



SRI Newsletter

System of Rice Intensification

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A day before his visit to India, Mr. Robert B Zoellick, the President of World Bank wrote an article in the Hindustan Times, "India could be a new pole of global growth" (Dec.2, 2009 - HT Online)¹. This article had one full paragraph on SRI,

"...I'm even more intrigued by what is known as SRI, or system of rice intensification, and I know this is also an area of interest for PM Manmohan Singh. Using smart water management and planting practices, farmers in Tamil Nadu have increased rice yields between 30 and 80 per cent, reduced water use by 30 per cent, and now require significantly less fertilizer. This emerging technology not only addresses food security but also the water scarcity challenge that climate change is making all the more dangerous. These are all lessons for our world."

This certainly is a major endorsement for the SRI method of cultivation. This statement is recognition of the SRI potential and also tribute to the farmers and civil society for taking this forward in spite of bitter criticism and even ridicule from some of the institutions. This might not convince some who refuse to listen to farmers and believe the ground realities, but this certainly is going to open more minds and more doors for SRI.

SRI's growing popularity has opened up greater debates and discussions to understand it better. Therefore, in the ensuing pages of this newsletter, we have opened up the debate on "What is SRI and What is not..." authored by Dr. Norman Uphoff.

Research on SRI is an ongoing process. Dr. Gopalakrishnan, an ICRISAT scientist who conducted systematic research concluded in his article that "between 40-50% of water can be saved" by adapting the SRI method as can be read from his paper. People's Science Institute with support of WWF-ICRISAT project has done excellent work in Himachal Pradesh, extending the SRI methods to wheat. The results are remarkable and there is lot of scope to introduce this in other wheat growing areas. Though some state governments are actively promoting SRI, the policy framework has not been put in place to take this method forward to the entire country. Ravindra of WASSAN discusses this very issue in his article. PRADAN organized a dialogue in Delhi to start the process for evolving a framework; the report gives a way forward in involving various agencies to support farmers in adapting the SRI method.

The experience from Tanzania in SRI cultivation indicates that a little support to the farmers is critical for transferring the skills and knowledge. There is a lot of scope to improve the productivity and livelihoods of the smallholder farmers, especially those who are completely dependent on rainfed cultivation of rice, though further studies need to be taken up in order to make local specific modifications to the SRI principles and practices.

Finally, we appeal to the SRI practitioners to use this Newsletter for sharing their experiences to the larger audiences. We also thank our partners and contributors for sharing their experiences thus far, which indeed goes a long way towards enriching the understanding on SRI.

Biksham Gujja

¹ <http://www.hindustantimes.com/News-Feed/india/India-could-be-a-new-pole-of-global-growth-WB-President/Article1-482145.aspx>

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How can we say What Qualifies as 'SRI' and What is 'Not SRI'?

Norman Uphoff

SRI methods have been adopted by more than one million farmers across Asia and the world, as these practices have become a well-known and accepted system for cultivating rice. The methods are even being adapted now to other crops. Dr. Norman Uphoff considers what boundaries, if any, can be drawn between 'SRI' and 'not SRI'.

Considering what we would not regard as 'SRI' helps to clarify the basic elements of what constitutes SRI. The starting point is to recognize that SRI is more a matter of degree than of kind. There is, to be sure, an 'ideal type of SRI' that is based on empirical experience and on factorial trials. Then there are specific practices that correspond to this ideal and evoke the productive potential of SRI principles to greater or lesser degrees.

The question of what is or is not SRI arises mostly from our use of language, when for convenience's sake we use the term 'SRI' as a noun rather than as an adjective. It is most productive and defensible for us to think of the extent to which certain use of SRI-recommended methods approach the ideal, or does not. Our language, however, leads us to conclusions in dichotomous terms. This is an unfortunate but persistent tendency in our thinking and speech.

This understood, we should consider, in operational terms, what kinds of rice cultivation are so far from the ideal of SRI that they should not be considered as 'SRI,' either for purposes of evaluation or for promoting new practices.

In extension efforts, my approach is to explain to farmers what we understand to be the ideal SRI practices, which will give highest productivity, and to explain particularly the reasons for these recommendations. We know from experience and

research that approximating this ideal can give farmers the most benefit from the resources they are investing in growing rice.

If farmers are not willing or not able to follow all of the practices recommended or to use all of them as recommended, this is their decision. But it should be an informed decision, and farmers should know what opportunities they are passing up by continuing to use older seedlings or by keeping their fields flooded. Farmers can benefit practicing from 'partial' SRI, so we accept that SRI is not an either/or proposition.

Below are reviewed the practices that are currently recommended to get most advantage from SRI opportunities, to get higher yields with less water, less seed and other inputs. The discussion is framed in such a way that indicates what is the 'minimum' that can justifiably be considered as 'SRI.' How many practices are necessary? To what extent does each need to be utilized? Which are the most important? What is an acceptable range of variation? These are all good questions, but their answers are not simple and are constrained by the variable nature of SRI.

The System of Rice Intensification (SRI) is better understood as an opportunity than as a technology. SRI theory introduces certain changes in the management of rice plants, soil, water and nutrients in order to create a more productive growing environ-

ment for the plants. This is done by promoting the growth of (a) larger and better functioning root systems, and (b) more abundant, diverse and active populations of soil biota.

These results of SRI practices distinguish SRI management from what is referred to by some scientists as best management practices (BMP). BMPs are mostly empirical, not guided by theory in the way that SRI is. While SRI started out purely empirically, as we now comprehend better its effects we can see that SRI is based on coordinated and explicit efforts to enhance the growth of (a) roots and (b) soil biota. This is the essential explanation for SRI results. What constitutes SRI is contributing to these changes in the growing environment for rice that produce more bountiful and resilient plant phenotypes.

The recommendations for SRI practice constitute more of a MENU than a RECIPE, presenting farmers with choices, all of which we have good reasons to believe are more productive. There are also a number of associated practices, such as seed selection or land leveling, that farmers should include in their rice cultivation, whether using SRI methods or not. We do not include these as SRI, however, because the term refers to a set of changes in crop management that derive from the work of Fr. Henri de Laulanié, started almost 50 years ago. How SRI has evolved since it moved beyond Madagascar is discussed in a table below, looking at what were Fr. Laulanié's original SRI recommendations, and how they have evolved and diversified.

- (1) If a rice crop is established by transplanting, farmers are advised to transplant YOUNG SEEDLINGS, preferably 8-12 days old, although possibly as old as 15 days (and even 18-20 days in cold climates). Plants' age is biological rather than calendrical. 'Young' refers to seedlings that are still in their

2nd or 3rd phyllochron of growth, and still have their greatest growth potential. Age can be expressed better in terms of leaf-age than number of days because this refers to the sequential completion of a series of biological processes. For SRI practice, young seedlings are plants in their 2-3 leaf stage, usually less than 15 days old.

Some SRI farmers are experimenting with direct-seeding of rice along with the use of other SRI-recommended practices, to reduce their labour requirements. Transplanting itself is not a requirement for SRI. If transplanting is done, the productivity that can be gained from using young seedlings is dramatic. However, this potency is not expressed in isolation, but rather in conjunction with the other recommended practices. Transplanting older seedlings, i.e., beyond the three-leaf stage, can generally be considered as 'not SRI,' because the benefits available from using young seedlings have been forfeited.

- (2) How young seedlings are GROWN and HANDLED is also crucial. They should be grown in unflooded nurseries and should be removed very carefully, keeping the seed sac attached to the root, and not removing the dirt from around the root. SRI seedlings once uprooted should be replanted in the field quickly (within 15-30 minutes) and gently, putting the roots into the soil as horizontally as possible, with no inversion of the root tips, as this creates 'transplant shock' and delays the young plants' resumption of growth. Transplanting should also be shallow (1-2 cm only). (These practices do not apply for direct-seeded SRI, of course.)

Handling seedlings in ways that cause root trauma or desiccation and unfavorable placement of roots in the



In SRI practice, young seedlings are plants in their 2-3 leaf stage, usually less than 15 days old.

soil is not acceptable practice for SRI. However, this is not considered as a defining characteristic of SRI, in the way that planting young seedlings (if establishing the crop by transplantation) is core to the concept and practice of SRI. Careful handling of seedlings is considered as very basic, good agronomic practice.

- (3) SRI rice plants are established with WIDER SPACING than conventional cultivation (10-20 cm), although, exactly how wide is a matter for empirical determination. SRI's higher yield is produced from plant populations per m² that are reduced by 80-90%, using SINGLE SEEDLINGS planted in a SQUARE PATTERN, with usually at least 25 cm between plants. In less fertile soil or with low-tillering varieties, however, 2 plants per hill and closer spacing (e.g., 20x20 cm) may be more productive, just as in more fertile soil and with varieties that tiller profusely, space between plants of 30 cm or even more can give higher yield. The square pattern facilitates intercultivation with weeder.

Spacing is a variable to be optimized, not maximized, to get greatest number of panicles and grains per m², not per plant.

Planting more than 2 plants per hill and spacing less than 20 cm creates plant density greater than desirable for SRI, although what is optimal depends on soil fertility and rice variety. Wider spacing is more relative than absolute, and it is always something to be optimized. If plant population is not reduced, there will be less productivity of land, labour and water than is achievable with the other practices, so reduced plant population is in my view an essential element of SRI, although how much reduction should be made is relative to local conditions rather than absolute.

- (4) Rather than keeping rice paddies continuously flooded, SRI proposes REDUCED WATER APPLICATION. (Fr. Laulanié recommended applying 'a minimum of water'.) Small amounts of water can be applied daily with short periods of drying the field during tillering, or fields can be alternately wetted and dried during the cycle. Keeping paddy soils moist but not inundated reduces water requirements by 25-50%, sometimes even more.

Since SRI practices have now been adapted to rainfed conditions, controlled irrigation is no longer considered a

requirement for SRI, although even there, water management practices are adapted to maintain well-oxygenated soil with sufficient moisture so that plants (and soil biota) have enough water to prosper. Farmers who have no irrigation facilities and rely entirely on rainfall (e.g., monsoon rains) who want to benefit from the other SRI practices manage their crop during the first 4-6 weeks so that there is no continuous flooding, which causes the roots to degenerate (suffocate). Such farmers do their best to grow strong, deep, healthy root systems so that their plants can withstand water stress later in the season when there is no more rainfall.

Continuous flooding of rice paddies is definitely 'not SRI' and would be a disqualification. However, water control is not an absolute and probably a majority of rice farmers can only regulate their water levels imperfectly. Exactly how much water is applied with SRI practice can vary considerably, with the results achieved from 'a minimum of water.' The principle is clear: reduce water applications and avoid continuous flooding. It is important that soil be intermittently exposed to air so that roots and aerobic soil organisms can get a rejuvenating supply of oxygen. Deliberate measures and redesign of paddy fields to achieve good surface drainage will often be part of conversion to SRI practice.

(5) Controlling weeds is more necessary when fields are not kept flooded all the time. SRI recommends use of a mechanical SOIL-AERATING WEEDER, pushed between and across the rows. This is made possible by the square spacing of plants. Weeding should start early, at 10-12 days after transplanting, as a preemptive strike against weed growth, and it should be done often, every 10-12 days after the first weeding



SRI rice plants established with wider spacing

until plant growth and canopy closure restrict further weeding operations. At least two weedings is recommended, but three or four are advised if possible, because these additional weedings will enhance production.

Breaking up the soil between rows and between plants creates active soil aeration, an important element for the best SRI results. But this is not a requirement; hand weeding or herbicides can be employed. However, these other measures do not aerate the soil, which is important for both plants and soil biota. Thus, the full benefits of the other SRI measures will not be received if there is no active soil aeration. Mechanical weeding is not a requirement for SRI, but it is highly recommended, because it contributes substantially to higher yield through soil aeration.

(6) While fertilizer can be used with SRI practices to sustain good yields, the best SRI results have been obtained with increased applications of ORGANIC MATTER, as much as possible, but usually at least 2 tonnes/hectare. While chemical fertilizer can be used productively with the other SRI practices, it does not enhance soil

fertility over time or promote abundant, balanced soil biota.

SRI can be said to involve at least some increase in organic fertilization, which will give better results than using fertilizer alone. The principle involved is to 'feed the soil, so that the soil can better feed the plants,' rather than to try to 'feed the plants' directly. Many farmers practice a version of SRI that is 100% organic, which is referred to as 'organic SRI' because chemical crop protection is not used either.

SRI was originally developed in the 1980s with use of fertilizer. It was only when the Madagascar government removed its subsidy for mineral fertilizer, and poor farmers could no longer afford to purchase this, that compost was tried with the other SRI methods and was found to give even better results. Compost is thus recommended – as much as possible. But it is not a defining characteristic of SRI. Rather it is an 'accelerator' when used with the other SRI practices.

So, what should be considered as the basic requirements for rice production to meet expectations for qualifying as SRI? 'Minimum SRI' would, in my view, meet at least four essential criteria:

- (a) Young seedlings should be used if the crop is established by transplanting; they should be younger than 15 days (not older than 3-leaf stage), unless ambient temperatures are cold, in which case somewhat older seedlings are still biologically 'young'.
- (b) Reduced plant population – transplanting single seedlings (or at most 2 per hill if soil fertility is low), with wider spacing in a square pattern – so that the number of plants per square meter is less than 25-30 per m².



- (c) No continuous flooding, maintaining soil conditions that are mostly aerobic because roots will degenerate under anaerobic conditions.
 - (d) Some increase in use of organic fertilization to improve soil structure, functioning and fertility. However, some chemical fertilization is acceptable if farmers do not have access to enough labour and biomass to make compost. The rice produced with fertilizer use cannot, however, be considered as 'organic SRI.'
- Gentle, careful handling of seedlings is associated with transplanting young, single seedlings, so it need not be considered as a criterion. On the other hand, crude handling of seedlings that induces 'transplant shock,' or deep transplanting (>3 cm) could be considered as disqualifications for SRI. 'Mechanized' transplanting is now being introduced with SRI's wide spacing in some countries, and this seems to produce good results if young seedlings are widely spaced and if both soil organic matter and aerobic soil conditions are provided. This is not 'gentle, careful handling' but it seems to work. Rice seedlings may look fragile, but if given a good growing environment they can be very tough and resilient.
 - Mechanical hand weeding for weed control is highly recommended, because it makes the benefits of the other practices even greater. However, some farmers do not have access to a mechanical weeder and yet could benefit significantly from the other practices. Hence, it is not stated as a requirement. Some kind of weed control will certainly be needed with wider spacing and when there is no continuous flooding. Active soil aeration is recommended, because it is more productive, but farmers could beneficially use the other SRI practices with hand weeding (or even herbicides, if they are not doing organic SRI) to control weeds. There is much evidence that mechanical weeding can add 1-3 tonnes/ha to yield.

Below is a review of the original SRI recommendations of Fr. Laulanié with initial and subsequent adaptations. An English translation of his technical paper is posted at: <http://ciifad.cornell.edu/sri/Laulanie.pdf>

Original SRI practices	Early adaptations	Subsequent adaptations	Reasons for recommending this practice
"Transplant... very young plants: Fifteen days is apparently the limit for advantageous transplanting..."	15 days represents the usual start of the 4th phyllochron; but Laulanié noted that with colder temperatures, one can use somewhat older seedlings; with warmer temperatures, younger seedlings are better; 8-12 days was considered a good range for doing transplanting	Direct-seeding in a square pattern with a mechanical seeder has been spreading to save labour; or broadcasting by hand and then thinning with a mechanical weeder in a square pattern; in some places mechanical transplanters have been developed or adapted for SRI principles, to save labour; so SRI does not require transplanting. The principle is: if transplanting, use young seedlings	Transplanting beyond the start of the 4th phyllochron reduces plants' growth potential for tillering and roots; TP is done best during 2nd or 3rd phyllochron; but most important is that young plant roots not be traumatized and direct seeding meets this requirement
"Transplanting single plants has been applied since 1965." This replaced planting rice seedlings in clumps of several seedlings: 4 to 6 or more	If the soil is not very fertile, 2 plants per hill will give higher yield; but expect soil fertility to increase over time with SRI practices, so this should be a transitory practice	This recommendation has been quite 'robust,' although the practical recommendation is for 1-2 plants/hill; there is no great harm in having 2 plants together, only greater root competition which can reduce yield	With wider spacing, all leaves, including the lower ones, can be photosynthetically active; this contributes to the plant's pool of photosynthate and also to the roots' nutrient supply because lower leaves supply plant roots

Original SRI practices	Early adaptations	Subsequent adaptations	Reasons for recommending this practice
<p>Wider spacing and square planting. “We propose starting with 25x25 cm spacing, up to 33x33 cm.” Careful and gentle transplanting is important; also setting plant roots in the soil horizontally reduces transplant shock</p>	<p>No specific spacing was advised as the sole SRI practice; spacing was to be optimum to get most tillers/m² – which depends on soil quality; closer spacing is better if soil is less fertile; since SRI practices improve soil over time, spacing should become wider over time</p>	<p>Optimum spacing should always be determined for specific soil, variety and climatic conditions; the highest yields have come from very wide spacing due to which fertility has been built up to high levels; spacing can even be up to 50x50 cm on the very best soil supporting the most productive phenotypes</p>	<p>With wider spacing, all leaves, including the lower ones, can be photosynthetically active; this contributes to the plant’s pool of photosynthate and also to the roots’ nutrient supply because lower leaves supply plant roots</p>
<p>No more flooding of rice paddies (even drain them as needed to keep soils mostly aerobic); manage irrigation system to give plants just the “minimum of water” that they need to support their growth and avoid senescence</p>	<p>The practice of applying small amounts of water daily, with short periods of drying soil, has been modified by many farmers to alternate wetting and drying (AWD), as this requires less labour with little if any loss of yield</p>	<p>Best practice for irrigation depends on the source of water and reliability of supply, also on the costs of labour for managing water; water is now too costly to continue using flooding for weed control</p>	<p>Under anaerobic/hypoxic soil conditions, roots degenerate [75% by flowering]; although rice can survive under inundation, it does not thrive; only anaerobic soil biota live with continuous flooding; and the benefits of mycorrhizal fungi are lost</p>
<p>Weeding with sarcluse [mechanical hand weeder], early and often</p>	<p>Hand weeding was often used because weeders were not available; herbicides could be used but these did not aerate the soil</p>	<p>Increasing appreciation that mechanical weeders can save time and reduce drudgery; motorized weeders are being developed</p>	<p>Soil aeration is accomplished by mechanical weeding, promoting the abundance and diversity of soil biota; weeding beyond the minimum will enhance crop yield</p>
<p>Fertilization recommendation to use manure as much as possible; Laulanié recommended that farmers not use chemical fertilizer so they could see the benefits of SRI using methods by themselves</p>	<p>SRI was developed with chemical fertilizer in the 1980s; when subsidies were removed, SRI recommendations were modified to promote the use of compost</p>	<p>Some efforts have been made to optimize the use of organic and inorganic nutrients together; chemical fertilizer works well with other SRI practices, but compost gives the best results, especially over time</p>	<p>Organic fertilization ‘feeds the soil, so that the soil can feed the plant’; this is better than fertilizer which only feeds plant and does nothing to improve soil structure and function over time</p>



Recommended practices that are not included as core SRI practices

Original SRI practices	Early adaptations	Subsequent adaptations	Reasons for recommending this practice
Establishment of a garden-like, unflooded nursery; careful handling of seedlings: gentle removal, quick transport to the field		Many variations have been developed, like growing seedlings on trays, or in plastic sheets with 'wells' for soil each planted with single seed	Seedlings grown in aerobic soil are more vigorous, shifting sooner to getting nutrients from soil rather than seed sac
Land preparation of the paddy field stays the same, but good timing of operations helps control weeds, good leveling of fields results in better water distribution and is needed for young seedlings to become well established		Mechanization is being developed for larger scale production	It is important to break up plough pan, which keeps soil more saturated and less aerobic

Other practices added later

Original SRI practices	Early adaptations	Subsequent adaptations	Reasons for recommending this practice
	<ul style="list-style-type: none"> Seed selection – to eliminate poor-quality seeds 	<ul style="list-style-type: none"> Seedbed solarization, to start with healthy seedlings Raised beds in the field for better growth Laser-leveling of fields to save water Mulching to conserve water and suppress weeds 	Create optimum growing environments for plants; proceed empirically and be open to new practices

SRI concepts and practices have been adapted to rainfed rice production, where irrigation is not possible during the season because there is no water supply and/or no water control. The other SRI practices, apart from controlled irrigation, are beneficial to rice plants if rainfall is managed to maintain moist but not inundated soil conditions for as long as possible, avoiding creating continuously hypoxic soil that causes rice plant roots to degenerate. If roots can be induced to grow deep and remain healthy, they can sustain rice plants when water in the surface horizon has depleted. Rainfed SRI yields in Eastern India have reached an average of 7 t/ha, which most irrigated farmers anywhere would be pleased with.

SRI concepts and practices have been further evolved and adapted for the more

productive management of other crops beyond rice: wheat, sugar cane, maize, even legumes like kidney beans, soya beans and vegetables. One can ask: How can this be 'SRI' if the methods are not even being used for rice? A more appropriate term for such adaptations might be 'SRI-inspired' or 'SRI-derived'. Fr. Laulanie's experimentation and observations led him to synthesize the original set of SRI practices, listed in the left-hand column of the table above. But there is no reason to restrict his insights and recommendations just to rice.

As these principles and methods have become more widely known and as their merits have been widely demonstrated, SRI thinking has challenged many previously-held beliefs and ideas about crop and soil management. In particular, it has raised the

profile of the biological dimensions of soil systems.

SRI is not, as argued by some, just an assembly of 'best management practices.' There are sound theoretical and empirical foundations for SRI recommendations that are robust and verifiable. The practical applications of SRI recommendations have considerable variation. That SRI is 'a moving target' does make understanding it more challenging. But at least one million farmers have already been able to grasp the utility of the principles and practices delineated above and we expect many millions more to follow.

Norman Uphoff, Program Leader for Sustainable Rice Systems, Cornell International Institute for Food, Agriculture and Development (CIIFAD)

Factors responsible for higher yields in SRI

Dr. S. Gopalkrishnan

Just by using the basic practices of SRI - starting with young seedlings; giving them wider spacing within and between hills; growing them in well-aerated soil; and with rich organic matter - it is possible to achieve at least 25-30 percent increase in yield when compared to the conventional agriculture, despite using significantly less seed, less water and even less chemical fertilizers. Bigger root mass and improved soil biological and microbiological activities were hypothesized as important factors responsible for higher yield with SRI management. Hence, the on-going SRI project (funded by WWF) is aimed to study the chemical, biological and microbiological properties of the soils of SRI and conventional method of rice cultivation.

On-station experiments were conducted during the 2008 rainy season (*Kharif*) as well as 2008-09 post-rainy season (*Rabi*) at B1 field within the International Crops

Research Institute for the Semi-Arid Tropics (ICRISAT) campus in collaboration with the Directorate of Rice Research (DRR), Hyderabad, India. Two treatments were



The number of tillers are much higher in the SRI treatments when compared to control with conventional practices.

evaluated, SRI and control (conventional methods), having three replications for each treatment.

For the two seasons (*Kharif* 2008 and *Rabi* 2008-09), respectively, the nursery (variety *Krishna Hamsa*) was prepared on 28th June and 28th November 2008. The transplanting was performed on 8th and 23rd July 2008 for SRI (11d old) and control (25d old), respectively, for *Kharif*. For *Rabi* the transplanting was undertaken on 10th for SRI (12d old) and 24th October 2008 for control (25d old). Soil samples (top 30cm layer of soil) were collected at vegetative growth stage (about 60 days from transplanting) and at harvesting, being then processed for soil chemical, biological and microbiological properties. Morphological observations of the rice crop were also made during the season and also at the time of harvesting.

Water productivity was found to be higher in the SRI treatments when compared to control and this was true in both the *Kharif* and *Rabi* seasons (Figure 1). With SRI, 45 percent less water was used when compared to the control in *Rabi*, whereas in the *Kharif* season it was reduced to 61 percent. The number of tillers (plant-1) was found to be much higher in the SRI treatments when compared to control with conventional practices. This was true in both seasons (34 vs. 20). However, tillers per unit area was found to be lower in SRI.

Plant height, number of panicles, grain weight and 1000-grain weight were also found to be greater in SRI when compared to the control treatments. Root length density and root dry weight was recorded as higher in the SRI treatments when compared to controls and these results were true for both seasons.

Microbial biomass carbon (MBC) was found to be much higher in the SRI treatments when compared to the control treatments

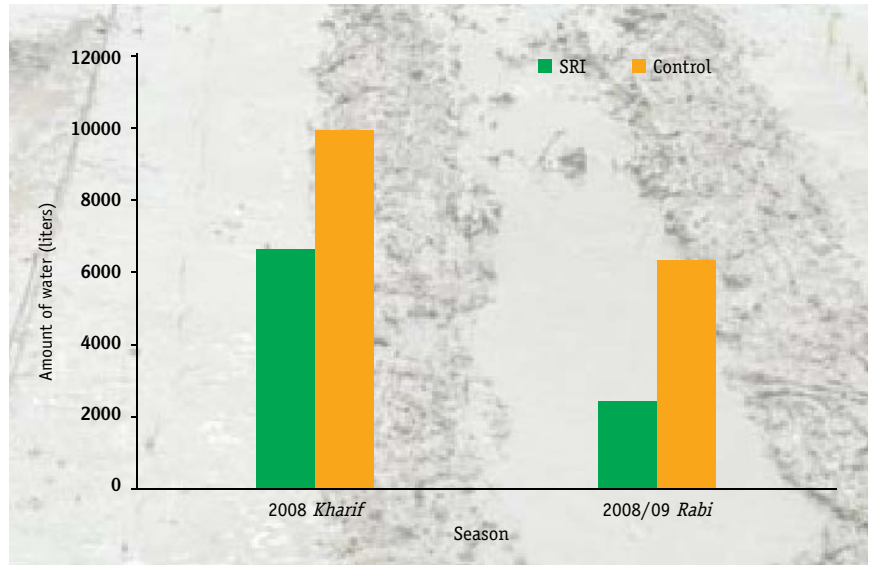


– an increase of 17 and 21 percent for the organic and inorganic plots of SRI, respectively. As expected, the dehydrogenase activity (microbial metabolic activity) was found to be lower in SRI when compared to control, which was true for both seasons, as under a nutrient-limited system, microbial activity will be less compared to balanced fertilization.

In the top 0-15cm soil profile, available P and total N were found to be greater in both seasons in SRI as compared to control, by 10-15 and 5 percent, respectively and this was true at both vegetative as well as harvesting stages. Not much difference was observed in any of the microbial counts studied (including total bacteria, fungi, actinomycetes, siderophore producers, fluorescent *Pseudomonas*, P-solubilizers and N₂ fixers) in either season.

One reason for little difference could be that a few years are needed to build up the population of agriculturally-beneficial microorganisms in the soil when a field is

Figure 1: Amount of water required for raising per kg seed (water productivity) during *Kharif* 2008 and *Rabi* 2008-09 season



converted to SRI practice from conventional farming, which has been dependent on inorganic inputs; this period is often referred to as the transition period. After a period of time (maybe after a few years), with reliance on organic fertilization, a clear-cut difference in the microbial

populations between treatments might be seen. Also, the general problem confronts enumeration of microorganisms from soil samples in the available culturing methods can detect and identify usually less than 10 percent of the total microorganisms present in the soil. Hence, molecular estimation techniques should be considered for use in the future.



Root length density and root dry weight are recorded as higher in the SRI treatments when compared to controls.

From the above observations and results, it can be concluded that significant water can be saved, between 40 and 50 percent, if the SRI method of rice cultivation is followed. Hence it can be the best-bet protocol for growing rice under rainfed but irrigated conditions or in lower-rainfall seasons when the wells and bore wells fail to recharge the underground water. Also, it can be concluded that big root mass and soil biological and microbiological activities play an important role in SRI compared to conventional method of rice cultivation. However, further studies, observations and repetitions of the above experiments should be done in order to confirm and refine these observations.

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Rice and wheat are the staple food grains in the mountain villages of Himachal Pradesh and Uttarakhand. The majority of households in these mountain states have small land holdings, about 0.4 ha (1 acre) in size and are unable to meet their annual food grain requirements since the states' average grain yields are as low as 2 T/ha. Adoption of System of Crop Intensification (SCI) methods has proven to be an effective technique for increasing the yield of paddy, wheat and other crops. The stalk volume in SCI crops is also much higher, providing more fodder for the cattle and more farmyard manure for fertilizing fields, besides increasing milk yields.

Since 2006, the People's Science Institute (PSI), Dehradun, has successfully been conducting field trials and promoting SCI in Himachal Pradesh (HP) and Uttarakhand (UKD) among more than 14,000 farmers. The average grain yields obtained in the past three years (2006-2008) under SCI management are 5.5 t/ha and 3.2 t/ha for paddy and wheat, respectively, as against average conventional crop yields of 3.6 and 1.9 t/ha, respectively.

Like in most parts of India, the South-West monsoon is a crucial factor in determining levels of agriculture output and farmers' incomes in this region. Erratic monsoon rainfall results in drought, seriously affecting the livelihoods of rural households, since farmlands of the majority of households are rainfed. The overall rainfall deficit during 2009 in UKD and HP was about 40 percent and 44 percent (up to August), respectively.

Despite the prevailing drought conditions, PSI has continued its efforts to mobilize farmers to adopt the System of Rice Intensification (SRI) for rice. PSI and its partners mobilized more than 13,000 farmers to use SRI methods in an area of about 545 ha in 2009, up from just 40 farmers in 2006. Most farmers made some

System of Crop Intensification in Himachal Pradesh and Uttarakhand

A Note on PSI's Experience during the 2009 Drought

Debashish Sen & S.N. Goswami



People's Science Institute (PSI) has been in the forefront over the last few years in promotion and adoption of SRI in various hilly and inaccessible regions of Uttarakhand and Himachal Pradesh working with small and marginal subsistence farmers, completely dependent on the yearly monsoons, for whom a drought is an imminent threat for their food security. As part of its work, PSI has been adapting SRI concepts and methods to other crops, in what is called the System of Crop Intensification not just in paddy but finger millet, kidney beans, Soya beans and maize.

alterations in the recommended SRI practices, transplanting 1 to 3 seedlings per hill (instead of just one) which being 10-25 days old (instead of less than 15 days) and keeping plant-to-plant and row-to-row spacing of 15-25cm x 15-20cm, respectively (somewhat closer than usually recommended). Alternate wetting and drying of field could not be followed due to the unavailability of irrigation water, thereby also limiting the use of mechanical weeders. These modifications accommodated the more severe weather conditions.

To further cope with delayed monsoon, PSI facilitated 1,279 farmers to adopt SCI in

other crops, namely *mandwa* (finger millet), *rajma* (kidney beans), soya bean, and *makka* (maize) covering 34.86 ha. Direct seed sowing (1-2 seeds per hill) was recommended at a spacing of about 20 cm x 30 cm for finger millet and 25 cm x 30 cm for kidney beans, 30 cm x 30 cm for Soya bean and maize along with at least two manual weedings. Organic fertilization was increased, which improved soil structure and functioning. Crop cuttings conducted in the past few months have showed an average increase in grain yield of 92 percent in paddy, 50 percent in finger millet, 69 percent in kidney beans, 29 percent in soya bean and 34 percent in maize from the SCI



plots compared with conventional plots where soil and seed were the same.

Thus, the SCI techniques promoted by PSI and its partners in the mountain states has demonstrated a high potential to address the drought situation, improving and ensuring overall food security in the mountain communities even during water-scarce periods. This paper shares PSI's experiences on SCI in UKD and HP during the current drought.

Background

More than three-fourths of the workforce in the states of UKD and HP is dependent on the farm sector for livelihoods and agriculture is evidently the mainstay of the local economy. With average landholdings of more than 75 percent of the rural households small (about 0.4ha (1 acre)) and the total irrigated area in the mountainous districts of these states only about 27 percent, monsoon rainfall is a crucial factor that regulates livelihoods of the farming communities. Erratic rainfall leading to drought affects not only crop production but has a cascading effect that hits the economic conditions of the marginal and small subsistence farmers.

The System of Rice Intensification (SRI) enables farmers to raise their rice production substantially, just by making changes in the

way they manage their plants, soil, water and nutrients, rather than by needing to increase inputs such as fertilizer, water and agrochemicals. Getting more output with less cost enhances profitability.¹

Promoting the System of Crop Intensification (SCI) for a wider range of crops than just rice is an ideal alternative that ensures water use efficiency by the crops while increasing their productivity.² Adoption of this low-input organic crop cultivation method, especially by the small and marginal subsistence farmers' families in the mountain states with small landholdings and rainfed fields, is expected to significantly improve their food security. Crop intensification has great prospects to overcome uncertainties in farming under rainfed lowland conditions while ensuring sustainable crop productivity and soil fertility too.²

In 2009, HP and UKD were among the most severely drought-affected states in Northern India, with a shortfall of 47 percent and 41 percent respectively in rainfall through the end of August. More than 50 percent of the farmers were affected under the severe drought-like conditions.³ PSI with over three years of experience in promoting and up-scaling the crop intensification technique in the mountain states of HP and UKD mobilized

more than 14,000 farmers during this time to cultivate paddy and other crops by following SCI principles. This was done with the financial assistance of Sir Dorabji Tata Trust, Mumbai in UKD and the WWF-ICRISAT Project, Hyderabad in HP. Experiences of PSI on SCI in paddy and other crops during the current drought year are briefly reported below.

Outreach

During *Kharif* 2009, 39 partner organisations (POs) working at local levels, 29 for UKD and 10 for HP, were selected by PSI for the programme. This covered 18 districts (13 in UKD and 5 in HP) with an area of about 587 hectares. More than 13,000 farmers adopted SCI for paddy covering 545 ha and more than 1,200 farmers adopted SCI for other crops, mainly kidney beans, finger millet, soya bean and maize, covering about 35 ha. Twelve training workshops of three days' duration each were conducted for imparting skills and knowledge to 47 selected Master Trainers (MTs) and 190 Village-Level Resource Persons (VLRPs) from the POs. Thereafter, PSI and its partners selected about 523 village clusters in different sub-basins of these two states.

The master trainers with the support of VLRPs conducted 317 two-day orientation

¹ Uphoff, Norman. 2007. Farmers' Innovation Improving the System of Rice Intensification. Paper for Farmer First Revisited workshop at Institute of Development Studies, University of Sussex, UK (http://www.future-agricultures.org/farmerfirst/files/T1a_Uphoff.pdf).

² Ingram, K.T. 1995. Rainfed Lowland Rice: Agricultural Research for High-Risk Environments. (Philippines): International Rice Research Institute, Los Baños, pp. 79-96.

³ Himachal to fight drought with NREGS expansion. *The Indian Express*, 3/09/2009 (<http://www.indianexpress.com/news/nregs-up-officials-set-aside-a-day-every-month-for-complaints/511778/2>).



workshops covering 14,605 farmers during March-April 2009. A user-friendly manual and a set of five posters on SRI prepared by PSI were also distributed to the trained farmers for their use. A film produced by PSI, “*SRI Vidhi: Kisanon key liye varda*”, was screened during the training and orientation workshops to motivate the farmers to adopt SRI methods. Media coverage on SRI over the Doordarshan TV channel resulted in wider dissemination about the practice.

Beginning in May-June 2009, PSI’s staff initiated follow-up activities along with its POs in providing field support to the SCI farming communities by enabling them to share their experiences when adopting SCI in paddy and other crops – mainly kidney beans, finger millet, soya bean and maize – with alterations to cope with water stress during the *Kharif* season for nursery bed preparation, sowing, transplanting and weeding. Harvesting of the crops was conducted during October-November 2009.

A Programme Monitoring Committee (PMC) was constituted, drawing representatives from institutions like the Central Soil and Water Conservation Research and Training Institute (CSWCRTI), Dehradun; G.B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar; and Uttarakhand Organic Commodity Board (UOCB), Dehradun – apart from senior personnel from PSI. Programme reviews were taken up from time to time to verify whether the interventions are likely to fulfill their proposed objectives and to provide proper guidance for the same.

Innovative Practices Adopted During Drought

PSI’s previous experiences of promoting SCI in rainfed areas were of immense help during the current drought year. The Institute’s staff, with the help of the Master Trainers and VLRPs, motivated the farmers

Table 1: Alterations in SRI practices during drought

Recommended Practices	Normal Year	Drought Year (2009)
Young Seedlings	8-12 days	10-25 days
Wider Spacing	25 x 25 cm	P to P: 15-25cm R to R: 15-20cm
Single Seedling/hill	1/hill	1-3/hill
Alternative Wetting & Drying	✓	Not under control
Inter-cultivation	2+ mechanical weedings	1+ mechanical/manual weeding
Organic Matter	<i>Panchgavya, Amritghol, Matkakhad</i>	<i>Panchgavya, Amritghol, Matkakhad</i>

to adopt SCI practices with appropriate alterations, to cope with the situation of acute water stress while increasing the crops’ productivity.

(A) Paddy

Instead of nurseries planted at one time, promotion of staggered nurseries (i.e., successive establishment of nurseries 7 days apart) was encouraged. These nurseries were established both individually and for groups of farmers. Farmers were motivated to raise these nurseries in their fields where water was more easily available and in other cases, in homestead lands. Such adaptations have been promoted to reduce failure of nurseries.

Instead of restricting the transplanting age of seedlings to 10-12 days, farmers transplanted such younger seedlings to fields with assured irrigation while older seedlings (up to 25 days) were transplanted in water-stressed fields. To further ensure crop survival, while one seedling per hill was transplanted in irrigated fields, in rainfed fields, transplantation of two to three seedlings per hill was carried out, at 15-25 cms and 15-20 cms plant-to-plant and row-to-row spacing, respectively.

Farmers could not practice alternate wetting and drying of their fields due to unavailability

of irrigation water, which also resulted in the lesser use of weeders; therefore in many cases only one round of mechanical weeding was practiced. However, farmers were encouraged to use more organic materials for fertilization, particularly *Panchgavya, Amritghol* and *Matkakhad*, to get higher crop yields. Apart from the above, in some places, line seed sowing of pulses was also carried out on alternate rows with paddy. At certain places in HP, paddy seeds were first allowed to germinate and then were sown in lines.

(B) Other Crops

In the case of *mandwa* (finger millet), farmers were recommended (a) to transplant one to three seedlings per hill, 15-25 days old, keeping plant-to-plant and row-to-row spacing of 15-25 cm and 15-20 cm, respectively, in case of available water, and (b) to undertake direct seed sowing, placing 1-2 seeds in a line, preferably 30 cms apart in rainfed lands. Direct seed sowing was also adopted in kidney beans, soya beans and maize.

Healthy seeds were selected and treated with organic formulations and one to two seeds per hill were sown, maintaining a spacing of about 25 cm to 30 cm. In all the crops, one to two manual weeding rounds were adopted, using a hand rake that



Table 2: Adaptations for SCI practice in other (non-rice) crops during drought season

Practice	Conv.	<i>Mandwa</i> (SCI) (Finger Millet)	<i>Makka</i> (SCI) (Maize)	Soyabean (SCI)	<i>Rajma</i> (SCI) (Kidney Beans)
Young seedling	Seed Sowing	Transplanting @ 15-25 days or direct line sowing	Seed sowing in line	Seed sowing in line	Seed sowing in line
Wider spacing	Broadcasting	P to P: 15-25 cm R to R: 15-20 cm	P to P: 30 cm R to R: 30cm	P to P: 30 cm R to R: 30cm	P to P: 25 cm R to R: 30 cm
Single seedling/hill	-	1-3 seedlings/hill or line sowing	1-2 seeds/hill	1-2 seeds/hill	1-2 seeds/hill
Inter-cultivation	1+manual weeding	2+manual weeding	2+manual weeding	2+manual weeding	2+manual weeding
Organic Manure	Compost	Compost, <i>Panchgavya</i> , <i>Amritghol</i> , <i>Matkakhad</i>	Compost, <i>Panchgavya</i> , <i>Amritghol</i> , <i>Matkakhad</i>	Compost, <i>Panchgavya</i> , <i>Amritghol</i> , <i>Matkakhad</i>	Compost, <i>Panchgavya</i> , <i>Amritghol</i> , <i>Matkakhad</i>

broke up the soil surface. Application of cowdung and *Panchgavya*, *Amritghol*, and *Matkakhad* was also taken up as much as farmers could do this.

Performance of SCI Methods during the Drought

Farmers who adopted SCI strategy were immensely happy since their crops performed much better than the conventional crops during the 2009 drought. Crop-wise comparative observations are briefly discussed below:

Paddy: Comparison of SCI paddy crops with conventional paddy is shown in Table 3. It reveals that SCI paddy produced increased numbers of effective tillers per plant, averaging 18 as compared to 5 tillers under conventional method in a single plant. The average panicle length and number of grains per panicle of SCI paddy was also considerably higher than the conventional paddy crop. The average grain yield of SCI paddy was 4.8 t/ha, whereas conventional paddy produced only 2.5 t/ha. This showed an average increase of about 92 percent in grain yield of SCI paddy over the conventional paddy crop. The table

also shows that there was about 67 percent increase in straw yield from SCI paddy when compared with conventional paddy.

On comparing the crop yields with the previous three years' data, one finds that during the present drought, the grain yields of the conventional crop decreased by 31 percent as compared to reduction of only 13 percent in the SRI crop.

SCI for other Crops: Observations of the application of SCI techniques for other crops – mainly finger millet, kidney beans, soya bean and maize – as recorded from farmers' fields are shown in Table 4. SCI performances of these crops have also been encouraging. The table reveals that the average number of ears/plant and kernels/cob produced were higher in the SCI crops when compared with conventionally culti-

Table 3: Comparative results of SRI and conventional paddy during normal and drought year

Particulars	Normal Year (2006-2008)		Drought Year (2009)	
	Conv.	SRI	Conv.	SRI
Average no. of effective tillers/plant	7	21	5	18
Average plant height (cm)	99	122	88	102
Average panicle length (cm)	18	24	19	25
Average no. of grains/panicle	93	177	90	174
Grain yield (Q/ha)	36	55	25	48
% Increase in grain yield		53		92
Straw yield (Q/ha)	111	145	51	85
% increase in straw yield		31		67

Table 4: Comparison of SCI and conventional cultivation of other crops during drought season

Particulars	Kidney Beans		Finger Millet		Maize		Soya bean	
	Conv.	SCI	Conv.	SCI	Conv.	SCI	Conv.	SCI
Average no. of ears/plant (in pulses: pods/plant, maize corn/plant)	34.0	56	3	5	2	3	35	56
Average plant height (cm)	163	205	70	89	149	174	50	66
Average No. of grains/ear (in pulses: seeds/pod, maize: cob/corn)	4	6	290	428	225	248	3	4
Grain yield (t/ha)	1.3	2.2	1.2	1.8	1.7	2.3	2.8	3.6
% increase in grain yield	-	69	-	50	-	34	-	29

vated crops. More than a 50 percent increase was recorded for SCI crops.

SCI-cultivated kidney beans, finger millet, soya bean and maize exhibited an increase of 26 percent, 27 percent, 32 percent and 17 percent in their plant height, respectively, over the conventionally cultivated crops. Significant average increase in number of grains in SCI crops was recorded which further contributed to the average increase in grain yield by 69 percent, 50 percent, 29 percent and 34 percent in kidney beans, finger millet, soya bean and maize, respectively. There was also about 15 percent increase in stalk yield (28.9 t/ha over 25.1 t/ha) from the SCI maize crop as compared with the conventional maize crop.

Problems Faced while Adapting SCI during Drought Season

Some of the specific problems encountered while practicing SCI during the current drought were as follows:

- Farmers were not able to prepare their fields on time due to the lack of rainfall, which further restricted them in using a mechanical weeder and from undertaking timely application of liquid organic manure
- More damaged nurseries have been observed, which increased labour cost and time
- 10 to 15 percent seedling mortality was observed in the case of paddy

- Less tillering, lesser grain development (more unfilled grains), and early maturity
- Shortfall in expected adoption and area coverage
- Lot of variability in adoption of recommended practices (seedling age, water management, spacing, weeding, etc.)

Despite the above problems, the crop-cutting results undertaken in the farmers' fields across the various districts of the two mountain states indicate that SCI techniques indeed had a very high potential for addressing issues relating to drought-like situations and improving and ensuring food security for the rural subsistence farming communities even during water-scarce periods.

In the coming years, where SCI has been successfully demonstrated, PSI proposes to increase the number of households and the area covered per household and also expand the coverage of crops other than paddy while experimenting with new crops.



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SRI can be a Lever for Systems Correction

Ravindra A

“The societal failure in understanding and dealing with ‘systems’ – be it irrigation or power or chemical inputs or extension or research is the root cause of ‘resistance’ to SRI. It is the ability of all to deal with such ‘systems corrections’ on which the future of our food security lies, be it SRI or any other system”, argues Mr. Ravindra on the resistance to larger-scale adoption of SRI in the Indian context.

It is rather strange that a new method of rice cultivation that promises higher yield with 30 percent less water, 90 percent less seed usage and much less need for pesticides and fertilizers is facing stiff resistance from the agriculture research establishment and policy makers. It is even more puzzling to see such resistance against the backdrop of overall stagnation in rice production in recent years, with no promising technology on the horizon, with declining potential for area expansion and with increasing dependence of rice on fast-depleting groundwater resources!

A deeper look into this ‘problem’ suggests a ‘systems’ failure in India’s agricultural sector. Led by the popular belief that ‘magic’ seeds and ‘miracle’ chemicals would provide

an engine of growth in productivity, the whole system of research, extension and public policy has become engrossed in and dependent on the subsidy-driven delivery of inputs. Caught within this reductionist paradigm, the agriculture sciences have forgotten the interconnectedness of various systems that mutually reinforce one another to contribute to productivity. The biological potential of the rice plant is far “under-exploited”, as Norman Uphoff often says, while the research system is chasing the hope of a breakthrough in creating new genetic potentials, not having fully exploited existing potentials with optimizing management.

The capacities of the present agriculture research system - too divided along the

fault lines of various disciplines to understand and work together on the complex system of rice cultivation in differing field situations – are quite limited. It is a well known fact that results of SRI in farmers’ fields are often more substantial than in many controlled experiments in research stations and research on something as multi-faceted as SRI does not attract attention or rewards.

The irrigation scenario is rather bleak. Propped up by power subsidies, rice is fast expanding into dry lands and today, around half of the rice produced in the country is irrigated by fast-depleting groundwater. It is well known that when the power is available free, there is no incentive for farmers to save groundwater. Efforts to regulate groundwater use by limiting electrical power availability create the perverse incentive for farmers to keep their motors always ‘on’ (with automatic starters) to make the ‘best use of limited hours of power’.

In the canal-irrigated areas, farmers have hardly any control over the irrigation systems. Systems corrections in the management of large irrigation structures are long due. The governments that can





invest substantially on increasing micro-irrigation systems in the name of saving water hardly care about making systems corrections in the irrigation sector as a whole. Water governance and systems improvement are a prerequisite for SRI. Public policy must create positive incentives to optimize water use and promotion of SRI could be a good lever to effect systems improvement in the water sector.

Farmers' experiences prove that SRI substantially saves on seeds, chemical fertilisers and pesticides; SRI also responds positively to increases in organic inputs. Good soil aeration, promoting better root growth etc., are complementary to a healthy rice crop; but these processes are stifled in normal rice cultivation. Rice consumes substantial fertiliser subsidies, which reached 120 lakh crore Rupees last year. Even a 25 percent reduction in the consumption of fertilizers for rice would be a huge saving to the national economy and SRI coupled with certain practices such as green manuring, holds out a larger promise to make production more efficient, profitable and sustainable. But the current Agriculture Extension Systems – based largely on subsidized input-led technology dissemination – is hardly equipped to promote an innovation based on transferring knowledge and skills and making systems changes.

Inundation of paddy fields is done mostly to reduce weed infestation in normal rice cultivation; there is a trade-off between application of water and employment of manual labour for weeding. Saying that 'it is an individual farmer's choice' which methodology will be used is rather naïve. The whole edifice of current production is propped up by highly inefficient resource use, large and ever increasing subsidies and larger inequities. If water is free, why should a farmer want to do his own weeding or hire labourers?

The nation has to decide on the trade-off



it wants and can support. Investing resources in disseminating SRI use, including some subsidizing of labour during the transition period (to SRI) would surely cost less than sustaining the edifice of inefficient water use, subsidized power and agrochemical subsidies. It would have more long-term benefits and benefits that are better-distributed. There is also a trade-off between present and future; continuing along the current path will reinforce the dwindling soil fertility, increasing pests and diseases, deepening groundwater crisis and not really address national food security which is under a serious threat today.

Portraying 'mechanization' as the key to SRI promotion is deceptive. Now the nation has to sustain large number of labourers artificially under the NREGS as the economic growth cannot absorb them. Labourers will negotiate more successfully with farmers whenever they are in demand; they can negotiate more in SRI as it involves a whole new skill set. There must be time for farmer-labour negotiations to settle down. Some studies have also shown that the overall usage of labour days will be reduced in SRI. It is the transition period that matters and this needs to be supported in a big way beyond finding good technical solutions. A society that can deliver NREGS in such a

large scale can easily deal with 'part-subsidizing labour' in the promotion of SRI, if it so wishes.

Societal failure in understanding and dealing with its challenges in 'systems' terms – be it irrigation or power or chemical inputs or extension or research - is indicative of why there has been 'resistance' to SRI. The policy makers have abstained from getting engaged in such deliberations. Mere decentralization of decision-making in public policy would not provide a space for SRI, as it is caught up within the current paradigm, impeded at various levels by old interests and old thinking. Being able to see and make 'systems corrections' will shape the future of our food security, whether with SRI or any other system.

The multitude of SRI farmers, rapidly increasing, has abundantly proved that systematic changes in the management practices along the lines of SRI principles can make rice production healthy and productive. The savings in public expenditure and resource use that SRI can bring about far outweighs the cost of making these corrections which will inconvenience some but benefit many.

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SRI for Food Security in the Rainfed Areas

A Report from PRADAN

Creating forums for sharing of experiences and information as well as latest innovations is one of the pre-requisites for scaling up SRI, as it is fast moving out of the promotion stage. In this context, the more said about the need for the timely interventions by the government – be it at Central or State level – the better. PRADAN, as one of the pioneering civil society agencies involved in the promotion and scaling up of the SRI methods, created such a platform/forum for a proactive interaction between Government and civil society agencies regarding the future and scaling up of SRI in New Delhi in December 2009. Find the brief report on the day's proceedings.

The National Resource Centre for Rural Livelihoods (NRCRL) of PRADAN, in collaboration with the Aga Khan Foundation and the Sir Dorabji Tata Trust, held a one-day experience-sharing workshop on December 23, 2009 at the Institute of Defence Studies and Analyses (IDSA), New Delhi. The workshop brought together different stakeholders involved in promoting SRI. Presentations were made by facilitating agencies, practitioners, scientists and senior government officials as part of the workshop. Discussions were facilitated in order to evaluate the role and importance of SRI in ensuring food security in rainfed areas as well as identifying scope for affirmative actions within the prevailing policy framework.

It was noted early in the workshop that over the last 50 years, 23 million hectares have been added to the Net Sown Area (NSA) in the country. Most of such landholdings fall in the ridge portions of rainfed areas and have been brought under rice cultivation. The fact that such holdings are located in the poorer parts of India makes SRI all the more relevant – precisely for the cost and yield advantages it offers, on the one hand and its resilience to the water-scarce conditions that characterise rainfed areas, on the other.



Dr. Sadamate, speaking at the workshop.

To validate the importance of SRI in this respect, a number of NGOs presented their experiences. PRADAN reported that in 2009, no less than 17,000 households undertook SRI cultivation in Bihar alone. Despite the delayed monsoons, the households reported enhanced yields of 4 to 7 tonnes per hectare during *Kharif*. Likewise, the Peoples' Science Institute (PSI), Dehradun informed workshop participants of increased grain yields under SRI to the extent of 67 percent in 2006, 89 percent in 2007 and 53 percent in 2008 compared to the grain yields obtained under conventional methods.

Where cost reduction is concerned, a study carried out by the Gujarat Institute of Development Research (GIDR) revealed

that SRI farmers being supported by the Aga Khan Rural Support Programme in India (AKRSPI) have saved roughly Rs. 10,873 per hectare compared with farmers still adhering to the conventional methods. In terms of resilience, ICRISAT-WWF Project's experience showed that SRI has been able to withstand extended periods without irrigation. Similarly, the Orissa SRI-Secretariat in Bhubaneswar recounted as part of an ongoing study on drought mitigation through SRI initial reports that while 38 percent of the entire cropped area under SRI suffered pest attacks, this percentage stood at 45 percent for lands cultivated under conventional methods.

As part of the presentations, NGOs were also able to exchange ideas on effective strategies and constraints faced. WASSAN, Hyderabad, shared information on how it has successfully promoted SRI under the command of village tanks by accounting for traditional modes of tank management and training irrigation overseers (*neerugattis*) in the SRI methods. The Madhya Pradesh Rural Livelihoods Programme (MPRLP) conveyed the many ways in which it has collaborated with both government and non-government agencies to upscale SRI in the tribal-dominated parts of Madhya Pradesh. Also, the M.S. Swaminathan Research Foundation (MSSSRF), Chennai, outlined how the drum seeding method can be integrated with SRI practices.

In discussing the challenges faced, NGO representatives and participants voiced the need for more intensified awareness-building and training events that would reach out to farmers as well as to the input suppliers and department heads at the district level. Since SRI is specifically being targeted now for rainfed regions and this demands an alternate system of wetting/drying soils, the participants agreed that it is crucial to dovetail *in-situ* Soil and Moisture Conservation (SMC) measures such as field bunds and farm ponds along with SRI. The

need to contextualise SRI for Boro paddy production was also underscored.

Apart from the challenges faced, presenters shared the diverse ways in which field experience was translating into innovative practices. The many ways in which PSI, Dehradun, has successfully adapted SRI methods to finger millet, black gram, soya bean, maize and wheat deserves mention in this regard. An exposure trip for farmers from PRADAN working areas to visit PSI assisted communities in early 2008 and encouraged them to take up wheat (SWI) in a similar manner. The farmers now state that their average yields have increased to 35 quintals per hectare, in the place of their usual previous output of 6 to 20 quintals per hectare.

Wider applicability and innovation of this nature has encouraged PRADAN to refer to a new System of *Root* Intensification, instead of the common SRI reference to rice alone. People's Science Institute is referring to its extrapolation of SRI methods and concepts to other crops as the System of Crop Intensification (SCI). Among other innovations, WASSAN—Hyderabad has established NPM (non-chemical pest management) shops in collaboration with the Andhra Pradesh Society for Elimination of Rural Poverty (SERP). These shops ensure timely availability of NPM inputs for SRI and also assist farmers in pest surveillance and management.

Besides making a mention of the replicable innovations, the workshop revealed a number of areas requiring further research and study. Dr. B.C. Barah from the National Centre for Agricultural Economics and Policy Research (NCAP) spoke of the complexities that constrain food security at both the household and national levels. He expressed concern that since the nature of the problem is much different at both levels, greater understanding is required to forge a course of action.



Mr. Mukesh Khullar addressing the audience.

To ensure success in the long run, the importance of assessing reasons for non-adoption of SRI practices was also emphasised. An equally important need was expressed to assess methane emissions under SRI in order to make a case for SRI as a Clean Development Mechanism (CDM), provided there is no offsetting increase in nitrous oxide, an even more potent greenhouse gas. The necessity for scientific research to ascertain the suitability of different seed varieties, both traditional and hybrid, for use with SRI practices in different agro-climatic zones was voiced. Likewise, the nutrient requirements and absorptive capacity of crops under SRI remains to be accurately ascertained in order to make for a system of good practices that would ensure timely replenishment of soil.

It was suggested by participants that a collection of good practices in due course could be pooled to make for a comprehensive Package of Practices. This should not turn SRI into a mechanistic formula, however, since farmer understanding and farmer responsibility and initiative are keys to SRI success and important in themselves.

In relation to the prevailing policy framework, modalities of the National Food Security Mission (NFSM) and its working arms at the district level, namely the Agriculture Training and Management

Agencies (ATMAs), were clarified. Sri Mukesh Khullar, Mission Director, National Food Security Mission (NFSM), informed that the Mission proposes to increase national rice production by 10 million tonnes to meet the anticipated shortfall of food grains. To achieve this, the Mission is targeting 5 lakh hectares for the promotion of SRI alone. The areas identified for SRI extension fall predominantly in high-potential districts which also have high levels of poverty, comprising large tracts of rainfed areas.

Sri Khullar stressed on the need for NGOs to partner with ATMAs for the successful expansion of SRI. He reiterated that in working with ATMAs, the Strategic Research and Extension Plans (SREPs) prepared by ATMAs at district level need to be pursued in all seriousness to delineate the scope and strategy for SRI implementation. In addition, it was made clear that NFSM – in the hierarchy of institutions – functions as a supervisory body for dealing with impediments or easing implementation in the long run, not as a line implementing agency.

In speaking of achievements made under NFSM, Dr. M. C. Diwakar of the Ministry of Agriculture (MoA), made a comprehensive presentation, which provided greater clarity on the macro-economic conditions. The



Some of the delegates attending the workshop.

enormity of India's food grain needs is such that they cannot be fulfilled with imports alone. Senior representatives of NFSM and the Ministry of Agriculture (MoA), particularly Ministry advisor Dr. Saini, highlighted the government's interest to invest in SRI for the purpose of achieving rice self-sufficiency. They indicated that there is no dearth for funds, but rather there was a need to strengthen collaborative ties between the government and NGOs to achieve this end.

As part of the ongoing dialogue with senior government officials, the view was expressed in plenary that the approach adopted by NFSM so far with regard to SRI is too engaged in scattered demonstrations, whereas the effort should bring more contiguous plots under SRI. Whereas the NFSM works through agriculture extension workers who have mostly a top-down approach, the promotion of SRI should ideally be farmer-led and bottom-up in its approach.

Similarly the focus should be on confidence and skill building, rather than remaining preoccupied with making physical inputs available to farmers. To achieve such ends, the focus should be more on compact area development. Up-scaling SRI through compact area development would require facilitating agencies to engage with landscape realities, institutional frameworks

and credit mechanisms simultaneously. The plenary affirmed that such an approach is more likely to create the required synergy for replication.

The issue of subsidies elicited considerable discussion as part of the deliberations on policy framework. The suitability of leveraging Employment Generation Programmes for supporting farm labourers (engaged in SRI) was considered. There was some questioning of the need for subsidies, as SRI has already proven itself to provide significant economic returns to farmers in practice. It was also enquired by participants as to how the subsidy (if proposed) should be structured. Since financial requirements at the individual farm level are not much, it was suggested that subsidy should be directed at creating infrastructure of common benefit for the community as a whole, such as appropriate tools, implements and weeders and structures for improving water control and (in some places) drainage. The development of common lands and water resources could also be achieved in this way.

In addition, subsidy should be structured in a way to ensure year-round availability and access to updated information on SRI technology. This, more than subsidising individual needs and requirements, would enable the adoption of SRI at a mass level.

In this regard, Prof. Phansalkar from the Sir Dorabji Tata Trust (SDTT) shared the example of the Telecom Industry where a shift of subsidy from individual phone lines to the installation of telephone towers (a common property) triggered an exponential increase of connections. It was jointly agreed that the issue of subsidy requires policy research and more careful forethought, as it will have far-reaching consequences. If it encourages a psychology of dependence among farmers, rather than encourage self-reliance, a good part of SRI's potential benefit will be foregone.

Sri. V. V. Sadamate, Member, Planning Commission, towards the end of the workshop suggested that the provisions of the Rashtriya Krishi Vikas Yojna (RKVY) can be equally enabling where SRI promotion is concerned. Sri. Sadamate pointed out that interested organisations should participate in the Comprehensive District Agriculture Plans (C-DAPs) and should refer more specifically to the sections pertaining to SRI therein. He clarified that SRI-related sections in the C-DAPs would provide the basis for NGOs to formulate proposals for SRI expansion in cooperation with district-level bodies. He guaranteed all that proposals with merit would be processed speedily, as the government is open to partnering with NGOs.

The workshop concluded with a recap of the day's discussion and with affirmation of evolving a two-tier strategy which could address issues at both national and household levels. Work at district and state levels would bridge between the macro and micro levels. The participants were thanked, and it was hoped that the clarity which had emerged from the day-long workshop would result in stronger working partnerships with the government, as much as the formation of nodal agencies at different levels, from village, district and state to the nation as a whole.

Symposium and Brain-Storming Workshop on SRI

23 – 24 November 2009 at Yashada, Pune, Maharashtra

Trupti Kadam

Sir Dorabji Tata Trust (SDTT), SRI NGO partners and rural communities organized a two-day Symposium and Brain-Storming Workshop on System of Rice Intensification (SRI) with active collaboration with the Department of Agriculture, Government of Maharashtra and the Yeshwantrao Chavan Academy of Development Administration (YASHADA), in order to promote rice cultivation for benefiting small and marginal farmers for food security. Mr. V. Ramani, the Director General of YASHADA, took personal interest in the event and contacted and convinced Mr. Prabhakar Deshmukh, Agriculture Commissioner (State Agriculture Department), to attend.

The active participation and interaction was planned for SDTT and its many SRI NGO partners in the state. Participants in the Symposium included Chaitanya, Amhi Amchaya Arogyasathi, Shramjivi Janata Sahayyak Mandal, Matrumandir, Parivartan, GYPM, BAIF-MITTRA, Centre for Experiential Learning, RC Jawhar and Mokhada, District and Taluka Agricultural and Technical Officers from 11 Districts and Research Officers from the Research Centre. All were invited for this event convened at YASHADA, Pune.

SRI resource persons attended from ICRISAT-WWF, Hyderabad; the SRI-Secretariat, Bhubaneswar; People's Science Institute, Dehradun; Centre for World Solidarity, Orissa and Department of Agriculture, Tripura. Senior officials from the Agricultural Department, NABARD, YASHADA, NGOs, media and SRI farmers from Rajgurunagar, Junnar and Chakan of

Pune District and others from Raigad District participated. The main objective was to share experiences and to promote SRI practices in the Maharashtra State.

A demonstration of SRI techniques and methods was put up by the SDTT SRI NGO partners, especially on raised bed nursery, mat nursery, single planting, spacing between plants, different types of weeders and markers, various traditional and improved varieties of seeds, posters, photographs and bunches of rice with tillers.

The objective of the Symposium:

- Create awareness among farmers and the Agriculture Department about the SRI methodology and encourage farmers to do paddy cultivation using the SRI methods
- To develop linkages and collaboration among NGOs, Agriculture Department,



Lighting of the Lamp by the Chief Guest Mr. V. Ramani, IAS, Dr. Sanjiv Phansalkar and Mr. Biswanath Sinha

agriculture colleges/universities and farmers

- Experience sharing of SRI experts who have implemented SRI methods in different districts and states of India and
- Promotion and scaling-up of SRI at the State Level

After the formal Lighting of the Lamp by the Chief Guest, Mr. V. Ramani (IAS), Dr. Sanjiv Phansalkar, Mr. Biswanath Sinha, and Dr. Sudha Kothari, the day's program was divided into 4 sessions where concerned representatives of the Maharashtra State Government, experts in the SRI methods, and representatives of the different NGOs spoke about the felt need for expansion of SRI, and the proactive role that the government had to take in it, plus the experiences of several NGOs, including the organizers of the Symposium, in promoting and scaling up of SRI among farmers. The day ended with the farmer participants themselves sharing their experiences and problems in actualizing the SRI methods of rice cultivation.

The objective of the second day's brainstorming session was to get support from the Agriculture Department, NGOs and Agriculture Research Center for improving the quality of SRI extension and to assess experiences of the government departments in the implementation of SRI.

The Symposium ended with a Vote of Thanks by Ms. Trupti Kadam, Rural Communes - Centre for Experiential Learning, the representative of one of the organizers of the Symposium.

Trupti Kadam

is the SRI Anchor Person from Rural Communes

SRI Promotion in the Western Ghats

S.P. Srikanth and Mr. Arun Balamatti

SRI methods of growing rice initiated by the Karnataka State Government and AMEF in the Sakleshpur mandal of Hassan district has infused new hopes for better yields among the paddy growing farmers of this hilly zone.

Sakleshpur taluk (mandal) in Hassan district of Karnataka has a different agro-ecology. Falling under the Malnad belt of the state, it is a hilly zone, receiving very high rainfall of about 3500 mm annually, spread over 100 rainy days. Coffee is the commercial crop grown on thousands of hectares on the hills while paddy is grown in the valleys in nearly 10,000 hectares, both during *Kharif* and summer.

As in the high rainfall areas, the soils here are highly acidic with Zn deficiency commonly observed in paddy. Because of the heavy rainfall and unfavourable drainage conditions, practicing SRI is quite difficult during the *Kharif* season. Water management apart, young tender seedlings cannot withstand heavy downpours. With flowing streams of water, SRI practices can be followed in this mandal only in the summer season. With the economy thriving on coffee and tourism, Sakleshpur is rather an unusual location for introducing livelihood improvement initiatives, except for the limited opportunity of promoting SRI in summer.

AMEF initiated a convergence programme with the State Department of Agriculture (DoA) in the summer of 2009. "It is reintroduction of SRI practices in this area by DoA", says Mr. G.H. Yogesh, Assistant Director of Agriculture (ADA), Sakleshpur. He recalls the DoA attempts to popularise SRI practices among a few farmers two years ago, but the efforts withered away quickly and farmers could not succeed in adopting SRI. This time, with the technical support from AMEF, he has been able to promote SRI among 40 farmers spread over 10 villages under the ongoing National Food Security Mission (NFSM) program.

Being part of the state extension effort, it is more of a demonstration than the participatory technology development process as is normally promoted by AMEF. Under NFSM, the DoA distributed 2kg of hybrid seed (KRH-2) to the farmers with some inputs like lime, organic manures, bio fertilizers and ZnSO₄. With AMEF's association, the DoA has adopted an "out of the box approach" where local youths, who also practice agriculture, are hired to promote SRI. The volunteers are trained on SRI practices by the

DoA and AMEF and are instrumental in demonstrating SRI practices, particularly nursery raising and transplanting.

As per the field visit observations in March – April 2009 to witness SRI promotion experiences in the area, shades of SRI practices among the farmers, typical of SRI adoption in the first year, were noticed. The age of seedlings transplanted varied between 14 and 25 days. Some farmers practiced water management principles and others have not, depending on the topography, as draining the water has been difficult in the low-lying areas even in summer. Farmers transplanted 2-3 seedlings per hill, and many maintained spacing between rows while struggling to maintain wide spacing between plants.

As some farmers could not do weeding in the early stages (as weeders were provided by the DoA late in the season), weeds were observed during panicle initiation stage too. But on the whole, farmers were excited, seeing the profuse tillering under even imperfect SRI, ranging from 18 to 47 tillers per hill, whereas in traditionally grown



Rajegowda doubles his paddy yield through SRI

Adopting SRI for the first time, Rajegowda, a young and inquisitive farmer from Anchagi village in the Sakleshpur taluk of Hassan district in Karnataka, has succeeded in doubling his paddy yield at first attempt.

A participant in the SRI promotion by the Department of Agriculture-AMEF and the ICRISAT-WWF Project-supported joint initiative, Rajegowda is one among the 40 farmers to have adopted SRI in his area in the year 2008-09. Selected farmers and local youth were trained on the SRI principles and practices. The youth have in turn identified potential villages and farmers for scaling up SRI within the project's operational area.

Rajegowda felt the difference in saving right from the beginning. He used just 0.5 *guntas* for his nursery (one acre= 40 *guntas*) to raise seedlings for one acre under SRI whereas with conventional methods, he was using over 2 *guntas*. When it came to labour for seedling pulling and transport, he hired only one labourer instead of the 7 in the conventional paddy nursery. He transplanted 15-day old seedlings to the main field and did not require any additional labourers

for the transplanting operation - he employs 5 women for this purpose under the conventional method, and he could manage his transplanting with the same number of labourers so there was no added cost for transplanting.

Rajegowda used the weeder every 10 days, four times, to manage the weeds. He noticed the difference in root growth and was surprised to see the root length in SRI plants. At the grain-filling stage, this was 7 to 9 inches in case of SRI whereas it was only 2-3 inches in the conventional paddy. Similarly, he counted the number of productive tillers per hill, which ranged between 20-26 in SRI as compared to 12-21 in the conventional method. The average number of grains per ear head was 123 (thus, 3,198 grains per hill) in comparison with 48 in the conventional paddy plants (960 grains per hill).

Rajegowda realized a grain yield of 24 quintals and had 1200 bundles of fodder yield (nearly half a lorry load) from SRI. This was double the 12 quintals of grain yield and 500 bundles of fodder that he got before. Although double, he does not consider this the best yield possible. Rajegowda is confident of getting at least 3 times the normal yield now that he understands the methods better. He has reason to believe this not only based on his personal experience but from seeing his neighbour Manjunath and two other farmers Ravi and J. D. Murthy in the neighbouring Kumbagatte village get 30 quintals yield from SRI. It is no surprise that Rajegowda has scaled up SRI adoption to 5 acres for the year 2009.

paddy plots, the number of tillers per hill ranges from 8-10, equal to the number of seedlings planted.

Generally, SRI paddy looked healthier and greener than the conventional paddy. Only one variety KRH 2 (hybrid) was supplied by the DoA for the SRI demonstration plots whereas farmers here use other varieties like Jaya and IR-64 under the conventional method. This led to some difficulty for the farmers in comparing tillers, plant height and other parameters between varieties. An interesting feature noticed was that azolla is naturally occurring in this habitat, even in aerated paddy fields during summer.

With poor soil fertility due to leaching and acidity, SRI is likely to become very popular among farmers here as an alternative farming practice to get better yields. As pesticides are also widely used in paddy, there is a good opportunity to promote eco-friendly paddy cultivation through SRI in this region. Encouraged by farmers' response, the ADA introduced IPM practices in conventional paddy farming during *Kharif* 2009. Also, he is planning to try out lime application under both conventional and SRI methods to combat iron-induced zinc deficiency and help farmers reap better harvests.

The NGO-GO partnership in Karnataka for SRI promotion has been rather weak. Mr. Yogesh being an AMEF alumnus has provided a fresh impetus to the AMEF initiatives. AMEF looks forward to strengthening and replicating this relationship in the future.

Mr. S.P. Srikanth is ex-Central Programme Officer - Programme Coordinator with AME Foundation and Dr. Arun Balamatti is former Executive Director of AME Foundation



Farmer turns promoter of SRI in Tamil Nadu

Mr. Nanjappan, a progressive farmer of Pothapuram village of Krishnagiri district in Tamil Nadu, has been cultivating paddy for 15 years. He was able to understand the philosophy and practice of SRI through a learning process initiated by an exposure trip to SRI fields in Pudukottai district, followed by participation in a SRI Consultation Workshop and modular trainings that are part of the AMEF's ICRISAT-WWF funded Project.



In the first season, Nanjappan was one among the two farmers in his village who took up SRI in 60 cents area, using variety ADT 43. When he transplanted the young seedlings (16-day old) in his fields, both his family members and other farmers in his village responded negatively and advised him to go instead for replanting with conventional method (30 to 40 day seedlings). But he did not give up.

To control weeds, Nanjappan followed the recommended inter-cultivation process three times in the initial stages, but as his field area is under canal irrigation, he found controlling water difficult. Despite certain constraints, his crop started smiling and the greater number of tillers under SRI management attracted other farmers, who

were initially astonished and eventually started showing interest in the practice.

Nanjappan explained to the other farmers patiently about the SRI method of cultivation whenever they asked him about it. Some of the farmers even counted the tillers on his plants whenever they passed by his SRI field. In the *Kharif* season he got a yield of 20 quintals of paddy, 10 percent more than under the conventional method and with considerable reduction in the cost of cultivation. He has scaled his SRI area up to 1.5 acres this season.

Today, Nanajappan is busy both cultivating paddy the SRI way and motivating other farmers to also go in his way. In the summer of 2009, he individually motivated 27 farmers covering 17 acres in his village. He is also actively involved in mobilizing critical inputs from the nearby research station of TNAU and other sources.

A report from AMEF

Crop rotation helps control weeds in SRI cultivation

When the ICRISAT-WWF Project and AMEF team visited the SRI fields of Mr. Devaraj in Thirumalvaady village of Palcode block, Dharmapuri district of Tamil Nadu, they were surprised to find a weed-free field. The growth of paddy under SRI (Red Ponni variety) was better with 22 tillers per hill when compared to 10 to 12 in the conventional method. Discussions with the farmer and his friends provided them with interesting insights to the weed-free condition.

According to Devaraj, crop rotation has helped him control the weeds. He had cultivated groundnut in the previous season and had not cultivated paddy for 5 years, as the Palcode region witnessed drought for the last 3 consecutive years. This broke the

cycle of weed reproduction and this gave his rice crop less competition.

The area is under canal irrigation from Kesarkuli Dam and water is released continuously for 4 days, with no water then issued for the next 5 days. This situation helped Devaraj in his alternate wetting and drying. Green manuring done in the field before taking up paddy also helped by enriching the soil and perhaps killing the seeds of the weed, due to decomposition. Devaraj had not applied FYM this season, which also helped in reducing the source of weeds as most farmers apply half-decomposed FYM.

Ms. Mathumalar and Dr. Diraviam,
AMEF Foundation, Dharmapuri

For articles, new coverage, information on SRI from various countries, visit the following websites:

www.ciifad.cornell.edu/sri/

www.sri-india.net/

www.wassan.org

www.info.worldbank.org/etools/docs/library/245848/index.html

www.groupementsrimada.org/

www.tefysaina.org/

www.foodsecurity.gov.kh/sri/default.htm

www.groupementsri.over-blog.com/

www.vietnamsri.wordpress.com/

www.erikastyger.com/

SRI_Timbuktu_Blog/SRI_Timbuktu_Blog.html

www.sripadiukm.blogspot.com/2009/09/system-of-rice-intensification-sri.html

www.sripadiukm.blogspot.com/2009/09/system-of-rice-intensification-sri.html



An Interaction

Farmers' Perception on SRI

Ronali Pradhan

SRI has been a matter of discussion in 5 villages of two Gram Panchayats of Nayagarh District in the state of Orissa because of the local NGO NIRMAN's facilitation and technical support. In 2008-09, in these villages, 18 farmers practiced organic SRI on 8.3 acres of land, which yielded good results. Each of them obtained more than 2 times the usual average yield obtained with traditional paddy cultivation methods from the same patch of land. During a field visit, interaction was held with 25 farmers, including new farmers who have planned to adopt SRI for the coming season after observing the outcomes of cultivating paddy the SRI way. Excerpts from the discussion:

Q. After practicing SRI for one season, according to you, what are the benefits of SRI?

Farmer 1 - Requirement for inputs is much lesser in contrast to the conventional method, which is the major advantage. Also it is a suitable farming practice for farmers with small land holdings and with a large number of family members to be supported. The major problem that farmers face is availability of seeds on time and this problem is almost negated with SRI as its requirement for seed is very much less. At the same time, as only organic inputs are used in SRI, the cash expenses are reduced further. When one compares the cost of production with the yield obtained, it explains the benefit that a resource-poor farmer can get out of SRI.

Farmer 2 - One major benefit which I have observed is that in the same plot, another

crop grown succeeding the SRI paddy is giving higher yield. I cultivated black gram in the same plot after harvesting a paddy crop with the SRI method and I got more than double the yield of black gram when compared to what I obtained in the previous years. The size of the grains are good and uniform in size, which means they fetch a higher price. Farmers who have not adopted SRI are now envious of my produce. When I discussed this with my peer group farmers, we came to a conclusion that higher yield was possible because of the organic approach, the looser soil structure due to the weeder operation and a high amount of crop residue due to larger root volume. Now, more number of farmers are interested to take up the SRI methods because one can get good yield for crops for 2 seasons because of SRI.

Q. What are the problems you have faced while practicing SRI for the first time?

Farmer 3 – Among problems like delayed transplanting due to late monsoon and termite attack in a few plots, the major problem faced by us with SRI is cattle menace. In the case of SRI, as tender young seedlings are transplanted, the seedlings are affected due to even minor damage caused by cattle. On the other hand, with the conventional method, older seedlings are transplanted. The first 20 days after transplantation in the case of SRI are crucial for survival of the seedlings, as cattle owners leave their cattle free outside to graze without any restraint.

Q. According to you, what can be a long term solution for this problem of cattle menace?

All Farmers – If in a village all farmers adopt SRI, then the cattle can be guarded effectively. On the other hand, an immediate step that can be taken in this regard is to initiate a dialogue with the existing Village Development Committees (VDCs) for mobilising and sensitizing the community to prevent open grazing as soon as the monsoon arrives, or else to allow the cattle to graze in a common place where fodder crops can be grown with the community contribution.

It was observed that all the farmers were very eager to share their experiences regarding the amount of paddy that they have obtained after practicing SRI. Despite the various field-level problems that they experienced with SRI, all of them expressed their desire to increase the land coverage under SRI this year and non-practitioners mentioned their plans to follow SRI principles in paddy cultivation in the coming season. In my view, this is the best part of SRI.

Interview Conducted by - Ronali Pradhan and Rekha Panigrahi, CWS
(Thanks to NIRMAN, Nayagarh, Orissa for organizing the interaction session with the farmers)

Ronali Pradhan is the Programme Officer with CWS, Bhubaneswar



SRI in Tanzania

Dr. V. Vinod Goud

Kilombero Plantations Limited (KPL), a Tanzanian private company, approached the ICRISAT-WWF Project to help in studying the rice cultivation practices of local communities around their farm and explore the possibilities of introducing SRI principles and practices to improve rice productivity and income for them and also to establish a demonstration plot of the SRI practices on their farm. In response to this request, Dr.V.Vinod Goud visited Tanzania in December 2009. The following report, in his words, describes his observations, experiences and initiatives undertaken during this short visit.

Rice is the second staple food after maize for millions of Tanzanians. It is also a cash crop. Kilombero Plantations Limited (KPL) is a private firm that acquired 5818 ha of a Farm close to Mngeta village at the base of the Udzungwas Mountains in the southern part of Tanzania in the Kilombero district. It is located at roughly 400 Kilometers interior on the south-western side of Dar-es-Salaam, the capital city of Tanzania. The Tanzanian government is giving top priority for agriculture with a slogan of "Agriculture First". This discouraged the Farm to grow oil palms as originally was planned and now the entire 5818 ha of Farm is targeted to grow only rice. Recently the Prime Minister of the country visited it after he came to know about the company's plans to grow rice on the massive Farm.

As part of its corporate social responsibility, KPL wants to work with local communities to help improve their living conditions. The government is also insisting on KPL to help the neighbouring farmers adopt better management practices for growing rice. In this context, on their invitation, I made a visit to the Mngeta Farm with an objective to help improve the rice productivity on the Farm as well as for the smallholder farmers in the neighbouring villages by exploring the possibilities of applying the SRI principles and practices under rainfed conditions.

I could stay on the Farm for only ten full days and carried out the quick feasibility

study for adopting the SRI principles and practices in the farm and in the fields of the neighbouring farmers, trained them and initiated a few field demonstrations. I spent the first couple of days familiarising myself with the surroundings, going around the Farm and interacting with its staff. It is amazing to see such a large Farm, its infrastructure and more so, growing rice purely depending on the erratic rains! Since 2007, the Farm management has been engaged in reclaiming the huge tracts of Farm land and cultivating rice under rainfed conditions through mechanization. So far, about 3000 ha has been reclaimed. The entire Farm is divided into 25 to 30 ha blocks by drainage channels, as it is a plain area and is prone to flooding during rainfall. There is no irrigation source at all on the

Farm, neither tube wells nor canals, though the Mngeta River flows to the southern side of the Farm. Sowing of rice seed is done using huge Planters which can plant 42 and 30 rows in one go while making the furrows along with dropping the fertilizer simultaneously. Huge quantities of seed (80 to 60 kilograms) are used for row sowing at a distance of 10 inches apart. The inaccessible marshy areas on the Farm are planted by broadcasting the seed aerially hiring small aircrafts from Kenya. Herbicides are used liberally to control the proliferating weeds. Despite following all these practices, the rice productivity was only 1 tonne per ha in the last two seasons!

This year the management has set a target to cover 3000 ha and had already covered about 1000 ha till the time of my visit, having started the sowing in October itself. The preferred varieties include – Saro 5, Kilombero Super and Kilosa. The Farm had also just completed the construction of a rice mill with a milling capacity of 120 tonnes per day. The Farm, if it is fully operational, is expected to be the first model of production - post harvest and quality processing - in Tanzania and perhaps in Africa and aims to produce high quality rice for the high-price market. I was told that for the last two weeks before my arrival





there were no rains there and absolutely dry weather prevailed, with day temperatures touching 36 degrees . Hot desiccating and swirling winds were common and I could see them going up very high, up to 20-30 metres, continuously swirling upwards.

The young rice plants were desperately looking for some moisture. Some were even drying up. If their grand plans were to succeed in growing rice on such a large area and utilising the milling capacity of the Rice Mill fully, the management had to have an assured irrigation source through bore wells, at least for part of the land in the future, to increase the rice productivity by adopting the SRI practices. To demonstrate the benefits as well as potential of increasing the productivity of rice, an SRI trial plot was established on the Farm in the varietal trials area. Training of the staff was also simultaneously undertaken with an intension that they would adopt the SRI methodology on the Farm when an irrigation source was created. During my stay, seedlings were raised on two raised beds with pre-sprouted Saro 5 variety of seed and the beds were maintained for a week while the staff was imparted training on the job but the transplanting could not be done due to lack of rainfall till that date. The staff was advised to begin transplanting the seedlings when it rained next and were given instructions to carry out the rest of the SRI practices thereafter.

SRI in smallholder fields

Three villages about the farm boundaries and Mkangowalo is one of them and it has seven 'sub villages' (perhaps equalling the hamlets in India). All the households in the village and sub-villages grow rice during the rainy season (Nov-Dec to April-May). Annual precipitation is around 1000 and 2000 mm from November to April. Average area of rice and maize fields/household is - 1.2 and 0.4 ha respectively. Soils are sandy loam to clay loam. The farmers here use mostly local

varieties of seed (ex: Kalimata). They mostly use their own seed or buy locally from fellow farmers – and as such there is very little access to improved varieties.

The farmers slash and burn their fields and prepare the lands mostly with local implements though farmers do use tractors. They broadcast the seed (about 40 to 50 kg/ha); in swampy areas, the farmers raise seedlings sowing random quantities of the indigenous seed on the small sites cleared for growing seedlings and transplant 6" apart when they are about one month old. Weed management is done through hand hoeing; again, in the swampy areas, some farmers use herbicides (2, 4, D). The yields range from 2 to 3 tonnes per ha. The rice fields are quite far away from the human habitation. Hence, interestingly, the adults in the family live on the fields in small huts during most of the rice growing season, leaving the aged and school-going children at their homes to take care of themselves. Majority of the people living here belong to the Ndamba tribe. The rest are Sukuma, who are pastoralists and there are some Masai as well. I had a long chat with the Village Chairman and his colleagues to learn about the village in general and the method of rice farming being practiced by the paddy farmers – to familiarise myself with the operations that they carry out from land preparation up until the harvest, the cost of cultivation, yields, income, etc.

The smallholders normally hand broadcast the seed. Those who can afford to engage a Power Tiller evenly spread the soil on the field after broadcasting the seed, which will also at the same time ensure the spread of seed evenly on the field. Those who cannot afford it will leave the field as is. After germination, thinning of the seedlings is done in the densely populated areas and the removed seedlings are transplanted in the sparsely populated areas. They get 5-6 bags (80 kg/bag) of paddy (Maunga in Swahili) per acre. Under the best conditions,

it goes up to 20 bags. I participated in a small farmers' group meeting on the same day and interacted with them and the discussion led to my discovery of the existence of large tracts of low lying moist flood plain lands, the practice of nursery raising of seedlings, transplanting, etc. This was a great relief for me and gave me hopes of trying to apply the SRI principles there and improve the yields considerably as some amount of irrigation/soil moisture is available during and after flooding by rains.

My further probing revealed that there is tremendous potential to teach and introduce several better management practices in their flood plain rice farming system. One farmer shared about his nursery bed and his plans for transplantation soon. After listening to his narration of all the steps that he has taken for raising the nursery, I explained where the gaps/lacunae were in his practices, their negative implications and the better ways of doing the same which would greatly influence the reduction in seed and improve the quality of planting stock. We agreed to visit his land in the flood plain next day.

Then, I demonstrated to the group and many standing onlookers practically as to how to select good seed from the seed lot that they stored for sowing for that season. We carried all the material required for the demonstration, but asked one of the farmers to bring his seed. I showed the inquisitive onlookers the 'floatation technique' for seed selection preparing a salt solution in front of them while dipping an egg periodically to determine the right concentration of solution and thus good seed was separated from the chaffy, diseased, weak ones, etc., which floated up in the solution. This demonstration was well received by them, as it looked like some 'magic' and also made them learn a simple technique of seed selection, which everyone could do, to use good quality seed for sowing.



The next day, we reached a field of one farmer, who had raised the nursery for transplanting seedlings. He used 10 kilos to raise the nursery on a randomly made site at the ground level, which was about one week old and sparsely populated and he estimated that the seedlings might not be sufficient even for one full acre. I explained to him and the other farmers that under the SRI method 2 kilograms of seed was sufficient enough to transplant one acre. After some discussion with the accompanying farmers, I agreed to demonstrate the nursery bed preparation, seed broadcasting on the bed and also transplanting the young seedlings already in the nursery bed through the SRI way the next day. I requested the farmer to make a small plot of land ready for this demonstration.



Then I showed them the marker and weeder that I brought from India. They were happy to see the same and everyone did a trial of running them on their fields and felt they would be very useful and expressed interest to use the machinery for transplanting and weed management if they were given to them. We further discussed the modifications that might be necessary for these implements for the local soils and farming conditions. Many suggestions came forth.

The next day, I conducted on job training to an identified group of interested farmers on seed selection, soaking and pre-germination of seed, nursery bed preparation and seed broadcasting, maintenance of the bed, scooping of seedlings from the bed and so on. On a small plot, the marking of criss-cross lines with a Marker developed by the welder of the Farm was demonstrated. The young seedlings were scooped from the nursery bed of a farmer identified the previous day and I showed the men and women farmers gathered there how to transplant tiny single seedlings at the cross cutting points. They liked it very much and many came forward to transplant the seedlings and appreciated the easiness with

which they could finish transplanting the trial plot, unlike in their practice of transplanting 3-4 seedlings closely.

Raising a nursery with just two kilograms of pre-sprouted seed and covering the entire one acre of land with single seedling transplantation in squares appealed to them very much and they expressed joy for learning a new technique in rice cultivation. Then I distributed 20 kilograms of pre-sprouted seed to 10 identified farmers, about 2 kilograms each and suggested them to raise two raised beds of 1m X 10m size for sowing. Two farmers came forward spontaneously and prepared the raised beds. The women and children gathered around and were watching the bed making and participating in broadcasting enthusiastically.

Over the next couple of days, I worked with the Welder of the farm machinery division, showing him the photos and designs of the marker and weeder while explaining the modifications required – one suitable for the upland flood plains and the other for the marshy flood plains in the low lying areas. The Welder designed two kinds of

weeders in a couple of days time, 1) one with a serrated wheel that will be driven by pushing the long handle fitted to it and 2) rake type two weeders for double and single row weeding. Both these types could be used in marshy as well as flood plain areas, the choice of which depends upon the moisture level in the fields. The next day, these implements were taken to the village and field tested by the farmers themselves and they found them to be working well. They felt that these simple implements would help them reduce the drudgery, seed quantity and make rice cultivation easier for them. I advised the Farm management to make more sets of these implements and distribute them to the farmers.

Before leaving the country, I made a detailed plan for all the small initiatives that I could make working with the farmers and the Farm staff during my short stay and gave a detailed report with the follow up to be taken up for them throughout the season.

Conclusion:

Rice is an important crop in Tanzania and all the households grow it for both food and cash. There is great scope to introduce the SRI principles and practices to the smallholder farmers, in order to reduce the cost of cultivation and improve the productivity. Though rice has to date been grown under rainfed conditions, there is scope to adopt the SRI practices by modifying them to the local conditions. Further systematic in-depth study of the rice cultivation practices, varieties, production problems, market mechanisms, policies of the governments, etc., undertaken in collaboration with other concerned local agencies will unravel the prospective opportunities of promoting SRI in different parts of the rice growing areas in Tanzania.

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Innovations to Reduce SRI Labour Requirements in Sri Lanka



Motorized weeder developed by S. Ariyaratna, Sri Lanka.

Mr. Ariyaratna Subasinghe, from Hingurak-goda, Sri Lanka, has designed and built a motorized weeder to save labour time. He is cultivating 5 acres (2 ha) with SRI methods and finds it difficult to do as many weedings as recommended for such an area. So he has developed this weeder (as you can see in the picture), with a Chinese motor, that he can make for about \$750 and which he considers a cost-effective innovation, given the yields he can get with the SRI methods.

An even more interesting innovation is a method of crop establishment he is using this season, similar to the one that Mr. Ramasamy Selvam in Tamil Nadu state of

India has started. The goal is to save the labour needed otherwise to construct and operate a nursery and to do manual transplanting, while still capitalizing on the benefits of other SRI practices.

Ariyaratna broadcasts germinated seed at the rate of 25 kg/ha onto a muddy paddy field. The resulting plants are more dense than the 5-10 kg/ha rate with transplanted SRI, but they are less dense than with the more usual broadcasting rate of 50-150 kg/ha.

At 15-20 days, he does a 'first weeding' which reduces the plant population as well as removes any weeds in the field. By doing

this in the usual SRI pattern of perpendicular passes of the weeder, he leaves preferably 1 plant, but possibly 2, at intersections of 25x25 cm or 30x30 cm across the whole field. This creates a plant population similar in number and spacing to what would be achieved with the presently recommended transplanting method. He continues to do additional weedings as and when needed, to control weeds and aerate the soil. His motorized weeder makes this task much easier and quicker. Mr. Selvam in Tamil Nadu broadcasts young seedlings, about 10 days old, rather than germinated seed and then eliminates 'excess' plants not growing at the desired 25x25 cm intersections by his first weeding.

Farmers with very small paddy holdings, who need to maximize their yield per hectare, will get highest benefit from the recommended careful transplanting of young seedlings. But farmers with larger landholdings, who benefit most from maximizing their returns per hour of labour, may find this modification of SRI practice advantageous, spending more for seed but reducing their labour cost.

This methodology has been evaluated by Dr. S. Ramasamy and colleagues at Tamil Nadu Agricultural University and has shown that there is about 40% reduction in the total labour needed, without a sacrifice in attainable yield.

<http://ciifad.cornell.edu/sri/countries/india/intnramasapster06.pdf>



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The views expressed in the bulletin are those of the authors and do not necessarily reflect the views of the ICRISAT-WWF project and SRI partners.