System of Rice Intensification

Sustainable Agriculture Milestones in the Americas
Relevant experiences in the region to address climate change and care for the environment and natural resources

Latin American countries reduced water use in rice farming by up to 50%, making the crop more sustainable in a context of climate change

Thanks to a series of innovative practices promoted by the Inter-American Institute for Cooperation on Agriculture (IICA) to address the current scenarios of climate change and water scarcity, farmers in several Latin American countries have reduced water use in rice farming by up to 50%.

These efforts are being undertaken within the framework of the program "Producing more from less", which seeks to achieve a more productive, competitive and resilient rice sector that is low in greenhouse gas (GHG) emissions. The program is implemented in South American countries, such as Chile, Venezuela and Colombia; in Central American countries like Nicaragua, Costa Rica and Panama; and in Caribbean countries, such as the Dominican Republic.

The initiative has also enabled farmers to reduce the use of other resources besides water. For instance, seed use per hectare has decreased from 100-120 kilos to just 24 kilos, significantly reducing costs without affecting crop yields.

"People used to tell me the system wouldn't work because they thought it required a lot of water. However, I took the plunge and saw great results from the start", says Fabio Diasa, a small-scale farmer from the municipality of Santo Domingo Norte in the Dominican Republic. In that Caribbean country, the system began to be tested in 2011.

Panamá

A paradigm shift

Rice fields often evoke images of large floods, given that this grain is traditionally grown under water. Rice is the crop with the highest water footprint in the world, requiring 1,700 liters of water to produce half a kilo of rice. Flooded rice fields are a major source of atmospheric methane, one of the greenhouse gases that contribute the most to climate change.

However, rice is also one of the main sources of food security in different parts of the world, including Latin America and the Caribbean. A staple food used in traditional dishes in many countries of that region, rice is a crop of key economic, social and cultural importance.

Rice is the fourth most consumed food in the region and is estimated to account for 11% of a person's average calorie intake. It is also the main source of income and food for millions of small-scale farmers, who are the main producers of this grain.

It is therefore crucial to reduce the environmental impact and ensure the sustainability of rice farming, which covers 5.3 million hectares in Latin America and the Caribbean.

Based on the conviction that more efficient and environmentally friendly rice production systems are required to guarantee competitiveness and sustainability in the face of climate change, efforts were undertaken in Latin America to promote, adapt and validate the SRI (System of Rice Intensification) methodology, which has been applied by more than 10 million farmers in 60 countries around the world. Developed in Madagascar, the system has been improved based on research conducted by Cornell University and other institutions.

On that island off the coast of Africa, the system began to be tested in the 1980s by French agronomist and Jesuit Catholic priest Henri de Laulanié, with the aim of improving the situation of poor farmers, who were dealing with falling rice yields due to soil degradation and environmentally harmful practices.

De Laulanié was able to prove that reducing plant competition, using fewer seeds, and applying intermittent irrigation instead of flooding, generated more positive results while protecting the environment.

Starting in the 1990s, Cornell University in the United States began to take interest in and undertake research on SRI. As a result, the system became more widely known and applied in other countries around the world besides the island of Madagascar. At present, SRI enables millions of farmers around the world to increase rice

productivity through changes in plant, soil, water and nutrient management, while reducing the use of external inputs. It is a cost-effective and climate-smart system.

In more than 60 countries, SRI has been proven to enhance the environmental and social sustainability of rice farming, while caring for soil health, generating greater resistance to extreme weather events such as strong winds and droughts, and reducing the use of agrochemicals. This translates into higher yields that improve the income of small-scale farmers.


Venezuela

Although the crop's water footprint (which measures the amount of water used to obtain the final product) varies between countries and regions, SRI has allowed for significantly decreasing it in all cases.
"In the Dominican Republic, a group of small-scale producers who joined forces and planted around 60 hectares achieved yields ranging from 10 to 12 tons, compared to the 4 or 5 tons obtained through the conventional method", explains Juan Arthur, Food Security and Agricultural Specialist at the IICA Delegation in that country.

In the Dominican Republic, the project was carried out by a group of partners comprised of the Dominican Agricultural and Forestry Research Institute (IDIAF), the National Agricultural and Forestry Research Council (CONIAF), the National Rice Growers' Federation of Colombia (Fedearroz) and IICA, with financial support from the Regional Agricultural Technology Fund (FONTAGRO).

Under the SRI system, farmers irrigate intermittently and without flooding until plants begin their flowering and continuous grain filling, with a thin layer of water of 1 to 2 cm. On the contrary, the conventional system provides for continuous flooding throughout the entire crop cycle (with a layer of 10 centimeters of water in most cases).


Chile

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Unlike conventional farming practices, which involve the extensive use of synthetic fertilizers, SRI fosters a greater use of organic fertilizers and microorganisms. This innovative method also provides for the use of mechanical weeding and integrated pest and disease management, while the conventional system is highly dependent on agrochemicals and flooding of the land to control weeds, insects and diseases.

"SRI is a concrete and sustainable solution for rice producers, which allows for intensive cultivation of the crop, using intermittent irrigation (alternating wet and dry soil conditions during the vegetative phase of the crop), thereby reducing water use by up to 50%", explains researcher Karla Cordero, who leads the Program for the Genetic Improvement of Rice of the Chilean Agricultural Research Institute (INIA), a state entity dedicated to development and innovation that forms part of the Ministry of Agriculture of that South American country.

Producing more from less

Latin America and the Caribbean is one of the regions that is most vulnerable to climate change, with its agriculture sector facing significant impacts. Greater climate variability affects water availability and, in turn, rice production.

Thus, it became necessary to implement the SRI methodology to facilitate intensified rice production, with less water use and without the need for improved or new varieties. It also reduces producers' traditional dependence on synthetic fertilizers and the excessive use of agrochemicals to protect their crops, ultimately resulting in a higher crop yield.

Between 2014 and 2015, pilot projects were implemented in different countries to observe the behavior of this methodology and its yields. The results were very promising. Consumption of water and inputs decreased by more than 50% and the required number of seedlings per hectare decreased from 120 kilos to 8 -10 kilos, in the case of manual transplanting, and to 24 kilos/ ha when using mechanical transplanters. However, mechanized transplanting was introduced with a view to incorporating medium and large-scale producers into the process in countries like Costa Rica where manpower is expensive, explains SRI specialist Didier Moreira.

This technique enabled producers in the above-mentioned countries to decrease production costs per harvest by 30% to 40%, adds the specialist.

The system is based on four basic principles that interact with each other:

- Fostering early, quick and healthy plant establishment, (when the plant reaches the two-leaf stage).
- Minimizing root competition (low plant density in a square pattern)
- Maintaining healthy, aerated soils enriched with organic matter, and fostering the development of beneficial microorganisms
- Improving water management by alternating wetting and drying of soils, through reduced and controlled irrigation

Adapting to change

Implementation of the SRI system in Latin American and Caribbean countries was a gradual process. IICA began by disseminating information, providing training and setting up demonstration plots, given that most of the region's rice farmers were planting under the conventional system. Farmers participating in the trials found the system to be efficient, economic, sustainable and profitable.

Some farmers have adapted quickly. This was the experience of farmers in Nicoya, Costa Rica, who cultivated a 250-hectare plot and reduced the density of the crop. They went from planting 3 and 4 quintals (one quintal= 100 kg) of rice seedlings per hectare (conventional system) to 1 and 2 quintals of seedlings, producing savings of up to US$ 100/ha, given that the cost for a quintal of seedlings was US$ 50. Yields were very acceptable despite the fact that no evaluations of this type had been carried out in any other country, explains Moreira.

The specialist adds that Colombia, Chile, the Dominican Republic and Venezuela are working with mechanized transplanting. In some cases, they have established certified genetic seed companies to support other farmers. "The current situation has forced producers to use bio-inputs and organic matter; save water and seeds; and use rainwater to irrigate. This has lowered the chemical load and decreased the carbon footprint".

The SRI system has demonstrated that there are more sustainable ways to grow rice. On the other hand, the global chemical fertilizer crisis triggered by the war in Eastern Europe in 2022, in addition to the ongoing environmental crisis involving climate change, a water deficit and the need to use less land for farming, make SRI an efficient and sustainable alternative.

SRI has also demonstrated the tremendous potential of the rice genome. Learning how to "produce more with less" will be crucial to achieve a sustainable agriculture sector in the 21st century.

System of Rice Intensification

Benefits of the System of Rice Intensification (SRI) that is being implemented in Latin American and Caribbean countries

- Greater productivity
- Reduced use of inputs (water, seeds, agrochemicals)
- Greater resilience to droughts
- Lower greenhouse gas (GHG) emissions
- Greater profitability
- Higher yields with the land, manpower and resources available
- Increased profitability and competitiveness
- Lower dependence on agrochemicals
- Lower manpower costs

Comparison of the System of Rice Intensification (SRI) and conventional production

SRI PRACTICES	CONVENTIONAL PRACTICES
Transplant young seedlings, preferably 8 to 12 days after the second leaf grows on the plant.	Directly plant or transplant seedlings within a period of 21 to 40 days.
Space out seedlings in a square pattern of at least 25 x 25 cm and up to 50 cm.	Plant seedlings very close to one another, randomly spaced out.
Plant only one seedling per hill.	Plant multiple seedlings per hill.
Intermittent irrigation and no flooding until the flowering and grain-filling stage, applying a film of water at a depth of between 1 to 2cm.	Continuous flooding during the entire crop cycle (water at a depth of 10cm or more in most cases).
Make greater use of organic fertilizers and microorganisms. Apply chemical fertilizers only when necessary.	Use synthetic fertilizers extensively.
Use mechanical weeders and integrated pest and disease management.	Depend heavily on agrochemicals and flooding to control weeds, insects and diseases.

"We went from using between 100 and 120 kilos of rice seeds per hectare to 24 kilos, and reduced water use by up to 30%. Now we have more vigorous, clean and healthy plants free of diseases or bacteria, with thicker stalks, more developed sprigs and more grains".

Israel Araya, Costa Rican farmer.

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