LEAD LECTURE https://doi.org/10.58297/UTUF5167

Overview of System of Rice Intensification (SRI) Around the World

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Abstract

During the past several decades, the System of Rice Intensification (SRI) has been validated in 65+ countries in Asia, Africa, and the Americas, with support from NGOs, government agencies, and the private sector. This presentation includes SRI updates from various regions and countries, insights into SRI networks, and a discussion of future trends and directions. While national networks have been established in ten Asian countries, regional networks are emerging in Africa and Latin America. Globally, a research network, equipment forum, resource center (SRI-Rice), and policy group (SRI-2030) are also active. Strengthening linkages within the global SRI community and between SRI networks can help with creating solidarity, collaborative problem-solving, sharing/providing information, and creating a more enabling policy environment. Climate change threats related to water shortages and GHGs, together with mounting food insecurity, have led some countries to consider SRI as a low-cost way of tackling these issues simultaneously. In 2021, nine countries included SRI in their Nationally Determined Contributions (NDC) to reduce methane emissions, showing increased government attention to SRI. Of 1,500+ journal articles about SRI from 60 countries, 43% are from India, 15% from Indonesia, and 9% from Africa. A third includes comparisons between SRI and other production methods, with the majority favorable to SRI regarding yield, water use, economics, and GHGs. Scaling up SRI globally can be assisted by increasing/improving extension, water management infrastructure/policies, SRI-adapted equipment access, marketing support, prioritized research, information access, and investigating/applying digital technologies and new financial incentives such as carbon credits, rice bonds, and other decarbonization strategies.

Keywords: System of Rice Intensification, SRI, rice

Introduction

During the past few decades, System of Rice Intensification (SRI) methods have been validated in 65+ countries. These countries, located in Asia, Africa, and the Americas, have experienced various levels of adoption. Some, like Vietnam, have experienced widespread adoption and strong government support. SRI was named the 2020 climate policy "breakthrough" for government initiatives in Vietnam to increase agricultural production there while reducing methane emissions from rice paddies (2020, Apolitical). Other countries, such as Uruguay and Argentina, are just beginning to investigate SRI.

SRI is an agroecological method of rice production that increases resource efficiency, reduces the carbon footprint, and is accessible to resource-limited farmers. It is based on the cropping principles of significantly reducing plant population, improving soil conditions and irrigation methods for root and plant development, and improving plant establishment methods. As SRI is a form of "open source agronomy," farmers are encouraged to adapt these methods to their own needs. In some countries, SRI is entirely organic, as in the Philippines, and in others, such as India, it may not always be. In addition, SRI, which was originally designed with irrigated systems, is now commonly adapted to rainfed systems in Asia and Africa. While SRI has long been successfully practiced by smaller farmers in the Global South, especially those who are resource-limited, a few larger farms in Pakistan, the USA, and elsewhere have shown that, with SRI-adapted equipment, SRI can be successful for larger-scale farmers as well. And, if SRI is to be scaled up to address the coming climate crisis, these larger farms will need to play a role.

While SRI was not a high priority for many governments or international research organizations over the past few decades, climate change threats, especially related to water shortages and GHGs, together with the increasing food insecurity exacerbated by the pandemic's effects on the global economy, have led a number of countries to take a closer look at SRI as a low-cost way of tackling some of these issues simultaneously, while many other agricultural innovations cannot. During COP26 in 2021, nine countries specifically included SRI in their government's Nationally Determined Commitments (NDCs) that embody countries' efforts to reduce national emissions and adapt to the impacts of climate change (Hong *et al.,* 2021). Thus, a new era of government interest in SRI may be within reach that could push forward needed policies for irrigation, extension, equipment access, and market opportunities. A new international NGO, SRI-2030, has emerged that encourages policies to reduce methane emissions through SRI.

Rice consumes up to 43% of the world's irrigation water and 24–30% of the total global freshwater (Surendran *et al.,* 2021). While SRI can demonstrably reduce water use for irrigated rice, current water shortages, together with labour issues, have led farmers in many countries to consider SRI adaptations that further reduce water use, including direct-seeded rice (DSR), conservation agriculture, and in some cases, ratooning. Gender-appropriate -adapted equipment for weeding and transplanting, if affordable, can further reduce required labour. As regenerative agriculture is gaining acceptance, more emphasis is being placed on soil health through better understanding and inclusion of organic inputs such as biochar, Trichoderma, vermicompost, manure, cover crops, and purchased or homemade organic formulations. Other future benefits for SRI farmers could accrue from carbon credits, regenerative agriculture certification, rice bonds, water credits, and other incentives related to decarbonization.

Regional Progress

Africa

Of the 27 African countries with SRI experience, the most active countries in terms of both SRI research and field programs are Kenya, Nigeria, and Tanzania, with the latter producing the most research. As few countries in Africa are self-sufficient in rice production, and food security is a growing issue in the region, SRI is being given more consideration. In addition, Benin, Burkina Faso, Togo, Mali, and Senegal have noted SRI in their 2021 NDC pledges to reduce global methane emissions (Hong *et al.,* 2021). The World Bank-funded SRI project associated with the West Africa Agricultural Productivity Program (SRI-WAAPP), which ran from 2014-2016, resulted in scaling up of SRI to 50,000 (primarily) smallholder farmers in 13 West African countries (Styger and Traoré, 2018). During 2023, the Scaling-up Climate-Resilient Rice Production in West Africa (RICOWAS) project, funded by the Adaptation Fund (Ramanujan, 2021), will follow on to SRI-WAAAP's efforts. The most recent country found to be successfully implementing SRI in Africa is Guinea Bissau, with up to four-fold increases in yield reported (World Food Program, 2022). Regarding knowledge-sharing, SRI-Africa.net in Kenya has a website serving the continent, and a West Africa facebook group posts regional updates. In October 2022, a new vertically integrated SRI network in Nigeria began to coalesce.

East Asia

Japan has an active national SRI network, meeting quarterly at the University of Tokyo since 2007. News reports from North Korea allude to the success of government SRI trials there, though details are scarce and unconfirmed. Although adoption in South Korea has been limited, SRI research continues, with most studies concerned with water reductions, water pollution, on GHGs. While SRI made steady progress in China, the numerous adaptations in spacial orientation, mulching, etc., and the variety of alternate names for SRI have made it more difficult to track. As theoretical questions on SRI's validity were satisfied, research in universities and national institutes have declined in the past few years in China, moving to local agriculture stations where SRI practices are fine-tuned for local adoption (SRI-Rice website, 2022).

Latin America

SRI has been slower to spread in Latin America than in Africa and Asia. Currently, 14 countries in the region have validated SRI methods over the past two decades. New ventures have begun with Inter-American Institute for Cooperation on Agriculture (IICA) in collaboration with the governments of Uruguay, Argentina, and Brazil. SRI interest began in Cuba, which led to adaptations for sugarcane. More recent regional leadership has been provided by IICA, a Costa Rica-based group that hosted a panel discussion on SRI for Food Security and Climate Resilience at the Sustainable Agriculture of the Americas Pavilion at COP27 in 2022. In South America, farms in general, tend to be larger, and farmers are more likely

to request mechanized equipment to convert to SRI methods. Hence SRI-adapted transplanters, seeders, and weeders are an important consideration in these areas. Governments in Latin America are showing increasing interest in SRI. For some countries, water conservation is the primary driver, though increasing interest in methane reduction and food security may result in additional studies and scaling up. Recent programs in Chile and Ecuador have shown success in adopting SRI to tackle water issues, with Chile moving toward direct seeding (DSR). Peru has also shown an interest in SRI related to malaria reduction.

North America

Although most USA rice farms are engaged in industrial agriculture and have not shown much interest in SRI, smaller organic farms in several eastern and southern states have successfully grown and marketed SRI-grown rice on a small scale. Most recently, the Jubilee Justice NGO in the southern USA has been working with traditionally marginalized black farmers to grow and market SRI-grown rice in Louisiana and Mississippi. While large-scale producers that either seed from airplanes or drill hybrid seeds in lines have yet to move to SRI, a farmer in Arkansas has shown that SRI can be quite profitably be grown on larger farms using an adapted row crop seed plate planter to direct seed single rice seeds at a wider spacing following a cover crop, with additional reduction in both water and agrochemical inputs.

South/Southeast Asia

SRI is being practiced to some degree in nearly all South and Southeast Asian countries. Indonesia and India continue to scale up SRI through many NGOs, Corporate Social Responsibility (CSR) projects and scattered government projects; a significant number of SRI research articles are being published in both countries. The most active national SRI networks/groups in South and Southeast Asia are located in India, Indonesia, and the Philippines. Vietnam has seen strong government support and widespread adoption, including over several million rural households as of 2016 (Mishra *et al.,* 2021). Myanmar and Laos included SRI in their governments' Nationally Determined Contribution (NDC) pledge at the COP26 (2021, Hong). The Philippine SRI Network, SRI-Pilipinas, has trainers available in nearly all provinces and is currently increasing efforts to engage the government. A network of partners across mainland Southeast Asia became active during the 6-year EU-financed SRI Lower Mekong River Basin (SRI-LMB) regional project that concluded in 2018. This project trained over 15,000 farmers in Cambodia, Laos, Thailand, and Vietnam, and was proven to raise yields, incomes, and labor efficiency on primarily rainfed farms (Mishra *et al.,* 2021).

Research

Over the last two decades, SRI-Rice, in association with the SRI Global Research Network, has collected over 2,000 research items that discuss SRI. Of these, over 1,500 are journal articles, which were written by over 1,000 first authors from 60 countries. 43% of journal articles are about India, 15% relate to Indonesia, and 9% are about Africa (as a whole). A third includes comparisons between SRI and other production methods, with the majority favorable to SRI regarding yield, water use, economics, and GHGs. Nutrient management, economics, and water management are top items for research (SRI Research Database, 2022). While there are nearly 100 journal articles on GHGs/climate change, interest in this area may increase research undertaken both on GHG mitigation and climate change adaptation in the future, along with conservation agriculture adaptations that reduce water use and soil disturbance. While the quality of some research articles from smaller institutions can be poor, the results may contain valuable, often local, insights that are not captured by researchers publishing more theoretical research in high-impact journals. Rather than exclude this research, it may ultimately be more productive to help authors in smaller universities and institutions to produce better quality work. Perhaps the SRI Global Research Network could be useful here.

Networks and Scaling Up

Ten national SRI networks have operated at various times in Asia over the past decade, some of which are very active while a few have become dormant. While many of the national networks are underfunded and could be strengthened, a dilemma remains, not only to figure out how to support them but how to fund them in a sustainable way that outlasts short-term support by donors. Regional networks are emerging in Africa (SRI-Africa.net) and Latin America (Red SRI). International groups include 1) SRI-Rice, a Cornell University center supporting SRI/SCI knowledge creation and sharing; 2) SRI-2030, an NGO focused on methane reduction through promoting policies supportive of SRI; 3) The SRI Equipment Innovators Forum (currently a Facebook group); 4) The SRI Global Research Network, which provides access to 2,000+ SRI

research items and other resources; and 5) other social media groups (SRI-Rice website).

Strengthening linkages within the global SRI community as a whole and between existing SRI networks not only creates solidarity but can help with scaling up, collaborative problem-solving, and getting information about SRI to those who need it. International, regional, and national SRI knowledge-sharing networks/groups, if adequately supported, have the potential to assist greatly with specific tasks, helping stakeholders locate information, reaching a wider audience, and creating a more enabling policy environment.

In addition to supporting national and regional networks, scaling up SRI globally can be assisted by increasing/improving 1) access to SRI-adapted gender-friendly small- and large-scale production equipment; 2) extension and follow up; 3) quality research on important priorities such as GHG measurements, nutrient management (especially organic inputs), adaptations towards conservation agriculture, water management, and gender issues; 4) access to domestic and international markets (and storage and milling facilities); 5) water management, policies, and infrastructure; 6) investigation and use of farmer incentives, including newer ideas such as carbon credits, rice bonds, crop insurance, certification (regenerative, etc.) assistance; 7) investigation and use of new communications and production technologies that are compatible with SRI and economically feasible; 8) data collection on the SRI spread, adoption and adaptation; and 9) awareness-raising through media, making use of increasing interest in reducing GHGs, water use, and food insecurity (all of which SRI does very well).

Conclusion

With support from NGOs, government agencies, and the private sector, the System of Rice Intensification (SRI) is increasing resource-use efficiency, improving food security, and reducing the carbon footprint associated with rice production in 65+ countries in Asia, Africa, and Americas. A number of national, regional, and international networks serve the global SRI community, though more support and strengthening of linkages within the global SRI community and between SRI networks would help with scaling up, accessing information, and reaching policymakers. As SRI is one of the few agricultural innovations that can help farmers both mitigate and adapt to climate change as well as reduce food insecurity, SRI is attracting more attention from governments as they try to reduce GHGs and help farmers deal with water shortages, extreme weather events, and other climate-related challenges. During 2021, nine countries included SRI in their Nationally Determined Contributions (NDC) to reduce methane emissions, showing increased government attention to SRI. Perhaps this spotlight on SRI will help direct policymakers to improve extension services, water management infrastructure and systems, and market access. Scaling up can also be assisted by investigating/applying digital technologies and new financial incentives for farmers, such as carbon credits, rice bonds, and other decarbonization strategies.

In order to further reduce water use and, in some cases, labour shortages, SRI is increasingly being adapted to use direct seeding (DSR), conservation agriculture, ratooning, and drip and sprinkler irrigation systems. In terms of scaling up and addressing labour issues, more emphasis needs to be given to providing access to (and in some cases gender-appropriate SRI-adapted equipment available for both small- and large-scale farmers in all regions.

While there is already a significant body of SRI research, quality remains an issue. More work on GHG measurements needs to be undertaken in order to better understand SRI's potential contribution to the mitigation of emissions. Priority research that will yield more benefits for farmers includes water management, economics, and nutrient management (especially fine-tuning organic inputs.) While SRI researchers come from a variety of educational and research institutions in over 60 countries, more effort is needed to help researchers in smaller universities and research stations produce better quality publications as their work contains valuable work on local adaptations that are often not covered by larger entities interested in investigating more complex theoretical issues.

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