Food and Agriculture Organization of the United Nations

SAVE AND GROW FARMING SYSTEMS
FACT SHEET 2

Agro-ecological zone
Tropical monsoon, irrigated and upland systems
Main cereal Rice

Higher yields from healthy plants in healthy soil

Traditionally, rice has been cultivated in most of Asia as follows: fields are first flooded then ploughed to create soft, muddy soil often overlying a dense, compacted layer that restricts downward loss of water. Rice seedlings 20 to 60 days old are then transplanted to the fields in clumps of two to four plants, randomly distributed or in narrowly spaced rows. To suppress weeds, the paddy is continuously flooded with 5 to 15 cm of water until the crop matures.

That system has enabled the cultivation of rice for millennia at low, but relatively stable yields. When the Green Revolution introduced high-yielding varieties, mineral fertilizer and chemical pest control, per hectare productivity in many Asian rice fields doubled in the space of 20 years.

A set of crop, soil and water management practices known as the System of Rice Intensification (SRI) takes a strikingly different approach. Seedlings 8 to 15 days old are transplanted singly, often in grid patterns with spacing of 25 x 25 cm between plants. To promote moist, but aerated, soil conditions, intermittent irrigation is followed by dry periods of 3 to 6 days. Weeding is done at regular intervals, and compost, farmyard manure and green manure are preferred to mineral fertilizer. Once the plants flower, the field is kept under a thin layer of water until 20 days before the harvest.

Since SRI was first developed in Madagascar in the 1980s, numerous trials have shown that the system out-yields traditional flooded-rice production, while reducing the use of water, seed, fertilizer and pesticide. The system was found to improve grain yields above those obtained under flooded systems by 40 percent in India and Iraq and almost 200 percent in The Gambia. In comparison trials with current improved practices in China, SRI methods increased rice yields by more than 10 percent. Rice grown using SRI consumed 25 to 47 percent less water than flooded systems in India and China, and required 10 to 20 percent less seed than traditional systems in Nepal.

KEY POINTS

Grown in moist, aerated soil, System of Rice Intensification rice has out-yielded flooded-rice by 40 percent.

A focus on soil health improves **the rice plant's access to nutrients** and enhances its physiological development.

Reduced irrigation also **reduces methane emissions** from rice fields.

In Viet Nam, farmers using SRI practices and **site-specific nutrient management** increased their per hectare net incomes by almost US$200.

The system's higher production costs could be reduced with **technological innovation**.

In China, seedlings are being planted on **zero-tilled permanent raised beds** under mulch.

The Governments of Cambodia, China, Indonesia and Viet Nam – where much of the world's rice is produced – have endorsed SRI methods in their national food security programmes, and millions of rice farmers have adopted SRI practices. More than one million Vietnamese rice farmers are reported to be applying SRI; their per hectare incomes have increased by an average of Us$110, thanks

to a 40 percent reduction in production costs. Farmers who were trained in site-specific nutrient management in Viet Nam benefited from additional annual income of up to Us$78 per ha.

In Morang district, Nepal, a group of farmers reported that SRI had often doubled their yields. In addition, their rice was maturing up to four weeks earlier, which saved water, reduced the risk of crop losses and made land available for other crops. In Mali's Timbuktu region, farmers using SRI produced twice as much rice per hectare as their neighbours. Since SRI plots could be harvested 10 to 15 days earlier, farmers had switched from lower yielding, short-cycle varieties to medium-duration varieties, which produce more grain.

The System of Rice Intensification could help to overcome many of the challenges facing the rice sector. With its emphasis on organic sources of plant nutrition and high fertilizer-use efficiency, SRI offers a means of reducing the environmental pollution caused by nitrate losses from rice fields. It may allow farmers to continue to cultivate rice in rainfed areas, such as northeast Thailand, which are increasingly affected by drought, and in major irrigated rice areas of China, Pakistan and India, where, by 2025, water supply is forecast to be insufficient to meet demand.

The system could also dramatically reduce emissions of methane from irrigated systems. At present, more than 90 percent of the world's rice is harvested from flooded fields, which emit methane totalling some 625 million tonnes of carbon dioxide equivalent annually. Emissions could be reduced by almost one-sixth if all continuously flooded rice fields were drained at least once during the growing season. The System of Rice Intensification does that several times during the growing season.

Scientists are seeking rigorous explanations of SRI's lower resource use and higher productivity, as well as examining the ways in which SRI guidelines are followed by farmers.

An important focus of SRI systems is improved soil health. Intermittent irrigation and the application of organic compost and mulch significantly increase the number of beneficial soil bacteria in the root zone. Since SRI rice is planted singly in healthy, aerated soil with more room to absorb solar energy, it can develop larger root systems, which would lead to a higher number of stems. The plants may also have longer panicles, more grains per panicle, and a higher percentage of mature grains.

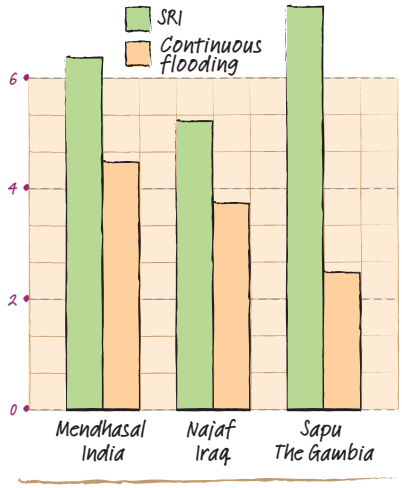
Higher yields may be due to increased nutrient availability and superior growing conditions. A more general explanation offered is that SRI exploits more fully the genetic potential of the rice plant. However, a recent review of SRI's reported high yields found a 'substantial diversity' in SRI practices, making it difficult to draw general conclusions about the impact of SRI as a 'singular technological package'.

Much of the debate around SRI centres on the increased demand for labour in SRI production. In The Gambia, labour costs of transplanting were two to three times higher than those of conventional flooded rice. A recent study in India found that because it was very labour-intensive, the system carried much higher production costs and was 'really uneconomical'.

However, proponents of SRI respond that it generates employment. In Tamil Nadu (India), SRI production was found to be the most suitable option for employing otherwise idle family labour during the dry season.

The labour requirements of SRI cultivation could be lowered with technical innovations, such as seedling trays that simplify seedling preparation and transplanting. Another option is replacing transplanting altogether with direct-seeding, which in Nepal produced yields 50 percent higher than those obtained from transplanted rice. In Sichuan province, China, seedlings are being planted on zero-tilled, furrow-irrigated, permanent raised beds under organic mulch or plastic film.

Grain yields of rice grown under continuous flooding and System of Rice Intensification (t/ha)



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