System of Rice Intensification (SRI)

Nepal: धान उत्पादन वृद्धि गर्ने तरीका

Left: Rice transplantation following the SRI method with young seedlings planted carefully and quickly to put minimum stress on the roots, planted singly to avoid root competition; and planted at a wide spacing to encourage greater root and canopy growth (Madhav Dhakal)
Right: Harvested SRI rice, the grain yield is higher than for traditionally grown rice (Madhav Dhakal)

A method for increasing the productivity of rice by changing the management of plants, soil, water, and nutrients

The System of Rice Intensification (SRI) was developed in Madagascar by Henri de Laulanie, in the 1980s. He worked with Malagasy farmers and colleagues to improve the possibilities of rice production. The practice contributes to both healthier soil and healthier plants, supported by greater root growth and the nurturing of soil microbial abundance and diversity. It is based on a number of well-founded agroecological principles. SRI concepts and practices have also been successfully adapted to upland rice.

SRI involves transplanting very young rice seedlings (usually 8-12 days old with just two small leaves) carefully and quickly so as to cause minimum disturbance to the roots. The seedlings are planted individually, in contrast to the traditional method where clumps of 3-4 are planted together, minimising root competition between the seedlings. The seedlings are kept widely spaced to allow better root and canopy growth, in a square grid pattern at a spacing of at least 25 x 25 cm. Planting can be done even wider at 30 x 30 or 40 x 40 cm and even up to 50 x 50 cm in the best quality soils.

The soil is kept moist but well drained and aerated to support increased biological activity. A small quantity of water is applied during the vegetative growth period following which a thin layer of water is maintained on the fields only during the flowering and grain-filling stages. Better quality compost, such as well decomposed farmyard manure, can be applied to achieve additional yield increases. Since weed growth will be more abundant and will be a problem in fields that are not kept flooded (and because of the wider spacing), weeding needs to be done at least once or twice in the first 10-12 days and a total of three or four times altogether before the canopy closes.

SRI does not require additional inputs like new seeds, chemical fertiliser or pesticides, but it does require the skilful management of the factors in production and, at least initially, 25-50% more labour inputs, particularly for the transplanting and weeding. As farmers become more skilled and confident in SRI, the amount of labour needed decreases and can eventually become the same or even less than with conventional methods.

SRI is being tried out by farmers in many areas of Nepal's middle mountains including in the Jhikhu Khola watershed. This area has an altitude of 800-2200 masl, and receives about 1200 mm annual rainfall, about 70-80% in the monsoon months (June to September).

WOCAT database reference: QT NEP15
Location: Panchkhal, Hokse, Bhimsensthan, Baluwa, and Patalekhet VDCs in the Jhikhu Khola watershed, Kabhrepalanchok district, Nepal
Technology area: ~ 0.1 km^2
SWC measure: Management
Land use: Annual cropping
Climate: Humid subtropical
Related approach: Evaluation of SRI through participatory research and development approach, QA NEP15
Compiled by: Madhav Dhakal, ICIMOD
Date: June 2006, updated November 2006

General comments: SRI is an innovation rather than a technology. It is gaining popularity all over the world. Increased yields of 50-100% have been reported in most places where it has been tried. The practice is gaining popularity in Nepal especially in the eastern Terai plains.

The technology was documented using the WOCAT (www.wocat.org) tool.

Classification

Land use problems

Limited production due to soil fertility decline, increased amount of agrochemical inputs and lack of sufficient irrigation water and irrigation infrastructures.

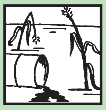
Land use

Annual crops: maize (before SWC), vegetables and rice (after SWC)

Climate

Humid subtropical

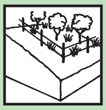
Degradation



Chemical deterioration: fertility decline and reduced organic matter content

Water erosion: terrace collapse due to stagnent water

SWC measures



Management: different planting, irrigation and soil fertility management method

Technical function/impact

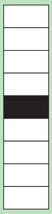
Main:
- improved plant management
- improved water management
- improved soil management

Secondary:
- increase in soil fertility
- increase in organic matter

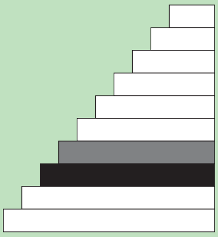
Environment

Natural environment

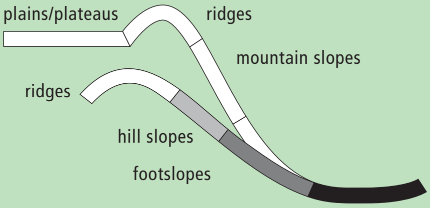
Average annual rainfall (mm)



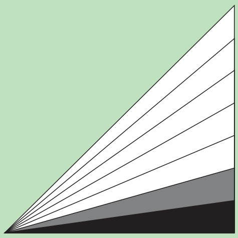
Altitude (masl)



Landform

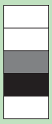


Slope (%)



Applied (large extent) Applied (medium extent) Applied (small extent)

Soil depth (cm)

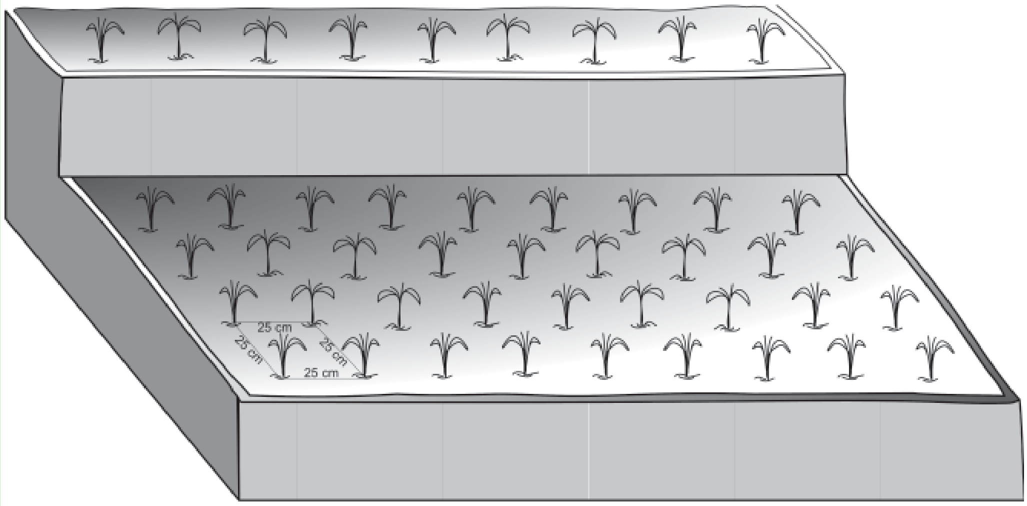


Growing season: 150 days (June to October) and 120 days (November to February)
Soil fertility: low to very low
Soil texture: mostly fine (clay), medium
Surface stoniness: mostly no loose stones
Topsoil organic matter: low to medium
Soil drainage: mostly medium, poor
Soil erodibility: medium

Human environment

Cropland per household (ha)

Land use rights: individual
Land ownership: individually owned/titled
Market orientation: subsistence (self-supply)
Level of technical knowledge required: field staff/extension worker: moderate, land user: low
Number of livestock: not relevant
Importance of off-farm income: in most farm households, off-farm income plays at least a minor and increasingly a major role. Occasional opportunities for off-farm income present themselves in the form of daily labour wages. Some households' members receive regular salaries, whilst an increasing number of Nepalis are working in India, the Middle East, Malaysia, and elsewhere and sending remittance incomes home.



Technical drawing
In the SRI method young seedlings (8-12 days old) are planted singly at a wide spacing of 25 x 25 cm or more

Implementation activities, inputs and costs

Establishment activities

Most of the farmers were already planting rice and rice fields did not need to be established.

Establishment inputs and costs per ha (2006)

Inputs	Cost (US$)	% met by land user
Note: SRI was tested mostly on traditional irrigated fields and in a few cases on traditional rainfed terraces meaning that all the field activities for the SRI method were regular annual operations.		

Maintenance/recurrent activities

1. Nursery bed preparation, seed treatment, and sowing: generally performed at the beginning of the monsoon season
2. Main field preparation (ploughing and levelling): generally performed at the beginning of the monsoon season
3. Transplantation: in monsoon, 8 to 12 days after seed sowing
4. Irrigation of the main fields (to keep fields alternately dry and moist) weekly after transplantation; during the flowering stage a depth of at least 2 cm of water is needed
5. Weeding: 3-4 times – firstly within the first 10 days and a further 2-3 times at 14-day intervals
6. Application of fertiliser
7. Application of pesticides (if required)
8. Harvesting: in October/November

Most of the work is performed manually using locally available agricultural tools like ploughs, levellers and spades

Maintenance/recurrent inputs and costs per ha per year (2006)

Inputs	Cost (US$)	% met by land user
Labour (449 person days)	740	100%
Equipment (machine hours)	136	100%
Agricultural		100%
Materials		
- Seeds (18 kg)	4	
- Fertilizer (301 kg)	94	
- Biocides (2 l)	56	
TOTAL	**1030**	**100%**

Remarks: All costs and amounts were roughly estimated by the technicians and the author (extrapolated from an area of 215 m^2), exchange rate US$1 = NRs 73 in 2006

Assessment

Acceptance/adoption

In the case study area only six farmers adopted SRI in 2003. By 2005, 35 farmers had spontaneously adopted the method, and interest in SRI in the Jhikhu Khola watershed is growing. Farmers are adopting the SRI method carefully and slowly by at first only putting small areas under SRI and then slowly increasing the area planted.

Drivers for adoption

- Demonstration and extension of the technique through participatory research and development

Constraints to adoption

- Requires more labour for weeding
- Uncertain rainfall during transplanting period

Benefits/costs according to land users

If rice fields need to be established, the short-term establishment costs and the benefits realised are about the same. However, most farmers already had rice fields and therefore the benefits are more than the costs.

Benefits compared with costs	short-term	long-term
establishment	equal	positive
maintenance/recurrent	positive	positive

Impacts of the technology*

Production and socioeconomic benefits

- ++ Increased crop yield: increased grain yield
- ++ Increased quantity and quality of fodder: increased above ground biomass
- ++ Increased farm income due to increased grain and biomass; savings on seed, fertiliser, and labour

Production and socioeconomic disadvantages

- \- Increased labour constraints: only the first weeding is labour intensive

Socio-cultural benefits

- +++ Improved knowledge of soil and water conservation and erosion: use of organic fertiliser, reduced chemical fertiliser application, different method of irrigation management adopted
- +++ Strengthened community institution: joint planning, discussing in a group and implementing the method systematically

Socio-cultural disadvantages

none

Ecological benefits

- + Increased soil fertility: use of organic fertiliser, reduced chemical fertiliser application

Ecological disadvantages

none

Off-site benefit

- + More irrigation water available for downstream use: SRI uses less water than traditional method

Off-site disadvantages

none

* All changes in technology may have gender and equity implications and potentially affect the members of disadvantaged groups differently. This has not been assessed here but should be considered when recommending technology use.

Concluding statements

Strengths and ➔how to sustain/improve	**Weaknesses** and ➔how to overcome
Compared to the traditional method, SRI consumed 50 to 75% less water, 75% less seed, 50% less labour for transplanting, 50-60% less labour for irrigation, and less pesticide; the cost of fertiliser and harvesting remained the same, thus the overall cost of production is the same or a little less ➔More experience sharing would help expand the area under SRI	Water control is the most difficult part of this method; to maintain alternate dry and moist field conditions, water needs to be available at 5-6 day intervals ➔ There needs to be good irrigation infrastructure or a perennial source of water to irrigate rice fields regularly
SRI method improved soil environment and reduced rates of riser collapse ➔Impact of long-term soil nutrient balance has yet to be studied	Transplanting 8-12 day old seedlings, especially under rainfed conditions, is quite difficult. Seedlings become old and unfit for transplanting when there is no rain during the transplanting time ➔ Establish two to three nursery beds at intervals of one week
40-50% more grain production and 20-25% increase in above ground biomass production compared to traditional method ➔ Experience sharing would help expand the area under SRI	This method is only suitable for smallholder farmers, in most countries it is not adopted on a large scale ➔ Involvement of national departments and local institutions and wider sharing of its proven benefits is vital to upscale the innovation
Conflict over water during irrigation time reduced ➔As above	Compared to the traditional method, the cost for weeding is 50-60% higher and the first weeding is difficult ➔ Overall cost remains the same

Key reference(s): ICIMOD (2007) *'Good Practices in Watershed Management, Lessons Learned in the Mid Hills of Nepal.* Kathmandu: ICIMOD ■ Uphoff, N. (2004) 'System of Rice Intensification Responds to 21st Century Needs'. In *Rice Today,* 3 (3):42 ■ IRRI International Rice Research Institute, www.irri.org.

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