR	11.2	Hybrid varieties
"	S2001	Trials	NR	NR	12.9	Hybrid varieties
Anqing Res. Institute	2001	Trials	12.15	10.02	17.56[2]	Hybrid varieties
Hunan Agric. Univ.	2001	Trials	11.67	NSD	13.1	Hybrid varieties
Meishan Seed Co.	2001	Trials	15.8	11.8	16.0	Hybrid varieties
Average			**12.4**	**10.9**	**13.5**	
CUBA						
Council of Churches	2001	F (1)	8.8	5.8	NR	From a manual
Sugar Cooperative	2001	Trial (1 ha)	9.5	6.6	NR	"
"	2002	Trial (1 ha)	11.2	6.6	NR	"
Sugar Mill	2001	Trial	5.2	2.8	NR	"
Average			**8.7**	**5.6**	**NR**	
THE GAMBIA						
National Agricultural	2000	Trials	6.8	2.0	8.3	Managed by
Research Institute	2001	F (10)	7.4	2.5	9.4	Mustapha Ceesay

NR = Data not reported or comparison not relevant; NSD = No significant difference; specific data not reported

[1] *D=Dry season, W=Wet season; S=Summer season; w=Winter season*

[2] *Theoretical yield calculated for that SRI crop*

Table 1. Summary data from conference reports on SRI and comparison yields (continued)

	Season[1]	No. of Farmers (F) or Trials (T)	Reported Average SRI Yield (t/ha)	Compar-ison/ Control Yield (t/ha)	Highest SRI Yield (t/ha)	Comments
INDIA						
Tamil Nadu Agr. Univ.	2001	Trials	6.3	6.4	7.6	Used 56% less water
INDONESIA						
AARC	D1999	Trials	6.2	4.1	NR	Sukamandi
"	W2000	Trials	8.2	NR	9.3	"
"	W2000	Farmers	6.5	NR	10.3	"
"	D2000	Trials	8.3	NR	9.7	"
"	W2001	Trials	8.4	6.7	9.1	"
"	D2001	Trials	7.3	4.8	8.7	"
IPM Program	D2001	F (3)	6.8	4.5	7.0	Ciamis
ADRA Program	D2001	F (7)	11.6	4.4	13.8	West Timor
Average			**7.8**	**4.9**	**9.7**	
LAOS						
Oxfam/CAA	W2001	F (3)	3.6	3.0	4.55	Seed:harvest ratio up from 1: 43 to 1: 203
MADAGASCAR						
ATS/CIIFAD	1994	F (39)	8.25	2.0	15.0	400 farmers doing
Ranomafana	1995	F (70)	8.04	2.0	16.0	SRI by 1999
French studies - HP[3]	1996	F (108)	7.7	3.6	14.0	With Min. of Agric.
Morandava	W1998	F (280)	4.38	Tradl 2.15	5.58	"SRA" = improved
"	D1998	"	6.92	SRA 3.49	9.11	system w/ inputs
French project data	1994-99	F (>2000)	8.55	Tradl 2.36	14.0	SRA = 3.77 t/ha
Cornell thesis - Station	2001	Trial	6.26	2.63	NR	SRI 10.2 t/ha in pre-
Farmer survey	"	F (108)	6.36	3.36	15.0	vious station trial
ATS "best farmer"	1999	F (1)	NR	NR	21.0	Not a sampled yield
U of Tana theses	2000	T/poor soil	6.40	2.48	6.83	Factor trials N = 288
"	2001	T/good soil	8.35	2.52	10.25	Factor trials N = 240
CRS - 20-40% SRI	2001	F (420)	2.4	1.5	3.2	Limited use of SRI
60-80% SRI	"	F (493)	3.7	1.5	7.5	Partial use of SRI
100% SRI	"	F (139)	4.2	1.5	15.0	Full use of SRI
			7.2	**2.6**	**12.8**	
MYANMAR						
Metta Foundation	2000	Trials	2.35	2.5	2.73	Planted 1 mo. late
"	2001	Trials	5.5	2.5	NR	On very poor soil
"	2001	F (~300)	5.75	2.5	6.5	Participants in Farmer Field Schools

NR = Data not reported or comparison not relevant; NSD = No significant difference; specific data not reported

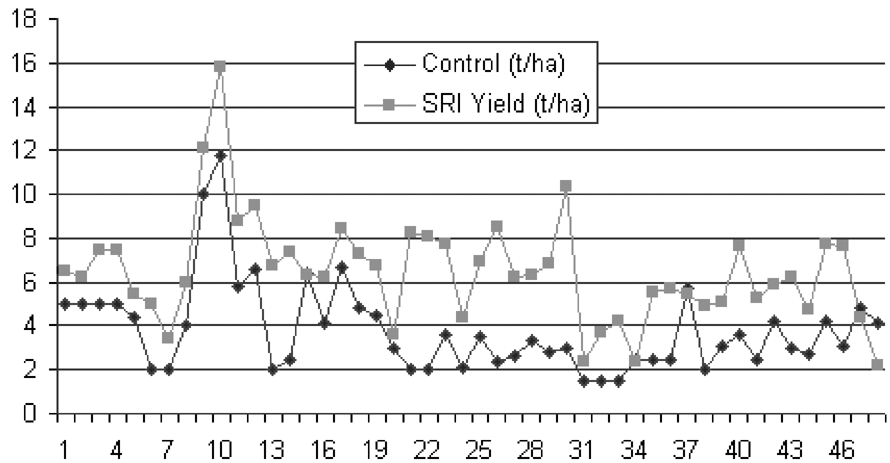
[3] High Plateau: 108 farmers in the regions around Antananarivo and Antsirabe

Table 1. Summary data from conference reports on SRI and comparison yields (continued)

	Season[1]	No. of Farmers (F) or Trials (T)	Reported Average SRI Yield (t/ha)	Compar-ison/ Control Yield (t/ha)	Highest SRI Yield (t/ha)	Comments
NEPAL						
Khumaltar RARS	1999	Trials	Lower yields compared		NR	No water control
"	2000	Trials	to usual methods		NR	Poor water control
Tarahara RARS	2001	Trials	NR	NR	8.0	More water control
Bairahawa RARS	2001	Trials	5.4	5.7	6.2	Poor water control
Sunrise Farm	2001	F (1)	NSD	NR	NR	Good plant growth
PHILIPPINES						
CDSMC	1999	F (10)	4.95	2-2.5	NR	Farmer volunteers
"	2000	F (10)	4.28	2-2.5	13.45	"
BIND	1999-01	T (10)	6.9	NR	NR	"
"	S2001	Trials	5.4	NR	7.3	"
"	W2001	F (26)	5.1	3.1	7.6	"
Agric. Training. Inst.	2001	F (1)	7.6	3.6	NR	ATI employee
Average			**6.0**	**3.0**	**9.4**	
SIERRA LEONE						
World Vision	2002	F (160)	5.3	2.5	7.4	Tradl. max. = 3.2 t/ha
SRI LANKA						
Ambepussa ATC	D1999	Trials	5.9	4.2	NR	
"	W2000	Trials	6.2	3.0	NR	
Wet Zone	W2001	F (135)	4.7	2.7	13.1	
Intermediate Zone	D2001	F (112)	7.7	4.2	15.2	
Dry Zone	D2001	F (10)	9.2	NR	NR	Measured by Dept. of Census & Statistics
3 agroecological zones	D2001	F (17)	7.6	3.1	11.4	
H. M. Premaratna	2000-01	Farmer	8-12	4.0	15.0	
Salinda Dissanayake	2000-01	Farmer	9-13	4.2	17.0	Measured by DC&S
Average			**7.8**	**3.6**	**14.3**	
THAILAND						
CMU/MCC	D2001	Trials	4.35	4.81	NR	No SRI effect has
"	W2001	Trials	2.19	4.16	NR	been seen here

NR = Data not reported or comparison not relevant; NSD = No significant difference; specific data not reported

Figure 1: Line plot of rice yields reported where data are available on both actual SRI yield and comparison/control yield



Note: Not all data from Table 1 are included because of missing values.

