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WHAT IS SRI?

Photo: Devon Jenkins

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Commonly known as SRI, the *System of Rice Intensification* is an agroecological rice production methodology that increases yields by focusing on individual plant health and aerobic, biologically healthy soils. With SRI, farmers use less seed and water, and fewer purchased inputs of fertilizer, pesticides and herbicides, yet achieve yield increases of 30-50% or more.

SRI is a proven methodology, with a strong record of success in 55+ countries, and active adoption by over 10 million farmers. The SRI-WAAPP project is building on early successes across West Africa to bring this powerful method to rice farmers across the region.

SRI works by unlocking the genetic potential in any variety of rice. Despite common beliefs, rice doesn't need to be flooded, and actually thrives when it's given soils rich in oxygen, organic matter and a diverse community of soil microbial life.

When farmers adopt SRI they learn a different way of growing rice – a knowledge system that enhances the growth and health of whichever rice variety they use. Because SRI is a knowledge and crop management system, and doesn't depend on purchased inputs, it creates a lasting change in the communities that adopt it. This represents a fundamental shift from many traditional development models, which often require long periods of outside intervention.

SRI consists of a set of four basic principles that need to be adapted to local conditions.

SRI allows individual rice plants to express their full genetic potential, giving farmers a tool to increase yields without depending on purchased inputs.

SRI-WAAPP is leveraging the regional nature of this project to connect farmers with similar conditions across West Africa, helping them identify and share innovations, and in the process enabling greater results and faster dissemination, adaptation and adoption.

With a focus on the health of individual plants and the soil, SRI doesn't just increase yields, but also makes rice cropping systems more resilient and sustainable.

Aerobic soils, decreased plant competition and incorporation of organic matter into soils leads to more robust root systems, healthier and more diverse soil microbial communities, better retention of water and nutrients in the soil, and plants that are more able to withstand pests, diseases, and severe weather, such as droughts or tropical storms.

In an era of increased uncertainty around global climate change and the impacts it will have on food security, rural livelihoods and national dependence on foreign food imports, SRI is a powerful tool for farmers and policy makers alike.

SRI raises yields substantially while reducing greenhouse gas emissions, and mitigating the impacts of climate change by making rice fields more resilient. Perhaps best of all, SRI is perfectly suited to the realities of smallholder farmers across West Africa, allowing them to produce more with the means they already have at their disposal.

Photo: Erika Styger

Above, SRI is already being adopted by farmers across West Africa, helping them raise yields, reduce costs, boost resilience, and enhance livelihoods, all while reducing dependence on iinputs. Top, a single rice plant, transplanted at 11 days old, is rapidly producing new tillers 16 days after transplanting.

ABOUT SRI-WAAPP

'Improving and Scaling Up the System of Rice Intensification (SRI) in West Africa' (SRI-WAAPP) is a three-year regional project aimed at adapting SRI to meet the diverse sociocultural and agroecological realities of rice farmers in the region. As part of the West African Agricultural Productivity Program (WAAPP), this project is funded by the World Bank, and jointly coordinated by CNS-RIZ in Bamako (Mali), and Cornell University's SRI-Rice Center (USA).

Learn more at: ***www.sriwestafrica.org/about***

SRI-WAAPP

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Publication Director: Dr. Gaoussou Traoré, Regional Coordinator

Editors: Dr. Erika Styger, Technical Lead; Devon Jenkins, Technical Specialist

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Photo: Devon Jenkins

SRI IN PICTURES

Transplanting young seedlings, at a low density, in rows

A team in Mali's Timbuktu region transplants single seedlings at the two leaf stage – typically 8-12 days after germination. While the field looks bare at first, the head start will allow the plants to start tillering without competition for sunlight, nutrients and soil / air space.

Traditional transplanting takes place several weeks later, as seen on the far right in Sierra Leone. These older seedlings have lost most of their tillering potential because of their long stay in a crowded nursery, necessitating dense planting.

Photo: Erika Styger

Photo: Erika Styger

Photo: Jean Apedoh

Controlling Weeds

Planting in rows helps farmers weed their fields quickly and effectively using simple mechanical weeders, like the cono-weeder pictured at left, while also ensuring that each plant gets an even amount of space. Weeds are reincorporated into the soil, helping add more organic matter and further fertilize the plants. Each additional weeding helps mobilize nutrients, aerate the soil, and stimulate root growth.

SRI doesn't require mechanical weeding, however, and farmers around the world are increasingly testing out strategies for weed prevention that minimize or eliminate soil disturbance, such as mulching with green manure, or combining SRI with other agroecological farming methodologies, like Conservation Agriculture.

Photo: Elske van Fliert

Photo: Miyatti Jannah

SRI crops (at left) are better able to resist damage from severe weather (Vietnam, top; and Indonesia, bottom) and insect attacks (bottom only).

Healthier individual plants

SRI management results in healthier individual plants, allowing whatever variety of rice used to achieve more of its genetic potential, even while dramatically reducing synthetic inputs.

Here, a conventional plant on the left, and an SRI plant on the right, clearly show the impact SRI management has on plant growth and health. While both plants are the same variety and same age, the differences are stark: the SRI plant is taller, has a more developed root system, more tillers, and greater overall health.

Deeper roots and greater plant health lead to more resilient plants, more capable of resisting high winds, drought, and pest and disease attacks (left). Since SRI reduces methane emissions – an important anthropocentric driver of climate change – it's unique among agricultural methodologies for its ability to both reduce the drivers of climate change and mitigate against its impacts.

SRI also enhances panicle size, grain size, grain fill, and overall grain quality, all while reducing seed use by 80-95%, cutting water use by up to 50%, and synthetic fertilizer use by up to 100%.

Photo: Robert Bimba

SRI PRINCIPLES AND PRACTICES

Despite local adaptation, SRI practices all stem from the same 4 principles

Unlike many other agricultural methodologies, SRI is not a fixed set of practices for farmers to simply apply to their fields. SRI needs to be adapted to local conditions, but despite this variation in how it is applied, the same basic principles underlie SRI no matter where and how it is adapted.

The key to SRI is understanding how it affects the morphology and physiology – or growth / shape – of the rice plants. SRI principles work together synergistically to induce a response in the plants, causing them to grow deeper and fuller roots, more tillers, a more open shape ('architecture'), and to produce healthier, fuller and larger panicles, with higher quality grain.

The key to SRI is the synergy between the different principles. When applied separately these principles don't result in the same morphological change. While not all of these principles can be carried out in the same way for each farmer and in each circumstance, the practices can be modified to most closely and effectively create the same synergistic effect. Farmers should focus on how best they can adapt the practices to maximize the 'SRI effect.'

The 4 SRI principles listed below each have practices that are associated with them, though these practices will vary locally, and can and should be seen as flexible guidelines, not hard-and-fast rules. Other practices as well may be used to help in implementing the 4 core SRI principles, and farmers are encouraged to experiment and adapt freely, while observing the effect these have on maximizing the 'SRI effect.'

The practices listed below represent possible implementations of SRI principles, but will vary depending conditions, locally available resources, labor and financial constraints, and farmer preferences. Farmers are encouraged to experiment widely to determine the optimal SRI practices for their circumstances – and these may vary between their own fields.

For more details on SRI practices and principles, see the SRI-WAAPP Technical Manual, available at: *www.sriwestafrica.org/documents*.

1. Favor Early and Healthy Plant Establishment

Careful and early plant establishment maximizes the plant's potential for shoot and root development, largely by minimizing early stress from both excessive competition among plants in the nursery and from transplanting. The earlier plants can be established in a rich soil, with plenty of space, the sooner they can develop roots and start tillering, and the healthier and more resilient they become. Most commonly, this means transplanting much younger seedlings, and if further pushed back can also include direct seeding.

According to their local conditions, farmers can choose from many SRI practices that support early and healthy plant establishment, including:

- Careful seed selection, sorting and treatment
- Raised bed nurseries
- Well leveled soils, enriched with organic matter
- Careful and shallow transplanting at a young age
- Direct seeding with seed pretreatment and shallow planting, with 1-2 seeds per hill only

2. Minimize Plant Competition

Minimizing competition for resources—such as nutrients, water, sunlight and soil volume—helps plants grow quickly and healthy, and become more productive with better panicle and grain development. This principle is highly interactive and dependent on Principle 1 and 3, early and healthy plant establishment and building fertile soils, respectively.

According to their local conditions, farmers can choose from many SRI practices that support reduced plant competition, including:

- Seeding or transplanting with increased spacing between plants (typically 25 cm or more between hills)
- Transplanting only 1 seedling per hill, or direct seeding only 1-2 seeds per hill

3. Build Fertile and Healthy Soils, Focusing on Organic Matter Applications and Soil Biotic Health

Healthy soils rich in organic matter and biotic life support a number of key functions and benefits, including:

1. Improved substrate for plant roots, and for microbial life to develop and support plant growth
2. Improved nutrient and water holding capacity of the soil
3. Improved fertilizer use efficiency
4. Favorable aerobic soil conditions
5. Protection and buffering against conditions created by climate change, be it variable rainfall patterns, increased temperature, pest and disease pressure.

According to their local conditions, farmers can choose from many SRI practices that build healthy soils, including:

- Sourcing organic matter from manure, green manure, agroforestry, cover cropping, etc.
- Integrating Conservation Agriculture and other agro-ecological methodologies that restore/enhance soil health

4. Manage Water Carefully and Avoid Flooding and Water Stress, for Ideal Plant Development

While rice plants can survive in flooded soils, they don't thrive. Much (though not all) of the world's rice production relies on flooding to reduce weed competition, but ends up limiting rice plant growth and reducing plant tillering. To compensate, plants are sown or transplanted at very high densities.

Water management is incredibly location-specific. According to their local conditions, farmers can choose from many SRI practices that support aerobic soils, with a healthy balance between oxygen and water, including:

- Careful field leveling, bunding, cover crops, mulching and organic matter applications for better water retention
- Alternate wetting and drying (AWD) to prevent flooded soils during the vegetative growth phase
- Collaborative improvement of rainfed lowland plots to manage water additions and drainage for areas without formal irrigation schemes
- Adjusting planting times and/or planting in mid-slope fields to take advantage of non-flooded soils

THE HISTORY AND SPREAD OF SRI IN WEST AFRICA

While SRI isn't new to West Africa, the SRI-WAAPP project is bringing it to a completely different scale.

As SRI first began spreading outside of Madagascar in the late 1990's and early 2000's, early trials took place in West Africa, including:

- Sierra Leone, 2000 – farmers working with World Vision saw yields increase from 2.5 to 5.3 t/ha with SRI
- Benin, 2002 – a former ECHO intern working with an agricultural ministry agent saw yields increase from 1.6 t/ha to 7.5 t/ha
- Senegal, 2003 – trials showed yields increase from 4-5 t/ha to 9-11 t/ha using SRI
- Guinea, 2003 – Chinese agronomists achieved yields of 9 t/ha when combining SRI with hybrid seed, compared to national averages of 2 t/ha

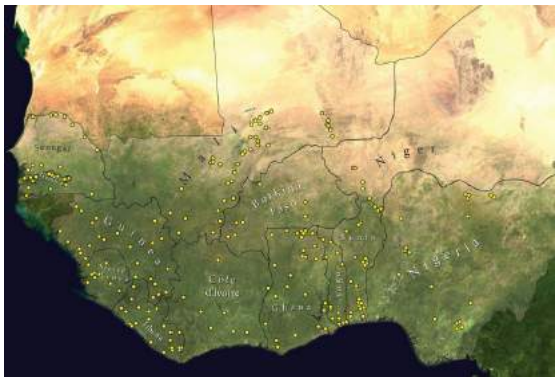
Photo: CHAP
Liberian President Ellen Johnson Sirleaf tours CHAP's SRI demonstration farm on the outskirts of Monrovia in April, 2014.

The first large-scale adoption of SRI began in Mali. The international NGO Africare first began promoting SRI on an experimental level in 2007 in Goundam (Timbuktu region). After positive results the first year (yields of 9 t/ha), the program expanded from 2 villages to 60 farmers in 12 villages the in 2008, with average yields of 9.1 t/ha. As elsewhere, profits were higher, while seed, water and chemical fertilizer use was substantially lower.

Africare expanded their reach again in 2009, while USAID's IICEM project began introducing SRI to other parts of the Timbuktu region, and introduced it as well in the Gao and Mopti regions. This success in Mali proved that SRI could deliver the same positive results across large areas.

Building off the success with IICEM, USAID launched a series of SRI trainings in Mali, Benin, Burkina Faso, Togo and Nigeria as part of their E-ATP program, beginning the first regional scaling up of SRI in West Africa. With the start of the SRI-WAAPP project in early 2014, SRI is now being scaled up in all 13 countries of the WAAPP.

Farmer trials, trainings, and large-scale adoption are occurring throughout the region, in nearly every major rice production zone, from the arid Sahel to the humid south. The ability of SRI principles to be adapted to differing circumstances has allowed farmers to apply SRI principles to unique local conditions, while still capturing the benefits in yield, input savings, resiliency, and increased profitability.



Map: Devon Jenkins
SRI sites are spread out across major rice production zones throughout the SRI-WAAPP 13-country project area. The map above shows major SRI sites in 2014.

Due to the different levels of experience with SRI in each country, SRI-WAAPP project countries are grouped according to their level of adoption and local expertise, which will change as the project advances:

- More experienced countries: Mali, Benin and Senegal
- Moderately experienced countries: Burkina Faso, Ghana, Nigeria, Sierra Leone, Liberia and Togo
- Least experienced countries: Niger, Côte d'Ivoire, Guinea and The Gambia

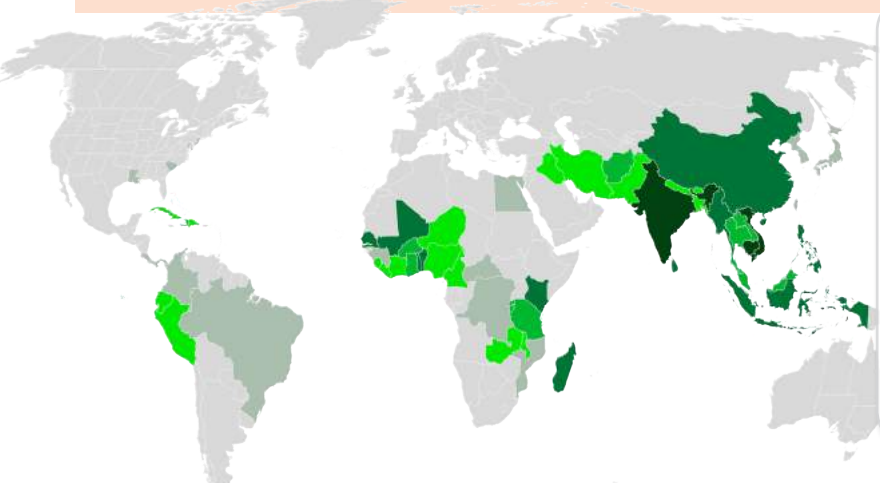
THE MALAGASY ORIGINS OF SRI

SRI's origin dates back to the early 1980's, when Fr. Henri de Laulanié, a French Jesuit priest and agronomist living in Madagascar, experimented over many years with various components of the rice system, including reduced irrigation, and planting single and young seedlings with wider spacing.

Before his death in 1995, Laulanié created a local non-profit organization called Tefy Saina, dedicated to aiding rural Malagasy communities, which collaborated in the mid 1990's with a project of Cornell University's International Institute for Food, Agriculture and Development (CIIFAD). After learning about SRI, Cornell's project evaluated SRI's efficacy, and after three years of trials became convinced of its utility.

Since 1997, a small group at Cornell began sharing experimental and farmer-based results internationally. A large international network of SRI practitioners and researchers has developed since then, adapting SRI methods to a variety of rice growing systems around the world.

In 2010, the SRI International Network and Resources Center (SRI-Rice) was established at Cornell University to improve the advancement and sharing of scientific and practical knowledge about SRI, and to support global networking of SRI practitioners and researchers.



Map: Devon Jenkins

Global Spread of SRI

While SRI was shown since the 1980's in its country of origin, Madagascar, by the late 1990's there was still little knowledge on how well it could work in other rice growing regions of the world. As knowledge of SRI spread and farmer trials started in Asia, other parts of Africa, and the Americas, it became clear that SRI works across a wide variety of rice production systems, and in diverse climate zones. As of 2016 SRI has been validated in 57 countries. Areas where SRI has been proven in farmer fields appear in dark grey on the map; countries with increased levels of adoption and support are shown in darker green. As SRI spreads, the methodology is adapted to local conditions, resulting in unique local expressions, despite a common methodological framework.