SATNET ASIA
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System of Rice Intensification (SRI)

Technology fact sheet

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Key facts

- Rice cropping systems that allow small-scale farmers to save water and seed.
- Poverty alleviating potential: both poor and non-poor farmers benefit by adopting SRI.
- Objective of SRI is to achieve more output per unit of land, labour, capital and water invested.

What is System of Rice Intensification (SRI)?

- During the past 50 years, irrigated agricultural area has more than doubled. The modernization of agriculture has had some negative environmental impact and the benefits have been inequitably distributed among countries and people.
- The competition for water, particularly between urban and rural areas has resulted in a situation where about 40 per cent of the world's rural population already faces water scarcity.
- The System of Rice Intensification (SRI) is a system of cultivation methods that combine a modified transplanting pattern and transplanting handling with modified water management and soil aeration (see technical details below).
- The main objective of SRI is to achieve more output per unit of land, labour, capital and water invested rather than to maximize rice yields (Uphoff *et al*., 2002).
- With SRI, water use can be reduced without compromising the yield by reducing water loss, in particular seepage and percolation from the rice field.
- SRI often produces higher yields compared to traditional cultivation methods in many countries.
- The SRI methodology aims to provide optimal growth conditions for individual rice plants, thereby maximizing tillering (Nemoto *et al*., 1995, cited in Bouman, 2004).
- Additional benefits: reduced use of water, seed and mineral fertilizer, resistance to insect pests, diseases, heat, drought and flooding, a shorter cropping cycle, higher milling out-turn, reduction in labour requirement after several years of use and lower production costs, thereby increasing farmers' incomes (Kassam and Uphoff, 2012).
- It is different from many other agricultural technologies in the sense that it is an innovation developed and promoted by civil society and relies on how rice plants, soil, plant nutrients and water are managed rather than relying on costly inputs[1].

History

- The System of Rice Intensification (SRI), originally called 'Système de Riziculture Intensive' was developed in Madagascar by de Laulanié in the 1980s.
- In the 1990s, a Malagasy non-governmental organization (NGO) promoted and developed the method before its cooperation with the Cornell International Institute for Food, Agriculture and Development (CIIFAD).
- Initially, de Laulanié developed SRI for irrigated rice cultivation but now its principles are adapted to rain-fed rice farming as well as to other crops in at least 28 countries globally.

Where it works

- SRI can be implemented in all rice agroecosystems. It has been adopted in more than 50 countries across South and South-East Asia, various countries in sub-Saharan Africa, the Middle East, Latin America and the Caribbean.
- Most farmers in developing tropical countries are small-scale producers who cultivate landholdings of less than three hectares.
- The technology is spread mostly by NGOs, Farmer Field Schools (FFS) as well as farmer-to-farmer communication (Uphoff and Fernandes, 2002).
- Farmers in many countries practice SRI, such as in Cambodia, China, Cuba, Indonesia, Lao People's Democratic Republic (PDR), Sri Lanka and, of course, Madagascar (Uphoff and Fernandes, 2002).

Technological aspects

- SRI is a rice cropping system usually based on six principles and associated practices. The practices should be understood as a menu rather than a recommended package.

[1] For a summarized comparison of the pros and cons of SRI, see Dill *et al*., 2013, page 8.

- Recommendations are flexible and can be adapted and innovated by farmers to suit soil conditions and the local availability of water, fertilizer and manure as well as labour, i.e. compost application is optional (Uphoff, 2007).
- Principles and associated practices:
  1) Start with young seedlings in the 2-3 leaf stage although direct-seeding is also possible.
  2) Avoid root trauma through gentle removal from seed beds, quick transplanting within 15-30 minutes, shallow planting and taking care not to invert root tips.
  3) Reduce plant density with single plants per hill at 25x25 cm distance (line to line and within lines) depending on soil quality (wider in high-quality soils) and square planting.
  4) Avoid continuous flooding – just enough water regularly with dry intervals, maintaining mainly moist but not flooded soil conditions.
     - First 10 days after transplanting: keep the field flooded (in case of many weeds: 2-3 weeks of prolonged flooding).
     - Then let the soil dry. Irrigate again after 3-5 days when the surface has dried.
     - One week before and after flowering: keep field flooded.
     - After flowering, during grain filling and ripening: repeat the watering and drying cycle.
     - Just before panicle initiation: ensure a non-irrigated period of 10-12 days (Belder *et al*., 2005).
  5) Actively aerate the soil (regular weed control, enhance nutrient mobilization).
  6) Add organic matter like straw, animal manure or compost to the soil – 'feed the soil, and let the soil feed the plant' (Kassam and Uphoff, 2012).
- Square planting is possible using one of two methods: (1) stretch a rope across the field along which seedlings are planted at fixed and marked distances (see Figure 1) or (2) use a wooden rake to mark out a square pattern on the surface of the field before transplanting. The rake method is faster than the rope method.
- The time needed for seedling preparation and transplanting can be reduced by using seedling trays with individual seed holes (Ceesay *et al*., 2006). However, the additional investment cost is uncertain.
- Application of additional organic matter (e.g. straw) is recommended and the combination of organic matter with mineral fertilizer under SRI enhances yields.
- Since there is less water in the field to control weed growth, this can be done either (1) by manual weeding and using a hoe, (2) with mechanical weeding devices or (3) by herbicides in the absence of mechanical options.

Figure 1. Transplanting rice in square pattern using a planting rope

Photo: S.K. Kriesemer

Economic aspects

- The labour requirement for SRI is site-specific; the total labour requirement is reported to have increased from 25 to 50 person-days before and after SRI adoption in Brazil, and reduced from 275 to 253 person-days in India. The reduction can be explained by the greater use of mechanical weeding devices.
- In general, the time needed for rice cultivation increases when SRI is applied for the first time, but after gaining experience over several seasons, the time required for transplanting is reduced.
- Table 1 compares SRI production costs and returns with those of conventional rice cropping in Timor-Leste.
- Although SRI reduces water use, this will reduce production costs only if the irrigation water is not free.

Environmental aspects

- Although a reduction in water use of more than 50 per cent has been reported for Asia, this might be lower (e.g. between 16 and 48 per cent reported from Senegal) depending on the season and soil type (Krupnik *et al.,* 2012a).
- SRI is not the only approach that reduces water use without affecting yield (Krupnik *et al*., 2012a).

Table 1. Costs and returns of SRI and conventional rice plots in Timor-Leste

	SRI	Conventional	Difference	
Yield (tons/ha)	2.94	3.24	0.30	
Market price for paddy rice ($/ha)	0.3			
Gross revenue ($/ha)	865.70	916.10	-50.40	
Seed quantity (kg/ha)	14.47	72.38	-57.90	***
Seed costs ($/ha)	5.79	28.95	-23.16	***
Pesticide and herbicide costs ($/ha)	14.09	17.03	-2.93	*
Fertilizer costs ($/ha)	12.33	6.52	5.81	***
Labour (person-days/ha)	209.11	201.75	7.36	
Hired labour costs ($/ha)	115.84	131.36	-15.53	
Total variable costs ($/ha)	148.06	4.03	-35.96	***
Net income ($/ha)	717.64	730.39	-12.74	

Note: *, **, *** Statistically significant difference at the 10 per cent, 5 per cent and 1 per cent level, respectively.
Source: Noltze *et al.*, (2013)

- Energy use is generally higher for rice and is mostly for fertilizer, followed by harvesting and seed, and by irrigation. Tillage and plant protection involve the least energy use. The reduced seed need in SRI is a considerable reduction in energy input.
- The repeated wetting and drying process in SRI increases the soil pore volume while the repeated application of organic matter increases the total soil C and N contents levels as well as soil microbial biomass, thereby improving soil quality.

Social aspects

- Water saving technologies like SRI affect men and women farm workers differently, depending on whether they are paid or not. If female labourers are paid, a shift from manual to mechanical weeding would reduce their income from farm work. If unpaid, it would reduce their work drudgery.
- Rural women in India work more than four times the number of days in rice cultivation than men and are paid half the wage of male labourers (Senthilkumar *et al.,* 2008). Increased weed control with SRI will increase their income but also increase their drudgery. If manual labour is replaced by mechanical tools, the income of female farm workers will be reduced.
- Senthilkumar *et al.,* (2008) report a shift from female to male labour in rice cultivation in Tamil Nadu, India.
- Farmers are encouraged to innovate and experiment and participate actively in the development of the technology. They acquire adaptive capacities that can also help them in other aspects of their lives.

Issues for replication

- Farmers face labour constraints due to other on-farm activities (e.g. production of other, higher value crops requiring their attention) or because they have to take up other paid, off-farm work.
- Farmers might prefer to use the limited organic matter resources available for the production of higher value crops like vegetables.
- Increased weed growth is a major problem of SRI.
- Difficulties in leveling the land as well as in water management.
- Farmers have to spend more time initially to learn the skills for transplanting the seedlings in a square pattern. However, this becomes easier after some production seasons.

Useful links

- Cornell University: SRI Rice: SRI International Network and Resources Center: http://sri.ciifad.cornell.edu/
- World Bank: System of Rice Intensification (SRI): Achieving More with Less: A new way of rice cultivation: http://info.worldbank.org/etools/docs/library/245848/index.html
- IRRI: http://irri.org/news/hot-topics/system-of-rice-intensification-sri

Related topics

IRRI: Saving water with alternate wetting and drying: http://www.knowledgebank.irri.org/training/fact-sheets/water-management/saving-water-alternate-wetting-drying-awd

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