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System of Rice Intensification for Increased Productivity and Ecological Security: A Report

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Introduction

The present technology of paddy production leaves behind ecological foot prints caused by overuse of fossil fuels and synthetic fertilizers that pollute almost a quarter to one third of world's annual fresh water supply. Overuse of water contributes to emission of greenhouse gases causing more global warming. Besides, input costs are high and the additional inputs, particularly synthetic fertilizers to increase production are leading to diminishing or constant returns over the years. The method is ill suited for rain-fed areas. Despite this, India has relied on such input management practices attempting to improve yield for its food security. Such highly intensive agriculture dependent on fossil fuels, damaging to soil and fresh water, and crop diversity is becoming questionable today.

The real challenge therefore is to develop/adopt strategies based on sound ecological principles and integrate traditional organic farming practices and biodiversity with scientific knowledge. System of Rice Intensification (SRI) is a promising resource conserving method of growing rice both under irrigated and rain fed conditions as the method is based on alternate wetting and drying interval. Application of controlled irrigation reduces nitrogen export to the environment in comparison with flooding irrigation management and reverses climate change. Around 40 countries of the world today are reaping the benefits of SRI.

Rice is grown on 42.5 m ha in India, which is the largest area among rice growing counties and provides 29% of the calorie requirement in India with a production of 85.59 million tons and average yield of 2.2 t per ha. Area under rice is expected to be reduced to about 40 million ha in the country in the next 15 to 20 years due to water shortage and rapid industrialization and urbanization. The Problems confronted in rice production particularly by resource deficient small and marginal farmers and rain-fed areas are well known.

G. B. Pant Social Science Institute, University of Allahabad, Allahabad organized a two-day National Consultation session on the subject on 6th and 7th, April, 2015. The Consultation explored the alternatives ways of resource efficient SRI method for paddy cultivation in comparison to the existing resource intensive post Green Revolution conventional method. It focused on examination of the SRI method, considering particularly the contributions of soil organic matter, indigenous rice varieties, responses and roles of soil microbes, resource-use efficiency, and labor use efficiency and productivity. It considered SRI and its relationships to biodiversity and ecological security, linking agricultural practices to the larger natural environment in which we live and produce. The Consultation also envisioned on a more desirable future, looking at SRI expansion across the country, at the roles and empowerment of farmers, and at the institutions, policies and knowledge-deepening that will make this all possible.

SRI: The Method

The SRI method of rice cultivation is based on a set of practices to manage plants, soil, water and nutrients that reduce seed requirement, save water and lower the costs of production while enhancing crop yield. The management practices include transplanting young 8-10 days old seedlings, widely spaced transplanting with one seedling per hill in a square pattern, use of compost and other organic amendments, intermittent irrigation before panicle initiation and shallow water management thereafter, up to maturity and mechanical weed control. The purpose of SRI is to convert the realizable genetic potential of a variety into reality on farmer's field. The probable yield could easily be calculated by multiplying the number of effective tillers per plant, number of grains per spike and 1,000 grain-weight per square meter or percentage of the harvest index of the total biomass per hectare of area.

Until recent years no worthwhile farm community based innovative method was experimented to increase yield with reduced inputs, although the SRI was known to Tamil Nadu farmers as single seedling planting a century ago and was tried in limited areas during the second decade of the twentieth century. The available evidence clearly shows that the rice farmers of Tamil Nadu obtained a yield of 6 t/ha by the application of SRI without any chemical fertilizers during those days when the country's average yield was about 1.5 t/ha. Unfortunately, it was forgotten with the initiation of Green Revolution which laid thrust on improved varieties, better nutrient supply, soil and water management, increased use of chemical fertilizers and plant protection chemicals. In this process the country ignored traditional varieties and use of organic fertilizers.

In recent times, SRI in India was introduced in 2000 in Tamil Nadu, Puducherry and Tripura and considered as a major breakthrough with reduced water use, lesser fossil fuel based inputs, increasing yields and environment friendly. The innovation is basically farmer centric. Today SRI is gradually spreading from farmer to farmer improving productivity and profits, reducing water inputs and challenging high input driven post Green Revolution agricultural practice. About one million farmers are reported to have tested SRI in more than 350 rice growing districts in the country. SRI became part of the National Food Security Mission in 2007. Now the core practices of SRI are also being applied to sugarcane, wheat, ragi, mustard and vegetable production. In brief, Indian agriculture is witnessing a fine blending of scientific and indigenous knowledge systems in agro ecological crop management.

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These farm based approaches clearly offer a ray of hope for small, marginal, resource poor farmers and food security of the nation.

Ground Results

Some ground results reported in the Seminar included experiences from the states of Bihar, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, and Gujarat and are reported below.

SRI is getting an important place among the small and marginal farmers in Gaya, Nalanda and Munger districts of Bihar where the yields are being enhanced significantly. The holistic approach of SRI is based on providing supportive environment to all parts of plant with special attention to its roots enabling full exploitation of genetic potential. In Uttar Pradesh an experiment was conducted to compare the methods of rice establishment and nutrient management during kharif season of 2014. It was conducted in split plot design with three replications. The main plots comprised of four planting methods, viz., conventional transplanting, SRI method, drum seeded and direct seeded. The better performance of the crop under SRI was the outcome of enhanced growth measured in terms of significantly higher plant height, number of tillers/hill, dry matter accumulation and leaf area index at different growth stages as compared to other methods of planting rice. The higher grain and straw yields coupled with lower cost of production and higher B:C ratio culminated in higher net return from SRI than conventional methods of rice planting.

Another experiment in Allahabad on SRI productivity and profitability on both at the farmer's fields and at on station trials certified for six consecutive years showed that rice cultivation involving two different systems of planting was distinct and SRI proved to be superior with an increase of 95% yield of Pusa Basmati 1. Harvest index figures crossed 40% mark and the B:C Ratio registered perceptible increase with SRI mean values exceeding 2.40 in all the green manured plots. Foliar feeding of liquid organic formulations has been consistently found useful for enhancing the vigor, health and productivity. Supplementary practices, viz., use of Bokashi manure and go-mutra culture had certainly helped in restoring health and soil fertility, concurrently functioning as a prophylactic measure against the attack of termites, root grubs, etc. At least eight promising isolates of Plant Growth Promoting Rhizobacteria were identified and isolated from the soils of research farms. It was observed that the germination ranged 92 to 100% against the 80% figure of control. Similarly, root elongation of up to 137% and shoot elongation of up to 27% was exhibited by these isolates, which entails promising potential for biological synergy in agro-ecosystems.

SRI demonstrations in Madhya Pradesh, Chattisgarh and Odisha responded for efficient and increasing trends in productivity enhancement, economic feasibility and net returns over conventional method during the years of investigation 2011-12, 2012-13 and 2013-14. Perceptions of paddy growers about biotic and a biotic stresses in cultivation of paddy in Haryana revealed that both these stresses had an impact on yield of paddy across all farm sizes in the state. SRI is considered as a solution to these problems and adoption of SRI has increased yield and returns per unit of land. Front Line Demonstrations (FLDs) are reported to be the most effective method for transfer of technology in a study in Navsari district of Gujarat conducted in 2012-13 and 2013-14 during kharif season. It was observed that there has been increased demand of SRI adoption, average yield recorded in the FLDs and farmers field was 8064 and 5083 kg per ha during 2012-13 respectively and FLD yield and farmers yield was 8168 and 4786 during 2013-14 respectively. The average additional gain of Rs 39,869/=ha was obtained by farmers through adoptions of SRI technology of paddy cultivation as compared to normal paddy cultivation. Nagaon and Marigaon districts of Assam have the highest numbers of SRI practicing farmers where SRI method of cultivation is observed to be a labor intensive practice with an increment of 12.9% in man days and 47% yield increase as compared to the Green Revolution method of rice cultivation.

SRI Future Area Expansion and Policy Concerns

The available evidence suggests that SRI application has been over-simplified and more often wide spacing and line transplanting are the only components that are being adopted by the farmers. Due to several practical reasons, the technology has not picked-up as expected. The issues like ground water/conjunctive irrigation system, planting of young and single seedlings, scarcity of water due to intermittent power supply, poor land terrain, lack of proper understanding of SRI practices, labor problems and non-availability of suitable markers, act as strong deterrents in spread of this technology.

The analysis of data in major rice producing states of India reveals a mixed and puzzled state of SRI adoption. The practical implication of SRI is still hard to be established at state level performances. On the other hand, ITK (Indigenous Traditional Knowledge) offers the leverage by locally evolved skills, experiences and eco-friendly practices to improve and prolong agricultural growth. ITK provides for the best remedies for the ailments of Indian agriculture. The combination of scientific and traditional knowledge elements in agriculture can do wonders for resolving the present day crises. An indigenous modern model, run on an Information and Communication Technology (ICT) platform may create a difference. This may facilitate adjusting the services with the input and climatic differences area-wise. ICT also makes it accessible to all corners of the country. This Swadeshi avatar in crop management may be digitally be linked with all the participants and may be popularized and promoted through the ICT instruments across the country.

In order to meet the second green revolution, the first strategy is to breed varieties of high yield threshold and second strategy is to use the improved package and practices like SRI. The innovative breeding-selection strategies involving conserved traditional varieties along with SRI technique, if planned and executed would make India food nutrition secure nation in an era of inevitable adverse effects of climate change. SRI method is much more than the location specific method with a set of principles. It is about helping the farmer how to understand the agro ecology of the crop Paddy and understanding the Paddy plants physiology and the plants response to abiotic condition. The best way is to educate the farmer with field exposures about the sets of principles and the possible variations while one is trying to implement SRI way of Paddy cultivation.

Norman Thomas Uphoff, Professor of Government and International Agriculture, Senior Advisor, SRI International Network and Resource Center (SRI Rice) and Core Faculty Member, Cornell Institute of Public Affairs, Cornell University, Ithaca, New York, USA looks upon SRI as a "good, practical, concrete, quick, low-cost way to begin working toward broader goals for solving India's food problems." If India fails to solve the problems of food security, then solving the many other problems that the country faces will become more difficult, and quite possibly impossible. SRI should not be regarded as a 'technology.' "Rather, it is better understood as a methodology, a phenomenon, a philosophy, a paradigm shift, even a social movement. SRI has permutated, it has adapted, and it has spread

to where it is changing the way that we understand and practice our agriculture, and possibly many other things. SRI is grounded in the physical and biological sciences; it touches upon-even encompasses-many dimensions of our social as well as natural universes".

"SRI method supports microorganisms in soil systems and in the plants contributing to greater productivity and robustness, and particularly to the super-yields that are not obtained with 'normal' rice crop management, which crowds the plants and suffocates their roots with continuous flooding. One of the main causes of the success of SRI methods is multiplying of microbes, activating and diversifying the microbial communities that live around, on and inside plants, even affecting in beneficial ways the expression of rice plant's genetic potentials. The interaction of roots and the soil biota represents an even more complex but promising area for study. Present knowledge needs to be added and to be reassembled with new and better 'boxes'–remembering that these boxes too will need to be challenged, questioned, and reconstructed in the future. Both science and practice are endeavors where we should continuously strive for new and better knowledge and technique, respecting what has been learned and done in the past, but not being captive or hostage of what is presently known and done". If SRI can teach us to be more humble and inquisitive, that could be a benefit even greater than putting more food on our tables, says Uphoff.

Why the Indian agricultural policy specialists ignored the SRI method, which was adopted by many countries in the 1940's and preferred the chemical intensive technology of green revolution is perhaps best known to them and is a matter of further analysis. Also the SRI method now having proved itself is not being adopted by the State on a large scale also needs to be explored and debated.