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Impact of System of Rice Intensification (SRI) in Increasing Agricultural Yield in India an Analytical Study

Economics

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ABSTRACT

The System of Rice Intensification (SRI) is being promoted worldwide, but relatively little is yet known about its impacts at farm level. This article reviews available evidence on the impact of SRI practices in terms of yield and productivity. Adoption of SRI practices necessarily changes the mix and allocation of inputs, in particular of water, seeds, fertiliser and labour. However, SRI impact studies have generally failed to distinguish between technological change – a more productive use of inputs, evidenced by a change in total factor productivity – increases in input use, or selection effects and their respective effects on yields. The studies reviewed point not only to modest increases in rice yields associated with SRI adoption, but also to concurrent increases in labour and fertiliser use. Often SRI is selectively practised on more fertile plots. As a result, no firm evidence on changes in total factor productivity can be discerned, while partial productivities of land and labour show mixed results. Though yields tend to be higher under SRI management, risk also seems to increase, which initially favours adoption by better-endowed farmers and on better soils. Evidence on SRI impact is further complicated by the large diversity of SRI practices associated with different biophysical, socio-economic and institutional circumstances. We conclude by identifying knowledge gaps surrounding the SRI phenomenon, encompassing agro-technical aspects, socio-economic issues and (dis)adoption behaviour.

INTRODUCTION

The system of rice intensification (SRI) has generated considerable debate globally, particularly with regard to its potential to raise rice yields. Proponents of SRI have reported that the average rice yield with SRI is double the current average yield and can be increased to the level of three to four times. Opponents say the reported high yields are due to measurement error and that usual information expected in support of these fantastic yields is missing. The number of SRI adopters has increased in India in recent years. We evaluate the impact of adoption of SRI practices on rice yields, the economics of paddy cultivation and labour inputs based on field research conducted in Purulia, West Bengal, India. Paddy yields with SRI were higher than those under conventional paddy cultivation by 32% and net returns were higher by 67%. Labour input was reduced by 8%. SRI adoption enabled farmers consistently to enhance paddy yields, increase returns and save labour; and enhance productivity with respect to the key inputs in terms of paddy output per unit of seed, fertilizer and labour-day. SRI promises to be a significant alternative for not only raising paddy yields, but also for managing paddy based farming in resource-starved regions.

To evaluate the performance of new rice establishment methods viz., system of rice intensification (SRI) and integrated crop management (ICM), a field study was conducted during 2008–11 in South Garo Hills, Meghalaya, foot hills of Eastern Himalayas, India. Field demonstrations were undertaken during wet seasons of 2008–11 and socio-economic information in the context of farmer's realities were obtained during 2010–11 using a well structured questionnaire administered to 134 farmers. The results indicated that the average higher productivity of rice under SRI and ICM demonstration was 209.9 and 185.4 %, respectively, over conventional rice culture (CRC). The SRI and ICM methods of rice cultivation could save seeds (97.56 and 60.98 %), saving water (78.05 and 63.66 %), reduce cost (70.33 %), higher yield etc. compared to CRC. The main reasons for non-adoption of SRI/ICM was related to involvement of more efforts, faith towards traditional practices, ignorance and lack of knowledge on scientific water management. The net-return of $816.69, $706.63 and $51.48/ha was realized under SRI, ICM and CRC, respectively. The co-efficient of multiple determinations (R 2) of the production function was 0.695 in SRI, 0.714 in ICM and 0.734 in CRC which indicated that about 69.5, 71.4 and 73.4 % of the variation in rice productivity under SRI, ICM and CRC, respectively were explained by the independent variable and remaining 30.5, 28.6 and 26.6 %., respectively in SRI, ICM and CRC were as a result of non-inclusion of some explanatory variables as well as other factors outside the farmers control.

The System of Rice Intensification, known as SRI, can reduce water requirements, increase land productivity, and promote less reliance on artificial fertilizers, pesticides, herbicides, and other agrochemicals, all while buffering against the effects of climate change and reducing greenhouse gases (GHG).

In a recent interview with Food Tank, Professor Norman Uphoff at Cornell, who has been studying the impacts of SRI management for more than 15 years, describes SRI as not a fixed technology, but, instead, as a set of principles and ideas. Ideas that translate into a combination of agro economic practices, which might differ depending on agro-ecological and cropping system conditions, but that can have widespread benefits. Application of SRI practices can raise household incomes, enhance soil fertility, and protect crops against climatic, pest, and disease stresses.

For irrigated rice production, for which SRI was first developed, farmers transplant young, single seedlings, spacing them widely in a grid pattern, keeping soils moist and fertile, but not flooded, enhancing them with compost and other sources of organic nutrients, doing regular and early weeding that aerates the soil, and incorporating weeds into the soil to decompose.

The broader application of SRI ideas and methods is referred to as the System of Crop Intensification (SCI). SCI practices have already been developed for wheat, finger millet, tef, sugarcane, mustard, and sorghum. A World Bank publication reports that at least 100,000 farmers in Bihar state of India are using SRI methods for rice and also with other crops. Increases in rice yields, according to the report, were 82 percent, and incomes were raised by 250 percent. The methods adapted for wheat, pulses, oilseeds and vegetables resulted in yield increases by 72 percent, 56 percent, 50 percent, and 20 percent, respectively, while the respective increases in income were 86 percent, 67 percent, 93 percent, and 47 percent.

In Ethiopia, SCI practices have been developed for tef as well as other crops. Resultsfrom the System of Tef Intensification (STI) have been so successful that the government's Agricultural Transformation Agency (ATA) is supporting its extension.

In India, the System of Sugarcane Intensification (SSI) has been very successful, and SSI is also being introduced in Cuba. According to the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and the Worldwide Fund for Nature (WWF), SSI practices can generate 20-100 percent greater sugarcane yield with 30 percent lower water requirements and a 25 percent reduction in chemical inputs. ICRISAT and WWF have produced a manual on the adaptations of the SRI principles to sugarcane production.

Today, Food Tank would like to highlight five ways how applying SRI practices and ideas can help "feed the world," support family farmers, and help protect the environment.

1. Reduce water use — In the 50 plus countries in which the benefits of SRI have already been demonstrated, there has been a 30-50 percent decrease in water usecompared to growing the same varieties on the same soil under flooded conditions. According to Oxfam America, "the significance of SRI lies not only in enabling farmers to increase yields with less water, but in the basket of associated social and environmental benefits."
2. Reduce costs associated with farming — By reducing their reliance on purchased inputs, farmers can cut their costs of production, an important consideration for cash-poor households. An average reduction of 23 percent was calculated from on-farm evaluations of impacts from SRI methods in Bangladesh, Cambodia, China, India, Indonesia, Nepal, Sri Lanka, and Vietnam.
3. Increasing household income — According to Uphoff, "No other innovation offers the net economic returns that SRI can provide" because costs can be reduced while income goes up. This is especially true in regions of the world where rice production is a break-even endeavor. In northern Myanmar, for example, under rainfed conditions, households' net incomes from rice production using SRI methods were increased eight-fold in real terms.
4. Creating resilience against climate change — According to areport published in the Proceedings of the National Academy of Sciences of the United States of America (PNAS), there is direct evidence of decreased rice yields due to higher night temperatures as a result of global warming. Practices will need to change to deal with these changing conditions. According to Uphoff, SRI's buffering against climate change is attributable to two things: 1) improvements in crop root systems, with larger, better roots and less degeneration than under flooded, hypoxic conditions; and 2) soil biodiversity and biological activity. Uphoff points to the beneficial effects that soil microorganisms can have when residing within rice plants as symbiotic endophytes. They can have an effect on plants' chlorophyll levels and photosynthesis and even on their expression of genetic potential as the plant-soil microbiome parallels the human microbiome in importance.
5. Increase yields — Uphoff first accepted the potential of SRI in 1997 after he visited farmers in Madagascar who had been producing just two tonnes of rice per hectare on their poor soils — by using SRI, they were able to average eight tonnes per hectare for three consecutive seasons on the same soils and with the same varieties, without having to purchase inputs. The average yield increases from on-farm evaluations across eight countries were 47 percent, according to Oxfam America.

CONCLUDING REMARKS:

Greater profitability. The costs of production with SRI averaged about 20 percent less per hectare, according to seven evaluations from five countries (Bangladesh, Cambodia, China, India and Sri Lanka). This, along with higher yields, means farmers' incomes from rice production increase by more than just their yield increase.

• Environmental benefits. Reduction in water requirements and reduced reliance on agrochemicals for high yield takes pressure off water-stressed ecosystems and enhances soil and water quality.

In specific agronomic terms, SRI farmers report the following advantages along with their higher yield and profitability:

• Drought resistance. Because SRI rice plants develop larger and healthier root systems, and establish these at an early age, the plants are more resistant to drought and periods of water stress.

• Resistance to lodging. With stronger root systems and tillers, in part due to the greater uptake of silicon when soil is not permanently saturated, SRI plants show remarkable resistance to wind, rain and storm damage.

• Reduced time to maturity. When SRI methods are used properly the time for maturation can be shortened by as much as 15 days, even while yield is being doubled. This reduces farmers' risk of agronomic or economic losses due to extreme weather events, pests or disease and/or frees up the land for other production.

• Resistance to pests and diseases. This has been frequently commented on by farmers and is now being documented by researchers. The China National Rice Research Institute, for example, reported a 70 percent reduction in sheath blight in Zhejiang province.

• Conservation of rice biodiversity. While high-yielding varieties and hybrids have given the highest yields with SRI methods (all SRI yields over 15 t/ha have been achieved with improved cultivars), very respectable yields can be obtained with traditional varieties as SRI plants resist lodging despite their larger panicles. In Sri Lanka, farmers using SRI methods have obtained yields of between 6 and 12 t/ha with "old" varieties. These are more profitable to grow because consumers are willing to pay a higher price for them, preferring their taste, texture and aroma.

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