Taking Roots

Experiences with System of Rice Intensification in Andhra Pradesh

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Centre for Sustainable Agriculture (CSA)

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Taking Roots

Experiences with System of Rice Intensification in Andhra Pradesh

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1. Introduction

For more than half of humanity RICE IS LIFE. It is the grain that has shaped the livelihoods, cultures, diets, and economies of billions of people in Asia. For them, life and livelihood without rice is simply unthinkable.

In India, Rice cultivation dates back to time immemorial. Vast majority of the farmers in the country derive their livelihood from rice cultivation. Rice is the staple food for 65% of the total population. For thousands of years, farmers' innovations and natural selection pressures like drought, submergence, flooding, and nutrient and biotic stresses led to a great diversity in rice ecosystems. In addition to the rich genetic diversity, each region adopted diverse cultivation practices to adapt to the local conditions. Culturally, rice is inseparable from the lives of the people.

The Green Revolution brought in significant changes in the way rice is cultivated. This major technological change, which was mainly initiated and steered by International Rice Research Institute (IRRI), Philippines, Indian Council of Agriculture Research (ICAR) and various State Agricultural Universities introduced monolithic thinking of rice cultivation as using new improved rice varieties mainly drawing genes from IR varieties, grown in impounding conditions, using tractors and chemicals in cultivation. The government undertook creation of infrastructure like dams and canals with great public and environment cost. Policy changes were made to provide inputs like improved seed, fertilizers and pesticides. An elaborate extension system was setup to advice the farmers on how to grow these new varieties.

This increased the dependency of farmers on external inputs leading to increased costs of cultivation. The use of water and chemicals also created several ecological problems. The productivity oriented extension systems encouraged excessive monoculture of the crop and varieties. India which once had 30,000 varieties of rice; today gets 75 % of its rice production from just only 10 varieties (Return to

Good Earth, 1990). The assured procurement with minimum support price made rice cultivation an attractive proposition for all the farmers.

With construction of dams and after the Green Revolution, rice became predominantly a canal-irrigated crop. Management of traditional tank systems was totally neglected. Gradually, even rainfed rice farmers started cultivating rice under tube well irrigation. This shift created the most serious economic and ecological damage. The ground waters started depleting at an alarming rate and the governments were forced to discourage rice cultivation under tube wells.

It was in this context, an innovative system of growing rice with less water named 'System of Rice Intensification' (SRI) was initiated in the state of Andhra Pradesh drawing lessons from the experiences of the farmers in Sri Lanka, Madagascar, and in Indian states like Tamil Nadu and Karnataka. In the state, the progressive farmers, NGOs, Acharya NG Ranga Agricultural University (ANGRAU) and the State Department of Agriculture took active role in promoting this model of rice cultivation.

The System of Rice Intensification (SRI) demonstrated that by changing the soil, water and nutrient management the yields in rice can be increased by about 25 or more while reducing water requirements by an equivalent percent. This gives farmers incentive to experiment with SRI method, which also reduces the cost of production and increases their net income per ha by even more than yield. This benefit to the farmer is more than the contribution of increased yields (Satyanarayana, et al 2006).

SRI is not just another set of package of practices but a whole paradigm shift in the way rice cultivation is understood and practiced. While the technology was adopted as a way out for the irrigation water crisis, the fundamental contradictions between rice cultivation by impounding water and SRI method with intermittent irrigation continue. University and extension system promoted SRI through demonstrations and subsidy inputs like free markers and weeders. The mainstream thus did not emphasise the paradigm shift.

SRI system, which is based on sound ecological and agronomic principles not only reduces water utilization by about 40 % but also the seed rate to 2 kg/ acre. SRI for the first time after Green revolution has brought in several innovations from farmers into mainstream agriculture. SRI also clearly demonstrates the biological potential

of the plant and the soil for higher yields, under suitable conditions. The initial experiences show SRI is best suited for organic production systems.

SRI is yet another case of technology developing from the diverse experiences of the farming community. In this instance farmer's practice preceded formal research. The formal research system is still skeptic about SRI method and their results are not very encouraging as the same old reductionistic framework is followed. While farmers and NGOs are very excited about the new method and are adopting SRI, there are equal numbers of farmers who are discontinuing SRI. This calls for a critical look into the experiences of SRI. SRI is suitable for certain conditions and the successful initiatives need to be understood and promoted.

2. Rice, Water and Debates

Rice being the only cereal that can stand water submergence has the long and diversified linkages with water. We can distinguish five water related categories of rice plant: rainfed lowland, deep water, tidal wetland, rainfed upland and irrigated rice. Historically, this made rice cultivation a collective enterprise. The investment and shaping of the landscape that are needed for the impounding water (flat lands with bunds or terraces) or maintaining a tank or canal required collective organization within the community. This water management also relies on collective interest: crop and water calendars for large blocks of fields in order to manage water efficiently. Such works as land preparation, transplantation and drying for harvesting also need collective action.

WATER IMPOUNDING

The field-level control of water for submerged rice growth has led, over the centuries, to the development of specific water management and cultivation practices. The impounded water in rice fields results in water percolation and groundwater recharge. Impounding water in rice cultivation prevents weed development, thereby avoiding the use of herbicides or reducing the labour required. The terrace system in mountainous areas is a typical product of the impounding technique and allows cultivation even on steep slopes. Impounding also results in flood control: field bunds have a significant water storage capacity, which reduces peak flows under heavy rains.

Water plays a prominent role in rice production. While many other cropping systems use water mainly for productive purpose (transpiration), the rice cropping system uses water in a wide variety of ways, both beneficial and non-beneficial.

Table 2.1. Water requirements of Irrigated Rice

Purpose	Consumptive use (mm/day)		Remarks
	Low	High	
Land preparation	150	250	Refilling soil moisture, ploughing and puddling
Evapo-transpiration	500	1200	Depends on outside temperature
Seepage and percolation	200	700	Impounded water
Mid-season drainage	50	100	Refilling water basin after drainage
Total	**900**	**2250**	

Authors like K. L. Sherawat (2005) argue that wetland rice systems are also able to maintain soil fertility on a sustainable basis. The essential components of wetland rice culture comprise cultivation of land in the wet or flooded state (puddling), transplanting of rice seedlings into puddled plots, and growing the rice crop under flooding. The land is dry or flood fallowed during the turnaround period between two crops. Following these cultural practices, two or three crops of rice or rice with upland crops in sequence are grown. Research has shown that the wetland rice system (growing rice in submerged soils) has a great ameliorative effect on chemical fertility: largely by bringing pH in the neutral range, resulting in better availability of plant nutrients and accumulation of organic matter. However, in the present context of increasing freshwater scarcity, there is a case to shift from the traditional way of growing rice to ways that are water-wise.

However, Dr. Norman Uphoff argues that the above argument overlooks entirely the effects of continuous flooding (hypoxic conditions) on (a) the plant roots (which degenerate under these conditions, resulting in reduced plant 'source' capacity) and on (b) the soil biota, biasing the composition of soil populations toward anaerobic organisms (e.g., practically eliminating fungi, which include the mycorrhizal associations that are so essential for the health and nutrition of most plants).

Even on the soil chemistry side, it ignores the fact that under flooded conditions, most of the N available is in NH4 form, rather than NO3 form. Yet IRRI research has shown that rice plants receiving the same amount of N in mixed (50-50) forms rather than all NH4 form will have about 40-70% more yield. This also ignores processes like silicon uptake, which is reduced under hypoxic conditions (more under aerobic conditions), which could explain at least in part why SRI plants are more resistant to lodging and wind and rain damage and also more resistant to insect damage.

Also there is recent work by Dan Olk and others, establishing that the organic matter which is in continuously flooded soils, becomes recalcitrant for decomposition, so the N becomes 'locked up' and unavailable.

Worldwide, new rice cultivation practices are being experimented at the field level. Many of these are motivated by the need to save water in the face of increasing shortages. Paddy rice consumes far more water than any other cereal does, even though much of this water is recycled.

During recent decades, international and national rice institutions have tested various new techniques for growing rice –aerobic, alternate wet and dry system, rice intensification – which partially or totally suppress the need for impounding water at the field level. These new techniques are revolutionizing the age-old idea that rice is an aquatic crop. Rice does develop well in water, and this property gives it a serious advantage in weed control, but recent developments demonstrate that rice can also be grown in dry soils. However, systems that consume less water are far more sensitive to water stress and depend on a reliable water supply during both the wet and the dry seasons. Such a supply can only be achieved by having a performant irrigation infrastructure. If these techniques realize their potential to improve water productivity, rice will become far more water-efficient.

3. SRI - Scientific Debates

System of Rice Intensification offers a new way of understanding rice cultivation, which makes best use of the local resources. The opinion of the scientific community is divided in this aspect. In order to understand the farmers experiences, a questionnaire based interview and observation based study was taken up during the year 2005-06. An attempt was made to map the institutions involved in promoting SRI, their special focus and interest and the processes adopted and the policy support system by the government.

Methodology

The survey was taken up with total of 566 farmers. The data on plant characters and yield parameters is average of plants in one square metre area. The data presented is expressed in terms of simple averages without statistical analysis. The data was collected three times during the cropping season: (a) during nursery stage/ immediately after transplantation, (b) in the middle of the season and (c) after harvest.

While some of the farmers were surveyed by Seetharamaswamy of CSA several organizations and individuals took this responsibility in various districts. They are: Laya – Visakhapatnam; CRIDA – Ranga Reddy; ARTS – Srikakulam; RIDS – Anantapur, Navajyothi – Medak; PEACE – Nalgonda; Y V Krishna Rao – Guntur, MARI – Warangal; RDT – Anantapur; Viksit Bharat Foundation – Ranga Reddy; Vikasa – Visakhapatnam; SIDS – Nizamabad; etc.

The survey included 331 farmers from 11 districts during Kharif and 173 farmers during rabi who practiced SRI (see Table 3.1). In addition during rabi 42 farmers at random were selected who adopted conventional practices. The survey also included 20 farmers who practiced SRI and discontinued in the subsequent seasons. Snowball sampling was followed in identifying the respondents for the study.

Table 3.1 District wise distribution of SRI farmers

District	*Kharif*	*Rabi*	Total
Anantapur	6	27	33
East Godavari	3	0	3
Kurnool	10	0	10
Mahaboobnagar	69	0	69
Medak	4	16	20
Nizamabad	48	51	99
Rangareddy	76	10	86
Srikakulam	13	55	68
Visakhapatnam	21	14	35
Warangal	41	0	41
West Godavari	40	0	40
Total	**331**	**173**	**504**

The findings of the survey / study are discussed under the following headings:

1. Farmers Experiences

a. Year of first cultivation of SRI: Of the farmers surveyed majority (303) were practicing SRI for the first time during *Kharif* 2005.

Case study 1

Unbelievable tillering capacity of Paddy

The story of Jagga Raju from Dirusumaru village of West Godavari district of Andhra Pradesh is known in the area for multiplication of seeds and farmers buy seeds from him. The nearby Krishi Vigyan Kendra (KVK) at Undi was experimenting with a new improved variety of rice (MTU 1071, now very popular among SRI farmers) and approached Jagga Raju for its multiplication in the year 2000. Raju had a wider interest in farming and gardening and experimented with the variety by placing rice seeds in potted plants and in raised beds. The plants grew with profuse tillering (over 150 tillers) and those that were grown in potted plants as single seeds had tillers of 200 and above. Jagga Raju had not heard about SRI or the Madagascar method. Empirically however he had proved that rice was not an aquatic plant. The training officer of the KVK often took the potted plants for demonstration purposes. Dr. Alapati Satyanarayana, then Director Extension, ANGRAU, had seen these plants and did not believe that they were from single seed. However, when he was exposed to SRI in later years he was able to make the connections. SRI in this case 'explained' a farmer innovation and could as a system build on it. Importantly it also seems to offer insights into an emerging innovation process in the rice fields of South Asia wherein the interaction between the research and extension staff with farmers is not seen as a one-way street but as a process with strong feedback loops which seem to collectively contribute to the knowledge pool.

Table 3.2 First implementation of SRI - Year-wise number of sample farmers

Region	2003	2004	2005	Total
Andhra			60	60
Rayalaseema		4	12	16
Telangana	11	13	231	255
Total	**11**	**17**	**303**	**331**

b. Area under SRI taken up by farmers: Among the farmers contacted, majority were trying SRI on experimental basis in less than an acre-sized plot.

Table 3.3 Area cultivated under SRI (2005-06)

Area (Acres)	*Kharif*	*Rabi*
Up to 0.5	117	43
> 0.5 to 1.0	82	116
> 1.0 to 2.0	95	4
Above 2.0	37	10
Total	**331**	**173**

c. Type of Soil: Across the state most of the farmers have taken up SRI in black soils (52 % in Telangana region, 62.5 % in Rayalaseema).

Table 3.4 Type of soil (2005-06)

Type of soil	*Kharif*	*Rabi*
Black soil	149	68
Red soil	96	51
Sandy loam	86	54
Total	**331**	**173**

d. Farmer's source of information on SRI: The main sources of information for farmers on SRI were the staff of Department of Agriculture and Acharya NG Ranga Agriculture University and NGOs. The Extension Department of ANGRAU has taken promotion of SRI through the District Agricultural Advisory and Transfer of Technology Centres (DAATT Centres). Media is generally active in the state in taking innovations to the farmers. All the vernacular newspapers carry special columns advising farmers on agriculture practices. The TV channels especially ETV through its *Annadat*a and *Jaikisan* programs were instrumental in creating awareness among the farmers on SRI. However, transfer of technology from the Department of Agriculture and Agriculture Universities remained a rigid package while the NGOs tried to draw the principles and adapt to the situation.

Table 3.5 Source of Farmer's Information on SRI (*Kharif* 2005-06)

Region	NGOs	Media	Department/ University	Farmers	Total
Andhra	34		26		60
Rayalaseema	6		10		16
Telangana	165	9	77	4	255
Total	**205**	**9**	**113**	**4**	**331**

2. Adoption of SRI practices

Nursery Stage

a. Size of the seedbed: As per recommendation, the seedbed should be 1 cent (about 40 sq. m), which is sufficient to produce strong seedlings for transplanting in one acre. Among the 214 farmers who have taken up SRI in more than 0.5 acres, majority

(41 %) have taken up nursery bed in ¼ cent only against the recommended 1cent/ acre. With more seed rate and smaller size seedbed, the seedlings are more crowded and growth is not vigorous.

Table 3.6 Size of the seedbed (*Kharif* 2005-06)

Region	<1/4 cent	¼ to ½	½ to ¾	¾ and 1	Total
Andhra	13	26			39
Rayalaseema	10	3		2	15
Telangana	78	44	9	29	160
Total	**101**	**73**	**9**	**31**	**214**

b. Seed bed preparation and sowing: The seedbed preparation in SRI needs special attention. A raised seedbed is recommended for better growth and easy transplantation but only 15% of the farmers have used raised seedbed as prescribed. While majority of the farmers applied FYM, others used chemical fertilizers. Few farmers have used presoaked and sprouted seed to have better establishment.

c. Seed rate per acre: To plant one seedling per hill at the recommended spacing of 25 x 25 cm a nursery with one to two kg seed is recommended compared with the 30 kg per acre seed rate in conventional practice. In SRI cultivation 64000 seedlings are required for 1 acre and 1kg of seed contains more than 70000 seeds (Annadata, 2006). Adopting 2kg seed rate per acre should take care of germination and other losses. However it is observed that farmers were using more seed rate, especially during rabi season. Farmers found germination and establishment related problems during rabi.

Table 3.7 Seed rate (2005-06)

Seed rate/acre	*Kharif*	*Rabi*
2 kg	303	72
3 kg	19	64
4 kg	7	30
5 kg	2	07
Total	**331**	**173**

It was also observed that about 57 % farmers were transplanting 2-3 plants per hill as they were not confident about the survival of the single plant per hill.

c. Varieties grown: Farmers have grown a wide range of traditional to improved varieties under SRI.

Table 3.8 Varieties Used

Seed variety	No. of farmers	
	Kharif	*Rabi*
BPT-5204	36	-
MTU 1001	14	-
MTU 1010	45	93
MTU 7029	12	-
MTU 9993	16	-
Jagityal	-	17
Ankur sonum	24	18
Hamsa	-	8
Jjlu	-	8
Tella Hamsa	110	18
Wgl-23985	33	-
Others	40	14
Total	**331**	**173**

d. Irrigation during nursery stage: Among the farmers surveyed during Kharif, 109 farmers were using rose can and 198 used a pot and others used a sprayer to water the nursery. The general opinion was SRI saves a lot of water during nursery stage.

e. Pest & disease control during nursery stage: No pest and disease was reported and no chemical was used by any of the farmers in both the seasons during the nursery stage due to the very short period of the nursery seedlings.

Main field preparation and transplantation

90% of farmers opined that SRI requires more precision and that the labour requirement has not drastically increased. Land leveling requires more hard work as the entire field needs to be uniformly irrigated.

a. Age of seedlings at transplantation: In the conventional system farmer have flexibility to take up transplantation at a convenient time. One of the main principles of SRI is to transplant younger seedlings to take advantage of the early and prolific tillering (Katayama, 1951). Farmers taking up SRI under rainfed conditions and tube well irrigation expressed difficulties in transplanting younger seedlings due to delayed rains and labor shortage. Probably there is a need to try a staggered nursery where seedlings of 8-12 days age would be available any day for about a month period so that transplantation can be taken up immediately after rains.

Table 3.9 Age of seedlings at transplantation (*Kharif*, 2005)

Region	Direct sowing	8-9 Days	10-11 Days	12-13 Days	14 –15 Days	15-20 Days	Total
Andhra		24	16	9	11		60
Rayalaseema		2	10	3	1		16
Telangana	2	16	58	128	37	14	255
Total	**2**	**42**	**84**	**140**	**26**	**14**	**331**

b. Spacing: Majority of the farmers followed square planting with 25 cm spacing on either side as most of the markers (cylindrical, wooden rake etc) have fixed spacing. However in areas where farmers had flexibility minor variations were seen. All the farmers have expressed satisfaction with 25 x 25 cm spacing.

Table 3.10 Spacing adopted by farmers (2005-06)

Spacing	*Kharif*	*Rabi*
20 x 20 cm	15	12
25 x 25 cm	250	91
Other	66	70
Total	**331**	**173**

c. Use of Markers: In the process of evolution of SRI various markers and marking techniques were designed by farmers and scientists. In some tribal areas of Paderu mandal, Visakhapatnam district transplantation and marking were done on the same day to save labour and for better visibility of markings.

Among the farmers, majority, were using cylindrical markers. However in some areas especially in Telangana region farmers also used ropes to mark the field with desired spacing to transplant the seedlings.

Case study 2

Roller marker – innovative adaptation of rangoli maker

Farmers of Andhra Pradesh welcome rice harvest by celebrating Sankranti, the harvest festival. Their womenfolk greet the goddess of wealth and happiness, by rangolis in their front yards. The rangolis are drawn with a cylindrical shaped devise, that has free movement when the handle is drawn, has holes in patterns. The cylinder is filled with mix of finely pounded lime and rice flour mix and when drawn on the ground forms beautiful patterns. The same devise Mr. Sapay Sriramamurthy of Pallamkurru village to invent the roller marker for SRI method of rice cultivation.

Sapay Sriramamurthy heard about SRI in 2003 when he read an article published in Annadata (a monthly Agriculture journal in Telugu). With the help of agriculture department he adopted SRI in his field. The transplantation in grids of 25 X 25 cms, using ropes to draw the grids, was the recommended practice. Since it was too cumbersome and painful he decided to invent something which will reduce the effort and time and give identical sized and shaped grids. And the roller marker was invented.

Table 3. 11 Different markers used by the farmers

Type of marker	*Kharif*	*Rabi*
Cylindrical	207	52
Rope	75	121
Wooden rake	43	0
4 Line	6	0
Total	**331**	**173**

c. Performance and availability of markers: The performance of the markers is satisfactory but the availability in some parts of the state is not adequate. So there is a need to make the necessary SRI implements available to the farmers.

The Department of Agriculture is supplying markers at 50 % subsidy through AP Agros. The performance of the marker is also good. Only 4 farmers expressed that

operation of the marker was difficult when the field is not cleaned properly (when green leaves were incorporated).

d. Transplantation: All the respondents expressed that SRI transplantation was simple. The labor/farmers who transplant the seedlings need one time training to acquire the skills. In Telangana areas, labour charge three bags of paddy/acre (Rs.2100/acre) for conventional transplantation while for SRI it was comparatively cheaper (around Rs. 1000/acre).

In field visits it was observed that in many places the transplanting was deep. Instead of placing the saplings on the top of the muddy field roots taking 'J' shape, the labour were forcing them in to the soil making the roots take "U" shaped. In some cases the main fields were still flooded with water at the time of transplantation. This affected the growth of the transplanted saplings. This calls for building the skills of the farmers and labour on transplantation. The main field in majority of the cases was found to be full of water on the transplantation day. The field should be moist but not watery for quick establishment of the tender seedling.

e. Establishment of Seedlings: All the farmers experienced anxiety over the establishment of seedlings. The use of younger seedlings, transplanting tender seedlings with wider spacing gives a sparse appearance to the main field after transplantation. But in one month time seedlings establish themselves. However, farmers complain that establishment of seedlings is poor in saline soils and during rabi season due to low temperatures.

f. Labour Requirement: One of the problems often raised by farmers and scientists on SRI is the increase in labour requirement during main field preparation, transplantation and weeding. For other practices, the labour requirement is similar to conventional practice.

Table 3.12 Labour requirement in SRI (*Rabi,* 2006)

Operation	SRI	Conventional
Main field preparation	9	6
Transplanting	16	12
Weeding	12 (3-4 weedings)	22 (2-3 weedings)

g. Laboriousness: Increased labour requirement could be converted into an opportunity for generating more employment for agriculture workers. However, the increased laboriousness is matter of concern. However in main field preparation and transplantation all the farmers and workers said SRI is less cumbersome.

Crop growth and Management

a. Tillering: In majority of the fields which were under SRI method had tillers in the range of 36-60 per hill. In the conventionally grown rice fields the tillers were in the range of 15-25.

Table 3.13 Average number of tillers per hill:

Region	Avg.	<15	15-25	26-35	36-60	>60	Total
Andhra	36	8	18	10	12	12	60
Rayalaseema	60				11	5	16
Telangana	37.3	1	42	88	123	1	255
Total	**37.1**	**9**	**60**	**98**	**146**	**18**	**331**

b. Weeding: Standing water in conventional paddy cultivation suppresses weed growth. In SRI only thin film of water is given with alternate wet and drying. As a result the weed growth is more. In conventional paddy weeding is done 2-3 times, in SRI method 3-4 weeding operations are needed. More weeds in SRI method are seen as an opportunity to incorporate additional organic mater into the soil.

In conventional paddy the weeding is done in very initial stages where women do the weeding manually. In SRI the weeding is done starting from 10^{th} day of transplantation, which requires use of implements. None of the respondents used chemical herbicides for weeding.

Table 3.14 Labour requirement for weeding in SRI method and Conventional paddy

Soil type	No. of weedings		Labour requirement	
	SRI	Conventional	SRI	Conventional
Black soils	3-4	2-3	15	24
Red soils	3-4	2-3	15	25
Mixed type	3-4	2-3	9	22

Though the weeding operations are more in SRI method, the use of mechanical weeders reduce the total labour requirement. But many farmers expressed that weeding operation with weeders was very difficult in heavy clay soils.

Table 3. 15 Implements used for weeding:

Type of weeder	Kharif	Rabi
Conoweeder	110	122
Rotary	171	36
Manual	50	4
Mandava weeder	0	12
Total	**331**	**173**

During kharif 48.3% of the Andhra region farmers were using rotary weeder. 94% of the Rayalaseema farmers were using rotary weeder. 50% of the Telangana farmers were using the rotary weeder. 52% of the total farmers were using the rotary weeder.

Performance of the weeder: Conoweeders were made centrally by ANGRAU and supplied to all the districts across the state through Department of Agriculture. AP government initially distributed them freely and later supplied with 50% subsidy thorough AP Agros. The weeders are also available at a sale price.

Farmers (54 % across state), especially from black cotton areas complained that they problem with conoweeder when used in muddy fields. This weeder is also not suitable to be operated by women. Farmers also had complaints about the quality of the conoweeders. There is an urgent need to design weeders to suit the diversity of the situations and their manufacturing should be decentralized. The design should be simpler and require less maintenance.

Since weeding is seen as one of the major difficulty in SRI method group discussions with farmers were conducted on weeding, weeders and the difficulties. Traditionally weeding in rice is done by women, but in SRI method men have to take the role of weeding. This gender shift has created an impression that weeding is a major problem in SRI method. Variation is also observed between small and big farmers. Small farmers who use family labor feel weeding in SRI method is easier as they can use the weeder and need not hire labor like in conventional rice. But big farmers who

hire labor especially in black cotton soils feel it is difficult because labor complain difficulties in operating the weeder.

c. Nutrient management: The respondents were a mixed group with majority adopting integrated nutrient management during Kharif. The general impression among the farmers was that the fertilizer requirement is generally less in SRI method as the weeds incorporated into the soil supply the nutrients.

Table 3.16 Different types of nutrient management

Type of input	Kharif	Rabi
Organic	72	17
Chemicals	37	82
Integrated	110	74
Total	**331**	**173**

Nutrient management by all the farmers was based on experience rather than soil testing. Farmers apply 5-10 cartloads of Farm Yard Manure at least once in three years. All the farmers expressed that they would prefer to use organic material if available in adequate quantities. However, majority of the farmers used chemical fertilizers like DAP and urea.

Availability of organic matter was expressed as one of the constraints due to decreased cattle population in the villages. Raising green manure crops in the fields also was not feasible due to water constraint during summer before onset of kharif. However, it was observed that most of the biomass available in the villages was not effectively used. Wherever innovative approaches like Dabholkar method were used, farmers could reduce/ do away with the use of chemical fertilizers.

One of the advantages of SRI method often cited by majority of the people is the increased biological activity in the soil. However the field staff of Agriculture Department and scientists from Agriculture University were skeptic about organic methods and recommended chemical fertilizers and pesticides. The impact of these chemicals on the soil microbial population in SRI fields need to be studied.

Table 3.17 Reports on incidence of pests and diseases (Rabi 2006)

Pests & Diseases	No. of farmers	
	SRI Method	Conventional
Blast		34
Gall midge		16
Stem borer	12	42

In rabi the incidence of blast, gall midge and stem borer were observed in 42 farmers' fields adopting conventional practices. However there were only 12 farmers who reported the incidence of stem borer in SRI practices. Wider spacing adopted in SRI method and no standing water are cited as reasons for having lesser pest incidence.

d. Irrigation: One of the main reasons for promotion of SRI method is the claim of reduced water usage. Majority of the farmers adopting SRI method irrigated their fields on alternate days across locations compared to regular irrigation under conventional practice. The critics raise the issue that in conventional paddy cultivation the amount of water in each application is less as the soils are saturated with water, where as in SRI method each irrigation requires more water as the water flow would also be vertical in addition to the horizontal flow. However this needs more careful study as the farmers' observation was that with the same amount of water instead of two acres of conventional paddy cultivation three acres of SRI could be cultivated.

During Kharif rains often cause excessive flooding in the fields. Lack of proper drainage facilities is major problem across locations, especially in coastal Andhra Pradesh where majority of the area is under canal irrigation. Farmers also expressed difficulties in managing alternate wetting and drying in sandy soils.

Managing thin film water as recommended was possible only in leveled fields. Majority of the lands were undulated and farmers expressed difficulties in maintaining uniform thin film of water across the field.

Table 3.18 Irrigation interval, in days, with SRI Method (Kharif, 2005-06)

Region	1	2	3	4	5	6	7	Total
Andhra	1	5	3	1	5	11	15	60
Rayalaseema	5	1	4				6	16
Telangana	1	118	43	35	25	15	17	255
Total	**7**	**124**	**50**	**36**	**30**	**26**	**38**	**331**

e. Source of irrigation: Farmers using tube well for irrigating their field expressed that water flow can be controlled better. Under canal-irrigated areas, individual farmers expressed difficulties in managing the thin film of water in their fields as recommended. In one of the locations it was observed that the farmer has to hire labor to siphon out water from the field. In such areas a community level water management system needs to be tried. Another problem raised by farmers is the uncertainty of water release from the dam and canals. The water supply systems need to be restructured as the entire canal irrigation system is built for flooding type of irrigation rather than controlled irrigation. Restructuring the irrigation channels may be more economical as the water saving would be significant.

Areas under tank irrigation also have similar problems. Though few initiatives were made through Water User Associations, successful experiences have not yet emerged.

Growing Rice in Drylands: Civil Society Innovation in Using SRI

Farmers in Mustikovila of Chennekottapalli Mandal of Anantapur district had in the past organised themselves with help from the Timbaktu Collective to desilt and repair a traditional tank in their area. This became their main source of irrigation in the chronically drought-affected Anantapur district. Over 500 farmers in tank-irrigated Mustikovila and adjoining villages in Rabi 2003 prepared their land and were misled by rains that lasted only three days, forcing the local administration to close the tank sluice gates.

Through the Timbaktu Collective some of the farmers had been to Narayana Reddy's farm to learn about paddy cultivation without flooding. Reddy later visited and advised them. One of the earliest persons to have experimented with SRI, Reddy considers SRI to be the 'innovation of his lifetime'. The farmers and the Collective got together and decided to have a strict monitoring and regulation of water use, with water released once in five days. With this they were able to save their crop. That year Mustikovila was the largest patch of land (over 370 acres) with a rice crop in the district, through the application of one of the SRI principles. SRI here was not about getting higher yields than a conventional plot, but more about allowing farmers to mitigate risk and re-establish control over resources. This benefited farmers who, over the years, had become increasingly dependent on external agencies. SRI rice was not seen as an end in itself but as means to greater food self-sufficiency and resource conservation in the region. The Collective has since carried on its SRI work, offering technical expertise to farmers in their region who were taking up SRI method.

Shambu Prasad (2006), System of Rice Intensification in India Innovation History and Institutional Challenges

Under tube well irrigation, though farmer has more control in irrigating his fields, they expressed difficulties with erratic power supply. In conventional system even if the irrigation is delayed by 2 or 3 days the crop can withstand whereas in SRI method as the water is maintained as thin film the farmer has to be more regular in irrigating the field. Another problem expressed by the farmers is the time of power supply. Many times the power to farmers is given during nights and farmers have the motors on auto start mode. This does not permit controlled irrigation. There fore a more comprehensive planning is required by the government with close cooperation of electricity department and Department of Agriculture. Power supply and water management should be planned at a feeder channel level.

Table 3.19 Source of irrigation (Rabi, 2006)

Source of irrigation	No. of farmers
Canal	64
Rainfed irrigation	31
Tube well	78
Total	**173**

Irrigation requirement and crop duration: The amount of water required is also influenced by the duration of the varieties used. The farmers' observations are

- MTU 1010 requires 6 irrigations in SRI method and 8 irrigations in conventional method according to data.
- Ankur Sonam variety requires only 5 to 8 irrigations in SRI method and 16 irrigations in conventional method

f. Root growth: All the farmers observed that the root growth in SRI method was denser and healthier (more in size and white in color).

g. Yield and Varietal Response: Farmers adopting SRI method obtained yields ranging from 28 to 40 q/acre compared to 15 to 25 q/acre under conventional system. On all yield related parameters like number of tillers, number of panicles, seed weight and chaffiness SRI farmers had advantage. The same response was seen across all the traditional and improved varieties. However the variation between the varieties needs to be studied.

Table 3.20 Varietal Response to SRI (*Rabi,* 2005-06)

Variety	Tillers		Panicles		Yield_(q/acre)		Wt of 100 seed (gm)		Chaffiness	
	SRI	con	SRI	Con	SRI	con	SRI	con	SRI	con
MTU1010	41	12	39	10	35-40	25	4.8	3.5	5%	8%
Ankur sonum	32	12	28	8-10	35-38	15	5	4 -4.5	10%	20%
Jagityal	22	10	20	6	28	19	5		8%	12%

Majority of the farmers across locations obtained the grain yield in the range of 21-30 q/acre while 72 farmers could get yields ranging from 31 to 40 q/acre. In the conventional practice best average yields were in the range of 20-30q/acre.

Table 3. 21 Grain Yields (quintals/acre) (Kharif, 2005-06)

Region	<10	10-20	21-30	31-40	41>	Total
Andhra	16	8	32	4		60
Rayalaseema			4	10	2	16
Telangana	25	62	109	58	1	255
Total	**41**	**70**	**145**	**72**	**3**	**331**

Ten farmers who cultivated MTU 1010 organically got yields up to 45-q/acre. MTU 9993 and Tella Hamsa varieties grown in red soils had less tillers per hill. Highest number of tillers of 65 –70 were observed in case of MTU-7029 and Ankur Sonum varieties across locations grown organically.

Number of panicles per hill: While in majority of the SRI plots 36-60 tillers were observed per hill, number of productive tillers ranged from 21 to 35. In conventional rice plots the number of panicles per hill ranged from 10 to 20.

Table 3.22 Number of panicles per hill (Kharif 2005-06)

Region	Avg.	<10	10-20	21-35	36-50	50>	Total
Andhra	26.9	9	19	9	23		60
Rayalaseema	49				10	6	16
Telangana	28.3	9	49	143	53	1	255
Total	**29.1**	**18**	**68**	**152**	**86**	**7**	**331**

Number of grains per panicle: On an average the number of grains per panicle in SRI method was 182. Variation was seen across regions and across varieties.

Table 3.23 Number of grains per panicle (Kharif 2005-06)

Region	Avg.	<150	151-200	201-300	301-400	401>	Total
Andhra	232.7	18	10	10	22		60
Rayalaseema	238	3	2	7	4		16
Telangana	187	105	84	50	5	11	255
Total		**126**	**96**	**67**	**31**	**11**	**331**

Table 3.24 No. of grains per panicle (*Rabi*, 2005)

Variety	SRI	Conventional
Ankur sonum	190-220	80
Jagityal	250-275	-
Swarna Masuri	350-400	320
BPT-5204	520-610	420

h. Net incomes: In general the average cost of cultivation with SRI method was less compared with conventional method of rice cultivation. This was mainly due to reduction in seed cost, water usage, chemical fertilizer and pesticide use. With SRI method farmers had added advantage of increased yield.

With SRI method farmers had added advantage of .y to iDuring rabi, net income of 154 farmers out of 173 farmers increased by nearly 30%. Ninety four out of 154 farmers had reduction in cost of cultivation in weeding and pest management. The average of five farmers who have grown SRI organically got the yield of 52q/acre compared to 48 q/acre in neighboring fields.

3. Constraints in adoption of SRI

While several advantages were observed with SRI method, it was observed that there were several farmers who discontinued the practice. To understand the constraints in adoption of SRI method, twenty farmers who practiced SRI method and later discontinued were interviewed. The main reasons expressed for their discontinuation were

- Yield increase with SRI method was exaggerated. No major difference in yield was observed between SRI method and conventional practices.
- Undulated lands are a problem and land leveling is not possible in majority of the areas.
- Weed management is one of the serious problems as the conoweeder is not performing well in heavy (black) soils.
- Constant attention of farmer is required in practicing SRI method. In conventional paddy this is not required.

- Irrigation/ water management: the regular controlled wetting of the field and draining the excess water is very cumbersome and this is very difficult in sandy soil since the field becomes dry within hours of irrigation so daily monitoring of water is a very difficult aspect of SRI cultivation.
- Irregular power supply is effecting the effective irrigation management. Farmers are forced to adopt irrigation schedules as per the electricity supply rather than crop requirement.
- Under canal irrigation the drainage systems are not designed and individual farmers have no choice to have controlled irrigation.
- The unreliable water supply system in major irrigation projects doesn't permit any irrigation calendar.
- Big farmers expressed operational difficulties in getting skilled labor at affordable wages.
- Problems of scale: The various operations adopted as part of SRI method suits smaller plots and small farmers. On large fields both labor and farmers express difficulties.
- Rat menace is more in SRI fields.
- Termite problems have increased in dryland areas, especially in red soils.

II. Institutional and Policy Support to farmers on SRI

Successful spread of any innovation depends on the coordinated effort of various players and stakeholders involved and providing policy support. Innovations in agriculture emerge from diverse sources. Various agencies were found to be involved in promotion of SRI method in Andhra Pradesh. Interestingly each of these agencies has their own agenda, priorities and perspectives, which drive them.

a. Research System: SRI is a classical case of farmer's practice preceding the research and scientific recommendation. Some of the innovative farmers and NGOs after learning from various sources initiated SRI method in small pockets. The major boost came when the Director (Extension) of Acharya NG Ranga Agriculture University started promoting through Krishi Vigyan Kendra's and DAATT Centres during Kharif 2003. Several farmers were trained and encouraged to take up SRI. Several articles were written and successful case studies were published. The demonstrations continued during 2004-05 and 2005-06. While these are

demonstrations conducted by the extension wings of the Agricultural University, the research system was skeptic about the claims made under SRI method. The research system is still continuing with the trials and yet to come out with recommendations.

Table 3.25 Yields from the demonstrations conducted by ANGRAU

Year	Total trials	SRI average yields (ton/ha)	Conventional paddy average yields (ton/ha)	Difference in yield (ton/ha)
2003-04 kharif	134	8.3	5.3	3.9
2003-04 Rabi	94	9.7	7.1	1.73
2004-05 kharif	194	7.8	5.9	1.9
2004-05 Rabi	311	7.3	5.56	1.53

Source: *Various reports of ANGRAU*

Directorate of Rice Research (DRR), based at Rajendranagar, is mainly focused on developing 'Aerobic Rice' and SRI method doesn't figure in their priority list. During 2006-07 with the initiation of WWF and WASSAN, DRR took up few field trials. The papers presented in one of the recent National Workshops organized by WWF, DRR and ANGRAU indicate successes with hybrid rice under SRI. .

The research system seems to be caught in a 'genetic improvement' paradigm of crop production. Technologies for all the problems and promises are built into breeding 'improved varieties' and now through Genetic Engineering. Farmer based management systems don't seem to be focus anymore, which is a major threat to the small farmer agriculture systems.

Much of the research work so far has focused on '*validation research*' either proving or disproving the practice and claims of SRI method in terms of input use, yields etc. The second set of research work focused on '*standardization research*' to standardize the practices within SRI method like age of the seedlings, weeding etc. Very little so far has happened in terms of '*advancement research*' on main impediments in scaling up SRI method that could positively contribute to realising the potential of SRI method. Even basic research to understand the results of SRI was not done.

Reducing SRI to a package of practices i.e., the proverbial 'six practices' would undermine realization of its potential. The attempts at standardizing SRI practices are not of much use as the farming situations in rice are diverse which needs local adaptation. The water availability and use, flooding situations, land and soil situations, varieties etc., differ substantially among the farming situations. Can on-station research be of use in these cases? The field situations cannot be simulated in the research farms and the farmer's observation and skills are of utmost importance in SRI. Also, as multiple factors are simultaneously and synergistically at work in SRI, it may not be of much use to have isolated factorial designs, which cannot capture the synergetic effects. This calls for a newer research designs to understand the successful field experiences than trying to fit them into the research designs in the research farms. SRI research should be on-farm research with farmers' participation.

Similarly, the research focus should shift beyond validation and standardization as substantial number of farmers across the country stand testimony to the efficacy of SRI in reducing the inputs and bettering the yields. Standardization of practices like age of the seedlings, plants per hill etc., lead to prescriptive practices that are not-so-useful in diverse farming situations. If the SRI principles are communicated well the farmers may in the course of time adapt to the SRI principles suited to their local situations. This may result in the evolution of site-specific practices rooted in farmer's experimentation. Scientific collaboration in farmers' experimentation would stimulate this process.

The research should focus on the real problems confronting scaling up of SRI. Water management in the irregular electricity regimes, protection of the crop against potential power failures, group-control over surface irrigation (e.g., under tank irrigation systems), appropriate controlled irrigation methods, improved techniques in catalyzing the soil biological processes, methods of SRI in alkaline soils, better nursery techniques, evolving agronomic measures for weed control and appropriate mechanization are some of the serious research questions that need attention.

The on-station research system cannot simulate the multiple constraints or opportunities that farmers have. The research system should gear up and to accept farmer-led, science supported research in SRI. The research system should find new partnerships to work with farmers and civil society to find solutions for some of these basic questions confronting scaling up of SRI method. Pursuing these

questions will pave a new way of agriculture research that transcends the boundaries of conventional disciplines.

b. Extension system: The Department of Agriculture is involved in campaigns, trainings and demonstrations for promoting SRI method. When water and power crisis have become major issues AP government announced a policy to promote SRI. As part of the program one demonstration per panchayat was announced and implements were supplied freely. Presently weeders and markers are supplied at 50 % subsidy through AP Agros. The Agriculture Officers were trained by the University scientists on SRI and they in turn train farmers. The extension system which is normally in 'recommendations'/ 'package of practices' approach has made the principles of SRI as a rigid recommendation. Every local adaptation deviating from recommended package is not seen as adoption. For example, the seed rate was reduced by most of the farmers after SRI experiences, and also started adopting uniform wider spacing, transplanting younger seedlings, using lesser water etc according to their situation and need. This study couldn't quantify such adoptions. Unfortunately, these are seen as discontinuation of SRI method.

The extension systems in vogue are mostly designed around input or commodity driven technologies. Subsidized demonstrations with rich 'progressive' farmers are the only methods used for extension of knowledge. These methods which were successful during the green revolution days, when most of the farmers were illiterate and new inputs were promoted failed to promote technologies which are more knowledge centric than input centric. The extension system which can pass on 'information' in the form of recommended practices or 'train' farmers in using them has to learn from 'practice'.

Extension system still needs to find appropriate drivers for the extension of SRI, which is more knowledge and farmer centric. The knowledge based and labour oriented technical processes can best be extended on the farmers' institutional platforms. As there are no incentives for markets and private bodies to extend SRI method, public sector extension on institutional platforms would be the key to SRI promotion. Farmer Field Schools is another promising extension method that can be of great use in up scaling SRI. Formal public sector extension agencies should evolve ways of working synergistically with these groups/ farmer's platforms / Institutions.

c. Civil Society Organizations: NGOs like WWF, Timbaktu, Laya, WASSAN, CSA, MARI etc., and organizations like Kisan Forum promoted SRI method on smaller scale across the state. They suitably adapted SRI methods to meet the local situations. Farmers were organized into institutions to take up SRI. But the spread effect is yet to be seen.

d. Command Areas: AP State Irrigation Department and Command Area Development Authority through JalaSpandana (an NGO formed by the farmers' and Water User Associations of Andhra Pradesh) piloted Participatory Training Programme in Rajolibanda Diversion Scheme (RDS), Priyadharshini Jurala Project (PJP) and Kurnool -Cuddapah Canal (KC Canal) in Krishna Basin. Farmers and Water User Associations were trained to adopt SRI.

Table 3.26 SRI performance during Rabi 2005-06 from Jalaspandana project

	SRI with 25 x 25	SRI with 25 x 12.5	Normal Paddy
No. of Hills/sq. m	16	32	53
Height of the crop (cm)	108	116.6	103
Panicle in a hill	24	20.6	12.4
Length of panicle (cm)	23.9	25.7	20.8
Main branches in a panicle	11.6	12.8	9.00
Grains in a panicle	99.6 F, 22.4 U	137 F 15.4 U	71.6 F 25.2 U
Grain weight 1000 no (gms)	35	35	30
Grain weight gm/sq m	780 F, 75 U	660 F, 40 U	545 F, 60 U
Yield 75 kg bags/per acre	41.6	35.2	29.06
Yield increase over normal paddy	43 %	21 %	-

F=filled, U=Unfilled

Source: http://www.jalaspandana.org

The report says that adoption of SRI technology across the state could save estimated water of 264 TMC in Andhra Pradesh.

A further greater challenge is in controlling the irrigation schedules. Given the anarchy in the water distribution in the canal irrigated areas (in dams or tanks); practicing SRI method is becoming a nightmare for the farmers. The existing systems are built for flood irrigation rather controlled irrigation. Controlled irrigation should

be tried in canal and tank systems at least on an experimental basis to generate experiences in this regard. Unless irrigation systems are controlled, they can not be managed; it makes any attempt at water saving improbable. The command areas also lack proper drainage systems, which are essential for better irrigation management. This would help only redesigning the existing irrigation channels with more controlled water management system under canal irrigated areas (in dams or tanks) but also designing most of the new systems that are going to be built as part of 'Jalayagnam'.

e. Watershed areas: Andhra Pradesh is a hub of watershed activity. Watershed programs are supported and implemented by NABARD, Department of Rural Development, AP Rural Livelihoods Project (APRLP) etc. In all these watersheds, SRI method is promoted as part of the water saving effort.

f. Policy Support: SRI is a stated policy of the state government of Andhra Pradesh. The pressures on the AP government to introduce reforms in power sector have forced the state government to withdraw 'free electricity' for the rice growing farmers. When they faced opposition from farmers unions and political parties, the Ministry of Agriculture and Department of Agriculture have strategically pushed promotion of SRI as irrigated dry crop and restrict 'free power' support to only those who adopt SRI. The Chief Minister announced a program to conduct demonstrations in 20,000 villages, and Rs. 4 crores was allotted for this purpose. Another Rs. 17 crores was allocated for supplying implements under subsidy. At the end of the season, the situation has not improved. The irregular power supplies, uncertainties in release of canal water, lack of proper drainage systems effect the adoption of SRI method. Every time only farmers are asked to change their practices while all other players and stakeholders are caught in their own old paradigms. The state government should come out with a clear policy to create appropriate infrastructure in the form of redesigning irrigation channels and building drainage systems and take steps to ensure regular power supply and calendar based water releases.

The state level government support for SRI method however, is limited to extending subsidies to weeders and markers through A P Agros, field demonstrations and supply of electricity only for SRI in rabi season under borewells as an exception. The latter is almost non- enforceable. As these policy support mechanisms are proving to be inadequate for large-scale adoption of SRI method, new ways of extension of

policy support needs to be explored. The following is an attempt to evolve such options.

Subsidies are extended at present for mechanical weeders. If labour for weeding is seen as a problem subsidizing labour rather than implements will expand the options and may address the real needs. A group/ area based approach to weeding may be considered rather than an individual farmer centric subsidy. In place of subsidizing implements if groups of labour trained in SRI are supported for weeding and transplanting operations for a defined area, it would be of immense relief to farmers. Eventually, this may evolve into a kind of contractual practice like normal paddy transplanting on contract basis. This will also entail labour subsidization instead of subsidizing implements, befitting very well into the government's objective of employment guarantee.

The weeders and markers are mostly centrally produced and the private sector enterprise has not really taken off. Removal of subsidies (transferring it to labour) in these implements may allow many individual enterprises to take off. The design of weeders should also be diversified and be made amenable to local production.

Implements however, would be an issue till SRI spreads to a reasonable scale. Establishing implements bank based on a group approach may be considered. Such banks would also prevent the implements given on subsidy from getting locked up with individuals.

Organic matter addition to soil is proving to be effectively contributing to yield increases in SRI method. A good practice is to promote green manure. State support must be extended to green manure crops beyond making available free seeds. Subsidies could be extended at least on par with the nutrient subsidies in case of urea.

Are promotional investments a real problem? If the costs of implicit subsidy in irrigation and inputs were accounted for, extending subsidies to SRI will prove to be cost-effective and environmentally sustainable. For e.g., even assuming that SRI saves about 4 irrigations, the implicit saving in electricity subsidy for these 4 irrigations would suffice for subsidizing at least 2 to 3 weedings reducing the cost of weeding even below the weeding in the conventional crop. Opportunities can be explored to integrate SRI promotional support with rural employment guarantee schemes.

3 days after transplanting

7 days after transplanting

12 days after transplanting

40 days after transplanting

45 days after transplanting

60 days after transplanting

4. Conclusions and Recommendations

System of Rice Intensification that evolved as a resource conserving technology management system from the informal research across the world is taking roots in Andhra Pradesh. The Andhra Pradesh farmers who are known for their innovativeness in adopting new technologies and adapting technologies to meet their requirements responded with great enthusiasm when SRI was introduced by individual farmers, organizations, formal research and extension system. The Acharya NG Ranga Agriculture University played a key role in promoting the technology. AP government announced a policy to promote SRI in the state. Many farmers who have taken up SRI have seen very positive results in terms of yield and water saving. However, the spread of SRI was not as fast and wide as expected.

The main reason seems to be seeing SRI as a rigid monolithic package of six principles. Otherwise, the principles are adopted by farmers according to their needs. When the farmers make changes and absorb the principles into their conventional system of rice cultivation whether it has to be considered as adoption or discontinuation is a question of perspective. Among the farmers, some of the principles have been adopted widely like wider spacing, less seed rate, transplanting younger seedlings, reduced water usage etc. While farmers could adopt certain practices which operate at farm level, many external factors influence the adoption of practices of transplanting younger seedlings, controlled irrigation etc.

The research system seems to have been caught up in its own paradigms and engaging itself in theoretical war over the claims made under SRI. While both the groups seems to have their own logic, they are also influenced by their own specialization, professional interest etc., which is unfortunate. The research system rather trying to solve the problems faced by the farmers in adopting SRI and try to do advance research to understand the new challenges posed by SRI have restricted most of the their work in validation research. There is an urgent need for a paradigm shift in this.

The transfer of technology model of the extension system has to change with more participatory and group based approach. Extension system still needs to find ways of working to promote knowledge and skill centric practices and shift from its present commodity centric and recommendation based approaches.

The government should create a policy environment where the institutional and infrastructural support is extended to the farmers who adopt technologies like SRI. Some of the major constraints like uncertainty in irrigation schedules both in canal irrigated areas and tube well irrigated areas due to conditions which are beyond the control of farmers need to be addressed immediately by the government. The savings on resources adopting SRI method are enormous. This needs a careful planning at macro level both on regularizing electricity supply, redesigning irrigation systems for better controlled irrigation and good drainage system. The policy operates through regulation and incentives. The incentives are only in the form of subsidies on commodities purchased from market. There is a need to have a shift to recast these support systems and support more local resource based, labor intensive systems.

The success and large scale adoption of SRI depends on how the research, extension system adopt to the newer ways of working and supporting farmers and on a conducive policy environment. Otherwise, it would be restricted to those small groups of innovative farmers, who can make changes in their practices based on their situations. The choice lies with the governments in making right priorities.