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New Hope for Indian Food Security? The System of Rice Intensification

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Executive Summary

Rice is the main source of food for more than half the world's population and its cultivation secures a livelihood for more than two billion people. The introduction of high-yielding varieties, fertilisers, pesticides and irrigation has improved rice yields significantly and expanded the area under which rice is cultivated. However, in the last 20 years yields and the area under rice have stagnated. The two most significant reasons for this stagnation are the lack of adequate water for irrigation and the increased costs of cultivation.

India will need to produce a lot more rice if it is to meet the growing demand, likely to be 130 million tonnes of milled rice in 2030 according to some estimates. Since there is not much scope to increase the area of rice cultivation (due to urbanisation and severe water constraints), the additional production will have to come from less land, less water and less human labour.

This paper describes the potential of an innovative rice cultivation practice—the system of rice intensification (SRI)—for allowing Indian rice farmers to not only enhance rice production and their net incomes, but also to solve the water crisis. Discovered through an unconventional agricultural development initiative in Madagascar in the 1920s, SRI is now known to rice farmers in 40 countries. SRI is a whole package of agronomic approaches which together exploit the genetic potential of rice plants; create a better growing environment (both above and below ground); enhance soil health; and reduce inputs (seeds, water, labour).

The authors make recommendations for how SRI can be more widely adopted in India, including setting a nationwide policy to adopt SRI on at least 25% of the irrigated rice area in the next five years. This will need to be accompanied by appropriate funding, capacity-building and research back-up. It will also require close collaboration among the state agricultural departments, agricultural universities, public works departments and civil society organisations.

A national focus on SRI will be especially important this season (2009-10) as India faces water and food scarcity due to the failure of the south west monsoon, the main source of water for agriculture in most of the country.

New Hope for Indian Food Security? The System of Rice Intensification

Biksham Gujja and T.M. Thiyagarajan

Introduction

Rice feeds more than half of the world's population. It has been cultivated in Asia for several thousand years; recently-discovered archeological rice in South Korea is reported to be 14,000 years old. Rice is now grown on about 250 million farms in 112 countries (Hossain and Fischer, 1995). About 95% of the crop is grown and consumed in Asia. Of all the cereals, rice produces the most calories per unit of land. This, combined with its capacity to withstand inundation and its ability to tolerate a range of climatic and agricultural conditions, accounts for its importance.

Between 2001 and 2007 global rice prices nearly doubled, primarily because of a drawing down of stocks to fill the gap caused by stagnating yields. Global rice stocks have declined from a 135-day supply to a 70-day supply over the last seven years—a 44% drop from 147 million tonnes in 2001 to 82 million tonnes in 2008. Fifty-nine million tonnes of additional milled rice will be needed by 2020 above the 2007 consumption of 422 million tonnes (Mohanty, 2009). Since there is not much scope to increase the area of rice cultivation (due to urbanisation and severe water constraints), the additional production has to come from less land, less water and less human labour.

Irrigated rice is grown on about 79 million hectares, contributing 75% of the world's rice production (Maclean *et al*., 2002). Historically, wetland rice cultivation in Asia has been focused on lands that are flooded or are prone to flooding during the wet/monsoon season. Though the main function of standing water is to control weeds, over a period of time this practice has become standard and it is widely believed that rice can't yield well without large quantities of water. However, it can in fact be cultivated with the same supply of water as other cereals (Parthasarathy, 1963).

Rice cultivation is a very water-intensive activity. To produce one kilo of rice requires 3,000-5,000 litres of water. About two or three times more water is needed for rice cultivation than other irrigated crops. It is estimated that irrigated rice receives 34-43% of the world's irrigation water (Bouman *et al.*, 2007). It is also estimated that by 2025, 15-20 million ha of irrigated rice will suffer some degree of water scarcity (Tuong and Bouman, 2003).

Rice in India

Rice plays a major role in India's diet, economy, employment, culture and history. Ninety per cent of the rice produced is consumed within the country. With 44 million hectares, India has the biggest area under rice worldwide; with a production of 96.43 million tonnes (2007-08) it comes second only behind China in total rice production. The area under rice accounts for 34% of India's food crop and 42% of its cereal crop areas.

Over the last 57 years, the area under rice has increased by 43% and rice productivity has increased by 230%, increasing rice production by 369% (Table 1). But India's current productivity is still much lower than many other rice producing countries; it needs to be increased despite the limited options for expanding the area or irrigation coverage.

TABLE 1. RICE AREA, PRODUCTIVITY AND PRODUCTION IN INDIA, 1950 AND 2006

	Area (million hectare)	Productivity* (kg/ha)	Production* (million tonnes)
1950-51	30.8	668	20.6
2006-07	43.8	2,131	93.3

* Milled rice

Source: Directorate of Economics and Statistics (2008). *Agricultural Statistics at a Glance* 2008. Department of Agriculture and Cooperation, Ministry of Agriculture, Govt.of India, New Delhi.

In fact, rice cultivation is in crisis the world over and India is no exception, with a shrinking area, fluctuating annual production, stagnating yields and escalating input costs. The cost of cultivation of paddy has consistently been increasing owing to the escalating costs of seeds, fertilisers and labour. With increasing labour scarcity due to urbanisation, sustaining the interest of farmers in rice cultivation has become a challenge.

There is clearly an urgent need to find ways to grow more rice, but with less water and fewer inputs. Until recently there had been no new solutions for improving productivity significantly. There have been efforts to develop technologies to reduce water use for rice cultivation, for example the alternate wetting and drying (AWD) method but none showed much promise in terms of increasing net income. However, an exciting approach has recently been developed—the system of rice intensification (SRI)—which not only reduces the use of irrigation water, but also increases yields significantly and enhances the livelihoods of rice farmers.

What is SRI?

SRI is not a technology, but rather a set of ideas and insights. It is a whole package of agronomic approaches which together exploit the genetic potential of rice plants; create a better growing environment (both above and below ground); enhance soil health; and reduce inputs (seeds, water, labour). SRI can increase farmers' rice yields, while using less water and lowering production costs (WWF, 2004). It uses all the usual agronomic practices for transplanted rice—raising a nursery, transplanting, irrigating, weed management and nutrient management—but there are some drastic differences in how these are carried out.

The SRI methodology was developed in the early 1980s by Fr. Henri de Laulanié[1]. He wanted to find ways to enhance the rice productivity of Madagascan farmers who were obtaining rice yields of less than 2 t/ha. He noticed that two innovative farmer practices — transplanting single seedlings and keeping the soil moist rather than continuously saturated — were more productive.[2] He added two practices, planting single seedlings in a square pattern and using a rotary-hoe perpendicularly in two directions. With the use of 15 day-old seedlings, along with the other practices that he had assembled, Fr. Laulanié recorded a remarkable difference in plant growth. He named this the system of rice intensification (Uphoff, 2005), but it took another two decades for SRI to become known to the rest of the rice world.

How does SRI differ from conventional rice farming?

Seedlings for SRI

In conventional rice farming, farmers generally transplant 4-5 week-old seedlings from the nurseries into the fields. However, SRI uses much younger seedlings (8-14 days old). This approach encourages profuse tillering because younger seedlings can quickly become established without suffering from transplanting shock.[3] Transplanting young seedlings also encourages them to produce more tillers since they will be in the main field for at least two weeks longer than in the conventional method of transplantation.

Unlike in conventional rice, in SRI only one seedling is planted per hill (the name for the area in which seedlings are transplanted) and the hills are spaced more widely than usual, which drastically reduces the density of seedlings required for planting (from about 200/sq.m to 16/sq.m). Thus only 5-7.5 kg of seed is required to plant 1 hectare, instead of about 50 kg/ha in conventional practice. And since the nursery area needed is reduced from 800 m^2 to 100 m^2 and the nursery is only needed for 14 days, costs are considerably reduced. A raised bed nursery method can be used (Photo 1), made with either dry or wet soil. Mat nurseries have also been proposed (Rajendran *et al*., 2004). Farmers use different ways to remove seedlings for planting according to their convenience.

1 Fr. Henri de Laulanié came to Madagascar from France in 1961 and spent the next (and last) 34 years of his life working with Malagasy farmers to improve their agricultural systems, and particularly their rice production, since rice is the staple food in Madagascar. Fr. de Laulanié established an agricultural school in Antsirabe in 1981 to help rural youths gain an education that was relevant to their vocations and family needs.

2 SRI may have been invented in Madagascar in the 1980s but historical evidence shows that practices similar to SRI had been developed by farmers in Tamil Nadu a century ago. Known as 'single seedling planting', they involved row planting at wider spacings. This method was promoted by the then Dept. of Department of the Madras Presidency (Thiyagarajan and Biksham Gujja, 2009). Such farmer innovations disappeared following modern agricultural introductions.

3 A rice tiller is a specialised grain-bearing branch that grows independently of the mother stem (culm) by means of its own adventitious root (Xueyong *et al*., 2003)

Photo 1. Raised bed nursery for SRI

Photo 2. Use of roller marker on raised bed

Planting

Planting is generally done in squares, often using a rope with markings at 25 cm intervals to guide the line of planting. Square planting is important to facilitate the use of a weeder of a particular width; if the spacing in one direction is greater it will take longer to cover the space in between or it will not be properly covered. A minimum width is required in both directions and thus a square is optimal.

A roller marker made of steel rods developed by a farmer in Andhra Pradesh has become a very useful tool in SRI (Photos 2 and 3). After planting single young seedlings at 25cm intervals, the plant density looks very low, but 4 weeks of robust tillering will produce a healthy crop (Photo 4).

Photo 3. Planting at intersections of grid lines made by the marker

Photo 4. Square planted field after four weeks

There were concerns that labour requirements for transplanting in SRI would be higher than for conventional planting, despite the fact that the number of seedlings planted is drastically reduced. However, a recent analysis of a World Bank-funded project in Tamil Nadu showed that farmers employed an average of 60 labourers for conventional planting and 35 for SRI planting (Water Technology Centre, 2009).

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Photo 5. SRI field with no flood water

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Photo 6. A rotary weeder in use

Water management

In conventional rice the recommendation is to irrigate to a depth of 5cm one day after the previously ponded water disappears from the surface. In SRI there is no need to keep the field flooded—it is enough to keep the soil saturated (Photo 5). Up to the panicle initiation stage, it is recommended to irrigate the field to 2.5cm once the irrigation water has soaked away and hairline cracks have developed. After panicle initiation, the field needs to be irrigated to 2.5cm one day after the previously ponded water soaks away so that the plants do not experience water stress (Thiyagarajan *et al.,* 2005). This involves alternate wetting and drying management.

This shallow irrigation can save nearly 50% in water use without any yield loss (Thiyagarajan *et al.,* 2002). An experiment conducted by the Directorate of Rice Research in Hyderabad showed a 22-29% water saving (Mahendrakumar *et al*., 2007). Ceesay *et al*, (2006) observed nearly three times higher grain yields under SRI (7.3 tonne/ha) compared with continuous flooding (2.5 tonne/ha). SRI water management has other benefits apart from higher yields and using less water. These include fuel savings from having to pump less ground water and fewer water conflicts among farmers relying on the same source of water.

Intercultivating with a weeder

A key aspect of the SRI approach is to use a hand operated weeder to disturb and churn the soil between the rows. This simultaneously incorporates weeds and aerates the soil (Photos 6 and 7). Farmers may be concerned that the limited irrigation in SRI might lead to weed infestations. But since weeder operations start after 10-12 days and are done every 10 days, weed growth is controlled. Experiments conducted by Rajendran *et al.* (2005) showed that intercultivation by a weeder increased grain yield by 24% compared to hand weeding. The cost of weed management in conventional cultivation (hand weeding twice at 15 and 30 days after transplanting) is about Rupees 3,200/ha, while the cost of intercultivation with a rotary weeder (four times: at 10, 20, 30 and 40 days after transplanting) is about Rupees 1,520/ha (Thiyagarajan *et al.*, 2005). This implies a 52% reduction in the cost of weed control.

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Photo 7. The churning of the soil by the weeder boosts plant growth

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Photo 8. Dense root network of SRI rice plant

Besides its lower cost, a weeder has several other advantages:

- Weed biomass is incorporated into the soil, adding organic carbon
- The nutrients taken up by the weeds return to the soil
- The churning up of the soil activates microbial, physical and chemical processes which are beneficial to crop growth
- If fertiliser top dressing precedes weeder operation, fertilisers are incorporated and nutrient loss by leaching is reduced
- Some earthing up takes place when the weeder is used. This makes the plants produce new roots which increases root activity.

Some interesting aspects of SRI are the partial mechanisation it involves, even in marginal farmers' fields, and the tendency of some farmers to modify the weeder to suit their conditions.

Using the weeder in both directions yields the maximum benefit, but labour availability and soil conditions can make this difficult for some farmers to achieve. Attempts are being made to develop a hand held motorised weeder but so far no-one has been able to develop an effective and efficient one. However, it would be a big advantage for SRI farmers who do not have enough labour for hand-operated weeders.

Nutrient management

So far, no specific nutrient management strategy has been developed or recommended for SRI. However, the use of organic manures is emphasised as they are found to give a better response. Since organic manures are difficult to find (few farms now have cattle or grow green manure), integrated nutrient management (INM), using both inorganic and organic manures, is currently recommended. In Tamil Nadu, growing Gliricidia (*Gliricidia maculata*) in field bunds and along fences is another recommended practice for SRI, as this is a ready source of organic material every rice season.

Experiments conducted at Coimbatore have shown that under the same nutrient application level, the leaves of SRI crops have a higher nutrient use efficiency (Sudhalakshmi, 2002) and a higher nitrogen content (Mahendrakumar *et al*., 2008) than conventionally-grown rice. This is further evidence that the SRI crop is able to take up more nutrients because of the greater root activity (Photo 8).

Response of rice to SRI practices

Field experiments conducted in many parts of India have shown the significant effect of SRI on root growth, tillering, yield, grain qualities, physiology, nutrient uptake, pest and disease interactions, water use efficiency, soil nutrient and microbial dynamics. Economics and the adoption pattern by farmers have also been studied. Higher grain and straw yields, coupled with lowered cultivation costs, leave farmers with higher net income (Stoop *et al*., 2002; Uphoff, 2002; Thiyagarajan *et al*., 2005; Rajendran *et al*., 2005). This experience with SRI has been repeated across many rice growing regions.

A systematic nationwide evaluation is being carried out by the Directorate of Rice Research of the Indian Council of Agricultural Research. Many civil society organisations are also studying the socio-economic aspects of SRI adoption.

Photo 9. A proud SRI farmer next to a hill planted with a single seedling which has more than 100 panicles

Photo 10. Large panicles with more than 300 grains per panicle

Grain yields reported from field experiments carried out in different parts of India showed yield increases from SRI ranging from 9.3% to 68% when compared with conventional practice (ICRISAT-WWF, 2008).

A number of on-farm evaluations in farmers' fields have been conducted by research institutions, extension departments and civil society organisations in Tamil Nadu, Andhra Pradesh, Tripura, Orissa, Jharkhand, Himachal Pradesh, Uttrakhand, and Punjab. One such evaluation was done with 100 farmers in Tamiraparani basin, Tamil Nadu. The average yield increase due to SRI was 1,570 kg/ha (Table 2). The biggest yield advantage achieved by a farmer was 4,036 kg/ha. The farmers also reported lodging resistance and an absence of rat damage in SRI crops (Water Technology Centre, 2009).

TABLE 2. SRI AND CONVENTIONAL RICE YIELDS COMPARED, 2004		
Parameters	**Conventional**	**SRI**
Trial area (m^2)	25	25
Grain yield—minimum (kg/ha)	3,887	4,214
Grain yield—maximum (kg/ha)	8,730	10,655
Mean grain yield (kg/ha)	5,657	7,227
Standard deviation	1,108	1,379

Source: Thiyagarajan *et al.*, 2005.

Sinha and Talati (2007) evaluated the impact of SRI practices on rice yields, the economics of paddy cultivation and labour inputs based on field research conducted in Purulia, West Bengal, India. Paddy yields with SRI were 32% higher than those under conventional paddy cultivation and net returns were 67% higher. Labour input in SRI was reduced by 8%. An economic appraisal of SRI in Tamil Nadu by Palanisami *et al*. (2008) showed that farmers using SRI methods are comparatively more efficient than those employing conventional methods under researcher-managed fields. The average levels of technical, allocative and economic efficiencies are 92, 76 and 70% respectively for SRI farms compared to 73, 35 and 25% for conventional rice farms. Higher allocative efficiency under SRI reflects the ability to choose optimal input levels.

Scaling up SRI across the country

The Green Revolution enabled India to become self sufficient in food grains and lifted millions of people out of poverty. However, from the early 1990s, India's agricultural growth has stagnated at less than 2%, well below the growth rates of other sectors. In 2006, while India's agriculture sector contributed only 16% to national GDP, about 70% of India's poor, who mostly live in rural areas, depended on agriculture for their livelihoods (World Bank, 2008).

The average estimated growth in food grain production in the country between 2004 and 2008 was 1.98%, which is higher than the average population growth rate of 1.5% over the same period. The total demand of food grains for 2008-09 has been estimated at 219 million tonnes, while production is expected to be nearly 234 million tonnes (Press Information Bureau, 2009). However, a drought this year due to the failure of the south west monsoon once again reminds us of the need to address water scarcity and rice production. In view of the huge domestic demand, rice production trends in India can have a global impact. For example, lower than expected production could destabilise the global rice market if domestic needs are protected or if rice is imported. This will affect the food security of poorer nations.

India is a water stressed country; 45% of all available water is used for agriculture with ground water accounting for about 70% of water used. A World Bank study estimates that by 2020, India's demand for water will exceed all sources of supply (World Bank, 2008). It is imperative that India strengthens its irrigation structure and improves its agricultural practices. The recent 2008 *World Development Report* (UNDP, 2008) shows that India's agriculture sector faces major constraints due to low investment and dilapidated irrigation infrastructure. India's recent high economic growth, which is likely to increase the industrial demand for water, means that even less water will be available for agriculture.

India needs to make significant and sustained investments in agricultural research, agriculture and general infrastructure in rural areas to face the challenge of decreased water availability for agriculture and to revive and sustain its agricultural productivity (World Bank, 2008).

India's population is projected to reach around 1.59 billion by 2050. This is about 470 million people more than today. At this rate, India will be the world's most populous country by 2035. Yet, today there are about 200 million underfed people and 50 million on the brink of starvation. There are more hungry people than in 1997, when India was importing food at great expense.

Therefore, the food situation is far from secure. There is some debate over the various rice demand projections for 2030 or 2050. However, one thing is clear: India needs to produce a lot more paddy than it is producing today to meet the growing demand, which is likely to be 130 million tonnes of milled rice in 2030. This target is achievable, being lower than the current average productivity in China and other countries. Therefore there is potential for India to increase its foodgrain production by concentrating on enhancing rice yields. SRI can improve productivity significantly. Besides increased paddy production, the enormous savings in water and seed resources are very appealing. Table 3 summarises these factors, assuming that SRI is practised on 20 million hectares of rice (out of India's current 43 million ha under rice).

TABLE 3. IMPACT OF SRI IN INDIA IF ADOPTED ON 20 MILLION HECTARES

	Level		Total estimate		Advantage due to SRI
	Current	SRI	Current	SRI	
Seed use	30 kg/ha	7.5 kg/ha	600m tonnes	150m tonnes	450m tonnes saved
Irrigation water	149 m^3	92 m^3	2,980m m^3	1,840m m^3	1,140m m^3 saved
Paddy production	3.17 t/ha	4.17 t/ha	139m tonnes	183m tonnes	44m tonnes extra production

Efforts to promote SRI

The efforts to promote SRI in India vary greatly from region to region. Tamil Nadu and Tripura are taking a systematic approach with technical, administrative and financial support from both state and central government funds. In these programmes, enlisted farmers are given training, inputs, SRI tools (weeders and markers), technical assistance and constant monitoring. In Tripura State the Panchayat Raj Institute is collaborating in demonstrations across the state. Large-scale demonstrations, farmer exposure visits and capacity building are taking place. But this level of activity does not occur in other states.

Many civil society organisations (CSOs) have shown great interest in promoting SRI in several states and have had significant impact among poor and tribal farmers. Private institutions are also getting involved. For example, the Sir Dorabji Tata Trust (SDTT) is supporting 107 CSOs in eight states for promoting SRI, with a focus on small and marginal farmers (Shambu Prasad, 2008). A Learning Alliance of CSOs has also been formed in Orissa State to work together and share knowledge and experience.

A national symposium on SRI has been organised every year since 2006 by the ICARISAT-WWF project. This provides a forum to exchange ideas and experiences on research, adoption, extension and policy issues. There are several virtual SRI groups, communities, farmers' associations and networks functioning in India. The electronic exchanges taking place on SRI are unique. The ICRISAT-WWF project also publishes a quarterly *SRI Newsletter* to disseminate new developments and experiences in SRI.

However, despite the promise of SRI, its uptake is not yet great enough to have an impact on food security. Other than Tamil Nadu and Tripura, no other state government has been able to realise the potential of SRI. There is also no strong commitment from central government.

Farmer difficulties in adopting SRI

Throughout history humankind has been resistant to change and to the acceptance of new ideas. SRI is no exception. The many new techniques proposed by SRI are often greeted with scepticism by the farmer who has been cultivating rice for decades. Thus, farmers must first be convinced through demonstrations and training. The farmer should then try SRI in a small part of his rice crop, then build up from there. In major rice producing areas, labour shortages are becoming a serious problem. The partial mechanisation introduced in SRI should be increased further to reduce labour requirements. In areas where agricultural labourers are still dependent on rice cultivation, efforts to train them in SRI are essential.

Some of the common problems faced by farmers in adopting SRI are:

- SRI demands more personal attention and constant involvement by farmers.
- Apprehensions about the new way of raising seedlings, handling young seedlings and square planting.
- Difficulties in leveling the main field properly.[4]
- Resistance of contract labourers to planting.
- Labour scarcity for transplanting.
- Drudgery of using a weeder.
- Unsuitability of weeder for some soils.
- Unavailability of weeders.
- Potential pest attack due to lush growth of the crop.

4 While leveling is also a recommendation for conventional rice cultivation, in SRI it is important because young seedlings may have establishment problems if there are depressions in the field where water stagnates.

SRI controversies

Some scientists have criticised SRI, describing the SRI results as "unconfirmed field observations" (UFOs) (Sinclair and Cassman, 2004; Sinclair, 2004). Some also state that scientifically accepted standards were not followed in the experimental work (Dobermann, 2004). These criticisms are based on past research carried out on agronomic practices that have no comparison with those of SRI. For example, the physiology of rice when it is grown under combined conditions of low plant density and shallow irrigation with alternate wetting-and-drying, plus soil-aerating intercultivation with mechanical hand weeders has not been studied. Dobermann (2004) has stated that SRI's workable recommendations are already widely used by farmers, and do not need to be promoted. However, this is not all true because no other system advises farmers to transplant single seedlings at the 3-leaf stage at a density of 16 seedlings per sq m, and to intercultivate them with a weeder.

Similarly, SRI can not be compared with other water-saving technologies like alternate wetting and drying (AWD) unless all the other practices that make up SRI are also evaluated. Researchers have shown the positive effects on crop growth and yield from interactions among practices that cause simultaneous growth increases in both root systems and canopy (Randriamiharisoa and Uphoff, 2002). Changing water management practices alters many other parameters to do with crop growth and health because there are profound differences between unflooded and flooded soil conditions.

Sinclair (2004) commented that SRI emphasises organic nutrients to the exclusion of mineral fertiliser and thus faces serious challenges in obtaining enough mineral nutrients from organic sources to achieve high yields. This is also incorrect. Proponents of SRI do not claim it is possible only with organic manures. On the other hand, SRI does emphasise the importance of the soil organic matter content and of soil health. This is because the response of rice under SRI is more pronounced when organic manure is added along with mineral fertilisers. In fact, most farmers apply chemical fertilisers along with available organic manure.[5]

In any case, the academic debate is meaningless to those farmers who are able to appreciate the benefits of switching to SRI. It is actual experience that sustains any new technology or practice and farmers are better judges than anybody else. That more and more farmers (about one million since 2003) are coming forward to adopt SRI is proof alone of its beneficial effects.

Conclusions

Until 2000, SRI was primarily known in Madagascar and a few other countries. Today rice farmers in nearly 40 countries are reported to be practising it. In India, more than one million farmers are practising SRI across almost all the rice cultivating districts. While the area under SRI is still relatively small (under 800,000 ha), it is expanding rapidly as farmers learn from each other. It offers rice farmers yield increases and other benefits whilst

5 The experiments reported by Sheehy *et al.* (2004) did not involve intercultivation with a weeder and hence this important SRI practice is not included (Vijayakumar *et al.*, 2004; and Rajendran *et al.*, 2005). Thus, the results from these experiments do not reflect the effects of SRI.

using less water, provided this is done in conjunction with other changes in how they manage the plants, soil and nutrients (Randriamiharisoa and Uphoff, 2002).

The yield potential of rice has remained practically unchanged since the development of the first semi-dwarf variety in the early 1960s (IRRI, 1995). Instead of continuing the same tired approach—slogans on raising the yield potential, closing the yield gaps, increasing yield stability, improving germplasm and improving crop management with extensive funding—simply encouraging rice farmers to adopt SRI will address many challenges in rice production simultaneously.

In the history of rice research, SRI is the only technique available which can:

- Increase yields
- Reduce seed and nursery costs (68% reduction)
- Reduce labour requirements for planting
- Reduce weed management costs
- Reduce irrigation water and power requirements (in bore well irrigated systems)
- Eliminate rat damage
- Eliminate lodging

2009-10 is expected to be a difficult season for farmers in India owing to the failure of the south west monsoon which covers a major part of the country. SRI can play a major role in such a water scarce situation. The current crisis should serve as a timely wakeup call for governments, multilateral organisations and donors to refocus on agriculture. However, there is no need to invest in a second Green Revolution to feed the country in the face of a growing population and shrinking land base for agriculture. Promoting SRI through a sustained campaign must be the most desirable option available now.

We make the following policy suggestions:

- The Union Government should set a policy to adopt SRI nationwide. The goal should be to cover at least 25% of the irrigated rice area in the next five years. This needs to be supported by the allocation of exclusive funds.
- Establish a systematic strategy for effective implementation, large scale capacity building and research backup. This should involve close collaboration among the state agricultural departments, agricultural universities, public works departments, and civil society organisations.
- Give financial support to research on improving management practices, tools and economic evaluation at farm level.
- Promote direct seeding with a drum seeder and machine planting (with suitable modifications) where labour scarcity limits SRI adoption.
- Provide farmers with subsidies for adopting SRI and incentives for saving water.

The principles of SRI are already being applied to other crops like wheat, sugarcane, finger millet, etc. When the concepts are fully adopted, the impact of 'more crop with less water' will have a lasting effect on our resource base. The impact of SRI is already visible in farms but there is a long way to go. A firm national strategy is now urgently needed.

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