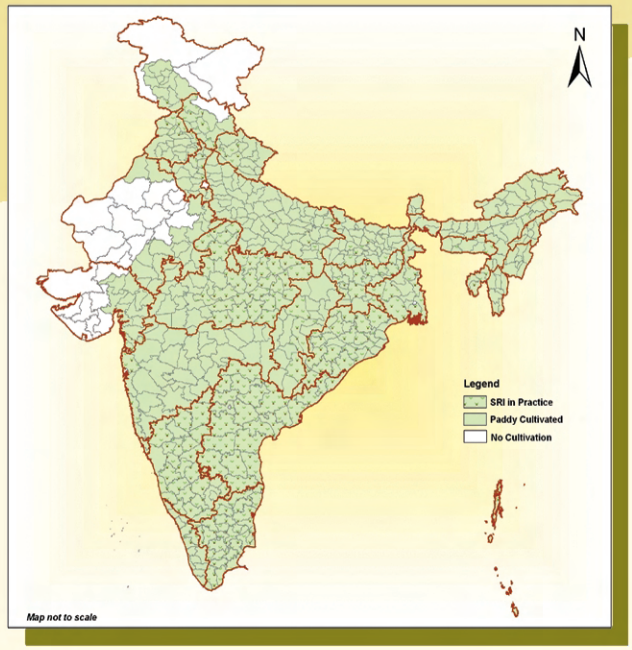
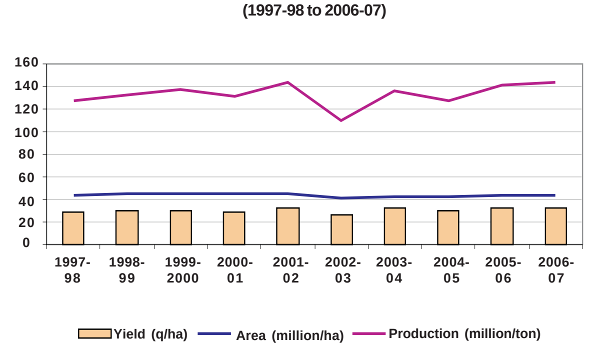
SRI Fact Sheet
INDIA



Total geographical area (million km^2)	3.29
Total population (billion people)	1.13
Total cultivable area (million ha)	126.92
Total paddy area (million ha)	43.7 (2007)
Paddy area (%) to total cultivable area	34.4
Major rice season(s)	Kharif, Rabi
Total paddy production (million tonnes)	141.1 (2007)
Paddy productivity (t ha^{-1})	3.21 (2007)
Constraints in paddy cultivation	Floods, drought, nutrient imbalance, inadequate availability of quality seeds

Fig. 1. India: Trends in Paddy Area, Production and Productivity (1997-98 to 2006-07)



Background

Rice cultivation is the most important agricultural operation in the country, not only in terms of food security but also in terms of livelihood. It plays a major part in the diet, economy, employment, culture and history of India. Ninety percent of rice produced is consumed within the country. With 44 million hectares India ranks number one globally in paddy area and with 141.1 million tonnes (2007) stands next only to China in total paddy production.

The area under rice accounts for 34 percent of India's food crop and 42 percent of its cereal crop areas. While there has been no net increase in the area of rice cultivation in the last 30 years, rice contributes nearly 15 percent of India's annual gross domestic product (GDP) and provides 31 percent of the total calorie supply. Paddy production has increased in India 4.5 times in the last 57 years - from 30.9 million tonnes (1950) to 141.1 million tonnes (2007). Enhancement in rice production is mainly credited to a productivity-led increase since harvested rice area for the corresponding period has expanded from 31 m ha to about 44 m ha, accounting for only 42 percent increase. However, productivity improvement in rice is now increasing at a much slower rate (deceleration) than during earlier decades. The trends in paddy area, production and productivity during the last decade are presented in Figure 1.

- Rice contributes to nearly 15 percent of India's annual gross domestic product (GDP) and provides 31 percent of the calorie/protein requirements of more than 70 percent Indians.
- Irrigated/flooded rice occupying 50 per cent area contributes nearly 70 percent of the total country's rice production with an average yield 4.5 t ha^{-1}.
- The present and future of India's food security depends on irrigated/flooded rice – a water-guzzling crop that consumes nearly 50-60 per cent of the nation's finite fresh water resources.
- Available data from SRI experiments across the country show an increase in grain yield up to 68.3 percent.
- Initially SRI tends to appear labour-intensive but recent interactions with practicing farmers show that there is overall saving in labour costs.

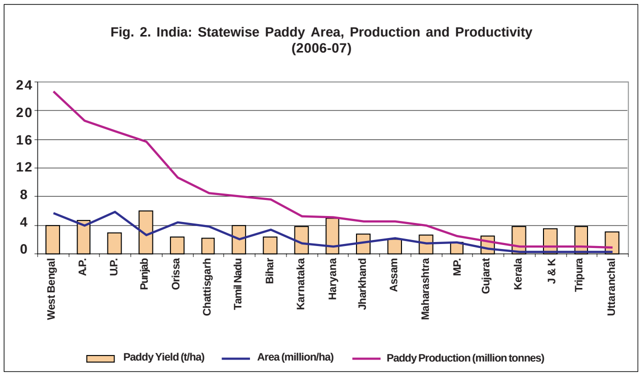


Fig. 2. India: Statewise Paddy Area, Production and Productivity (2006-07)

The state of Uttar Pradesh has the largest rice area in the county but the highest paddy production comes from West Bengal (Figure 2). However, paddy productivity in these two states is lower than 4 t ha^{-1}. In fact, the country's average productivity is lower than all the neighbouring countries, Asian average (4.21 t ha^{-1}) and world average (4.15 t ha^{-1}) Globally, Egypt with 9.97 t ha^{-1} ranks number one in paddy productivity followed by Australia (8.15 t ha^{-1}).

Irrigated/flooded rice though occupying only 50 percent of the total paddy area, contributes nearly 70 percent of the total country's rice production with an average yield 4.5 t ha^{-1}. Thus, the present and future of India's food security largely depends on irrigated/flooded rice – a water-guzzling crop that consumes nearly 50-60 percent of the nation's finite fresh water resources. For example, flooded rice requires 900-2250 mm of water depending on the water management, soil and climate factors.

The country needs to its increase its food grain production to 450 million tonnes by the year 2050 to meet its food security. Increase in paddy production will have to come from the same area or even a reduced area. This means the future of rice production has to come by improving yields. The System of Rice Intensification (SRI) – introduced in India in 2000 when the Tamil Nadu Agricultural University (TNAU) initiated experiments involving SRI principles – provides an option to improve yields whilst simultaneously reducing other inputs.

The TNAU's experimental results in 2000 were followed by an evaluation on farmers' fields and in 2003, TNAU passed SRI for adoption by rice farmers in of the state. Andhra Pradesh was next, when the Acharya N.G. Ranga Agricultural University (ANGRAU) introduced SRI in farmers' fields during *kharif* 2003. The Andhra Pradesh experience generated nationwide interest and today, SRI is known to all rice-growing states of the country and is being practiced in more than 150 rice-growing districts (rice is grown in 564 districts in the country) by hundreds of thousands of farmers from all over the country. The results are very encouraging. Several agricultural universities and Indian Council of Agricultural Research (ICAR) institutes have also taken up research on SRI. Many organizations, governmental and non-governmental (NGOs), are involved in actively promoting SRI. Indeed, NGOs are playing a leading roll in promoting SRI particularly supporting small and marginal farmers in many states. Since its inception in 2000, SRI has proved itself and is today part of the National Food Security Mission, as a method to improve rice production.

Performance

Going back to the first experimental result from Coimbatore in 2000, significant increase in grain yield occurred due to the use of the weeder and this increase generated interest in the core SRI principles. The increase in grain yields obtained in standard field experiments with SRI principles ranged from 16 to 49 percent in Tamil Nadu. Available data from SRI experiments across the country show an increase in grain yield up to 68.3 percent. Negative response in comparison to conventional cultivation has also been reported from Kerala and Uttrakhand (Table 1)

Table 1 . Grain yields in SRI recorded in experiments across India

S.No.	Location	Grain Yield (t ha^{-1})			Source
		Conventional	SRI	% increase/ decrease	
1	Tamil Nadu Rice Research Institute, TNAU, Aduthurai	4.7	7.1	+ 48.9	Rajendran et.al., 2005
2	Soil and Water Management Research Institute, TNAU, Thanjavur	4.8	6.6	+ 35.8	Rajendran et.al., 2005
3	Agricultural Research Station, Mannuthy, Kerala	4.6	3.7	(-) 18.6	Anitha et.al., 2007
4	14 Research stations, ANGRAU, Andhra Pradesh	4.9	5.7	+ 16.6	Mallikarjuna Reddy et.al., 2007
5	Indira Gandhi Agricultural University, Raipur, Chattisgarh	5.9 (2006) 4.3 (2007)	6.6 5.1	+ 12.0 + 17.8	Shrikant Chitale et al., 2007

S.No.	Location	Grain Yield (t ha^{-1})			Source
		Conventional	SRI	% increase/ decrease	
6	Agricultural Research Institute, Patna, Bihar	3.9	6.1	+ 55.1	Ajaykumar et. al., 2007
7	G.B. Pant University of Agriculture and Technology, Pant Nagar, Uttrakhand	6.5 (2005) 6.2 (2006)	5.8 6.6	- 10.4 + 6.9	Bisht et.al., 2007
8	Agricultural Research Station, ANGRAU, Nellore, AP	2.7 to 5.8	3.8 to 6.8	+ 3.3 to 22.7	Ramesh Babu, 2007
9	Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puduchery	2.2	3.7	+ 68.3	Sridevi and Chellamuthu, 2007
10	University of Agricultural Sciences, Hebbal. Karnataka	6.9(aerobic method)	8.0	+ 15.8	Prabhakara Setty et.al., 2007
11	ICAR Research Complex, Umiam, Meghalaya	4.0 (2005) 4.7 (2006)	4.4 5.2	+ 9.3 + 10.2	Munda et.al., 2007
12	Central Rice Research Institute, Cuttack, Orissa	4.9 (2005) 5.6 (2006)	5.9 7.0	+ 20.4 + 25.0	Rao et.al., 2007

Rice plants exposed to SRI principles express genetic potential in a manner hitherto not experienced with the present-day package of practices. The plants have profuse root growth which is reflected in higher tillering (up to 100 per hill) and vegetative growth. The number of panicles (up to 90 per hill) and number of grains per panicle (up to 360) and minimum sterility add up to the higher yield levels (up to 14 t ha^{-1}).

Grain yields obtained by farmers of different states in SRI and conventional cultivation are presented in Table 2. The yield increase is seen to have varied from 23.0 to 96.4 percent. The data from Andhra Pradesh shows the fluctuations in yield advantage.

Table 2 . Average grain yields in SRI and Conventional Cultivation

S.No.	State	Year	Season	Grain Yield (t ha^{-1})			Percent increase
				Conventional	SRI	Increase	
1	Tamil Nadu	2003-04*	Rabi	5.7	7.2	1.5	26.3
		2007-08	Rabi	4.4	5.7	1.3	29.5
2	Andhra Pradesh	2003	Kharif	4.9	8.4	2.5	51.0
		2003-04	Rabi	5.5	7.9	2.4	43.6
		2007	Kharif	5.0	6.2	1.2	24.0
		2007-08	Rabi	5.2	6.6	1.4	26.9
3	Tripura	2006	Kharif	4.5	7.0	2.5	55.6
4	Himachal Pradesh	2007	Kharif	2.8	5.5	2.7	96.4
5	Uttrakhand	2007	Kharif	2.9	5.3	2.4	82.7
6	Bihar	2004-06	Kharif	3.8	4.7	0.9	23.0

(Tamil Nadu 2003-04 data collected from 100 farmers and 2007-2008 from 1456 farmers. Rest of the data is from state status reports received)

The maximum grain yields reported from farmers are as follows – Tamil Nadu: 14.2 t ha^{-1}, Andhra Pradesh: 10 t ha^{-1}; Tripura: 10.7 t ha^{-1}; Jammu and Kashmir: 8.0 t ha^{-1}; and Punjab: 9.8 t ha^{-1}. The effect of SRI on various aspects such as water-use efficiency, soil nutrient dynamics, nutrient-use efficiency, pest and disease interactions, grain quality, plant physiology, varietal response etc., are being studied by various research institutes across the country.

Experiences in Adoption

The overall benefit of SRI to the practicing farmer comes in the form of higher profits, part of which are generated by a 70 percent saving of seeds (seeds saved for one acre of about 25 kg would feed a farmer's family for a month. One can imagine the saving for a village, region, state and country!). Irrigation savings of almost 30-40 percent (8419 m^3 ha^{-1} instead of 16,634 m^3 ha^{-1} and imagine the water saved in a region!) also amount to profit-generation. SRI has also revamped mechanization efforts in rice cultivation. The use of a marker and weeder are already popular; efforts are on the way to develop motorized weeders and convert the transplanting machine to suit SRI principles of using a single seedling and maintaining wider spacing.

On the flip side, since SRI uses less seed, less fertilizers and no weedicide, it also offers a shrunk market for certain agro-based industries and thus does not attract their patronage. It also requires more commitment and involvement from farmers and extension personnel than does conventional cultivation, and this is one of the factors for slow or non-adoption. "Seeing is believing" is true for SRI and those (including scientists) who do not see the principles being adopted and the subsequent crop response, never accept the benefits of it.

Initially SRI tends to appear labour-intensive but recent interactions with practicing farmers show that there is overall saving in labour costs. On-field training, exposure visits to successful farmer fields, and constant drive are essential. Community SRI offers scope to share trained manpower and tools. It is gratifying that many farmers immediately start research on SRI by modifying techniques and gadgets. A very promising phenomenon is the embracing of SRI by several NGOs across the country. In fact, SRI promotion is taking place in some states only through the efforts of NGOs.

SRI has revived rice cultivation in labour-scarce areas because of several advantages. Farmers who use ground water for rice cultivation very well recognize SRI's low water-use. The yield advantage has been realized by farmers with all the varieties tried by them. Farmers who are involved and committed thus continue with SRI.

The coverage on SRI by media viz., newspapers, magazines, All India Radio, TV channels has been very helpful in the spread in some states. While an increasing number of farmers are getting interested in SRI in India, there are several issues in the adoption and scaling-up of SRI at the farmers' level.

- Farmer's are mentally unable to accept the drastic changes in agronomic practices and advocated benefits of SRI, which is eliminated only when they adopt and see for themselves. Some are easily convinced when they see the success of other farmers
- The key SRI principle of using the weeder appears to be a major hurdle because of the required skill and energy to operate continuously. A motorized weeder will solve this problem.
- Contract planting labourers initially resist SRI planting because of the younger age of the seedling and the need for square planting. Training of these labourers appears essential.
- Proper levelling and provision of drainage is a pre-requisite for SRI planting, which is usually ignored. If improperly done, seedling mortality may result in killing the interest of the farmer.
- Farmers who feel that if they cannot control water management then SRI is not suitable for them, do not realize that they can adopt all other SRI principles and get higher yields.

Way Forward

It is now recognized that SRI benefits farmers, in terms of reducing the cost of cultivation and increasing the total income and net profit. At the same time, SRI does require more attention and involvement. Promotion across the country is highly variable: aggressive in states like Tamil Nadu and Tripura, and yet to take off in some states. At the moment, SRI-area in the country could not be more than one percent of the total rice area of 44 million hectares. The attitude of all stakeholders in rice production requires a drastic change if the majority of rice farmers have to change over to SRI. For sure, SRI is an answer to food security in India besides reducing water consumption in rice cultivation.

It is necessary to encourage leaderships in SRI scaling up. Training and exposure visits are crucial to bring new farmers to the SRI fold. Thus, the role of extension personnel is critical.

The following policy interventions are essential for further scaling up of SRI in the country

- Information and training: farmer-to-farmer exchanges could prove an effective tool to promote SRI.
- Making SRI tools easily available to the farmers: facilitate large scale manufacture and distribution.
- Facilitate laser-levelling by providing hiring facilities.
- Promote community SRI: sharing resources and trained manpower.
- Set up a monitoring mechanism on the implementation and adoption of SRI in each state and an apex body.
- Systematically evaluate SRI in each state.
- Educate PWD officials on the need for regional water regulation, such that each state is benefited by adopting SRI.
- Make national institutes more responsible for considering SRI towards national food security.

Source for basic data in graphs, tables and map : Directorate of Rice Development (DRD), Patna; Department of Agriculture and Cooperation Ministry of Agriculture, Govt. of India; Survey of India (Soil), Hyderabad

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