# System of Rice Intensification

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***Combining several innovative practices, SRI is a different way of cultivating rice, including changes in nursery management, in the time of transplantation, and in water and weed management, which could well easily counter the side-effects of the Green Revolution***

The System of Rice Intensification (SRI) emerged in the 1980s as a synthesis of locally advantageous rice production practices in Madagascar. Fr Henri de Laulanie, a Jesuit priest who had been working in Madagascar since 1969, integrated the techniques that he saw being used and helped create awareness about the new technique all over the world. Today, SRI has been adopted in many states in India and the response from the farmers has been overwhelming because they have reaped the benefits of the method.

SRI is a combination of several innovative practices, which includes changes in nursery management, the time of transplantation, and water and weed management. It is a different way of cultivating rice though fundamentally the practices remain more or less the same as in the conventional method. There is, in this practice, an emphasis on altering certain agronomic practices of the conventional method of rice cultivation. It is not a fixed package of technical specifications but a system of production with four main components, that is, soil fertility management, planting method, weed control and water (irrigation) management. Several field practices have been developed around these components.

The key elements of SRI practices are as follows.

I. Transplanting young seedlings, before the start of the fourth phyllochron of growth
II. Reducing plant population by as much as 80–90 per cent per square metre
III. Converting paddy soils from the anaerobic, flooded status to mostly aerobic conditions, by alternate wetting and drying
IV. Improving active soil aerations with mechanical weeders
V. Increasing soil organic composition

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There are numerous benefits of this technique that have an impact on households (HH), countries and the planet at large. These benefits are enumerated here.

**NEED FOR SRI**

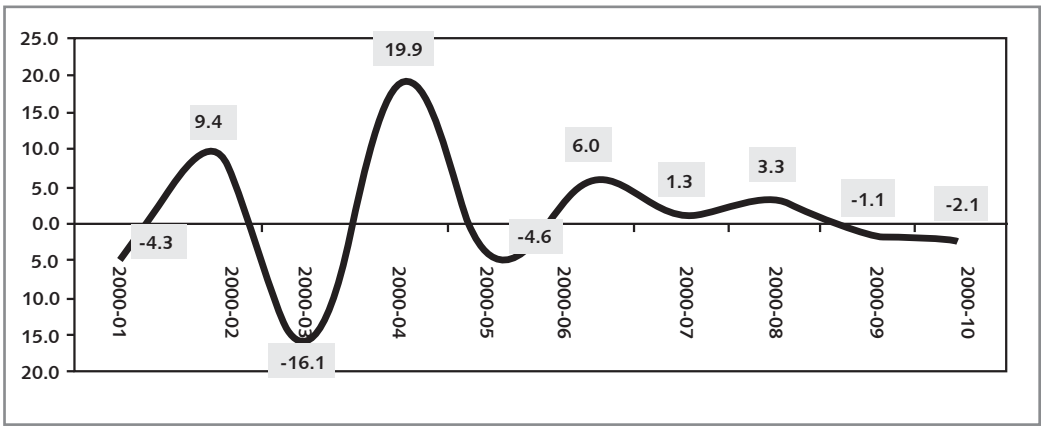
There has been stagnation in the productivity of grain especially in the Green Revolution areas that have been contributing disproportionally to the national food supply and the food security of the country. Among the factors that have led to a decline in productivity are inappropriate plant, soil, water and nutrient management practices. The management and efficiency of the surface irrigation systems is in serious disarray, and the costs of irrigation continue to mount because of the continued neglect of

Fig. 1: Benefits of SRI

| Benefits for Rural HH | Benefits for Countries | Benefits for the Planet |
|---|---|---|
| More rice grown to eat and sell from the same amount of land, in a cost-effective manner (HH food security) | Improved food security | Less pressure to convert remaining forests and natural landscapes to agriculture |
| Higher incomes/Lower costs including less water (income security) | Water freed up from the rice sector for other crops, people, natural systems | Enhanced ecosystem services involved in regulating water, soil, climate |
| Reduced dependency on purchased inputs (seeds, fertilizers, pesticides) | Budget savings on new water projects, food imports, energy and fertilizer subsidies | Reductions in Green House gases, especially methane |
| Enhanced natural resource base | Improved soil and water quality from reduced loads of nitrogen fertilizer and pesticides | Less loss of plant and animal biodiversity from soil and water pollution |
| Reduced risk and vulnerability | More resilient, productive rural communities | Reduced flashpoints for conflict over food, water, land |
| Improved farm/ family health | Improved public health | Improved planetary health |

(Source: http://www.sri-india.net/documents/More_Water_For_The_Planet.pdf)

Fig. 2: Trends in Growth Rate(%) of Rice Yield (GOI, 2010)




maintenance and the ineffective operation of irrigation systems.

Groundwater resources are being over-exploited, partly encouraged by policies that provide farmers with an unlimited amount of free water. The quality of the soil is declining in many areas due to inappropriate tillage practices, the overuse of agro-chemicals, the lack of ground cover and other poor management techniques that have contributed to erosion, loss of soil structure and function, salinization, nutrient depletion, loss of soil biodiversity and, ultimately, desertification. Nearly 90 million tonnes of soil are lost annually.

The policies for subsidizing chemical fertilizers are proving to be very expensive fiscally, without demonstrable/commensurate contribution to agricultural productivity, leading to negative impact on soil systems. The excessive focus on varietal changes for productivity enhancement while ignoring the new synergetic possibilities of interactions that are emerging globally is contributing to the developmental dilemma. Existing extension systems are overstretched and have not delivered adequately to small and marginal farmers in rain-fed areas. Scarcity of labour is threatening the continuance of rice farming as well.

## EMERGENCE AND IMPACT OF THE GREEN REVOLUTION

The Green Revolution led to sizeable increases in returns from the land and, hence, to the raised income of farmers. Moreover, greater disposable incomes led to the introduction of new farm inputs, and milling and marketing services. Farming families led a general increase in demands for goods and services, thus stimulating the rural non-farm economy, which in turn grew and generated significant new income and employment of its own. In India, the percentage of the rural population living below the poverty line fluctuated between 50 and 65 per cent before the mid-1960s but then declined steadily to about one-third of the rural population by 2003. Research shows that much of this steady decline in poverty is attributable to agricultural growth and associated declines in food prices. The Green Revolution also contributed to better nutrition by raising incomes and reducing prices, which permitted people to consume more calories and a more diversified diet.

The Green Revolution in India, as well as in Asia, stimulated a debate about how agricultural and technological changes have affected the poorer farmers. It has been argued that the owners of the large farms were the main adopters of the new technologies because of their better access to irrigation, fertilizers, seeds and credit. Small farmers were either unaffected and sometimes even harmed because the Green Revolution resulted in lower product prices, higher input prices, and efforts by landlords to increase rents or force tenants off the land. It is also argued that the Green Revolution encouraged unnecessary mechanization, thereby pushing down rural wages and employment. The Green Revolution also led to large-scale environmental damage. Excessive and inappropriate use of fertilizers and pesticides has polluted waterways, poisoned agricultural workers, and killed beneficial insects and other wildlife. Irrigation practices have led to a salt build-up and have eventually led to the abandonment of some of the best farming lands. Groundwater levels are retreating in areas where more water is being pumped for irrigation than can be replenished by the rains; and the heavy dependence on a few major cereal varieties has led to a loss of biodiversity on the farms. Some of these outcomes were inevitable as millions of largely illiterate farmers began to use modern inputs for the first time. In addition, inadequate extension and training, an absence of effective regulation of water quality and input pricing, and subsidy policies that made modern inputs too cheap and encouraged their excessive use, also created a negative environmental impact.

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It has often been argued that the Green Revolution provided the only way in which India could have increased food availability within the country. Until the 1960s, India was successfully pursuing an agricultural development policy, based on strengthening the ecological base of agriculture and the self-reliance of peasants. Land reform was viewed as a policy necessity and most states initiated measures to secure tenure for tenant cultivators, to fix reasonable rents and to abolish the *zamindari* system. Ceilings on land holdings were also introduced.

## LOSS OF DIVERSITY

Diversity is a central principle of traditional agriculture in the regions of Punjab, as in the rest of India. Such diversity contributes to ecological stability, and hence to ecosystem productivity. The lower the diversity in an ecosystem, the higher is its vulnerability to pests and disease. The Green Revolution package reduced genetic diversity at two levels. First, it replaced mixtures and rotations of crops such as wheat, maize, millets, pulses and oil seeds with monocultures of wheat and rice. Second, the introduced wheat and rice varieties came from a very narrow genetic base.

## INCREASE IN USE OF PESTICIDES

Because of their narrow genetic base, High Yielding Varieties (HYVs) are inherently vulnerable to major pests and diseases. In Punjab, the rice variety PR 106, which currently accounts for 80 per cent of the area

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under rice cultivation, was considered resistant to white-backed plant hopper and stem rot when it was introduced in 1976. It has since become susceptible to both diseases, in addition to succumbing to rice leaf-folder, hispa, stemborer and several other insect pests. The natural vulnerability of HYVs to pests has been exacerbated by other aspects of the Green Revolution package. Large-scale monoculture provides a large and often permanent niche for pests, turning minor diseases into epidemics. In addition, fertilizers have been found to lower the resistance of plants to pests. The result has been a massive increase in the use of pesticides, in itself creating still further pest problems due to the emergence of pesticide-resistant pests and a reduction in the natural checks on pest populations.

The 'miracle' seeds of the Green Revolution have thus become mechanisms for breeding new pests and creating new diseases. Yet, the cost of pesticides or of breeding new 'resistant' varieties was never counted as part of the 'miracle' of the new seeds.

## SOIL EROSION

Over the centuries, the fertility of the Indo-Gangetic plains was preserved by treating the soil as a living system, with soil-depleting crops being rotated with soil-building legumes. However, during the Green Revolution, marginal land or forests have been cleared to make way for the expansion of agriculture; rotations have been abandoned; and the cropland is now being used to grow soil-depleting crops year after year. Since the start of the Green Revolution, the area under wheat, for example, has nearly doubled and the area under rice has increased five-fold. During the same period, the area under legumes has been reduced by half. Today, 84 per cent of Punjab is under cultivation, as against 42 per cent of India as a whole. Only four per cent of Punjab is now forested and most of these have plantations of Eucalyptus.

## WATER SHORTAGES

Traditionally, irrigation was used in the state of Punjab only as an insurance against crop failure in times of severe drought. The new seeds, however, needed intensive irrigation as an essential input for crop yields. Although HYVs of wheat may yield over 40 per cent more than traditional varieties, they need about three times as much water. In terms of water use, therefore, they are less than half as productive. One result of the Green Revolution has, therefore, been to create conflicts over diminishing water resources. Wherever crops are dependent on ground water for irrigation, the water table is declining at an estimated rate of one-third to half a metre per year.

Increased use of fertilizers, however, has not compensated for the over-use of the soil. HYVs rapidly deplete micronutrients from soils and chemical fertilizers (unlike organic manure, which contains a wide range of trace elements) cannot compensate for the loss. Micronutrient deficiencies of zinc, iron, copper, manganese, magnesium, molybdenum and boron are thus common. Because of soil

deficiencies, the productivity of wheat and rice has declined in many districts of Punjab, in spite of increasing levels of fertilizer application.

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The Green Revolution depended upon an input-based extension system, in which imported techniques were taken to large farmers, who had assured irrigation facilities. These farmers were provided inputs such as seeds, fertilizers and agricultural equipment through the government machinery. But the same model may not be applicable to small and marginal farmers, who are dependent upon rainfall to meet their irrigation requirements. Small and marginal farmers do not even have the capital to meet the risk of the vagaries in rainfall and, thus, are more prone to risks of erratic rainfall. Such farmers require a process-oriented extension system, in which they are provided with low-cost, subsidized technical support along with long-term, hand-holding support. This extension system needs to have built-in, hand-holding support and facilitation to bring about an institutional change in the behavioural pattern of the farmers. Given the fact that these farmers would have a strong cross-learning approach with their peers, it is imperative to develop a strong cadre of community resource persons (CRPs) with sound technical knowledge and a willingness to support the farmers in the field. There is also a need to create a pool of extension workers to provide on-farm support to the farmers, and train and motivate these farmers to take up low-cost technological inputs, which will help them fight against the vagaries of nature.

## OUTREACH OF SRI IN THE WORLD

The SRI methodology was synthesized in the early 1980s by Fr Henri in Madagascar. He devoted 34 years of his life, working with Malagasy farmers, to improve their agricultural systems and, particularly, their rice production because rice is the staple food in Madagascar. SRI gained momentum in 1999, and since then has spread all across the globe. Today, this practice is being followed in more than 40 countries across the globe, including major rice producing countries such as China, India, Indonesia and, Brazil. The area under SRI in some of the countries has been listed in the figure 3.

Fig. 3: Area under SRI

| No. | Name of the country | Year of Data | Area in Hectares |
|---|---|---|---|
| 1 | China | 2009 | 2,51,000 |
| 2 | Korea | 2009 | 250 |
| 3 | Cambodia | 2011 | 24,293 |
| 4 | Indonesia | 2011 | 1,00,000 |
| 5 | Laos | 2010 | 2,625 |
| 6 | Myanmar | 2007 | 4,000 |
| 7 | Timor Leste | 2010 | 3,400 |
| 8 | Vietnam | 2009 | 2,32,365 |

(Source: http://sri.ciifad.cornell.edu/index.html dated 31/10/11)

This demonstrates the fact that, in the last two decades, most of the rice producing countries of the world have adopted SRI as a method of rice cultivation.

### OUTREACH OF SRI IN INDIA

Within a span of 10 years, SRI has reached over 2,50,000 farmers in over 250 districts across India. SRI has become a part of the state policy in Bihar (which declared 2011 as the year of SRI), Tripura, etc. This has been possible largely due to civil society innovations. Financial Institutions such as the National Bank for Agriculture and Rural Development (NABARD) and funding agencies such as the Sir Dorabji Tata Trust (SDTT) have played a very important role in spreading SRI across the country.

### STATE GOVERNMENTS

States such as Tamil Nadu, Tripura, Andhra Pradesh, Bihar, Chhattisgarh, Uttar Pradesh, Odisha and Jharkhand are actively engaged in the promotion of SRI. Agencies such as the Bihar Rural Livelihood Promotion Society (BRLPS) and the Society for Elimination of Rural Poverty (SERP) have been instrumental in spreading SRI within Bihar and Andhra Pradesh.

### NABARD

NABARD is also extensively engaged country-wide in spreading SRI through its NGO partners. These are working primarily in Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Maharashtra and Karnataka. In Jharkhand, NABARD's target was to cover 30,000 farmers, covering 7,500 acres in 22 districts in 2010.

### SRI in Berhampur, Orisha

The method of rice cultivation under SRI is proving to be the means to deal with the problem of erratic monsoon in Berhampur. Whereas paddy farmers in the state face extreme crop loss due to low rainfall and pest menace, the small and marginal farmers in Ganjam district, who experimented with the SRI method, are confident of a good harvest. D. Anuradha, a woman farmer of Panibandha village, said she was expecting a better harvest using SRI than with the conventional method of paddy cultivation although no chemical fertilizer or pesticide was used.

Showing the standing crop in her field, Pranhasini Mohrana said she had not expected to get a good yield despite the low rainfall. "A great myth in our minds that paddy cultivation needs standing water was broken through the SRI method of cultivation," she said. T. Bhagirathi was confident that he would harvest more than 40 quintals of paddy from one acre of land, on which he used the SRI method. According to him, the progress of the plants shows that there would be a higher yield of grain as well as straw. These farmers know that success in their fields will surely change the mindset of other farmers and the latter will also come to believe in the magic of the SRI method. The method uses one-tenth of the seeds used in the conventional cultivation because it has fewer plants per unit area. It requires less expenditure on fertilizers and pesticides and shatters the myth that paddy needs deep standing water. Under the SRI method, paddy fields are never flooded.

The Hindu, 21 November 2009

## DTT AND OTHER DONORS

SDTT has initiated the promotion of SRI and livelihoods in the low Human Development Index (HDI) states, particularly in eastern India. Within a short period of less than three years, SDTT reached out to 81,138 SRI farmers in 2010–11. Over 8,000 ha of land was covered in Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Odisha, Uttar Pradesh and Uttarakhand. Other donors and promoters (including WASSAN, PRADAN, AME foundation, AKRSP, CWS and other state NGOs) are also being supportive in Karnataka, Andhra Pradesh, Tamil Nadu, Himachal and Uttar Pradesh.

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## VARIOUS ACTORS ENGAGED IN THE PROMOTION OF SRI ACROSS INDIA

The promotion of SRI in India is not limited to government departments only. Many are engaged in the promotion of SRI across India, ranging from civil societies to various organizations. The Tamil Nadu Agriculture University is working extensively in Tamil Nadu; SERP and Acharya NG Ranga Agriculture University are promoting SRI in Andhra Pradesh; SDTT and its partners are engaged in the promotion of SRI in Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Odisha, Uttar Pradesh, Uttarakhand and West Bengal; the Department of Rural Development is working in Tripura; BRLPS is working in Bihar; WASSAN and PSI are promoting SRI in Tamil Nadu and Himachal Pradesh, respectively.

## STEPS FOR SCALING UP SRI

Scaling up SRI is a process-oriented system, in which the major focus is on building the capacity of farmers, to adopt the SRI method of paddy cultivation. The strategy is to primarily target small and marginal farmers, who are at the highest risk of facing food insecurity. The major focus of the intervention is to change the mindset of the people rather than to provide them with inputs in the form of cash or kind.

In order to address the needs of the small and marginal farmers in the rain-fed areas, there is strong need to create a pool of resource persons, who will work directly with farmers and provide them hand-holding support for a period of at least three to five years so that the farmers are able to adapt to SRI as a method of rice cultivation. Given this situation, it is not an easy job to do. It is thus required that these extension workers are trained well to mould and convince the farmers and to help change their mindsets.

Village-level resource persons have to be trained in the technical aspects of SRI along with motivational training. The focus of these training programmes will be on building and equipping village youth with the required knowledge, attitude and skills, to become involved in a transformational role. These resource persons, in turn, will help farmers to implement the full package of practices for a season.

## CONCLUSION

The economic viability of SRI has been experimented with and tested by many community based organizations (CBOs), government agencies and academic institutions across the globe. The success of this method of cultivation in rice has led to

the adoption of this method in other crops as well such as with sugarcane, wheat, rye and vegetables. Small and marginal farmers are adopting this technology on a large scale in order to have maximum productivity from the small landholdings they possess. Its economic and social viability still remains to be tested among large farmers but given the results which this method has achieved among the small and marginal farmers, the outlook seems positive. And once the economic and social implication is established among the large farmers, SRI will definitely achieve new heights in terms of its coverage and output.

There is also strong need to develop a mechanism to reach out to the poor and small farmers in rain-fed areas, in which there is a large scope for the spread of SRI. There is need to have an institutional mechanism, which will provide hand-holding support to the farmers for at least three years so that they are able to understand the method and adopt it in their fields. The institutional framework also needs to address the capacity building need of the farmers so as to bring about a change in their mindset, and to mitigate the risk of the vagaries of nature. Although there has been tremendous achievement in the last decade, there still remains a long way to go, which will be possible only with strong governmental support and the presence of CBOs within this institutional framework.