SYSTEM OF RICE INTENSIFICATION (SRI)

Proceedings of the Experience-Sharing National Workshop: Fifth National SRI Workshop

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Bangladesh Rice Research Institute
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Organized by
SRI National Network and BRRI

Co-Sponsored by
Padakhep Manabik Unnayan Kendra
A Centre for Sustained Human Development

SRI National Network Bangladesh (SRI NNB)

ADRA	An international development organisation
Amon	Summer/rainy season rice growing period, also called *kharif*
AWD	Alternate Wetting and Drying, a new method of irrigation management
BAU	Bangladesh Agricultural University located at Mymensingh, Bangladesh
Bigha	A unit of land which is one third of an acre or 33 decimals
Boro	Winter rice growing season in Bangladesh under irrigation system
BRAC	The largest international development organisation of Bangladesh 3origin
BRF	Bangladesh Rice Foundation
BRRI	Bangladesh Rice Research Institute
CERDI	Central Extension Research and Development Institute
CARE	An international development organisation
CRWRC	An international development organisation
DAE	Department of Agricultural Extension
DG	Director General
ED	Executive Director
FAO	Food and Agriculture Organisation of the United Nations
Haor	A vast low lying depression area in the north eastern part of Bangladesh
IFDC	International Fertiliser Development Corporation
IRRI	International Rice Research Institute
Kbd	*Krishibid*, an agriculturist
MoA	Ministry of Agriculture
MP	Member of Parliament
NGO	Non- Government Organisation
PETRRA	Poverty Elimination through Rice Research Assistance (a project of IRRI)
RBP	River Basin Programme (implemented by Oxfam BD in the char areas)
Rs	Rupees (unit of Indian currency)
SRI	System of Rice Intensification
SRI NNB	SRI National Network Bangladesh (SRI coordinating body in Bangladesh)
SSO	Senior Scientific Officer
STW	Shallow tube well
Upazila	A sub-district, an administrative tier in Bangladesh

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1. Introduction and Background

The System of Rice Intensification (SRI) follows a set of principles in rice production management for a more efficient interaction between plants, soil, water and nutrients; creating a congenial environment for the healthy growth of plants and realizing their best potential productive capacity. In brief, SRI involves:

- Carefully planting single, young seedlings at optimally wide spacing
- Keeping soil moist but well-drained and aerated
- Adding compost or other organic materials to the soil when possible.[1]

These practices not only increase rice yield significantly, but also help to save our soil and environment, and ensure a more sustainable production system.

SRI was first evolved in Madagascar in the early nineteen eighties. Trials were initiated in other countries after the Bellagio conference held in 1999. Today, this system is being tried in about 50 rice-producing countries including China, India, Indonesia, and other countries in Asia, Africa and Latin America. In many of these countries, the government and its research and extension organs are now actively engaged in promoting SRI together with NGOs, universities, local bodies, and individuals.

SRI was introduced in Bangladesh a decade ago with the initial SRI trials undertaken by the Department of Agriculture (DAE) in Kishoregonj[2] and CARE Bangladesh in Rajshahi and Mymensingh, followed by a number of organizations such as Bangladesh Rice Research Institute (BRRI) and BRAC. In January 2002, in a workshop where among other representatives from different organisations, Prof. Norman Uphoff of Cornell University and Dr. Noel Magor of the IRRI/PETRRA project were present, "a Steering Committee was formed for organising a working group of all interested institutions , and to coordinate, facilitate and strengthen future SRI programmes in the country"[3].

This committee developed into the SRI National Network in Bangladesh (SRI-NNB). Under a PETRRA project, trials were conducted in 12 Upazillas of six districts in the country by Bangladesh Rice Research Institute (BRRI), BRAC, CARE/POSD, and Syngenta (BD) during two consecutive *Boro* seasons, 2002-03 and 2003-04. The overall results were satisfactory and encouraging.

Under the FoSHoL project of ActionAid Bangladesh, more SRI trials were conducted in selected areas of five districts during two consecutive *Boro* seasons, 2005-06 and 2006-07. The results were highly encouraging, especially the community/block approach tried during the second year. Oxfam GB, Bangladesh, started SRI trials during the 2005-06 *Boro* season[4] and continued the same in extended areas under its River Basin Project. The SRI NNB initially facilitated the trials by providing technical assistance through training, monitoring and evaluation.

In spite of favourable responses from the farmers, however, progress in the dissemination of SRI has so far been restricted, due to lack of a coordinated and systematic approach for its promotion, including lack of policy directives and active support from the government and its research arm. The attitude of the Extension arm of the Ministry of Agriculture has been favourable, but due to lack of budget provision, its role has so far been limited to providing some technical support to the SRI farmers in different localities. Nothing systematic has been undertaken.

Initial trials have been so far sporadic, and conducted mostly in an unorganised manner, in scattered small plots of marginal farmers within the command area of STWs, where most farmers follow an irrigation

[1] SRI website: http://sri.ciifad.cornell.edu
[2] Kbd. M. Wasiuzzaman, the then Deputy Director (DD) of DAE, initiated SRI trials in Kishoregonj.
[3] Final Evaluation Report of SP 36 02 submitted to PETRRA, June 2004 (p. 1).
[4] The trials were conducted in its River Basin Project (RBP) areas in the northern Char areas to improve food security of poor farmers.

method that seriously hampers the application of 'alternative wetting and drying (AWD) method' of irrigation and other SRI principles. Results, therefore, could not be as expected[5].

Action-Aid trials have clearly showed the necessity of adopting a block/community approach in SRI production so that all the SRI principles could be followed, paving the way to effective irrigation management, ensuring reduction in costs, and significantly raising output and profitability. Among other problems faced was the adverse effect of cold wave in northern areas of the country on transplanting young seedlings (10 to 15 days old) during the winter (*Boro*) season. Practising farmers suggested transplanting of three-week old seedlings to tackle the seedling mortality problem[6].

Another problem faced has been to ensure enough organic manure for SRI plots, including compost. Due to easy availability of chemical fertilisers and their subsidized price, farmers now tend to use only inorganic fertilisers and in an unbalanced manner, resulting in increasing loss of soil fertility. Every farmer should be motivated to have at least one compost pit in the homestead since organic soil amendments enhance the productivity of chemical fertilizers used because organic matter promotes more life in the soil.

2. The Experience-Sharing Workshop

The fifth SRI national workshop titled 'SRI Experience-Sharing Workshop' was hosted by Bangladesh Rice Research Institute (BRRI) at Gazipur, Bangladesh. The workshop was jointly organised by SRI National Network and BRRI, and was co-sponsored by *Padakhep Manabik Unnayan Kendra* (A Centre for Sustained Human Development). It was held in the VIP Conference Room of BRRI on 28 April 2010. Policy makers, researchers, practitioners including field workers, and senior scientists from BRRI, BARC, IRRI, and BAU participated along with representatives from *Padakhep*, a partner organisation of Oxfam GB, the Department of Agricultural Extension (DAE), Bangladesh *Krishibid Samity*, Bangladesh Rice Foundation (BRF), and SAFE Development Group, IFDC, FAO, ADRA Bangladesh, CRWRC, and other members of SRI-NNB. A list of participants is provided in Annex A.

The main objective of the workshop was to bring together policy makers, scientists, extension specialists, and practitioners on SRI:

- To share the experiences on SRI from recent research studies and field trials, both by scientists and farmers in the country, including its achievements and limitations;
- To review and discuss progress in the spread and adoption of SRI practices in other rice-producing countries with special reference to our neighbouring country India; and

[5] A scientific paper presented by Prof. Najrul Islam from BAU in this workshop has amply reconfirmed this view. He asserts from his research findings that following all the principles of SRI results in realizing the highest yield. The paper is enclosed in the Annex of this report.

[6] Scientific reason for using young seedlings is to allow maximum effective tillering, which occurs before they reach the fourth phylochron stage. Three weeks old seedlings in the cold wave area may not reach this stage in three weeks since growth under such an adverse condition is usually stunted. Research is needed to find an answer to this problem.

- To come to a consensus on the need and potentialities of SRI in the country, and to recommend measures to be undertaken on the promotion of SRI and overcoming its limitations by collaborative efforts of the Government's research and extension organs and the NGO community, universities, local bodies and interested individuals for promotion of sustainable increase yield in rice and help improve food security in Bangladesh.

SRI Field visit: Before starting the workshop deliberations, a field visit was arranged to the experimental plots of Abu Bakar Siddique Sarker, SSO, Agronomy Division of BRRI and a Ph.D. student carrying out field experiment on different aspects of SRI practice as part of his doctoral dissertation for BAU. The Chief Guest accompanied by participants of the workshop visited the field to have a view/visual observation on the SRI practices. Mr. Sarker explained different aspects of the practices and the special features and advantages of SRI over the conventional method. The crop was almost ready for harvest. This was the concluding year of the three-year experiment undertaken by him. He reported in the workshop on his preliminary findings so far.

The workshop was graced by the presence of the Honourable Minister for Agriculture, Begum Matia Chowdhury MP, who was the Chief Guest. Kbd Dr. Wais Kabir, Executive Chairman of BARC, chaired the workshop. After recitation from the Holy Quran, the welcome address was delivered by Dr. M. Abdul Mannan, the Director General of BRRI.

3. Welcome Address

Dr. Mannan welcomed all the participants. He specially thanked Begum Matia Chowdhury M. P., the Honourable Minister for Agriculture, for kindly accepting the invitation to join the workshop as Chief Guest. In his address, he briefly narrated the valuable contribution of BRRI scientists in evolving many new rice varieties that have contributed to significantly increasing rice production in the country. BRRI has also evolved a number of modern equipments for improving rice farming practices. The scientists are now engaged in evolving improved salt-tolerant rice varieties for the coastal areas, and also submergence-tolerant varieties for the low-lying areas, which will be released soon.

The DG said that BRRI is aware about the needs of the farmers in the country, and is taking steps to do the needful. A number of super-rice varieties have been collected from China, and work is going on, especially to evolve suitable high-yielding short-duration varieties for the *Boro* season. He mentioned that BRRI was co-sponsoring the SRI workshop. Currently, research work is being conducted on SRI method by one of its scientists. If the results are favourable, BRRI will hopefully go ahead with further studies on the method. He hoped that the active participation of all the invited guests would contribute to the success of the workshop.

Message from Prof. Norman Uphoff, Program Leader for Sustainable Rice Systems, Cornell International Institute for Food, Agriculture and Development, and Global Coordinator of SRI

Prof. Muazzam Husain, Coordinator, SRI NNB welcomed the guests and participants on behalf of the Organising Committee of the Workshop. He read out a message from Prof. Norman Uphoff.[7] In his message, Prof. Uphoff congratulated the organisers of the workshop, thanked the BRRI for hosting and co-

[7] The full text of the message is reproduced in Annex 2

organising the workshop, and greatly appreciated the interest and support of Begum Matia Chowdhury to the workshop for agreeing to attend as the Chief Guest.

4. Experience Sharing by Different Organisations

4.1 SRI Progress in Tripura, India

Prof. Muazzam Husain briefly narrated the promotion of SRI in Tripura, India. A rice specialist in the Ministry of Agriculture of the State Government of Tripura took the initiative in 1999 *Boro* season to start some trials of SRI in the State. The results of these trials at the State Agriculture Research Station were encouraging, and the further trials were started to evaluate and fine-tune SRI practice for local conditions on farmers' field from 2002-03 to 2004-05. The success of these field demonstrations led to initiation of planned expansion throughout the State in 2005-06 to cover 75,000 hectares of land by 2009-10.

Participating farmers were provided Rs. 4,500/- per hectare for popularising SRI, covering mostly costs of land preparation and organic inputs such as bio-fertilizers. The three-tier *Panchayati Raj* institutions (PRIs) were also actively involved, which helped in extending the SRI area within a short period of time. Local government bodies took an active interest in SRI, reflecting farmers' enthusiasm for the new methods when tried and in turn building more farmer acceptance.

The State government has actively accepted SRI methods as a strategy to increase the state's rice production and attain self-sufficiency in food grains in the State. Bangladesh shares close similarities in topography, soil composition, and rice-cultivation tradition with Tripura. Therefore, much of its experience would be relevant in Bangladesh.

4.2 Papers of Dr. Baharul Islam Majumder, Sr. Agronomist, Dept. of Agriculture, Tripura:

Dr. Baharul Islam Majumder, the rice specialist who gave state-wide leadership for SRI evaluation and extension in Tripura, had agreed to present the keynote in this year's SRI Experience-Sharing Workshop. However, due to some unforeseen problems faced in obtaining a visa in time, he could not attend the workshop. Dr. Majumder sent a message to the participants and a paper for presentation. Another paper on SRI progress in Tripura was also received. Dr. Muazzam Husain, SRI National Coordinator, briefly shared with the workshop participants his message and the contents of his papers.

Adoption rate of SRI in Agartala, Tripura was highly encouraging. In 2002-2003, the initial year of SRI replication at farmer level, only 44 farmers participated, which expanded to 440 farmers in three years. During the first year of the planned expansion period (2005-06), the number of farmers using the new methods went to 880. In the year 2007-2008 162,485 farmers practiced SRI in 32,497 hectares of land covering 13.77% of the rice cultivated area. During 2008-2009 *kharif* season alone, the number of SRI practitioners increased to 123,910 farmers, and by 2008-09 it rose to 250,000, covering an area of 50,000 ha.

The farmers reported that their costs of rice cultivation had slightly reduced while a significant increase of their rice yield was attained.

Dr. Majumder also shared information from Tamil Nadu state of India where 27% rice cultivation area (538,000 hectares of land) of the state has been brought under SRI. In three years, the number of farmers practicing SRI increased from only 880 to 197,450 and it is still rising.

The large-scale expansion of SRI in Tripura was possible due the mass movement that emerged to support SRI by the State Government and *Panchayati Raj* institutions with active farmer support. For promotion of SRI, the state government contributed a little less than 50% of the cost in the demonstration plots.

In the introductory part of his paper, Dr. Majumder presented how better rice cultivation has evolved through relentless efforts of farmers just through their observations and experimentation. He lamented that "contemporary irrigated rice cultivation has become quite uniform with a standard set of practices," preferred by scientists who were pleased with high external inputs. But in recent years there has been a diminished yield growth rate reaching a plateau.

Seeing this decreasing yield rate and plateau for further increases underscores the importance of SRI at the moment. With all good intentions and satisfied with a few decades of increase in yield, the Green Revolution has ignored indigenous rice varieties, has increased external input use and farmers' financial dependence, and all this has affected bio-diversity and is contributing to adverse climate change impacts.

Dr. Majumder pointed out that "SRI is quite different from the approach of the Green Revolution in that:
a) It is not a seed-based approach,
b) It makes reductions in inputs such as seeds, water, fertilizers, and labour and yet gives more yield, and
c) It originated outside of the established scientific institutions."

Farmers' experience has proven that SRI brings in higher resource-efficient productivity, which is good for the farmers, the soil and the rice plant itself. All the participants were impressed and regretted his absence because they would have liked further clarifications from him on SRI success in Tripura State.

A gist of the paper submitted by Dr. Majumder titled "System of Rice Intensification (SRI) – A Traditional Method of Rice Cultivation of India?" was also presented by Prof. Husain. The main theme of the paper was that a method of single seedling planting of paddy, close to the present-day SRI method of cultivation was developed by farmers of Tamil Nadu, India, about a hundred years ago. This practice, along with another farmer-devised version of the single-seeding practice, called Gaza planting, which involved a detailed package of practices, was also introduced during the first decade of the twentieth century. Main features included single seedling planting, row planting, use of organic manure, weeding, and economic water management. These practices were closely similar to the present SRI practice. However, one concept of SRI, namely early transplanting was not there in this practice; and the concept of soil aeration was also not well understood. The method had resulted in substantial increase in yield. He mentioned that after two to three decades of its introduction, these systems apparently seemed to have gradually given way to somewhat different practices, the reasons for which are unknown. However, he mentioned that "seeing these historic 'echoes' could make it relatively easier to promote SRI today. The intention of this paper is not to suggest that SRI originated in India. Rather we wanted to document that many of its practices have been utilised in India long ago, and farmers were able to use them quite successfully. The paper does not diminish the importance of SRI but rather shows that it is grounded in biological potentials and realities that have existed in the rice genome for millennia." (This interesting paper is attached in Annex 2.1 (b) for the benefit of the readers.)

4.3 A.B.S. Sarker's SRI Research at BRRI

Abu Bakar Siddique Sarker, a Senior Scientific Officer of BRRI, briefly narrated preliminary findings from his Ph.D. research study conducted on SRI production and management practices during three consecutive *Boro* seasons.

The study found that SRI methods result in a proven increase in rice yield. Average SRI yields were around 2 tons/ha higher than conventional yield. He briefly stated the different advantages of the SRI practice, and his

findings on different aspects of SRI on the performance of the practice. For example, during the *Boro* season on the time of transplantation the first half of December gave the highest yield; on age of seedlings 12 day old seedlings gave best results, best spacing of seedlings in transplantation was found as 25x25 and 25x30 cm; in water management, at the initial stage, irrigating with an interval of two to three days gave best results; in fertiliser management, combination of organic with recommended dose of chemical fertiliser gave better results; and in seedling raising, compost bed method was found to be preferable. He also indicated that any short-term project of SRI would be not effective. Changes in age- old traditions in rice cultivation, for that matter bringing about any change in farmer practice, requires a reasonable time span. All stakeholders here need to be addressed to facilitate them comprehending and adopting SRI techniques.

4.4 BRRI study on Perception of Farmers on SRI in Satkhira

Dr. Rafiqul Islam, Senior Scientific Officer, Agriculture Economics Division, BRRI, mentioned in his presentation that the farmers who had received support from IRRI/ PETRRA project in Tala Upazila of Satkhira district during 2003-2004 are still continuing SRI method of rice cultivation. The farmers have adopted the principles of SRI according to their farm and social conditions.

In his study it was found that farmers have received 30% higher yield than that from conventional methods during the 2009 *Boro* season. The farmers transplanted tender-aged seedling in wider spacing and also used manure during land preparation, which are key principles of SRI. Dr. Islam also stated that the production cost of rice has been reduced by 20% due to savings of seed, chemical fertilizer, and other costs. Although, according to them, the labour cost was a little higher in the SRI plots compared to the conventional method, the higher level of yield generated more income for the farmers.

Forty percent of *Boro* land in the village is now under SRI management, and all farmers present at a village meeting expressed their support for the SRI method as superior to the conventional method. He stressed that SRI approach should be promoted with dynamic initiative and a more appropriate way to increase rice production in an environment-friendly method.

4.5 Findings from SRI Research at BAU Mymensingh

A scientific study on performance of SRI was conducted by a Ph D student of BAU under the supervision of Prof. Najrul Islam of BAU. The study consisted of 59 trial plots. The factorial trials consisted of single SRI practices to using all practices on different plots. The study found that when all the recommended practices of SRI were followed in the field the highest record of yield was achieved. He concluded that SRI was superior to the conventional method of rice production; and adoption of SRI requires good understanding of its component technologies.

Dr. Islam recommended that research and trials should be conducted in different agro-climatic zones of the country involving varieties and for fine-tuning of component technologies, which will create more awareness among farmers, scientists and other stakeholders. Under existing soil and environmental conditions in Bangladesh, integration of organic manure and chemical fertiliser will be conducive. Adoption of AWD technology of IRRI would be more efficient in water management under SRI. Appropriate institutional support is needed to promote research and adoption of SRI across Bangladesh.

He mentioned that SRI method of rice production should be promoted to the farmers with government and non-government initiative to improve food security situation of the country. A joint programme with all concerned government and non-government agencies might make a larger impact of SRI to boost up rice production in the country.

4.6 SRI in Farmers' Field of RBP Project, Oxfam Bangladesh

Mr. Kazi Monir Mosharof, Program Coordinator, Padakhep, presented the findings on SRI trials sponsored and supported by Oxfam GB, Bangladesh, and implemented by Padakhep through nine associate organisations in five districts of Gaibandha, Kurigram, Lalmonirhat, Jamalpur and Shariatpur, in the River Basin Programme (RBP) areas of Oxfam.

The key findings show gradual increase in number of farmers and area under SRI, higher yields, lower costs, and higher profitability of SRI than under farmers' normal practice. Among the limitations of SRI were mentioned: problems in transplanting young seedlings, especially due to cold waves during the *Boro* season; and problems in practicing recommended practices in irrigation. Recommendations included: adoption of a community or block approach, mainly for efficient irrigation management; development of suitable transplantation implements and tools; and adjusting transplanting time for escaping cold injury during seedling and early plant growth periods in cold wave-prone areas.

5. Discussion

After presentation of experiences and findings of different organizations and scientists, open discussion was conducted. The open discussion was facilitated by DG, DAE.

5.1 Kbd. M. Wasiuzzaman, President of Bangladesh Krishibid Samity

SRI is a proven technology on which much research has been done, and over 40 countries have adopted it. Therefore, effort must be given for its extension in Bangladesh. It is unfortunate that BRRI has not yet accepted SRI for increasing rice yield. "Let us all (government and non-government agencies) work together for SRI extension. There are projects on granular urea extension, leaf-colour-chart extension, and on drum seeder extension. Why cannot we have a project on SRI?"

5.2 Dr. A.B. Siddiqui, ED, BRF

He mentioned that SRI is a system of rice production management, and all its components need to be tried in an integrated manner. He also said that for better success a block/ community approach is necessary; and that joint efforts should be undertaken for further research and trials for promotion of SRI in Bangladesh.

5.3 Dr. M. A. Hamid Mia, IRRI Liaison Scientist, Bangladesh

Dr. Hamid Mia stated that SRI increases yield, but so far we could not consistently disseminate its benefits to farmers. He also believed that some practices associated with SRI are very difficult for the farmers to practice such as land levelling and transplanting young seedlings.

He suggested that comparative cost analysis of SRI and farmers' current practice may be re-examined, and all stakeholders should jointly go for research. He also asserted that SRI is location-specific method. It is also necessary to identify appropriate farmers for SRI. He believed that we must adopt a demand-driven approach for SRI dissemination and in providing SRI services: 'It must be a menu and not a recipe'. According to him, SRI suggests transplanting 8 day-old seedlings[8] but farmers could not practice this. They transplant 21 to 22-day seedlings

[8] Although Dr. Mia mentioned 8 day-old seedlings, the SRI manual published by SRI NNB suggests that only during the *Aman* season 8 day-old seedlings may be transplanted. The manual suggests that during the *Boro* season, due to cold weather, two-week old seedlings may be transplanted. Our subsequent experience shows that early transplantation may be avoided or

5.4 Mr. Alamin from Bhanga Upazila

One participant, Mr. Alamin from Bhanga under Faridpur District, Bangladesh, narrated his short experience on SRI practice. He partially adopted the SRI practice by following only two factors. These were transplanting single seedling and use of 15-day-old seedlings. However, he did not follow the other essential components of the practice such as wider spacing, the alternate wetting and drying method of irrigation, weeding by using a rotary weeder, and using more organic fertiliser for improving soil quality. As a result, no significant increase in yield was found in his trial. It may be noted here that to obtain best result, these other factors also must be followed.

6. Designated Speakers

6.1 Speech by Kbd. M. Sayeed Ali, Director-General of Department of Agriculture Extension, Bangladesh

FAO awarded in 2000 the then (also now the current) Prime Minister Sheikh Hasina for her achievement of food grain sufficiency. In her second term at present her government has brought grain production, mainly rice, to a break-even-point. However, rice production should be further increased. SRI has proven its potentiality to contribute towards a sustainable increase in rice production. There are other technologies that also increase yield. Nevertheless, research on SRI adoption and expansion should be conducted. SRI is location-specific. Therefore, research may also include determination of areas suitable for SRI in different parts of Bangladesh.

He said information from Agartala, Tripura, is encouraging. Rice cultivated areas in Bangladesh and Tripura have reasonably similar characteristics. It would have been nice to have Dr. Baharul Islam Majumder presenting his keynote paper. Although Dr. Muazzam Husain presented the paper very well, some of the questions the participants had could have been better posed to him for good understanding. However, the result of SRI in terms of increase in yield, decrease in cost, and rapid expansion among the farmers is rewarding. We have much to learn from the Agartala experience.

He concluded saying there is no doubt that SRI showed significant increase in rice yield. There is gap in understanding of SRI, proper experimentation in the field, and recognition of SRI by the scientific community. We can expect joint ventures among different interested parties that include government departments, NGOs and the farmers. We must opt for coordinated programmes to better understand SRI and take advantage of SRI for optimization of rice yield.

6.2 Speech by Chief Guest, Honourable Minister for Agriculture, Government of the People's Republic of Bangladesh

With greetings to all participants from government, NGO and the farmers, Honourable Minister for Agriculture, Begum Matia Chowdhury MP, began with the concern of her Ministry on food security. She said that population was increasing gradually. At the same time, land area under cultivation was decreasing due to expansion of industries, housing and other non-farming activities. To feed the increasing population of the country, therefore, any technology that can increase yield is welcome. It has been observed that both the farmers and supporting agencies from government and non-government sphere are convinced of SRI to be a yield increasing technology. Many new technologies have been in practice since long. Nevertheless, SRI in combination with many of these practices appears to have proven to be a successful method of rice

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delayed in areas during the period when they suffer from cold wave. It is enough that transplantation is done before the initiation of the fourth phylochron stage of the plant. Further research is suggested on this aspect.

cultivation in many countries. Some principles of the SRI method are already being practiced by many farmers in Bangladesh.

For effective replication of any new technology or practice in agriculture, the current policy of taking up more and more short-term 'projects' should not continue to be a primary focus. In the case of SRI, the Agriculture Ministry of the present government would support undertaking SRI demonstration and extension activities as part of a regular programme of the Department of Agricultural Extension that will be sustainable. She observed that it has become a practice that while a project runs, some changes are visible, but after the end of the project, no follow-up activities are undertaken to sustain the impact of the project.

She said that labour is a big concern of farmers of Bangladesh, and it is often believed that SRI is labour-intensive. Labour is becoming scarce in rural area. Therefore, the SRI promoters should take into account that intensifying labour requirement may be a burden to marginal farmers.

She informed further that *Boro* rice cultivation has been gaining in popularity over other rice seasons on the ground that environmentally it is relatively less hazardous. In the *Haor* area, we need to go for short-duration rice varieties. She feels, however, that if all efforts are given over to rice cultivation in *Boro* season throughout the country, it may lead to overtaxing of farmers' time and resources. Cost of production is very high during the Boro season. *Amon* rice cultivation is being neglected. If everybody concentrates on *Boro,* it would not be a reasonable approach to promoting agriculture in Bangladesh. She agreed that *Boro* yield is increased, but she pondered, at what cost? Does cost-benefit analysis indicate it to be comparatively most profitable?

She called the attention of all concerned to the focus on issues of northern Bangladesh, which is being over-studied. She insisted that scientists and other stakeholders concentrate also in other parts of the country. All parts of Bangladesh should be supported and taken advantage of, in an equitable manner.

She cited the present disaster in the *Haor* due to early flash flood that inundated nearly 50,000 hectares of standing rice. Prevention of such a disaster could only be addressed by the joint efforts of the Water Board, and agricultural research and agricultural extension. Scientists did not disseminate proper knowledge to *Haor* farmers on the unsuitability of BR 29, a long-duration variety. She claimed that information from the media suggests that BR 28 which would have been more appropriate to the *Haor* area was not promoted; rather BR 29 was promoted for the ulterior benefit of traders.

The Ministry of Agriculture welcomes more research. She said research on increase of yield is given priority. Further research on SRI can be undertaken to check the hurdles remaining and on things that are hampering the expansion of SRI. Our main focus in looking at any technology should be: whether it benefits the farmers economically and contributes to better food security.

She emphasized that research results must be sustainable. Scientists and activists should take all measures that farmers are able to sustain the benefit of the research. They should see that the farmers are able to grasp the knowledge and skill to keep up with the technology and gain from practicing what they suggest. We welcome technology / knowledge that increase yield, she added. Agriculture farming is conducted by the private sector, and therefore arbitrators are the farmers – farmers will take the final decision on whether to accept or reject any technology. She suggested that scientists and NGOs work in close collaboration and in consultation with farmers. Improved and appropriate crop management practices must be taken to the farmers' field to derive best results. Keeping them in the researchers' field is not enough.

The Ministry of Agriculture of Bangladesh has its door open to all initiatives and programmes that benefits the farmers, she reiterated. At the end she wished all the best to the effort taken by SRI Network Bangladesh and its collaborating institutions; and underlined the issue that they should all take measures to increase yield.

6.3 Concluding Speech by the Chairperson, Dr. Wais Kabir, Executive Chairman, BARC

He said that no technology is panacea. We try to accept any technology that increases yield. Now we need a technology that reduces water requirement; and a technology that reduces labour, besides increasing yield. As Dr. Hamid said, we do need joint and collaborative work on SRI so that we can accept SRI, if necessary even in a modified form. We should remember that in Bangladesh, agriculture is location-sensitive.

Dr. Kabir asserted that short-lived projects do not sustain. Instead of a 'project,' we need a 'program' approach on SRI, and it will then be sustainable. Agricultural extension and research in Bangladesh have earned a good reputation in the world, showing commendable success. So let us all give SRI an opportunity to prove its potential in Bangladesh.

7. Recommendations

- The workshop recommended an integrated and coordinated programme approach by government (research and extension) and non-governmental organisations (national and international) for promotion of SRI in a planned manner. The DAE would support extension/promotion of SRI as a regular programme, and BRRI should conduct research on overcoming various constraints that the farmers face in specific areas.

- More research is necessary for a planned and systematic expansion of SRI in Bangladesh. The concurrent recommendation was to carry out coordinated research on SRI, especially multidisciplinary action research. This has been recommended to be carried out by government and other organizations working at the field level. At the same time, SRI practices by farmers shall also be nurtured by organizations working directly with farmers.

- Action research by practitioners on identified impediments related to water management, transplantation of young seedlings during winter cold waves, labour and weeding may be given priority. Studies on identifying areas most suitable for SRI should be one of the research activities, including finding out better combination of SRI practices appropriate for different agro-ecological zones in Bangladesh. Social, environmental and ecological studies may also be undertaken to better reflect the benefits of SRI. In particular, studies may be conducted on how SRI can better address a number of negative ecological impacts that affect the environment, bio-diversity and climate change.

- In pursuance of the above, it was also recommended that:
    a. Collaborative joint venture should be undertaken by government (GO) and non-government organisations (NGO); and
    b. SRI NNB would play a coordinating role in this respect.
- It was also suggested by the Chief Guest to convene such national workshops in the capital city to reduce time wasted on the road. This would allow spending longer time to presenters and the discussants.

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ANNEX - 1

Annex-1: Workshop Participants

Ministry of Agriculture

1. Hon'ble Minister Begum Matia Chowdhury
2. Mr. C Q K Mustaq Ahmed, Secretary
3. Mr. Anwar Faruk, Addl. Secretary, and MD, Seed Wing
4. Mr. A Z M Shafiqul Alam, Addl. Secretary, PPC
5. PS to Hon'ble Minister for Agriculture

Bangladesh Rice Research Institute

6. Dr. M. Abdul Mannan, DG, BRRI
7. Dr. M. A. Salam, Director (Res)
8. Dr. A K G Md. Enamul Haque, Director (Adm)
9. Dr. M. Jalil Mridha, Head, Agronomy
10. Dr. M. Shahe Alam, CSO and Head, Ag Econ Div
11. Head, Irrigation and Water Management
12. Head, Physiology
13. Head, Soil Science
14. Head, Adaptive Research, Head, Training
15. Mr. ABM Siddique Sarker, SSO, Agonomy
16. Shah Asadul Hoq, Agronomy
17. Dr. M. Hazrat Ali, PSO and Head, Rice Farming System
18. A. B. Siddique, Agricultural Economics Division
19. Humanyun Kabir, Adaptive Research Division
20. Dr. Rafiqul Islam, Agricultural Economics Division
21. Head, GQN
22. Head, Farm Division
23. Head, Statistics
24. Dr. Mohibul Hasan, Entomology
25. Head, Genetic Resource and Seeds
26. Head, Training
27. Head, Publication
28. Dr. M. Quayum, Agricultural Economics Division
29. Head, Pathology
30. Dr. Bijoy Kumat Biswas, Head-in-charge, Workshop and Machinery Maintenance
31. Head, Biotechnology
32. Head, Farm Machinery and Post Harvest Technology
33. M. Eusuf Harun, PSO

Department of Agricultural Extension

34. Kbd. M. Sayeed Ali, DG, DAE
35. Kbd. M. Fazlul Karim, Director (Training)
36. Kbd. M. Shahidulla Kaiser, Director (Cash crop)
37. Kbd. Rafiqul Islam, DD (Cash crops)
38. Ataul Haque

Bangladesh Agricultural Research Council

39. Kbd. Dr. Wais Kabir, Executive Chairman

CERDI

40. Kbd. Tofazzal Hossain, Executive Director

Seed Certification Agency

41. Kbd. M. Rashiduddin, Director

IRRI Bangladesh

42. Dr. M. A. Hamid Mia, Liaison Scientist
43. Ahmed Salahuddin

Bangladesh Agricultural University

44. Prof. Dr. Najrul Islam, Head, Dept. of Agronomy
45. Dr. Md. A. Kader, Dept of Agronomy
46. Md. Alimur Rahman, Dept of Agronomy

Krishibid Institution Bangladesh

(Kbd. M. Wasiuzzaman Akond, Chairman, Krishibid Institution attended. His name has been listed under SRI NNB as he is also a member of the Executive Committee of SRI NNB)

BRAC

47. Dr. M. Serajul Islam, Chief Agronomist
48. Kbd. Mr. Taslim Reza, Senior Sector Specialist, BDP

Padakhep Manabik Unnayan Kendra

49. Mr. A B M Siddique, President
50. Dr. Sk. Tanveer Hossain, Director, Agriculture and Environment
51. Mr. Monir Mosharof, Programme Coordinator
52. Mr. Salahuddin Ahmed
53. Mr. Aminul Islam
54. Mr. Ruhul Matin

IFDC

55. Ms. Ishrat Jahan, Resident Representative, Asia Division
56. Mr. Mofizul Islam, Sr. Agricultural Specialist

ADRA Bangladesh

57. Mr. Elidon Bardhi, Country Director
58. Mr. Gomes Babul, Project Manager

CIMMYT

59. T P Tiwari, Agronomist

CRWRC

60. Mr. Mathew Mitra
61. Mr. Sanjoy Ranjan Kar
62. Mr. Apurba Ghagra

BRF

63. Dr. A B M Siddiqui, Executive Director (He is also a member of the EC, SRI NNB)

SRI NNB

64. Kbd. M Wasiuzzaman Akonda, President, Krishibid Institution, and Member, EC
65. Mr. Gopal Chowhan, ED, Safe Bangladesh, and Member, EC
66. Mr. Luther Das, Monitoring Specialist
67. Prof. AM Muazzam Husain, Coordinator, SRI NNB

Media

68. Representative, Mati-O-Manush (BTV)
69. Representative, Channel I (TV)
70. Representative, Channel I (TV)
71. Representative, Daily Jugantor
72. Representative, Gano Chetona

ANNEX - 2

Annex-2: Text of Message from Prof. Norman Uphoff

Cornell University

College of Agriculture and Life Sciences

Norman Uphoff, *Program Leader for Sustainable Rice Systems*
Cornell International Institute for Food, Agriculture and Development
33A Warren Hall, Ithaca, NY 14853

Telephone: 607-255-1902
Fax: 607-255-1005

ntu1@cornell.edu
http://ciifad.cornell.edu

April 25, 2010

To: Dr. Muazzam Husain
Coordinator, National SRI Steering Committee

From: Prof. Norman Uphoff, Sustainable Rice Systems Program,
Cornell International Institute for Food, Agriculture and Development

Re: Occasion of the ***National SRI Experience-Sharing Workshop***, April 28

Let me congratulate you and your colleagues on organizing this important event, and I would like to thank and commend the Bangladesh Rice Research Institute for hosting and co-organizing this workshop. The interest and support of the Honorable Minister for Agriculture, Begum Motia Chowdhury, is also greatly appreciated, elevating the status of this meeting by attending as Chief Guest.

The merits of System of Rice Intensification (SRI) practices and concepts have now been seen in ***39 countries*** all around the world. The newest member of *'the SRI club'* is the Democratic People's Republic of Korea, whose farmers can greatly benefit from a methodology that raises output with a reduction in external inputs.

It is gratifying to see in Bangladesh as in other countries that the demonstration and dissemination of SRI principles is a ***collaborative effort*** that links partners in the government and NGO sector, in universities and research institutions, in the private sector, and in rural communities. SRI is more than a technical innovation; it also represents ***a model for agricultural improvement***, bringing together the knowledge and skills of persons in diverse walks of life.

SRI differs in several ways from the strategy of the ***'Green Revolution'***:

- Instead of requiring ***new varieties*** (improved genotypes) and ***more inputs*** of agrochemical fertilizers and crop protection, SRI just modifies the way that ***plants, soil, water and nutrients are managed***. This produces more beneficial and robust phenotypes, getting more output from available inputs. Alternative practices enable plants to grow bigger and better ***root systems***, and they also enhance the abundance, diversity and activity of ***beneficial soil organisms***.

- Instead of transmitting to farmers a ***set package of inputs and practices***, to be adopted as they are told, farmers are encouraged to do their own experiments and evaluation: to determine what age of seedlings, what spacing, what water management schedule, etc., is *most productive for their conditions*. With SRI, farmers are ***adapters*** rather than ***adopters***. We regard SRI more as a ***menu*** than as a ***recipe***. We want farmers to become skilled and motivated innovators, indeed ***partners***, in achieving agricultural improvement more broadly.
- Much agronomic improvement has previously focused mostly on getting ***higher yields***, whereas SRI promotion is most concerned with ***productivity*** -- of ***water*** (crop per drop), of ***labor*** (kilograms of paddy per day or per hour), and of ***capital*** (profitability) as well as of ***land*** (conventional agronomic yield). Water-saving, farmers' income, resistance to biotic and abiotic stresses are collectively more important than yield. More attention needs to be paid to the whole set of objectives and constraints involved in rice production.

While this workshop will focus on the potentials, achievements and limitations of SRI to improve performance in the rice sector of Bangladesh, I hope that everyone will keep in mind that these methods and concepts are relevant to ***other crops***. In India, a ***Sustainable Sugarcane Initiative*** (SSI) has been launched by WWF and ICRISAT to increase the production of ***sugarcane*** -- by using less water and less fertilizer. From India and also Ethiopia and Mali, we now have reports that SRI ideas applied to ***wheat*** (SWI) are raising the productivity of this crop. In India and also Ethiopia, we are seeing SRI-related methods substantially increasing the production of ***finger millet*** (*ragi*). In Orissa state of India, according to a report in *The Hindu* (April 13, 2010), farmers there are raising yields of ***vegetables*** (such as tomatoes and brinjal) and ***mustard*** by using their own adaptations of SRI methods.

There remains much to be studied and known about these results, but the effects appear to be related to ***changes in roots and soil biology***. These have received relatively little scientific attention, compared to above-ground plant science and soil chemistry and soil physics. Observations and experience over the past decade now give grounds for optimism that food insufficiencies can be remedied even in the near-run. I hope that all of the partners coming together for this workshop will approach SRI experience ***both critically and imaginatively***. I would like to be with you on this occasion, but my teaching responsibilities at Cornell University limit my travel during the academic term. You have assembled a very strong and impressive set of participants, all the way from the field level to Dhaka at the center. I wish you all a very productive and successful workshop.

Norman Uphoff
Professor of Government and
International Agriculture

ANNEX - 3

Annex-3: Workshop presentations

3.1 (a) SRI Progress in Tripura, India

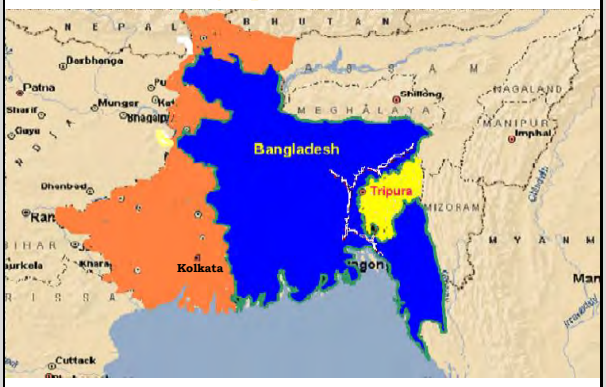
TTRIPURA STATE EXPERIENCE IN ADOPTION OF SRI: THE ROLE OF GOVERNMENT AND PANCHYATI RAJ INSTITUTIONS

Dr. Baharul Majumdar

Dept. of Agriculture, Agartala

Adapted from presentation to 3rd National SRI Symposium, Coimbatore, Dec. 2008

Geographical Location



Agartala-Kolkata distance went from 350 km before Partition, to 1,645 km

3

- **Distances (in km)**

Kolkata	1,645
Guwahati	587
New Delhi	2,637
Shillong	487

Distance to sea (from Sabroom) – 60 km

4

Brief Profile

- Union Territory on 1st July, 1953; Became State from 21st January, 1972 (3rd smallest Indian State)
- Long international border (856 km)
- Forest land: officially 60% of total area
- 4 Districts, 17 Sub-Divisions, 40 Blocks, and 1 Autonomous District Council
- Princely State merged in October, 1949
- 4 Zilla Parishads, 513 Gram Panchayats, 527 ADC Villages, 1 Municipal Council, and 12 Nagar Panchayats

5

STATE PERSPECTIVE PLAN: OBJECTIVES FOR 2001-10

State Government commitments:

- Achieve self-sufficiency in food grains by 2010
- Improve farmers' economic condition

PERSPECTIVE PLAN IMPLEMENTATION

- After 7 years of implementation of the Plan, food grain production only had risen from 5.13 lakh tons to 6.35 lakh tons
- There remained a shortfall in foodgrains of about 1.50 ~ 1.60 lakh tons
- Rapid growth in food grain production cannot be achieved without adoption of a proper system for improvement of crop management
- Advent of SRI in 2005 came at right time

Shrinkage in Cultivable Area

Diversion of agricultural land for non-agricultural purposes, i.e.,

- Domestic and other developmental uses
- Area for fencing along border
- Road construction
- Brick kilns
- Plantation crops like rubber, etc.

Rice is the growth engine of the State's economy

Two-pronged strategy was adopted to increase the rice production per unit land per season

- Crop management – through SRI
- Varietal technology – hybrid rice

Category of Farmer

Category	No. of farmers
Marginal (< 1 ha)	405,788
Small (1 to 2 ha)	54,598
Small-medium (2- 4 ha)	17,032
Medium (4 - 10 ha)	1,803
Large (> 10 ha)	207
TOTAL	479,428

Operational Holdings

Farmers	Operational holdings (%)		Area operated (%)		Average size of holding (ha)	
	TRIPURA	ALL-INDIA	TRIPURA	ALL-INDIA	TRIPURA	ALL-INDIA
Marginal (below 1 ha)	84.6%	63%	47%	19%	0.3	0.40
Small (1 to 2 ha)	11.4%	19%	28%	20%	1.4	1.41
Small-medium (2-4 ha)	3.6%	12%	16%	24%	2.6	2.72
Medium (4 - 10 ha)	0.4%	5%	3%	24%	5.2	5.80
Large (above 10 ha)	0.04%	1%	6%	13%	78.8	17.18
Total	100%	100%	100%	100%	0.56	1.32

Experimental Demonstrations

Started in farmers' fields in crop year 2002-2003:

Kharif	Farmers		Area	Total
• 2002-03	44	@	0.2 ha	8.8 ha
• 2003-04	88	@	0.2 ha	17.6 ha
• 2004-05	440	@	0.4 ha	176 ha
• 2005-06	880	@	0.4 ha	352 ha

At this point, the State Government was persuaded to give SRI full backing

At first, SRI introduction met with:

- Criticism
- Resistance
- Opposition

Visit of Dr. M.S. Swaminathan to SRI fields

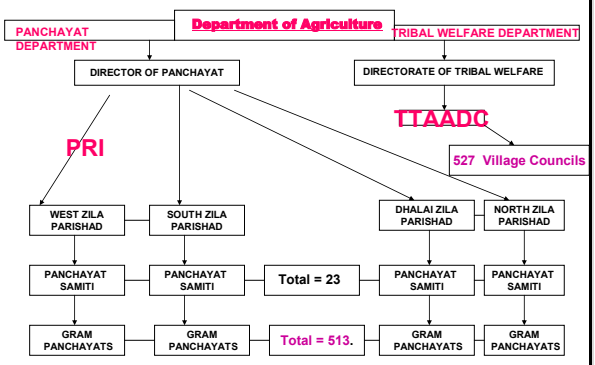
MASS MOVEMENT

emerged to support

SRI MOVEMENT

having cooperation of the State government and Panchayati Raj instituions

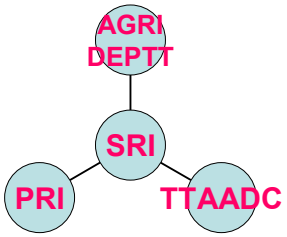
REFORMULATED INSTITUTIONAL APPROACH



Awareness-cum-Training for Public Representatives

- Future Food Crisis
- What is SRI?
- Why SRI is Essential
- How to Practice SRI
- How to Adopt SRI
- Incentives for SRI
- Problems Related to Practice and Adoption of SRI
- How to Minimize Problems
- Incentives for SRI Adoption

Large-Scale Adoption of SRI



PRI / TTAADC Contributions

- Farmers' Mobilization
- Weeders
- Markers
- Labour Cost – 20-25 man-days
- Drainage and Irrigation Channels

FINANCIAL BREAK DOWN OF SRI DEMONSTRATION COSTS:

Sl No.	Item/Input	Physical		Financial (In Rs)	
		Per ha in Kg/ No	Per 0.2 ha unit area	Per ha in Kg/ No	Per 0.2 ha unit area
1	Seed (Kg)	5	1	70.0	14.0
2	N:P:K @ 20:10:10 kg/ ha				
	a) Urea	44	9	230.0	46.0
	b) SSP	63	13	330.0	66.0
	c) MOP	17	4	89.0	18.0
3	Organic Manure	10	2	2,500.0	500.0
4	Bio-Fertilizer @ 4.0 Kg/ha per cultivator per strain-3 strains	12	2.4	360.0	72
5	Plant Protection Chemicals:				
	a) Prophylactic	LS	LS	200.0	40.0
	b) Bio- agents	LS	LS	150.0	30.0
6	Nursery Materials	LS	LS	500.0	100.0
7	Contingency Expenditure	LS	LS	71.0	14.0
	Total			4,500.0	900.0

Funding Pattern :

- Demo. Cost per Hectare : Rs. 4,500.00
- From State Plan : Rs. 2,000.00
- From Macro Mgmt : Rs. 2,500.00

Rate of Adoption of SRI in Tripura

YEAR	Area covered through SRI (ha)	Total paddy area (ha)	Covered through SRI (%)	Farmers involved (no.)
2002-03	8.8	239,670	0.003	44
2003-04	17.6	242,110	0.007	88
2004-05	176	238,950	0.07	440
2005-06	352	237,150	0.14	880
2006-07	14,678	235,272	6.23	73,390
2007-08	32,497	235,938	13.77	162,485
2008-09	50,000	235,500	21.23	250,000

Rate of SRI Adoption in Tripura

Year	Area covered under SRI	Total area in paddy	Percent covered under SRI	No. of farmers involved
2006-07	14,678 ha	235,272	6.23 %	73,390
2007-08	32,497 ha	235,938	13.77%	162,485
2008-09	24,782 ha (Kharif only)	192,000	12.90% (Kharif only)	123,910 (Kharif only)

Total SRI target for 2008-09 is 50,000 ha
Achievement shown is only for Kharif Season 2008

Productivity of Rice – Tripura *vs.* All-India

Year	Yield (tons/ha)			
	All-India	Tripura	SRI in Tripura	Increase over present practice
2003-04	2.077	2.396	5.360	2.964
2004-05	1.984	2.352	5.025	2.673
2005-06	2.102	2.383	4.690	2.307
2006-07	2.084	2.503	4.271	1.768
2007-08	N.A.	2.550	4.321	1.771

Increase in foodgrains production through adoption of SRI in Lakh tons

Year	Projected foodgrains requirement	Likely production with present trend	Additional production from SRI adoption	Projected production
2008-09	8.09	6.74	0.50	7.24
2009-10	8.22	6.88	0.75	7.63
2010-11	8.34	7.03	0.90	7.93
2011-12	8.48	7.17	1.00	8.17

Per ha average yield increase through SRI – 1 Mt

South Tripura District, Rajnagar Agric. Subdivision: Dimatali -- all tribal village, 21/78 farmers using SRI -- **6.5 t/ha SRI yield vs. 2.5 t/ha conventional** -- ***two years ago not even doing row planting***

3.1 (b) Paper of Dr. Baharul Islam Majumder

System of Rice Intensification (SRI): A Traditional Method of Rice Cultivation of India?

Baharul Islam Majumder

Agricultural practices that were evolved over the many centuries before agricultural science was ascendant, derived mostly from farmers' observations and experimentation. Much before there were agricultural research programs, farmers selected superior crops, designed better cultivation methods, domesticated animals, and found ways to make their farming systems more productive. However, after the establishment of scientific research institutions, agricultural advancement was gradually taken out of the hands of farmers, and they started looking to these institutions to fix their problems. While this evolution of scientific leadership has contributed to substantial agricultural development the world over, farmers' experiments and innovations have gotten less recognition and reporting. Sometimes, indeed, innovations made by farmers have been appropriated by researchers and then handed back to them.

Rice, the world's most widely grown and eaten cereal crop, was domesticated as many as 11,000 years ago, as seen from recent archaeological findings in China. Since then, farmers in many agro-climatic zones have experimented with different varieties, have tried alternative methods of cultivation, and have disseminated various practices. In spite of the fact that rice is cultivated under diverse agro-ecological conditions in about 110 countries, contemporary irrigated rice cultivation has become quite uniform with a standard set of practices, viz., establishing a nursery, transplanting seedlings, applying nutrients to enhance soil fertility, weeding, irrigation, and plant protection, with minor variations across regions.

The Green Revolution starting in the 1970s popularized the use of high- yielding varieties in order to rapidly increase food grain production to meet the growing demand. But this came with a price – the sidelining of traditional varieties, many of which had desirable characteristics, and greater reliance on chemical fertilizers. Utilization of organic sources of plant nutrition was diminished, and farmers became increasingly dependent on purchased inputs: seeds, fertilizers and pesticides, looking to formal research and extension services for guidance. By the end of the 20th century, increasing awareness of the problems of environmental degradation and of the dangers of over-use of chemicals in agriculture led to a revival of interest in organic agricultural production to some extent. Simultaneously, industrial development, burgeoning populations, and changing climatic conditions made it more necessary to use water economically when irrigating crops, especially rice. These and other developments made it imperative for rice research to concentrate on resource efficient production. The main avenues pursued included hybrid rice, new plant types, biotechnology modifications, and water-saving technologies, etc.

Some of the new approaches have originated from outside the realm of formal research institutions, one innovation being the increasingly popular System of Rice Intensification, known as SRI. This originated in Madagascar in the 1980s through the observations and experimentation of Father Henry de Laulanié, and subsequently it has been popularized by the sustained and committed efforts of Dr. Norman Uphoff and many other scientists and civil- society leaders over the past decade. Today SRI methods have been validated in more than three dozen countries, and they are spreading rapidly in countries that produce two-thirds of the world's rice – China, India, Indonesia, Vietnam, and Cambodia. In the last five years, SRI has become a dynamic movement in India joined by farmers, civil society organizations, universities, research institutions, government agencies, foundations and private sector.

SRI is quite different from the approach of the Green Revolution in that: a) it is not a seed-based approach, b)

it makes reductions in inputs - seeds, water, fertilizers, and labour– yet gives more yield, and c) it originated outside the established scientific institutions. SRI has come as a boon to rice farmers, with drastic reduction in seed rate (by 80% or more), reduced water requirements (by 30–40%), frequent reductions in labour, and yet increased yield of grain and straw (by 20 – 70%, and sometimes more).

Today, SRI has been accepted by hundreds of thousands of farmers in India, spreading from farmer to farmer when there is no support of agricultural extension. Several state governments have initiated special programs to promote SRI. The Government of Tamil Nadu reports for the 2008-09 cropping year that it had achieved 5.38 lakh hectares under SRI management out of a target of 7.5 lakh hectares. This suggests that about 27% of the state's area under rice cultivation is cultivated with SRI methods. Similarly, the state of Tripura which has supported a major program for SRI dissemination reports that in this past year, SRI methods were used by 197,450 farmers on 16.7% of its paddy area. Three years ago, the number of farmers in Tripura using SRI methods was 880.

However, the purpose of this article is not to report or assess the spread and merits of SRI. Rather we want to pursue some questions that have interested us as they surely occurred also to others. How it is that such productive practice --which does not depend upon 'modern' inputs, but rather on how plants, soil, water and nutrients are managed, could have been undiscovered for so many years? With all of the millions of farmers who grew rice in India, and elsewhere, over so many centuries, why weren't availed these opportunities to use land, labour and water more productively? We were curious whether there might be some precursors of SRI in the Indian past which would attest to the innovative capabilities of farmers and also confirm the inherent biological underpinnings of SRI. We are gratified to be able to report in this article on some farmer innovations made in rice production in Tamil Nadu about a century ago. These foreshadowed the SRI management system and indeed achieved the same kind of productivity gains. It turns out that SRI principles and practices have long-standing roots in India, at least in Tamil Nadu state, although having learned this raises another question: Why did the use of these practices die out? Our curiosity prompted research into this matter of previous innovations in rice production practices, and with some digging as well as a bit of luck we can share with readers some very interesting, even inspiring history of agricultural development. Today, SRI is known to many rice farmers of Tamil Nadu as 'OttraiNatruNadavu' (single seedling planting). Here we document that single- seedling planting was known and practiced 100 years ago in Tamil Nadu. Also, other practices and principles associated with SRI were being advocated.

Starting From a 1928 Government Publication

This story begins with our discovery of a publication of the Royal Commission on Agriculture in India. Its Abridged Report contained the following statement, which launched our ensuing investigation: In Madras, 120,000 copies of a leaflet on the single-seedling planting of paddy have been issued… the leaflets circulated in that Presidency, as in other provinces, are of little real value, unless they are issued in connection with a definite demonstration of their subject matter. The results of leaflets advocating the single-seedling planting of paddy are likely to prove very disappointing, unless the cultivators to whom they are given are provided with ample opportunities of seeing for themselves the advantages arising from the adoption of this practice….This was a reference to a single-seedling planting system for rice that was being promoted at the time in British India's Madras Presidency, which included parts of the present states of Tamil Nadu, Andhra Pradesh, Karnataka and Kerala. The Commission's emphasis on the value of demonstrations of the practice is worth noting. This publication showed us that: a) there was a rice production method in use in the1920s based on 'single seedlings', b) this method was seen as offering advantages over the conventional method of planting several seedlings together in a clump (or hill), and c) authorities were convinced that this single-seedling method needed wide publicity and demonstrations to convince farmers to follow it. As part of this dissemination strategy, a manual on the new method was printed. This is the first published reference that we came across on the use of single seedlings, and it led to the 'excavation' of an interesting story.

Farmer Contributions to a Tamil Journal on 'Practical Life'

When we tried to track down a copy of the leaflet mentioned by the Royal Commission on Agriculture, we could not trace the exact publication mentioned. However, in the library we did come across a Tamil journal titled Pizhaikkum Vazhi (Practical Life) published in 1911 which provided extensive evidence of farmer innovation consistent with our present SRI understanding of how to improve rice production. This journal had published a series of articles which reflected the experiences of farmers practicing single- seedling planting – and more. The articles noted that the single-seedling planting technique was already known for some years before the articles were published. Probably this innovation dates from 1906-07. The documentation indicated that the innovation had begun spreading in the region. Thus, although we could not track down the publication mentioned in the Commission report of 1928, we could establish that there had been a practice referred to as the 'single-seedling planting technique,' that it was beneficial, and that it was utilized in some parts of India more than 100 years ago! The articles in the Tamil journal Practical Life showcased not only single- seedling planting, but also another method of cultivation, referred to as the Gaja method. This was very similar to the SRI cultivation presently advocated in Tamil Nadu. Three articles were published in 1911 in Volume 3 of this monthly journal, which was edited by G.A. Vaidya Raman, B.A., and published by G.A. Vaidya Raman and Co.,3&4, Sunkurama Chetty Street, George Town, Madras (presently Chennai).

We would like to compare the practices described in these articles (published in1911) with others published a few years before (1906) in the Tanjore District Gazetteer. The first Practical Life article is a narration of the experiences of the farmer, Kulandai Veludaiyar, with the single-seedling planting method during the previous year. The location of his community, Mudiyanur, reported to be in Kallakurichitaluk at that time, is in what is presently Villupuram district of Tamil Nadu.

The second article is a conversation between an unnamed farmer who is a member of the District Agricultural Association (identified as 'Member') and another farmer named 'Reddiar'.3 Although the article did not say who the 'Member' was, we inferred that he was Kulandai Veludaiyar, the author of the first article. This was confirmed on our visit to the concerned village. The discussion took place in what was then South Arcot district (the exact location not known). It appears that direct seeding was the prevailing practice in this area, and 'Member' was comparing the advantages of transplanting single seedlings with direct seeding. The resistance and disbelief of 'Reddiar' to the new idea which 'Member' proposed is reminiscent of what is heard and said about SRI at the present time.

The article shows that single-seedling planting had already been practiced in all of the wetlands of the Government Farm at Palur, now the Vegetable Research Station under Tamil Nadu Agricultural University; and it was the Farm Manager (SubramaniaIyer) who educated Kulandai Veludaiyar about it. We also find that the single-seedling planting method had been discussed in the District Agricultural Association meeting convened by the District Collector, so the innovation had institutional recognition and support.

In the third article, Vaidyalingam Pillai proposed a very interesting package of practices which he called Gaja planting. He said that he first tried Gaja planting on 50 kulis (i.e., one-sixth of an acre) in Kalathur-Melkarai village of Nannilam Taluk of Thanjavur district, and from this experience he supported and wanted to promote this practice known as Gaja planting. This article showed that package Gaja planting was being advocated by the Government Farm Manager (C. Narayanasamy Iyer). Several innovative ideas on nutrient management were recommended by Vaidyalingam Pillai, and he described a rice-rice relay cropping cultivation method. Single-seedling cultivation appears to have been developed by Mr. Aparanam Pillai (location not known) during 1905-06 season, and the Gaja planting method, which also included single-seedling planting, was apparently developed by Mr. T.S. Narayanasamy Iyer of Thirukkaruhavurin 1911. It is clear that single- seedling planting was promoted by the government and was adopted in government farms, and that the Farm Managers were involved in the promotion of this practice.

Recommended Practices

Varieties used: Kulandai Veludaiyar reportedly used Garudan Samba and Perunsamba varieties, long-duration varieties generally grown as a single rice crop and sown in August-September. In the second paper, the varieties Garudan Samba, Perunsamba and Sadai Samba were mentioned. VaidyalingamPillai did not mention the variety that he used when he tried row planting for the first time. But for a rice-rice (relay cropping) cultivation, he recommended Paangu, Kuruvai, Poonkaar and Swarnavaari varieties for the first planting, and Vellai Sirumanian and Sembaalai for inter-row planting.

Seed rate: Kulandai Veludaiyar used a seed rate of 1padi 5 (1.135 kg) per cent of nursery, seeding 10 cents with Garudan Samba, and another 10 cents with Perunsamba, with the intention of planting in 3 acres. Actually, he was able to plant 5 acres with the seedlings of both varieties. This would mean that 5.15 kg seeds per acre were used (12.73 kg ha-1). The farmer said that after this experience, he stored only 5kalams (136 kg) of seed paddy instead of the usual 50 kalams (1,360 kg). He also mentioned that other farmers used to sow60 padi per kaani (1.33 acre), which is about 51.2 kg/ acre (126.5 kg/ha). This means his reduction in seed was as much as 90%, as with SRI.

In the second paper, Kulandai Veludaiyar recommended 8 padi of seeds to be sown on 8 cents to plant 1 kaani (1.33 acre). This would be a seed rate of 16.87 kg per ha. Vaidyalingam Pillai recommended 1 padi of seeds to be sown on 3 cents for planting 1 acre (i.e., only 1.135 kg per acre, or 2.8kg/ha) because planting density was so much less with the Gaja method, where seedlings were quite sparsely sown, with a seed rate even lower than that recommended now for SRI (5-7.5 kg/ha).

These rates can be compared with the recommended seed rates published in the Tanjore Gazetteer of the Madras Presidency (1906). The present Thanjavur district was part of the Tanjore district of Madras Presidency. The seed rate given for planting 1 acre was higher for Kuruvai varieties (1½ to 3 kalams = 41 to 82 kg per acre, i.e., 101 to 202 kg ha-1) than the samba varieties (1½ kalams = 41 kg).

In another publication of 1920, we find this statement: 20 lb. from 7 cents of land will plant up to one acre (22.4 kg to plant 1ha). But this seed-rate is usually very largely exceeded, up to 150 lb. per acre (168.3 kg per ha) being used.
From these reports and calculations, we can make some comparisons. The seed rate used by Kulandai Veludaiyar and Vaidya lingam Pillai ranged from 2.8 to16.87 kg per ha, while the normal seed rate used during that period was 101 to168 kg per ha. So, there were some farmers of the early 20th century who recommended reducing the seed rate drastically, by 90% or more. Meanwhile, the Agricultural Department publication (1920) recommended 22.4 kg seed rate to plant 1ha. Even today, while the recommended seed rate in Tamil Nadu is 20 kg per ha, farmers are using much higher seed rates of 75 kg per ha, while for SRI, only 5- 7.5 kg is required per ha.

Kulandai Veludaiyar reported that the sparsely distributed seedlings in his nursery escaped disease attack, while the conventional nurseries of other farmers were seriously affected. Besides, dense planting affected adversely the seedlings' capacity to establish immediately after transplanting. The concept of low seed rates and thinly sown nurseries was thus introduced100 years ago. Farmers also recognized a benefit of sparsely-placed seedlings in terms of plant protection. Current research on SRI nurseries by TNAU researchers has also reported less pest and disease attack.

Main field preparation

The Tanjore District Gazetteer describes recommended field preparation as follows: The fields are well manured either by penning cattle on them or by spreading over them the dung of sheep and cattle, ashes

or town sweepings, and then watered to the depth of two or three inches. Four to six ploughings are done. When procurable, green leaves are given as additional manure, either between the first and last ploughing or after all ploughings are over. The ploughing is also supplemented with the use of manvetti (spade). The field is smoothed by pulling a plank over it just before transplantation. Vaidyalingam Pillai emphasized proper leveling and stated that the size of each paddy should be not more than half an acre, to permit better field leveling and give more control over water levels. He stated that the mud should be deep, dark and nice. The field where he tried row planting was dug up with a manvetti, then leveled and ploughed three times, with sufficient jatropha leaves applied. The field was then again ploughed three times to get the required soil conditions. The importance of good levelling of the field, now emphasized in SRI, was also well recognized by Kulandai Veludaiyar.

Seedling age: According to the Tanjore District Gazetteer published in 1906, the seedlings are allowed to remain in the beds for varying periods according to the kind of paddy sown. Generally it may be said that the Kuruvai varieties of paddy should not be transplanted before the lapse of 15 to 25 days, the kar varieties before the lapse of 25 to 35 days, and the samba varieties before the 40th to 55th day. A traditional rule is that the seedlings should be left in the seed bed/beds for one-fourth of the period that the crop requires to mature. For Kuruvai varieties (3-5 months duration), the seedling age ranged from 15 to 35 days, and for the samba varieties (6½-8 months duration), it was from 40 to 55 days While Kulandai Veludaiyar used 25 day-old seedlings, Vaidyalingam Pillai recommended 30-32 day-old seedlings. Obviously, the young seedling concept which is given much prominence with SRI, was not known by farmers during this earlier period.

The young seedling concept in SRI is aimed at exploiting the early vigor of the seedlings in terms of tillering. But there is always some hesitation on the part of farmers, especially the labourers, to handle young seedlings of only 12-15 days age. We also see some farmers using 20-day-old seedlings in SRI when they have difficulty in raising seedlings in time, due to lack of irrigation water.

Treatment of seedlings

When pulling seedlings from the nursery, beating the roots on a wooden stick to remove the adhering soil is a common practice in conventional cultivation, even today. This practice was criticized by Kulandai Veludaiyar, and he stated that the roots were instead to be rinsed in water. As seen in the translation of his article, he emphasized the retention of good vigor by the seedlings by this method. There was no mention about handling of seedlings by Vaidyalingam Pillai. Reducing the trauma to the seedlings before transplanting is one of the recommendations in SRI. This was partially recognized 100 years ago by recommending avoidance of the normal rough treatment given to seedlings.

Planting: The row spacing adopted by Kulandai Veludaiyar was ¾ feet (22.5 cm), but we could not discern what spacing he used within the row. Vaidyalingam Pillai, on the other hand, has given more specific detail. He mentions the use of ropes for row planting, with inter-row spacing of 1 ½ feet (45 cm), and within the row, spacing was 1 foot (30 cm). This spacing was for the situation of a single rice crop.

For rice-rice relay cropping (a new method of rice cultivation described by Vaidyalingam Pillai), row spacing for the fi rst crop was 2 ½ feet (75 cm), and then the relay crop is planted in the middle of these rows when the first crop was at flowering stage. With 45 x 30 cm spacing, the number of seedlings (single seedling per hill) would be 7-8 plants per square meter. We note that with SRI, optimum spacing can be up to 50 x 50 cm (4 plants per sq.m) for very fertile soils.

Best spacing is a function of soil fertility. In all three rice-growing methods reported by these farmers, single seedlings were planted. Also, it was noted that labourers expressed the opinion that with single seedlings, the crop will never come up. But their skepticism was subsequently shown to be misplaced. Less labour

requirement for single-seedling planting in rows was reported by Kulandai Veludaiyar. He stated that for one kaani of land, 10 labourers would be enough (19 labourers per ha) instead of the normal requirement of 15-16 per kaani (28-30 labourers per ha). This represents a reduction in labour requirements of about 35%.

Department showed that it took 12-15 women to plant 1 acre (30 to 37 per ha). One of the major concerns with SRI has been higher labour requirement for planting. However, like the farmers of 1911 doing single-seedling planting, many farmers in Tamil Nadu now have reported 30-40 % reduction in labour for SRI planting. Kulandai Veludaiyar recognized that hand weeding was easier because of row planting. Vaidyalingam Pillai said that Thanjavur farmers who planted seedlings in bunches should pay attention to how much space is required for each hill. This showed his awareness of the advantages of lower plant density.

Row planting**:** It is fascinating to see that row planting was introduced in Tamil Nadu 100 years ago along with single-seedling planting. It has been thought that row planting first came here with introduction of the Japanese method of rice cultivation, and then reinforced with the promotion of IR8 in the 1970s. But farmers in Tamil Nadu started this practice a century ago, making an important conceptual advance in rice cultivation. Not only row planting, but also wider spacing between the hills and within the row was advocated by Vaidyalingam Pillai. This is similar to SRI, where we recommend square planting at 25 cm spacing as the starting distance, adjusting this according to soil fertility levels. In SRI, 50 cm spacing has been reported to be advantageous in Madagascar after soil organic matter has been built up through SRI practices over a number of years. Vaidyalingam Pillai recommended spacing of 45 x 30 cm already in 1911. The currently prevailing conventional planting method entails about 200 seedlings per sq. m. compared with the SRI recommendation of 16 plants. Vaidyalingam Pillai considered 7-8 plants per sq. m. sufficient. The rice-rice relay cropping that he proposed is another fascinating invention by a farmer, one not yet pursued in modern rice cultivation.

Nutrient management: A century ago, farmers used only organic sources for soil nutrient amendments. The Tanjore District Gazetteer shows that the silt brought by the water of the Cauvery River was well supplied with nutrients, so the alluvial soils of Tanjore did not require manuring. However, construction of check dams interfered with this. The manures ordinarily used were the dung of sheep and cattle, ashes, town refuse, leaves, oil refuse, and the silt from dry tank-beds. Kulandai Veludaiyar did not discuss manures, but Vaidyalingam Pillai describes innovative approaches for manuring the crop. He said that he did not place one sirangai (handful) of sand and one sirangai of FYM at the planting site of each seedling as done in Thirukkarugavur (recommended by Mr. T.S.Narayanasamy Iyer) and as instructed by the Farm Manager when trying Gaja planting for the first time. Also, oil cake was not placed on the hills while weeding. He thought that application of jatropha leaves (quantity not mentioned) was the best manure. When he described the package of practices, he advocated the following:

• At the location for planting each seedling, place 1 sirangai of sand and 1 sirangai of manure and mix well with the soil around. The seedling should be placed over it.
• 20 days after planting, dig the inter row space superficially with a manvetti (spade) and incorporate whatever green leaves are available.
• 40-45 days after planting, dig around each hill, place a mixture of oil cake @ 2.3 kg/cent with manure around each hill and close it with soil.
• In the rice-rice relay crop, harvest only the tops of the first crop; cut the straw and incorporate it as green manure.

Water **management:** We found stated in the Tanjore Gazetteer:… after transplantation, the field is kept in a half-dry condition (resembling recently burst boil) for several days, until the crop recovers from the

sickly appearance consequent on transplantation (i.e., fromtransplanting shock) and becomes green, and then it is regularly supplied with water. In some places (e.g., Sirkazhi), it is considered necessary to change the water every week, and even to allow the earth to get for a short time into a certain 'waxy' condition, which is considered very beneficial. Ordinarily, however, the water is not changed. The depth admitted is generally two inches at first, and rises with the crop till, at the time the ears are forming, it is about 8 inches (20 cm). Up to this stage it is generally believed that (for the samba crop at any rate) the more water there is standing in the field without submerging the plants, the better the crop will be. After this period, most ryots prefer to leave the field dry, though some think a small flooding of about two inches of water is beneficial.

The mention of 'half-dry' condition during the early days after planting is quite similar to what is prescribed now for SRI. Irrigation practices followed were not mentioned in the first two articles. But Vaidyalingam Pillai recommended shallow flooding of 2.5 cm during the first week after planting, 4 cm during the next 2-3 weeks, and 5 cm afterwards. More than 5 cm flooding was not approved of. The fields were irrigated every 4-5 days. Vaidyalingam Pillai says that the Gaja planting irrigation method contradicts the common adage: neeruyara nelluyarum, meaning 'paddy yield will increase in accordance with flood water depth' and he noted Tanjore district farmers' habit of flooding their fields up to bund level. He felt that more flooding lowered tillering. But he deferred to the fact that 'experienced people' believe more water will increase the yield, and he invited the opinion of experts on this matter.

That Vaidyalingam Pillai even questioned the continuous flooding of rice paddies and took exception to high water levels is a conceptual advance. There were at the time no conflicts about sharing river water, and less water scarcity than today. The general assumption was: the more flood water in fields, the higher the yields. Even today, when we have so much pressure on availability of water for irrigating rice, and conventional flooding is still practiced, we see a farmer in 1911 advocating less flooding for rice production. The current recommendation in conventional rice cultivation is to irrigate to 5 cm depth one day after the disappearance of ponded water. But farmers rarely adopt this recommendation and keep their fields flooded continuously unless their water supply is limited. The innovative farmer view on tillering and water depth is also noteworthy in light of the ongoing scientific debate over SRI. Sinclair (2004) has stated, for example, that "ample" water, implying continuous flooding, maximizes rice yields. The popular myth of more water being good for the plant thus still exists. But the current experience of SRI farmers and experimental evidence show this to be a myth, as was realized by Vaidyalingam Pillai a century ago. The Gaja planting irrigation method augurs well with the water-saving concept of SRI. It is remarkable that a farmer was thinking about reducing the water use for rice a hundred years ago.

Weeding and inter-cultivation: The Tanjore District Gazetteer states that weeding is invariably done by hand. It is sometimes done only once, sometimes as many as three times. The first weeding never takes place before the fifteenth day after transplantation, and the last not later than two months from that time. There is no specific discussion of weeding in the three Tamil articles, but Vaidyalingam Pillai advocated shallow digging of the inter-row spaces with a manvetti 20 days after transplanting and again at 40-45 days after transplanting, removing soil around each hill to place manure. For his first crop of Gaja planting, each hill was pressed with the foot. The shallow digging of inter-row spaces and pressing each hill with the foot are a conceptual advance as it aimed not only at the weed control but was an activity disturbing the soil – similar to the inter cultivation with a mechanical weeder that is recommended in SRI today. These practices indicate some understanding on the farmer's part that disturbance to the soil around the hills had beneficial effects. No modern rice cultivation methodology seems to have this concept except SRI, which underscores the importance of active soil aeration. The weeder use recommended with the Japanese method of cultivation was aimed at weed control only.

Criticisms on Single-Seedling Planting

The criticisms faced by farmers who practiced single-seedling planting in 1911 were little different from what has been happening for SRI farmers planting single seedlings today. Since the single-seedling field at first did not look like a planted field, the labourers of Kulandai Veludaiyar pressured him to plant two seedlings in the other fields. Seeing the fast growth of the single-seedling planted crop, however, other farmers concluded that the crop growth was good although they attributed this to good fertility of the field rather than to the methods used. In the conversation between the farmer and Kulandai Veludaiyar ('Member'), the farmer thinks that the single-seedling results depend on a new variety and wants to see the seeds. This kind of concern, reluctance and non-acceptance (please see the translation of this conversation) is often experienced by those promoting SRI now. Vaidyalingam Pillai comments on the mockery of people who saw the single seedling planted field initially. This experience is reported many times these days by farmers who have taken up SRI cultivation, and who have had to deal with the objections and criticisms of family members and neighbors. Vaidyalingam Pillai focused on another point in adopting new methods of cultivation. He said that even if articles and experiences on improved techniques like Gaja planting are published every month in the journal (Pizhaikkum Vazhi) and on every page, they will not be sufficient to achieve public awareness and acceptance. Everyone who has tried the new method should publish their experiences, he advised. The difficulty of achieving change was a slow process then as it is now. Adoption of SRI by farmers is slow in many places, and many scientists still refuse to acknowledge the benefits of SRI. But as noted in the introduction, acceptance has become accelerated where there is strong and consistent institutional support.

Growth and Grain Yield

The quick establishment of single-seedling practice and the early commencement of tillering was mentioned in the Tamil articles. Kulandai Veludaiyar reported 10, 15, even 20 tillers in 2-3 weeks' time. Vaidyalingam Pillai applied his mind in a scientific way to compare the length of the panicles, number of grains per panicle, and the grain weight.

- Tillering started from 12 days after planting, with profuse and thick tillering following, reaching 70-120 tillers.
- All the panicles were noted to be well filled and uniform, as seen with SRI.
- Average panicle length was 37.5 cm long, and there were more grains per panicle for any given length, presumably because of more branching. Pillai reported Gaja panicles having 95 more grains compared with equal-length panicles from conventional crop methods.
- Number of grains per rupee weight was less by 24 (meaning single-grain weight was higher).

These observations show the scientific attentiveness of a farmer hundred years ago, at the same time the Madras agricultural college was being established at Coimbatore. Yield levels were not quoted in the Tanjore District Gazetteer to know what were typical yields with standard methods.

The yield obtained by Vaidyalingam Pillai from Gaja planting was 6,004 kg /ha which is computed from his statement that he obtained 324 padis from 0.5 maa. The farmer also says that he harvested only 5 kalams (2,206 kg ha-1) from the same field the previous year using bunch planting.

These are precise statements on area and measurement. The farmer compared his yield with the yield reported by Narayanasamy Iyer at Thirukkaruhavur (1,522 padis per acre, i.e. 4,268 kg ha-1) and stated that higher yield could have been obtained if manures were applied as done in Thirukkaruhavur. Vaidyalingam Pillai harvested 2.7 times more grain yield by Gaja planting method when compared to the yield obtained from the same field the previous year when bunch planting was adopted. Average rice yield during 1911 in Tanjore district was 1,006 pounds per acre (1,128 kg ha-1 rice, i.e., 1,693 kg paddy ha-1) as per crop-cutting experiments.10 Average yield during 1911-191511 was 1,492 kg ha-1 according to Sivasubramanian (1961). Thus, the yields obtained by Tanjore farmers adopting Gaja seedling as reported in 1911 was considerably higher than the average yield of the district. Vaidyalingam Pillai obtained 3.5 to 4 times more than the average yield reported

for the period, and Narayanasamy Iyer obtained 2.5 to 2.9 times higher yield. Indeed, the yield reported by Vaidyalingam Pillai in 1911 was 17 % higher than our contemporary Tamil Nadu state average yield of 5,135 kg ha-1 (2006-07). The yield obtained by Narayanasamy Iyer (4,268 kg ha-1) almost 100 years ago was close to the current state average for the decade 1997-98 to 2006-07 of 4,528 kg ha-1. The grain yield obtained by Kulandai Veludaiyar from his single-seedling planting was 8.3 times more than the maximum yield previously obtained by him. The yield for single-seedling planting was 27.8 % more than the average yield of South Arcot district in 1911. It is remarkable that such high yields could be obtained by farmers by their own innovations a century ago.

Other Benefits of Single-Seedling Planting

Kulandai Veludaiyar reported several other benefits of single-seedling planting which should be considered, because these are things that rural household appreciate in addition to yield:

- No disease attack
- Earlier maturity by 20 days
- Higher straw yield
- Hand weeding was easier due to line planting
- No rat damage
- All tillers became productive
- Less expenditure needed and more profit obtained
- No damage in flood-prone fields because establishment was faster.
- Since the stems are thicker, there is more resistance to drought.

All these are benefits also realized with SRI practices at present. It is noteworthy that Kulandai Veludaiyar found single-seedling planting to be the best way to deal with flood- prone fields.

Continuance of Single-Seedling Planting in Madras Presidency

With all of these benefits, the question naturally arises why these practices did not persist, and why they need to be reintroduced today under the aegis of SRI. Unfortunately, we do not have a good answer to this question. This is a question which the agricultural science community as well as NGOs and others should be considering. We have come across several other documents that showed single seedling planting was recommended and practiced for quite some years in the Madras Presidency. It was evolved under the label "Economic Planting of Rice".

Raghavachari (1915) reported that the system of planting single seedlings was coming into vogue in Thanjavur district. Single-seedling planting was reported in 1918 in Eruvellipet village (near Villupuram, i.e., near Kulandai Veludaiyar's Mudiyanur), seven years after his article was published, according to Slater (1918), who was at the time Professor of Indian Economics in the University of Madras. Slater stated that "the village of Eruvellipet has generally adopted the system of 'single transplantation' of paddy recommended by the Agricultural Department." It is noteworthy to see that "experiment has proved that if each seedling is separately planted and all are evenly spaced, there is a considerable saving of seed and a heavier crop.

The new method is spreading, but as yet very slowly. Unless the grains are sown thinly in the seed-bed, single transplantation takes more time and labour, and if this is not realized, disappointment follows. The poor farmers, moreover, naturally and properly, refuses to experiment, as he cannot afford a failure, and waits to see with his own eyes that a new method is an improvement before he adopts it. Richer farmers, who can afford to experiment, also can afford to employ hired labour, and they find that the coolies they employ will not change their methods unless compelled to do so by strict supervision. They want to do their work in the semi-automatic manner attained by unchanging habit, and not to tax their brains and think about what they are doing." In a 1920 publication of the Madras Agricultural Department,, there is a statement: "If the planting is done singly, when the women become accustomed to it, they will plant more quickly." Probably the 22.4 kg seed rate per ha applies to single seedling planting. There are, however, no more details of single

seedling planting in this publication. The Royal Commission on Agriculture in India's Abridged Report 3 shows that single-seedling planting was recommended at least up through 1928. Other publications show that what was called "Economic planting of rice" was recommended and practiced in Madras Presidency at this time. We do not know details of this method, but it is clear that less seeds were used and single seedlings were planted. In a paper presented at the Indian Science Congress of Madras (5 June 1929) on the topic 'Recent agricultural development in Madras', the then Director of Agriculture, R.D. Anstead stated: "cultural improvements such as the economic planting of paddy from thinly sown nurseries have been adopted over a wider area as a result of demonstration and propaganda. By economic planting, by green manuring, and by using selected strains, the department has demonstrated to ryots (farmers) that it is possible to increase the yield of paddy very considerably." In a much-later note on this topic, it is reported that "crop raised from thin-sown nursery always gave increased yield ranging from 6 to 15 percent compared to the crop raised from thick-sown nursery." It is interesting to find that by "saving at least 25 lbs of seeds per acre by reduced rate over the 10 million acres of paddy in the Province (Madras), there will be a saving of nearly a lakh tons of paddy seed. In Tanjore district alone this saving will feed its population for 3 weeks."

Summary and Conclusions

We have seen that the single-seedling concept of present-day SRI method of cultivation was developed by farmers of Tamil Nadu about 100 years ago and was made known through a Tamil monthly journal, Pizhaikkum Vazhi (Practical Life). The concept included line planting. Another farmer-devised version of single-seedling practice, called Gaja planting, which involved a detailed package of practices reported in this Tamil journal, specified wider spacing between and within rows so that plant population was only 7-8 plants per sq. m., with improved results.

The single-seedling planting method appears to have been followed in Government Farms, so this was evidently accepted by the agricultural establishment. A Government publication of 1928 mentions single-seedling planting favorably and endorses the need for demonstrations to convince farmers. This indicates that the method was in vogue for more than 20 years. But how long it lasted and why it disappeared we just do not know. Ironically, now we are talking (again) about single-seedling planting through SRI. The description of Gaja planting matches the principles of SRI in many respects, viz., single seedlings, less number of plants per sq.m, shallow irrigation, and inter -cultivation.

The use of younger seedlings which SRI promotes is the missing element in Gaja planting for highest gains in productivity. The rice cultivation practices generally followed in Thanjavur district at the beginning of the 20th century are documented in the Tanjore District Gazetteer published in 1906. This helped us compare standard results with those from the single-seedling planting method. The discussion of 'half dry' field condition during the first days after transplanting, mentioned in the Gazetteer, and the advice of 'not more than 5 cm irrigation' associated with Gaja planting shows that already a century ago some persons did not consider high water levels and continuous flooding necessary. The innovative nutrient placement and recycling of straw in rice-rice cropping system described by Vaidyalingam Pillai shows the creativity of farmer-experimenters. Kulandai Veludaiyar carried out his own research on the suitability of single-seedling planting and reported that it was successful in low lying sodic soils, sandy soils, flood-prone saline soils, and marshy soils.

The publications of Rao Saheb Kulandai Veludaiyar and Sri Vaidyalingam Pillai in 1911 showed innovative, scientifically valid approaches towards rice cultivation that are applicable still today. Credit for single-seedling planting and row planting should go to these Tamil Nadu farmers, and we should note the merits of Gaja planting proposed by Vaidyalingam Pillai which has many similarities with SRI.

SRI is certainly a major breakthrough in the conceptualization and practice of rice cultivaAtion. More than its specific practices, it has contributed to making people think differently in order to get more production and higher resource productivity. It challenges the conventional approach of expecting that only high input-

oriented agriculture can get more production. This reverses the logic of much current thinking on agriculture.

This paper has shown how similar approaches were tried out in India a hundred years ago. Seeing these historic 'echoes' could make it relatively easier, to promote SRI today. The intention of this paper is not to suggest that SRI originated in India. Rather we wanted to document that many of its practices have been utilized in India long ago, and farmers were able to use them quite successfully.

This paper does not diminish the importance of SRI but rather shows that it is grounded in biological potentials and realities that have existed in the rice genome for millennia.

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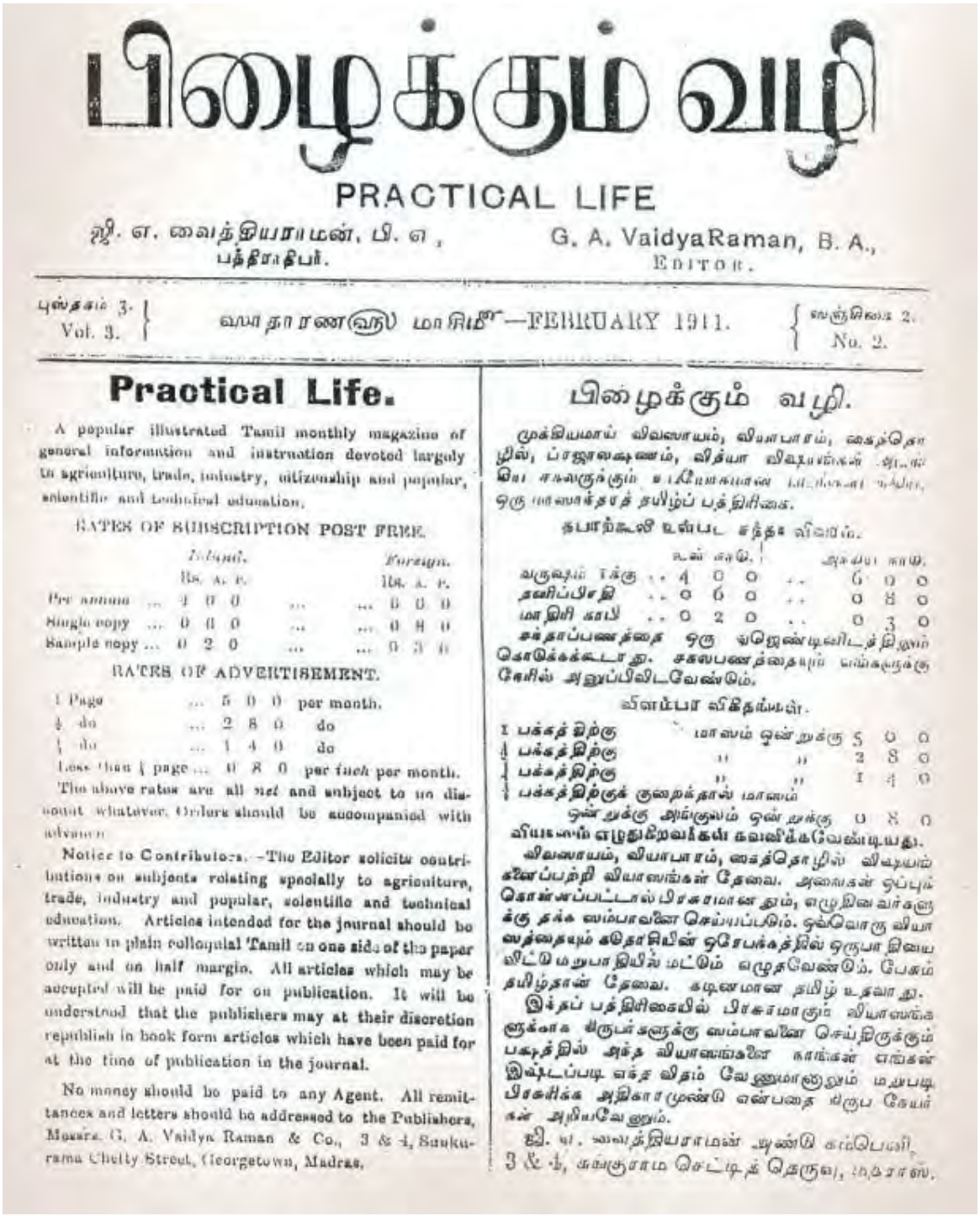

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விவசாயம், வியாபாரம், கைத்தொழில் விஷயம் சேர்ப்பதற்கு வியாஸங்கள் தேவை. அவைகள் ஒப்புக் கொள்ளப்பட்டால் பிரசுரமானதும், எழுதினவர்களுக்கு தக்க லம்பாவினை செய்யப்படும். ஒவ்வொரு வியாஸத்தையும் கடதாசியின் ஒரேபக்கத்தில் ஒருபாதியை விட்டு மறுபாதியில் மட்டும் எழுதவேண்டும். பேகம் தமிழ்தான் தேவை. கடினமான தமிழ் உதவாது.

இந்தப் பத்திரிகையில் பிரசுரமாகும் வியாஸங்களுக்காக கிருபாகளுக்கு லம்பாவினை செய்திருக்கும் பக்ஷத்தில் அந்த வியாஸங்களை காங்கள் எங்கள் இஷ்டப்படி எந்த விதம் வேணுமானாலும் மறுபடி பிரசுரிக்க அதிகாரமுண்டு என்பதை கிருபை செய்தல் அறியவேணும்.

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3.2 BRRI Presentation on Perception of Farmers on SRI in Satkhira

Socio-economic Evaluation of Rice Cultivation under SRI Methods

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PSO and Head Agricultural Economics Division, BRRI

Abstract

The study aimed to know the comparative management practices, assess the comparative profitability of rice cultivation under SRI and conventional methods and understand the farmers' knowledge, perception and attitudes towards SRI over conventional method of rice cultivation. Both primary and secondary level data were used in this study. The primary data were generated through conducting Focus Group Discussion (FGD) with 25 villagers consisting of farmers, teachers, traders, labourers and village leaders in Dewanipara village of Tala Upazila under Satkhira district. Under SRI method, farmers used only one seedling per hill while 4-5 seedlings per hill were transplanted under farmer's practice. However, it is necessary under SRI method to transplant the uprooted seedlings immediately after uprooting. If delayed, the rate of root damage and mortality tends to be higher. The farmers practicing SRI method required a bit lower amount of water (1-1.5 inch) all the times throughout the crop establishment stage compared to the conventional method (CM) (2-2.5 inch) but the total frequency of irrigation was 35 times for SRI and 30 times for CM. One shortcoming was that they did not use the alternative wetting and drying method of irrigation to maintain aerobic condition of the soil. Under SRI method farmers did three times weeding, while under CM method farmers did two times weeding. Quantity of seed required for SRI method was about 80% less than that of CM. The farmers reported that the SRI method required less chemical fertilizer compared to CM. It was also observed that the SRI method generated 40% higher yield compared to conventional method. The study revealed that 40% percent of the *Boro* rice area was covered by SRI method and generated an extra benefit of about 38% over the conventional method (CM). Per unit costs of production for SRI and CM were Tk. 16.05/kg and Tk. 18.14/kg on full costs basis and it was Tk 14.94/kg and Tk. 16.72/kg on cash cost basis, respectively. However, the partial budgeting analysis revealed that the SRI adopters gained an additional benefit of TK.1840/bigha over conventional practice. It is impressive that 100% farmers of the village are in favour of SRI - though it was found to be slightly high labour demanding, had higher weed problem and 7-10 days longer crop field duration.

.Background

The System of Rice Intensification known as SRI is a methodology that applies certain principles and techniques providing insights about how rice plants can be assisted to perform better. It improves their growing environment by introducing different practices for managing plants, soil, water, nutrient and microbial interactions for increasing the productivity of irrigated rice cultivation. The recommended techniques for SRI can be summarized in terms of six main elements:

(i) Seedlings are transplanted when they are very young, normally 8-15 days old, when they have just two leaves

(ii) Seedlings are widely spaced, only one seedling per hill rather than in clumps of three or four plants, and in a square pattern of 25 by 25 cm apart or wider if the soil condition is good

(iii) Seedlings are also transplanted very carefully, gently, immediately after collecting them from the nursery or seedbed and placing the tiny roots in a position so that they can quickly resume their downward growth

(iv) Water is carefully managed during the vegetative growth stage, up to the time of panicle initiation. An alternative drying and wetting method of irrigation is recommended to be followed in this practice

[9] *The authors acknowledge the help of M. Abdus Salam, SO, M. Ariful Islam, SO and M. A. Bakr Siddique, PSO of Agricultural Economics Division, Bangladesh Rice Research Institute in conducting the FGD and in many ways to prepare the draft.*

(v) As weed is a major problem of rice cultivation under SRI, it is recommended to begin weeding about 12 days after transplanting and do 2-4 weeding at 10-15 days interval

(vi) Application of organic fertiliser or compost is recommended to have better yield than chemical fertilizer doses. Use of organic manure improves soil quality and helps in sustainability of cropping

Development and spread of SRI around the world

The SRI was first developed in Madagascar in the 1980s by Fr. Hendri de Laulanie S. J. who came to Madagascar from France in 1961 and spent the next 34 years of his life working with Malagasy farmers to improve their agricultural systems, and particularly their rice production. The first trials outside of Madagascar began in the year 1999. SRI was introduced in Bangladesh the same year with the initial SRI trials undertaken by the Department of Agriculture (DAE) in Kishoregonj[10] and CARE Bangladesh in Rajshahi and Mymensingh, followed by a number of organizations such as Bangladesh Rice Research Institute (BRRI) and BRAC. A few other countries also gradually started trials on SRI. In Bangladesh, a steering committee was set up in 2002 to coordinate the promotion of SRI in the country. This later was renamed as the SRI National Network Bangladesh (SRI NNB). Under the PETRRA project funded by IRRI, trials were conducted in 12 Upazillas of six districts in the country by Bangladesh Rice Research Institute (BRRI), BRAC, CARE/POSD, and Syngenta (BD) during two consecutive *Boro* seasons 2002-03 and 2003-04. Later on, under the FoSHoL project of ActionAid Bangladesh, SRI trials were conducted SRI trials in selected areas of five districts during two consecutive two *Boro* seasons (2005-06 and 2006-07). The results were highly encouraging, especially the community/block approach tried during the second year. Oxfam GB, Bangladesh started SRI trials during 2005-06[11] and continued the same for three consecutive years beginning from the 2005-06 *Boro* season.

Today SRI is being tried and adopted in more than forty countries of the world (Table 1). The rapid spread of this methodology was due to the fact that it increases rice yields dramatically without requiring the purchase of new seeds, chemical fertilizers or other costly inputs and also partly due to the speed and cheapness of modern electronic communication.

Table 1: Update on SRI activities / progress around the world

S.E. Asia, E. Asia & the Pacific Islands	S. Asia and S.W. Asia	Africa	America and Caribbean
China	*Afghanistan*	*Benin*	*Brazil*
Cambodia	*Bangladesh*	*Burkina Faso*	*Colombia*
DPR Korea	*Bhutan*	*Egypt*	*Costa Rica*
Indonesia	*India*	*Ethiopia*	*Cuba*
Japan	*Iran*	*Gambia*	*Ecuador*
Laos	*Iraq*	*Ghana*	*Guyana*
Malaysia	*Nepal*	*Guinea*	*Peru*
Myanmar	*Pakistan*	*Kenya*	*USA*
Philippines	*Sri Lanka*	*Madagascar*	
Solomon Islands		*Mali*	
Thailand		*Morocco*	
Timor Leste		*Mozambique*	
Vietnam		*Rwanda*	
		Senegal	
		Sierra Leone	
		Zambia	

[10] Krishibid M. Wasiuzzaman, the then Deputy Director (DD) of DAE, initiated SRI trials in Kishoregonj.
[11] The trials were conducted in its River Basin Project (RBP) areas in the northern Char areas to improve food security of poor farmers.

Literatures say that the SRI method of rice cultivation has been getting popularity world-wise because of its manifold advantages as:

- SRI practices lead to healthier, more productive soil and plants by supporting greater root growth and by nurturing the abundance and diversity of soil organisms. The agro-ecological principles that contribute to SRI effectiveness have good scientific bases. SRI concepts and methods have been successfully adapted to upland non-irrigated rice, and they are now being extrapolated to other crops like millet, wheat and sugar cane.

- SRI *does not require* the purchase of new seeds or the use of new high-yielding varieties. Although the highest yields with SRI have been obtained from improved varieties, most traditional or local varieties of rice respond well to SRI practices and command a higher market price. And while chemical fertilizer and agrochemicals can be applied with SRI, their use is not required as organic materials (compost, manure or any decomposed vegetation) can give good or even better results at low cost. Farmers report that when SRI methods are used correctly, rice plants are better able to resist damage from pests and diseases, reducing or eliminating need for agrochemical protection.

- Because plant populations are greatly reduced with SRI, **seed costs** are cut by 80-90%, and because paddy fields are not kept continuously flooded, there are **water savings** of 25 to 50%, a major benefit in many places. However, cessation of flooding means that increased weeding is required. If this is done with soil-aerating implements like a rotating hoe, this cost has a benefit of enhanced crop production.

- SRI *does require* **skillful management** of the factors of production and, at least initially, **more labour,** particularly for careful transplanting and for weeding. Since yield increases are usually 50 to 100%, and possibly several times present levels, the **returns to labour** can be very great. The **profitability** of rice production can be greatly increased when yield goes up with a reduction in the costs of production. As farmers gain skill and confidence in SRI methods, their labour input in fact decreases, and over time SRI can even become **labour saving** compared with conventional rice-growing methods.

- SRI is a work in progress, with improvements continually being made, including better implements and techniques that further reduce labour requirements. Farmers are encouraged to make their own improvements in SRI methods and to share experience within the farming community. Yield is the most evident (and controversial) feature of SRI, but many other considerations are also driving its spread around the world. Additional information on SRI benefits such as resistance to drought and storm damage, shorter time to maturity, and more milled rice resulting when SRI paddy is processed.

Objectives of the present study

The present study aimed to investigate farmers' perceptions on some of the issues/points discussed above with a hope to continue socio-economic investigation with farmers from different rice production environments with a view to speed up the adoption of this method of rice cultivation throughout the country.

However, the specific objectives of this study were to:

- Know the comparative management practices adopted in SRI and Conventional Methods (CM) of rice cultivation at farm level;
- Assess the comparative profitability of rice cultivation under SRI over and Conventional methods;
- Ascertain the farmers' knowledge, perception and attitudes towards SRI over Conventional method of rice cultivation; and
- Provide policy advocacy for making the rice production profitable at farm level.

Data collection and analysis

Focus Group Discussion (FGD) meeting with 25 villagers consisting of farmers, teachers, traders, labourers and village leaders was conducted in Dewanipara village of Tala Upazila under Satkhira district for data collection. A set of checklist type of questionnaire was used as a guideline for discussion and taking notes from the stake holders. The checklist questionnaire consisted of socioeconomic profile of the village, farmers' knowledge about SRI, comparative information on seedbed management, seedling use, land preparation, water management, fertilizer and weed management, labour requirement, and profitability in rice cultivation under SRI and conventional method. Mostly descriptive statistical techniques like mean and percentage were used for analyzing the collected data. The results are presented in tabular form.

Results and Discussion

Socio-economic profile of the village

Socio-economic profile of the study village is presented in Table 2. Total population of this village is about 2000, among them 53% was male and 47% was female. The total number of households in study areas is about 320. Out of them, 28% was farm households. Among the farm households, 19% was small, 6% medium and 3% large in terms of land holding. The remaining 72% was non-farm households, out of them 63% was agricultural labour and 9% was non-agricultural labour, respectively. The literacy rate of this village was little bit higher (70%) compared to national average (64%). Literacy rate of male (40%) was higher compared to female (30%).

Table 2: Socioeconomic profile of the study village

Socioeconomic parameters	No.	%
Total family	320	100
Total farm family	90	28
Small farm family	60	19
Medium farm family	20	6
Large farm family	10	3
Total non-farm family	230	72
Agricultural. labour family	200	63
Non-agricultural. labour family	30	9
Farmers participated (farm family)	25	28
Total population of the village	2000	100
Male population	1060	53
Female population	940	47
Literate population	1400	70
Male literate population	560	40
Female literate population	420	30
Signatory knowledge population	200	10
Illiterate population	400	20

Farmers' knowledge, attitude and perception about SRI

Farmers' knowledge and attitudes towards SRI method was assessed and the relevant information are presented in Table 3. Indeed it is impressive that, 100% farmers of the village are in favour of SRI-though it is slightly high labour demanding, high weed problem and 7-10 days longer crop field duration. They are convinced with the SRI methods as it takes comparatively less water, less fertilizer and less seed. However, they mentioned about water logging problem in their field which hinders them timely planting resulted to use 20-22 days older seedlings. They suggested that if dredging is done in the Kapotakhya River then it would help receding stagnant water and they could transplant timely with optimum seedling age.

Table 3: Farmers' knowledge about labour used in SRI

	SRI	CM	Change
Seedling raising	4	6	-2
Land preparation	3	2	1
Uprooting seedlings	3	2	1
Transplanting	6	4	2
Gap filling	1	0	1
Fertilizer application	1	1	0
Manure application	3	3	0
Pesticides application	1	1	0
Weeding	12	7	5
Harvesting & carrying	12	10	2
Threshing	3	3	0
Total	49	38	11

Farmers' perception evaluation on SRI as shown in Table 4 that most of the respondents knew about SRI from NGO personnel and still learning about it in details. All participating farmers also reported that 100% of their lands were brought under *Boro* rice cultivation using irrigation water from STW. Forty percent of the *Boro* rice area was cultivated by SRI method and the adopters of SRI have earned extra benefit of about Tk 4000/*bigha*[12] over the conventional method (CM). All adopters opined that SRI method is really a good practice for rice cultivation which resulted in higher yield as well as higher return.

Table 4: Farmers' perception on SRI

Items	Qty.	%
Awareness of total farmers	90	100
Awareness of participating farmers	25	100
Boro acreage	60	100
Irrigated acreage	60	100
Boro acreage under SRI	24	40
Profitability over conventional (Tk/*bigha*)	4000	40
Farmers recommended SRI as good practice	25	100

Comparative scenario of seedbed management

Table 5 showed comparative scenario of seedbed management for SRI and CM. The findings revealed that the land requirement for seed bed of SRI technique (1 decimal of seedbed for transplanting 33 decimal land area) is significantly less than that of conventional method (4 decimal of seedbed for transplanting 33 decimal land area). Quantity of seed required for raising seedlings of SRI method is only 2 kg/*bigha* whereas it was much higher (10-12 kg/*bigha*) for CM. Total labour requirement for seedbed management in SRI method was substantially less compared to that of CM. Water and fertilizer requirement was also less in SRI method compared to CM. The level of insect-pest infestation was very low in SRI plot compared to CM.

Table 5: Comparative scenario of seedbed management for SRI and CM

Items	***Boro* (BRRI dhan28)**	
	SRI	**CM**
Area of seedbed (acre)	0.01	0.04
Qty of seed (kg)	2	10-12
Labour requirement	Less	More
Water management	less	More
Fertilizer management	Less	More
Weed management	Normal	Normal
Pest management	Less	More

[12] A standard *Bigha* consists of 33 decimals of land

Comparative scenario of seedling use

The comparative scenario of seedling used in SRI and CM of *Boro* rice cultivation is shown in Table 6. Most of the farmers in the study areas transplanted BRRI *dhan*28 using 20-22 day old seedlings for SRI practices whereas for normal practices farmers usually transplant 30-35 day old seedlings. Under SRI method, farmers used only one seedling in a hill but they transplanted 4-5 seedlings/hill under farmer's practice. Labour requirement for uprooting seedlings which is good for transplanting one *bigha* of land in SRI method was a bit higher (3 man-days) compared to that of CM (2 man-days). It is an imperative for SRI that uprooted seedlings are to be transplanted immediately after uprooting. If delayed, root fixation is delayed and seedling mortality tends to be higher. In case of CM, it is usually not a problem and even rice growers can transplant seedlings a couple of days later after uprooting seedlings. However, seedling mortality rate is lesser in SRI method compared to CM if transplanted immediate after uprooting; and the seed to seed growing period under SRI is reduced by 10 to 12 days.

Table 6: Comparative scenario of seedling use for SRI and CM

Items	*Boro* (BRRI dhan28)	
	SRI	CM
Age of seedlings (days)	20-22	30-35
Use of seedlings/hill (no.)	1	4-5
Problem faced during uprooting seedlings	No	No
Labour required for uprooting seedlings	3	2
When to transplant after uprooting seedlings	Immediate after uprooting	Even after one day
Yield inversely related to seedling age	Yes	Yes

Comparative scenario of main land

Table 7 showed comparative scenario of main land for SRI and CM. The SRI practice required comparatively high land with loamy type of soil where water logging does not exist and this method needs special care for land preparation. The surface of the soil is to be levelled evenly/smoothly for placing tending seedling. On the other hand, farmer's practice needs no botheration during transplanting. Therefore, SRI method needs a bit higher labour for land preparation and transplanting compared to CM. Spacing of SRI is about 30cm x 30cm and about 20cm x 20cm in CM respectively. Gap filling is required in both the methods. SRI method requires more labour (1 man-day/*bigha*) for gap filling compared to CM (1/2 man-day/*bigha*). However, the farmers generally do not practice gap filling in CM while it is a required practice for SRI. Wider spacing and transplanting of younger seedlings in SRI method compared to CM produces more productive tiller ultimately resulting in higher yield.

Table 7: Comparative scenario of main land for SRI and CM (1 *bigha*)

Items	*Boro* (BRRI *dhan*28)	
	SRI	CM
Type of land required	High	Any type
Soil type required	Loamy	Loamy
Additional care needed for land preparation	Yes	No
Labour required for land preparation (man-days)	3	2
Labour required for transplanting seedlings (")	6	4
Line to line distance (cm)	30 x 30	20 x 20
Plant to plant distance (cm)	30 x 30	20 x 20
Seedling mortality rate (%)	5	8-10
Necessary of gap filling	Yes	Yes
No. of gap filling required	1	1
Labour required for gap filling (man-days)	1	0.5
No. of unproductive tiller	Less	More

Comparative scenario of water management

Water management is a crucial factor for *Boro* rice cultivation as it is a high water demanding crop and grown in dry season. However, *Boro* rice cultivation in both SRI and CM requires irrigation but at different levels and numbers (Table 8). Farmers reported that the SRI method requires more number of irrigation (35 times for SRI and 30 times for CM) as little amount of water applied (1-1.5 inch) each time compared to CM (2-2.5 inch). The farmers reported that though the rice cultivation in SRI method requires no additional water management but it is an additional botheration for them to maintain water level (1-2 cm) until 10-12 days after transplanting of seedlings. Both the methods required irrigation water every alternate day. The farmers reported that they do not have any knowledge about alternative wetting and drying (AWD) technique of irrigation water management.

Table 8: Comparative scenario of water management for SRI and CM

	BRRI *dhan*-28	
	SRI	**SRI**
Frequency of irrigation application (no.)	35*	30
Interval of irrigation water application (day)	1	1
Maintenance of water level*	1-1.5"	2-2.5"
Farmers knowledge about AWD	None	None
Need additional water management	None	None
Problem faced in getting irrigation water	No	No

** 1-2 cm up to 10-12 days and then 1-1.5 inch until hard dough stage*

Comparative scenario of fertilizer and weed management

The most important aspect of crop production is fertilizer and weed management. This section of the paper dealt how fertilizer and weed management practices were handled under SRI and CM of rice cultivation. Farmers opined that the SRI method required less chemical fertilizer, while rice cultivation under CM required more chemical fertilizer (Table 9). The use of organic fertilizer in either case was normal. While weed problem was high for SRI compared to CM. Weed problem was significantly low in CM of rice cultivation. The SRI method required three times weeding, while the CM of rice cultivation required 2 times weeding. Regarding weeding, SRI methods required 12 man-days/*bigha*, while for CM only 7-8 man-days/*bigha* was enough.

Table 9: Comparative scenario of fertilizer and weed management in SRI and CM

	BRRI dhan28	
	SRI	**CM**
Use of chemical fertilizer	Less	More
Use of organic fertilizer	Normal	Normal
Weed problem	High	Low
Frequency of weeding	3	2
Labour requirement for weeding (man-days/*bigha*)	12	7-8
Pest problem	Less	More
Field duration of crop (days)	140	130
Yield (kg/*bigha*)	1120	800
Overall comments of participating farmers	Good	-

As reported by farmers, pest problem in SRI plots was less compared to CM of rice cultivation. Asikin and Koeswara (2001) found that the SRI practice has less pests problem (<3 percent per hill) compared with farmers' fields (< 8 percent per hill). Mursad and Hasan (2000) found the beneficial: harmful insect ratio to be 5:3 on SRI plots during the vegetative growth period compared to 5:4 on their regular plots. The conclusion of the seasonal report was: "The experience of that new technology of SRI has just opened up a light of hope to the poor farmers to boost up the rice production and to be self reliant in cereal food." The SRI method increased crop field duration up to 10 days compared to CM of rice cultivation during *Boro* season due to

transplantation of younger seedlings. However, the seed to seed duration under SRI is usually 10-12 days less than that under CM. The yield advantage of rice cultivation under SRI method was significantly higher than the CM, which was estimated to 40 percent higher compared to CM. The overall comment on SRI made by the farmers was good.

Table 10: Comparative profitability between SRI and CM of Boro rice cultivation, 2010

Cost items	**BRRI dhan28 (Tk/bigha)**	
	SRI	**CM**
Total cost of seedling raising	310	941
Cost of ploughing and laddering (Hired)	500	450
Cost of labour for land preparation: Family	240	120
Hired	360	240
Cost of seedling uprooting and transplanting (Hired)	960	720
Cost of fertilizers (V): Urea (1140 / 1710)	360	600
TSP	440	660
MoP	120	120
Gyp	100	150
Zinc	120	180
Cost of organic fertilizer (Family)	400	400
Cost of labour for fertilizer application: Family	120	120
Cost labour for organic fertilizer application: (Hired)	360	360
Cost of pesticides and labour for pesticides application (Hired)	120	120
Cost of labour for weeding: Family	360	240
Hired	1080	720
Irrigation cost: Hired	4550	3250
Harvesting and carrying cost: (Hired)	1800	1500
Threshing cost (Hired labour + machine)	510	510
Land rent (50:50 share basis)	6825	4875
Interest on operating capital @ 9% for 5 months	345	283
Total cost: Full cost basis	19980	16515
Cash cost basis	18735	15373
Gross return: (Tk/*bigha*)	20200	15000
Paddy	18200	13000
Straw	2000	2000
Net return: (Tk/*bigha*): Full cost basis	**220**	**-1515**
Cash cost basis	**1465**	**-373**
Per unit cost of production: Full cost basis	**16.05**	**18.14**
Cash cost basis	**14.94**	**16.72**
Benefit-cost ratio (BCR): Full cost basis	**1.01**	**0.91**
Cash cost basis	**1.08**	**0.98**

Input utilization/use structure

On an average total man power requirement in SRI method was higher (148 man-days/bigha) compared to CM (116 man-days/bigha). In fact, the operations like land preparation, uprooting seedlings, transplanting and weeding required more labour in SRI plot compared to CM plot. However, cost of labour use was 27% higher in SRI compared to that of CM. Number of irrigation and interval was same for SRI and CM.

Requirement of chemical fertilizer in SRI method is comparatively less than that under CM. Fertilizer cost for SRI practice was about 40% less compared to farmer's practice. Per *bigha* cost of cultivation of BRRI *dhan* 28 were Tk. 19,980 and Tk. 16,505 on full costs basis and Tk. 18,735 and 15,373 on cash costs basis for SRI and conventional method respectively (Table 10). Per *bigha* gross return was Tk. 20,200 and Tk. 15,000 for SRI and conventional method respectively. Net return for SRI method was Tk. 2,000 and Tk. 1,465 on full costs and cash costs basis respectively. Net return was 38% higher in SRI method compared to that of CM. Per unit cost of production of SRI and CM were Tk. 16.05 and Tk. 18.14 on full costs basis and it was Tk 14.94 and Tk. 16.72 cash cost basis, respectively.

Partial budgeting

Partial budget analysis was carried out to assess overall economic advantage of SRI method of *Boro* rice cultivation over CM of farmer's practice. However, the empirical analysis revealed that the SRI adopters could gain extra benefit of TK.1,840/*bigha* by adopting SRI technique instead of normal practice (Table 10.1).

Table 10.1: Partial budgeting of SRI vs. CM of *Boro* Rice Cultivation (Tk/*bigha*)

Items	Debit	Items	Credit
	SRI		CM
A. Cost of production using SRI	18,735.00	A. Cost saved for not practicing CM	15,375.00
A. Revenue forgone for not practicing CM	15,000.00	A. Revenue earned from SRI	20,200.00
B. Profit/Loss	**+1,840.00**	A. Profit/Loss	-
D. Total	35,575.00		35,575.00

Summary of some economic changes

The most important economic advantages of SRI over CM of rice cultivation are shown in table 11. Though the labour requirement was 27% higher in SRI, the return to labour was 6% higher in SRI compared to CM of rice cultivation. The yield advantage was 40% higher in SRI than that of CM which generated additional net revenue of 38% over CM.

Table 11: Summary of some Economic Changes

Economic parameters	BRRI *dhan*-28			
	SRI	CM	Change	% change
Labour required (man-days/*bigha*)	49	38	+ 11	27
Grain yield (kg/*bigha*)	1,120	800	+ 320	40
Cost of labour (Tk/*bigha*)	5,910	4,650	+ 1,260	27
Revenue earned (Tk/*bigha*)	20,200	15,000	+ 5,200	35
Net revenue earned (Tk/*bigha*)	14,290	10,350	+ 3,940	38
Return to labour (Tk/man-day)	410	387	+ 23	6

Conclusion

Farmers of Dewanipara are aware of SRI method. They know how to grow rice under SRI method. However, they modified certain practices such as maintaining seedling age in SRI method of rice cultivation. They transplant fifteen to twenty two days old seedlings. Water logging in the main plot is the main constraints to transplant timely. Though the seedling age was higher (22 days old) than the SRI recommendation, they used to transplant single seedling per hill. They also had no knowledge of AWD, which they do not follow. By using the AWD practice, they could not only save cost of irrigation, but could also ensure better aeration of the soil that helps better growth of roots and healthier plants leading to higher yield and profit. They do not bother about higher labour requirement, weeding problem and water management under SRI methods as long as they receive higher yield and profit from it. The labour skill factors are evident in the SRI methods as 6% higher return to labour was accumulated to the farmers' net return over conventional method of rice cultivation. Farmers reported that they received around 40% higher yield from SRI compared to conventional method. More training and motivation provided to the farmers of the village on SRI could further raise their yield and profitability.

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3.3 Presentation on SRI Research at BIRRI

Welcome to the Presentation

on

AN INVESTIGATION INTO THE CRITICAL FACTORS OF SYSTEM OF RICE INTENSIFICATION FOR MAXIMIZING THE BORO RICE YIELD

Presented by

Md. Abu Bakar Siddique Sarker

Supervisor: Professor Dr. Najrul Islam

Co-supervisor: Professor Dr. M A Samad

WHAT SRI IS ?

- The System of Rice Intensification - in French, *le Système de Riziculture Intensive*, referred to as SRI in English
- SIMA in Spanish - which literally mean "system" rather than a "technology"
- SRI is a set of specific intensive practices consisting of some principles, these should be verified according to local conditions

Significance of the research work

- Rice is the staple food of Bangladeshi people.
  - Its demand is increasing over time because of increasing population growth.
- When the population in Bangladesh was 130 million, rice demand was 23.06 M mt. which was coming from about 10.76 M ha of land.
- Total rice area will be reduced
  - 10.76 to 10.18 M ha by the year 2025
  - Rice demand by that time will be 26.38 M mt.
  - The additional 14.3% rice will have to be achieved from 5% less land area.
- Higher rice production is therefore, to be achieved through system intensification of rice production methods.

Significance of the research work (Cont.)

- SRI is a new concept for
  - Increasing rice yield as a rice production method
  - Most of the knowledge about SRI is quite recent
- SRI is an innovative technique, which has the potentiality to improve rice production without dependence on or less dependence on
  - New rice varieties
  - Much chemical inputs
  - Maintaining healthier natural environment.
- The concept was first developed in Madagascar by Fr. Henri de Laulanie, S.J.,
  - who worked with Malagasy farmers during 1961 and 1995
  - explored the possibilities of enhanced rice production

Significance of the research work (Cont.)

- With good management of plants, soil and water, rice yields can be increased 10 tons per hectare by SRI (Norman Uphoff)
- With good use of SRI practices, it is usually possible to increase rice yields by 50 to 100%
- Already increases of 200 to 300% have been achieved, where the initial level of production was low
- The technique is now being studied and evaluated in many south and south-east Asian countries by
  - Scientists,
  - Extension workers and
  - Rice growers
- Now more than 17 countries from Asia which covers 90% of the world's rice growing region, are practicing SRI

Significance of the research work (Cont.)

- Results from many other countries of the world give evidence of quite positive results from SRI methods.
- The new technique of SRI may change the traditional management practices to bring out the unexploited potentiality of rice production in Bangladesh.
- Different aspects of SRI evaluated and achieved encouraging results. such as
  - yield maximization
  - Comparison with other production practices
  - Integrated crop management practices and
  - Varietal performance were examined
- Some other GOs and NGOs in Bangladesh also initiated SRI method in a very limited magnitude in farmer's field and showed some promising results.
- It is proved that SRI would be a low input, low cost and high productive technology for the resource poor farmers.

THE CRITICAL FACTORS OF SRI

- Rice is water loving plant but we treated an aquatic plant.
- Rice seedlings lose much of their growth potential if they are transplanted more than 15 days after they emerge in their nursery.
- During transplanting, trauma to seedlings and especially to their roots should be minimized.
- Wide spacing of plants will lead to greater root growth and accompanying tillering.
- Soil aeration and organic matter create beneficial conditions for plant root growth

THE CRITICAL FACTORS OF SRI

To give effect to these factors, SRI is communicated in terms of a set of practices or techniques which should be understood as starting points for experimentation and for fitting SRI to local conditions.

1. To start transplanting by young seedlings
   - Preferably 8-12 days old and not more than 15 days
   - When the plant still has just two small leaves and the seed sac is still attached to the root
2. To transplant seedlings quickly and carefully
   Allowing only 15-30 minutes between uprooting from the nursery and planting in the field
3. Seedlings should be put 1-2 cm deep into soil that is muddy but not flooded.
   They should be laid into the soil with care, with roots lying horizontally so that their root tips are not pointing upward

THE CRITICAL FACTORS OF SRI

4. To Transplant the seedlings far apart,
   - One seedling per hill
   - Relatively few plants per m^2
   - In some soils, 2 plants per hill may give more tillers per m^2
   - More plants in a hill will create inhibitions on root growth due to competition
5. To transplant in a square pattern to facilitate weeding.
   - The most common SRI spacing is 25 x 25 cm,
   - With good soil conditions, the hills can be up to 50 x 50 cm apart.
   - With a square pattern, weeding can be done in perpendicular rows.

THE CRITICAL FACTORS OF SRI

6. Keep the soil well drained
   – No need to keep water continuously flooded during the vegetative growth period.
   – Panicle initiation stage, keep only a thin layer of water on the field until 10-15 days before harvest,

   A. Apply small amounts of water daily
   – Just as much as needed to keep the soil moist and saturated, but no standing water.
   – During tillering stage, the field should be left to dry out for several short periods (2-6 days), to the point of surface hairy cracking,

   B. Alternate Flooding and drying the field
   – For alternating periods of 3-6 days each throughout the period of vegetative growth.

THE CRITICAL FACTORS OF SRI

7. To control weeds, early and frequent weeding.
   - This is best done with a simple mechanical hand weeder often called a 'rotating hoe,' starting about 20 days after transplanting.
   - At least once more and if possible 2 or 3 times more, until canopy closure makes weeding difficult and no longer necessary.
8. To add nutrients to the soil, preferably in organic form such as compost or mulch.

- **An understanding of the critical factors of SRI underlying the higher productivity is yet to be developed.**
- **It is needed to establish agro ecologically suited critical factors of SRI for sustainable productivity.**
- **It is also needed to validate and promote SRI technology for uptake to Bangladeshi farmers.**

Objectives of the research work

The study has been undertaken with following objectives:

- To find out the effect of crop establishment time and seedling age on crop performance of Boro rice under SRI.
- To find out the water management and soil stirring effect on the performance of Boro rice under SRI
- To find out the effect of spacing and seedling raising method on crop performance of Boro rice under SRI
- To find out the integrated use of manure and fertilizer on crop performance in Boro season under SRI
- To find out the critical factors for higher performance of Boro crop under SRI

Methodology to be followed

- The proposed research has been carried out at the BRRI research farm at Gazipur.
- Total Six experiments will be conducted to fulfill the above objectives.
- Experiments No. 1, 2, 3, 4 and 5 have been already experimented.
- Based on the 1st year performance of experiments No. 1, 2, 3 and 4, Experiment No 5 has been designed for 2nd year.
- In 3rd year, experiment No. 6 has been under taken.

1st year Experiment No. 01

Effect of date of planting and seedling age on tiller production and crop performance of Boro rice

Treatments:

Factor A: Date of planting:

- T_1 = 15 November (Pre-cold)
- T_2 = 30 November (Pre-cold
- T_3 = 15 December (Cold)
- T_4 = 15 January (Cold)
- T_5 = 30 January (Post-cold)
- T_6 = 15 February (Post-cold)

Factor B. Seedling age:

- S_1 = Germinated seed
- S_2 = 8 days after germination
- S_3 = 12 days after germination
- S_4 = 16 days after germination

Results: Grain yield (t/ha)

SEEDLING AGE	NOVEMBER, 15		NOVEMBER, 30		DECEMBER, 15		JANUARY, 15		JANUARY, 30		FEBRUARY, 15	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
GERMINATED SEED	4.22	4.42	7.12	6.80	6.26	6.12	5.52	5.40	4.49	4.35	4.27	4.30
8 DAYS AFTER GERMINATION	4.78	5.10	7.60	7.65	7.61	7.55	6.18	6.25	4.69	4.75	4.38	4.40
12 DAYS AFTER GERMINATION	4.75	5.25	7.71	7.80	7.80	7.75	6.22	6.42	4.76	4.82	4.55	4.62
16 DAYS AFTER GERMINATION	4.34	4.50	7.12	7.00	6.70	6.62	6.25	6.40	4.85	4.95	4.62	4.75

- The result showed that grain yield under SRI at early transplantation (November 15) and late transplantation (After 15 January) did not performed well, where as transplanting between November 30 to December 15 produced higher grain yield.
- Similarly, grain yield was lower when germinated seed was transplanted after that grain yield was increased at 8 and 12 days old seedling. But yield increasing was not reflective at 16 days old seedling.

Comment: Transplanting under SRI should be done with in December 01 to 15 with 12 or 16 days old seedling

The picture of different stages of 1st experiment

Transplanting time

Just after transplanting

Three days after transplanting

12- days old seedling

The picture of different stages of 1st Experiment

25 days after transplanting

Panicle initiating stage

Grain filling stage

Ripening stage

1st year Experiment No. 02

Effect of improved water management technique and soil stirring on the crop performance of Boro rice

Treatments:

Factor A: Irrigation management

I_1 = Conventional

I_2 = 2 - 3 cm depth of water was added during irrigation just for soaking the soil than further irrigation was added at 3 days after disappearing. It was continued from 15 DAT to P I stage than 5-7 cm standing water was kept up to hard dough stage

I_3 = 2 - 3 cm depth of water was added during irrigation just for soaking the soil than further irrigation was added at 5 days after disappearing. It was continued from 15 DAT to P I stage than 5-7 cm standing water was kept up to hard dough stage

I_4 = 2 - 3 cm depth of water was added during irrigation just for soaking the soil than further irrigation was added at 7 days after disappearing. It was continued from 15 DAT to P I stage than 5-7 cm standing water was kept up to hard dough stage

I_5 = 5-7 cm depth irrigation when the water level goes bellow 15 cm from ground surface (through PVC pipe)

I_6 = 5-7 cm depth irrigation when the water level goes bellow 25 cm from ground surface (through PVC pipe)

The picture of different stages of 2nd experiment

25 days after transplanting

Tillering stage

Ripening stage

Maturity stage

Factor B: Soil stirring

- S_1 = One stirring at 20 DAT
- S_2 = Two stirring at 20 DAT and 35 DAT
- S_3 = Three stirring at 20 DAT, 35 DAT and 45 DAT
- S_4 = Weekly stirring after 15 DAT

Results: Grain yield (t/ha)

IRRIGATION	S_1		S_2		S_3		S_4	
	2008	2009	2008	2009	2008	2009	2008	2009
I_1	5.68	5.50	6.10	6.22	6.63	6.75	5.52	5.70
I_2	7.03	7.42	7.66	7.88	7.82	7.90	5.81	5.85
I_3	6.88	7.10	7.20	7.35	7.41	7.50	5.66	5.70
I_4	4.78	4.65	5.49	5.30	5.78	5.77	5.17	5.20
I_5	6.59	6.85	6.74	6.95	6.54	6.66	5.73	5.60
I_6	4.12	4.25	4.34	4.50	4.76	4.45	4.37	4.40

The results indicated that higher grain yield was achieved under Irrigation I_2 and I_3 in respect of other tested water management practice. Similarly stirring S_2 and S_3 performed higher grain yield.

Comment: Higher yield of SRI can achieve under Irrigation I_2 and I_3 with stirring S_3 performed higher grain yield

1st year Experiment No. 03

Effect of integrated use of fertilizers and manures and soil stirring on crop performance of Boro rice

Treatments:

Factor A: Fertilizer and manure

- N_1 = Absolute control
- N_2 = 10 t/ha of manure
- N_3 = 15 t/ha of manure
- N_4 = 10 t/ha of manure + 50% of the rec. inorganic fertilizer
- N_5 = 5 t/ha of manure + 50% of the rec. inorganic fertilizer
- N_6 = 10 t/ha of manure + 100% of the rec. inorganic fertilizer
- N_7 = 5 t/ha of manure + 100% of the rec. inorganic fertilizer
- N_8 = 100% of recommended fertilizer

Factor B: Soil stirring

- S_1 = Weekly stirring
- S_2 = Stirring at 15 DAT, 30 DAT and 45 DAT
- S_1 = No stirring

Results of 3rd experiment

NUTRIENT MANAGEMENT	WEEKLY STIRRING		STIRRING AT 15, 30 AND 45 DAT		NO STIRRING	
	2008	2009	2008	2009	2008	2009
N_1	3.13	3.00	3.16	3.20	3.07	3.10
N_2	4.15	4.10	4.24	4.40	4.05	4.18
N_3	4.54	4.45	4.72	4.85	4.38	4.45
N_4	6.21	6.15	6.49	6.60	5.84	5.80
N_5	5.83	5.72	5.98	6.20	5.32	5.40
N_6	8.00	8.20	8.44	8.52	6.97	7.05
N_7	7.39	7.65	7.83	8.05	6.48	6.65
N_8	7.09	7.22	7.18	7.35	6.26	6.32

The result indicated that higher grain yield was obtained in Fertilizer and manure management N_6 and N_7. Similarly stirring S_2 performed better grain yield.

Comment:
To achieve maximum grain yield under SRI, Fertilizer and manure management N_6 and N_7 may adopted under Stirring S_2 management.

1st year Experiment No. 04

Effect of spacing and seedling raising methods on crop performance of Boro rice

Treatments:

FACTOR A: SPACING (cm)

S_1 = 25 X 15
S_2 = 25 X 20
S_3 = 25 X 25
S_4 = 30 X 20
S_5 = 30 X 25
S_6 = 30 X 30

FACTOR B: SEEDLING RAISING METHODs

M_1 = GERMINATED SEED
M_2 = 10 DAY OLD SEEDLING FROM COMPOST BED
M_3 = 10 DAY OLD SEEDLING FROM NORMAL SOIL BED
M_4 = 10 DAY OLD SEEDLING FROM SEEDLING RAISING TRAY

The picture of different stages of 4th experiment

Results of 5th experiment

TREATMENTS	GRAIN YIELD (t/ha)	TREATMENTS	GRAIN YIELD (t/ha)
$S_1 M_1 N_1 I_1$	5.60	$S_1 M_1 N_1 I_2$	5.95
$S_2 M_1 N_1 I_1$	6.42	$S_2 M_1 N_1 I_2$	7.10
$S_1 M_2 N_1 I_1$	6.40	$S_1 M_1 N_2 I_2$	7.65
$S_2 M_2 N_1 I_1$	7.15	$S_2 M_1 N_2 I_2$	8.70
$S_1 M_2 N_2 I_1$	7.62	$S_1 M_2 N_1 I_2$	6.68
$S_2 M_2 N_2 I_1$	8.46	$S_2 M_2 N_1 I_2$	7.79
$S_1 M_2 N_2 I_2$	7.80	$S_1 M_1 N_2 I_1$	7.48
$S_2 M_2 N_2 I_2$	9.12	$S_2 M_1 N_2 I_1$	8.10

Comments:

The highest yield performance was obtain by S2 M2 N2 I2 (9.12 t/ha) treatments combination followed by S2 M1 N2 I2 (8.70 t/ha) than S2 M2 N2 I1 (8.46 t/ha) and S2 M1 N2 I1 (8.10 t/ha).

The picture of different stages of 3rd experiment

Results of 4th experiment

SPACING	M1= GERMINATED SEED		M2 = 10 DAY OLD SEEDLING FROM COMPOST BED		M3 = 10 DAY OLD SEEDLING FROM NORMAL BED		M4 = 10 DAY OLD SEEDLING FROM TRAY	
	2008	2009	2008	2009	2008	2009	2008	2009
S_1 = 25 X 15	6.35	6.52	6.42	6.50	6.30	6.45	6.40	6.25
S_2 = 25 X 20	6.50	6.70	7.44	7.50	6.41	6.55	6.43	6.45
S_3 = 25 X 25	7.25	7.00	7.96	7.80	8.10	8.00	7.50	7.58
S_4 = 30 X 20	7.00	6.85	8.04	8.00	8.05	7.85	7.48	7.52
S_5 = 30 X 25	7.27	7.10	8.40	8.25	8.15	8.05	7.80	7.72
S_6 = 30 X 30	7.30	7.25	8.45	8.40	8.20	8.35	7.82	7.80

Comments:

Higher grain yield was observed in spacing S_5 and S_6 under M_2 and M_3 seedling raising methods. So these two seedling raising methods and spacing may adopt.

2nd year Experiment

On the basis of 1st year information, Experiment No. 5 was under taken

Effect of selected factors of System of Rice Intensification (SRI) practice for higher Boro rice performance

Factor A: Spacing (Two)
S_1 = 25 x 15
S_2 = 30 x 30

Factor B: Water management (Two)
I_1 = 5-7 cm depth of water was added followed by further irrigation at 3 days after disappearing. It was continued from 15 DAT to P I stage than 5-7 cm standing water was kept up to hard dough stage
I_2 = 2 - 3 cm depth of water was added during irrigation just for soaking the soil than further irrigation was added at 3 days after disappearing. It was continued from 15 DAT to P I stage than 5-7 cm standing water was kept up to hard dough stage

Factor C: Fertilizer and manure management (two)
N_1 = 100% of the recommended inorganic fertilizer
N_2 = 10 t/ha of manure + 100% of the recommended inorganic fertilizer

Factor D: Seedling raising method (Two)
M1 = No stirring
M2 = Stirring at 15 DAT, 30 DAT and 45 DAT

The picture of different stages of 5th experiment

3rd Year Experiment

Based on the 1st and 2nd years experiments (experiment 1, 2, 3, 4, and 5) information's 3rd year experiment (6th experiments) has designed as follow:

Experiment No. 6:

Effect of selected factor of System of Rice Intensification (SRI) in comparison with recommended practices for maximizing the Boro rice yield.

Objective:

- **To select the best SRI techniques with compare to recommended practice for obtaining the highest performance of Boro rice**
- **To recommend the best SRI practices for the highest performance of Boro rice**

Treatments

Factor C: Spacing (S)

S_1: Recommended spacing (15 x 25 cm)
S_2: Best performing spacing in SRI (30 x 25 cm)

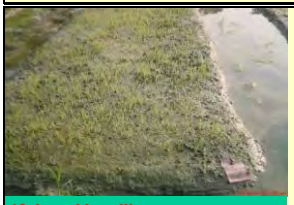
Factor D: Seedling age (A)

A_1: 40 days old seedling seeding on last week of November and transplanting on 1st week of January.

A_2: 12 day old seedling raising in compost bed and transplanting in 1st week of November

Factor E: Soil Stirring (M)

M_1: No stirring
M_2: Three stirring at 15 DAT, 35 DAT and 45 DAT



12 days old seedling

Transplanting of 12 days old seedling

Transplanting of 40 days old seedling

Comparison of 12 and 40 days seedling on March 08

Treatments

Factor A: Irrigation (I)

I_1: 5-7 cm depth irrigation followed by further irrigation at 3 days after disappearing water from the soil. This irrigation will continue before panicle initiation stage after that 5- 7 cm standing water will keep up to hard dough stage.

I_2: SRI water management such as 2 - 3 cm depth of water will add in the field during irrigation time just for soaking the soils and again water will add after 3 days of disappear from soil. This irrigation will continue before panicle initiation stage after that 5- 7 cm standing water will keep in the soil up to hard dough stage.

Factor B: Manure and Fertilizer (N)

N_1: Manure 10 t/ha + 50% of the recommended inorganic fertilizer (50% inorganic recommended fertilizer is 125-40-50-5 kg/ha of N-P2O5-K2O-S respectively. All will apply at basal except N. N will apply at ¼ N at basal, ¼ at 20 DAT, ¼ at 35 DAT and ¼ at PI)

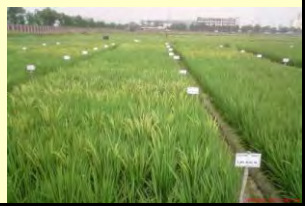
N_2: Manure 10 t/ha + 100% of the recommended inorganic fertilizer management (100% inorganic recommended fertilizer is 250-80-100-10 kg/ha of N-P2O5-K2O-S respectively. All will apply at basal except N. N will apply at ¼ N at basal, ¼ at 20 DAT, ¼ at 35 DAT and ¼ at PI)

Total Factor combination:

Experimental Design = SPLIT-SPLIT-PLOT
Replications = 3
Treatments = 4 x 4 x 2

****** FACTOR(S) ******

** MAINPLOT ** Stirring (M) 2 x Irrigation (I) 2 = 4 levels	** SUBPLOT ** Spacing (S) 2 x Seedling Age (A) 2 = 4 levels	* SUB-SUBPLOT * Manure and Fertilizer (N) = 2 levels
Irrigation x Stirring	Spacing x Seedling Age	Manure and fertilizer
MP 1 = I_1M_1 MP 2 = I_1M_2 MP 3 = I_2M_1 MP 4 = I_2M_2	SP 1 = A_1S_1 SP 2 = A_1S_2 SP 3 = A_2S_1 SP 4 = A_2S_2	SSP 1 = N_1 SSP 2 = N_2



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3.4 Presentation on SRI Research at BAU, Mymensingh

Results of SRI Trials at BAU

Professor Dr. Najrul Islam
Dept. of Agronomy

Rationale

- The population increase is in commensurate with Rice Demand in Bangladesh
- The rice production has reached a plateau and the nation as well as the Govt. is at a loss to decide how to cope up with the increasing Rice Demand
- The average yield of rice is only 2.43 t ha^{-1} (BBS, 2006). This yield figure is: Japan- 6.22t, China-6.06t, Korea-7.00t and USA-6.35 t/ha (FAO, 1999)
- The yield enhancement of rice is of our high expectation but how that is possible!

Possible ways for increasing rice yield:

A] Varietal Improvement

B] Optimization of management options

- The System of Rice Intensification (SRI), which is an integrated and agro-ecologically sound approach of rice cultivation.
- SRI could be attempted as an alternative management option.

This is because:

- SRI- a set of practices and principles for managing plants-soil-water-nutrient dynamics in mutually beneficial ways, creating synergies.
- SRI can control/ modify the environment in such a way that the existing genetic potentials can more fully be expressed and realized.

Components of SRI

Component	Parameter
1.SS vs. MS	Single Seedlings; Multiple Seedlings
2.YS vs. OS	8-day old seedlings; 30-d old Seedlings
3.WS vs. NS	Wider Spacing; Narrow Spacing
4. AS vs. Ss	Aerated Soil; Stagnant soil
5.sS vs. W	Soil Stirring; Weeding
6. C vs. F	Compost vs.Fertilizer/Fertilizer+Compost
7. LT vs. JT	Shallower vs. Deeper transplanting
8. QT vs. DT	Quicker vs. Delayed transplanting

- A number of field trials were conducted with several aspects of SRI at BAU site, Mymensingh

Objective

- to examine the effect of components and package of SRI practices on rice yield in both the transplant *aman* and the *Boro* seasons

Methodology

- 5 field trials were conducted in 2004-05 T. *aman* and *Boro* seasons.
- 4 field trials were conducted in 2005-06 *Boro* season.
- One field trial was conducted in 2007-08 Boro season.
- Site: Bangladesh Agricultural University, Mymensingh

Table 1.2 Effect of fertilizer management on the yield of BRRI dhan 31 (T.aman)

Fertilizer	Grain yield (t/ha)
F1	2.07c
F2	4.03b
F3	5.45a
Sx	0.039
LS	0.01

F1- Cowdung @ 5t/ha
F2- Cowdung @ 10t/ha
F3- BRRI Recommended Fertilizer (NPKSZn)

Table 1.4 Effect of spacing on the yield performance of BRRI dhan 31 (T.aman)

Spacing	Grain yield (t/ha)
S0	3.43d
S1	4.25a
S2	3.87bc
S3	3.72c
S4	3.98b
Sx	0.051
LS	0.01

S0- 25 cm x 15 cm
S1- 25 cm x 25 cm
S2- 30 cm x 30 cm
S3- 40 cm x 40 cm
S4- 50 cm x 50 cm

Table 3.2 Effect of seedlings/hill on the yield performance of hybrid rice cv. Jagoron in Boro season

Seedlings/ hill	Grain yield (t/ha)
1	6.94a
2	6.42b
Sx	0.036
LS	0.05

Table 3.4 Effect of seedling age on the performance of hybrid rice cv. Jagoron in Boro season

Seedling age	Grain yield (t/ha)
A1: 08-day	6.70a
A2: 12-day	6.26b
A3: 16-day	4.48c
Sx	0.044
LS	0.01

Table 3.8 Effect of spacing on the yield performance of hybrid rice cv. Jagoron in Boro season

Spacing	Grain yield (t/ha)
S1	5.26d
S2	6.34c
S3	7.50a
S4	6.81b
Sx	0.051
LS	0.01

S1- 25 cm x 25 cm
S2- 30 cm x 30 cm
S3- 40 cm x 40 cm
S4- 60 cm x 60 cm

Table 3.10 Interaction effect of seedling age x spacing on the yield of hybrid rice cv. Jagoron in Boro season

Interaction (A x S)	Grain yield (t/ha)
A1 x S1	5.31f
A1 x S2	6.49de
A1 x S3	8.09a
A1 x S4	6.92c
Sx	3.31
LS	0.31

A1- 8 day old seedling
S1- 25 cm x 25 cm
S2- 30 cm x 30 cm
S3- 40 cm x 40 cm
S4- 60 cm x 60 cm

Table 4.4 Effect of water management on plant on the yield Boro rice cv. BRRI dhan 29

Water management	Grain yield (t/ha)
W1	5.78c
W2	6.91a
W3	6.77ab
W4	6.62ab
W5	6.45ab
Sx	0.13
LS	0.01

W1- Conventional
W2- Alternate drying and wetting of soil (SRI water management)
W3- Just saturated for one month and then 2.54cm (1-2") standing water until drying followed by further irrigation
W4- Just saturated for one month and then 5.08cm (3-4") standing water until drying followed by further irrigation
W5- Just saturated for one month and then 7.62cm (4-6") standing water until drying followed by further irrigation

Table 5.2 Effect of seedling raising methods on the yield of Boro rice cv. BRRI dhan 29

Seedling raising methods	Grain yield (t/ha)
Direct seeding	4.88b
Sowing of sprouted seed	5.95a
Dapog bed seedling	6.13a
S3- Nursery bed seedling (Normal)	5.79a
Seedling raised from compost applied nursery bed	5.81a
Sx	0.112
LS	0.01

Table 5.4 Effect of fertilizer management on the on the yield of Boro rice cv. BRRI dhan 29

Fertilizer	Grain yield (t/ha)
F0- Control	3.14f
F1- BRRI recommended fertilizer (RF)	6.99b
F2- 5 ton cowdung	4.15e
F3- 10 ton cowdung	5.25d
F4- 15 ton cowdung	6.65bc
F5- 5 ton cowdung + 50% RF	6.20c
F6- 10 ton cowdung + 50% RF	7.62a
Sx	0.133
LS	0.01

Table 6.2 Effect of spacing on the grain yield of Boro rice cv. BRRI dhan 29

Spacing	Grain yield (t/ha)
S1- 25 cm x 25 cm	5.95 b
S2- 30 cm x 30 cm	6.14a
S3- 40 cm x 40 cm	5.75c
Sx	0.06
LS	0.01

Table 6.4 Effect of soil stirring on the yield of Boro rice cv. BRRI dhan 29

Soil stirring	Grain yield (t/ha)
W1-Normal weeding	5.19b
W2-Weekly soil stirring by JRW	5.77a
Sx	0.05
LS	0.01

Table 6.8 Interaction effect of spacing and soil stirring on the yield of Boro rice cv. BRRI dhan 29

Soil stirring	Grain yield (t/ha)
S1 x W1	4.52d
S1 x W2	5.18c
S2 x W1	5.95a
S2 x W2	6.33a
S3 x W1	5.71b
S3 x W2	5.79b
Sx	0.08
LS	0.01

S1- 25 cm x 25 cm
S2- 30 cm x 30 cm
S3- 40 cm x 40 cm

W1-Normal weeding
W2-Weekly soil stirring by JRW

Treatments for Expt. 8

(Boro rice cv. BRRI dhan 29)

One level SRI practice

01. SS/30/3/**C**/NS(T_1)
02. SS/30/**1**/NPK/NS (T_2)
03. SS/**8**/3/NPK/NS(T_3)
04 AS/30/3/NPK/NS(T_4)
05. SS/30/3/NPK/**WS**(T_5)

Two level SRI practices

06. SS/30/**1/C**/NS (T_6)
07. SS/**8**/3/**C**/NS (T_7)
08. AS/30/**1**/NPK/NS(T_8)
09. SS/8/3/C/NS(T_9)
10. SS/**8/1**/NPK/NS(T_{10})
11. AS/30/3/**C**/NS(T_{11})
12. AS/30/3/NPK/**WS**(T_{12})
13. SS/30/**1**/NPK/**WS**(T_{13})
14. SS/**8**/3/NPK/**WS**(T_{14})
15. SS/30/3/**C/WS**(T_{15})

Three level SRI practices

*16. SS/**8/1/C**/NS*(T_{16})
17. AS/30/**1/C**/NS(T_{17})
18. AS/8/3/**C**/NS(T_{18})
19. AS/8/1/NPK/NS(T_{19})
20. SS/**8/1**/NPK/**WS**(T_{20})
21. SS/**8**/3/**C/WS**(T_{21})
22. AS/30/3/**C/WS**(T_{22})
23. SS/30/**1/C/WS**(T_{23})
24. AS/8/3/NPK/**WS**(T_{24})
25. AS/30/**1**/NPK/ ***WS***(T_{25})

Four Level SRI practices

26. **AS/8**/3/**C/WS** (T_{26})
27. **AS/8/1**/NPK/**WS** (T_{27})
28. **AS/8/1/C**/NS (T_{28})
29. **AS**/30/**1/C/WS** (T_{29})
30. SS/**8/1/C/WS** (T_{30})

All SRI Practices

31. **AS/8/1/C/WS**(T_{31})

All Conventional practices

32. SS/30/3/NPK/NS(T_{32})

Table 8.2 Effect of using increased number of SRI levels on the yield of Boro rice cv. BRRI dhan 29

Treatment	Grain yield (t/ha)
Conventional method (1)	5.08
All SRI (1)	6.93
One level SRI (5)	4.39
Two level SRI (10)	4.74
Three level SRI (10)	5.48
Four level SRI (5)	5.81
Sx	0.231
LS	0.01

Table 9.4 Effect of fertilizer management on the yield of Boro rice cv. BRRI dhan 29

Fertilizer	Grain yield (t/ha)
F1- BRRI recommended fertilizer (RF)	6.80d
F2- 15 ton cowdung	6.13e
F3- 15 ton cowdung + 25% RF	7.39c
F4- 15 ton cowdung + 50% RF	8.25b
F5- 10 ton cowdung + 50% RF	7.81bc
F6- 10 ton cowdung + 100% RF	8.80a
F7- 10 ton cowdung + 150% RF	8.86a
Sx	0.132
LS	0.01

Table 10.1 Effect of fertilizer management on the yield of Boro rice cv. BRRI dhan 29 (2007-08)

Treatment	Grain yield (t/ha)
Con+RF	6.09ab
Con+15t CD	4.39bc
Con+RF+5t CD	6.63a
SRI+15t CD	4.42bc
SRI+10t CD	4.22c
SRI+50%RF	6.04ab
SRI+RF+5CD	7.08a
SRI+RF	6.66a
SRI+1.5RF	6.77a
SRI+RF+CD+Bio	7.74a
CV (%)	13.75
Significance	**

Table 10.2 (Contd.)

Treatment	% Increased over conventional method of rice cultivation	
	Grain yield	Straw yield
Con+RF	00.00 *	00.00
Con+15t CD	-27.90	-20.87
Con+RF+5t CD	08.87 **	10.85
SRI+15t CD	-27.40	-24.04
SRI+10t CD	-30.69	-28.71
SRI+50%RF	-00.70	01.07
SRI+RF+5CD	16.35 **	15.45
SRI+RF	09.41 *	10.97
SRI+1.5RF	11.18	27.64
SRI+RF+CD+Bio	**27.20**	**29.66**

Experimentals

Plate 01: 8-day old Seedling in nursery bed

Plate 02. Final land leveling required prior to transplanting

Plate 03. Seedlings used in Expt. 3

Plate 03. First watering after transplanting

Plate 04. Single seedling is growing up

Plate 05. Using Japanese Rice Weeder

Plate 06. Establishing seedlings in the plots

Plate 07. Tillering phase of Brri dhan 29

Plate 08. SRI crop at pre-flowering state

Plate 09. Differential crop performance due to treatments

Plate 10. A hill with 69 panicles from a single seedling in a SRI plot

Associate Organization and RBP Program Area

Organization name	Working site
SKS-Foundation	Saghata, Gaibandha
Samakal Samaj Unnayan Sangstha	Sundargonj, Gaibandha
Gono Unnayan Sangstha	Sadar, Gaibandha
Akota	Sadar, Gaibandha
RSDA	Rowmary, Kurigram
Zibika	Sadar, Kurigram
Own Village Advancement	Sadar, Lalmonirhat
Gonochetana	Dewangonj, Jamalpur
Sariatpur Development Society	Naria, Shariatpur

Plate 12. Left-Crop with 3 SRI levels of practice Right-Crop with 4-SRI levels of practices

Table 1: Key findings of SRI from 2005 to 2008

Findings	Boro, 2005-06		Boro, 2006-07		Boro, 2007-08	
	SRI	FP	SRI	FP	SRI	FP
Monitored farmer & demonstration plot	10	10	44	44	62	62
Monitored area (decimal)	95	70	432.5	1241.5	909	865
Spacing (cm)	24	18	25.13	16.68	25	17-25
Average age of seedling (days)	16	37.6	15.69	36	15.5	51.5
Average number of effective tillers (no.)	29	21	28.28	17.23	28.1	17.2

Plate 15. Boro rice cv. Jagoron with SRI practice of irrigation

Plate 16. BRRI dhan 29 in Boro season with 4 levels of SRI practices

Table 2: Average yields of rice in SRI technology and Farmers' Practice (FP) in different upazilas.

Upazila/ district	SRI (Avg yield, t/ha)			FP (Avg yield, t/ha)		
	2005-2006	2006-07	2007-08	2005-06	2006-07	2007-08
Sundarganj & Saghata, Gaibandha	8.61	6.27	5.97	5.66	4.69	4.65
Rowmari & Sadar, Kurigram	7.46	6.54	8.5	7.43	4.57	6.76
Nikli, Kishoreganj	--	5.57	--	--	4.85	--
Dewangonj, Jamalpur	--	--	7.73	--	--	5.99
Naria, Sariatpur	--	--	5.73	--	--	5.04

Cost of production of Paddy

Cost Item	Cost per hectare (Taka)			
	SRI	% of Total Cost	Non-SRI	% of Total Cost
1. Seed	825.5	2.2	2,039.5	4.6
2. Fertilizer	7987.0	20.9	8581.0	19.2
3. Insecticides	561.6	1.5	1227.9	2.7
4. Irrigation	10,552.0	27.6	11836.0	26.5
5. Labour *	18,257.0	47.8	20995.0	47.0
Total Costs	38,183.0	100	44679.0	100

Plate 20: SRI performance was demonstrated to the Scientists & Extension Personnel (Expt. 10)

Table-3: Economics of rice production through SRI & FP in 2005-2006

Upazila/District	SRI				Farmers Practice (FP)			
	Gross revenue (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)	Benefit-cost ratio	Gross revenue (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)	Benefit-cost ratio
Gaibandha, Kurigram, Lalmonirhat	84242	38183	46242	2.2	68155	44679	23476	1.5

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Rowmari & Sadar, Kurigram	80193	45523	33099	1.74	56974	51112	5861	1.11
Nikli, Kishoreganj	68708	52258	16450	1.31	59859	45997	13862	1.30


Oxfam
National Workshop on System of Rice Intensification (SRI)
Chief Guest : Dr. C. S. Karim, Hon'ble Advisor, Ministry of Agriculture & Ministry of Water Resources
Chairperson : Mr. M. Abdul. Aziz ndc, Secretary, Ministry of Agriculture
Venue : BARC Conference Room
Farmgate, Dhaka
Date : Wednesday 13 February 2008

3.5 Presentation on SRI in Farmers' Field of RBP Project, Oxfam by Monir Mosharof, Padakhep

Disaster Risk Reduction and Vulnerable Livelihoods (River Basin) Program

Implemented By
Agriculture and Environment Division
Padakhep Manabik Unnayan Kendra

Supported By
Oxfam-GB

Associate Organization and RBP Program Area

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Nikli, Kishoreganj	68708	52258	16450	1.31	59859	45997	13862	1.30

Limitations

- Transplanting
- Uniform irrigation
- Cold injury in boro season

Recommendations

- Community approach (as block/ scheme cultivation) is necessary for getting better output of the technology, particularly for water management
- Needed to develop suitable transplanting tools
- Transplanting time needed to be adjust (depends on locality) for escaping cold injury during the seedling and early growth stage.

THANK YOU

ANNEX - 4

Annex-4: An Update of SRI Progress in Bangladesh and Future Plans (June 2012)

Introduction

The System of Rice Intensification, known as SRI method, is gaining popularity among rice farmers in many areas of Bangladesh in recent times for its potential to improve productivity of land, labour, irrigation water and other inputs simultaneously. SRI not only increases rice yield, but also helps save our environment. This system was originated and developed in Madagascar in the 1980s, and since 1999 its validity has so far been seen in 50 countries across the world, providing farmers with increased income and food security. SRI involves a set of principles that are at times radically different from the traditional ways of growing rice.

SRI involves transplanting single, young seedlings, removed from an upland (garden-like) nursery with care and re-established quickly into the field, instead of the conventional method of transplanting multiple seedlings, 30-50 days old, in clumps, pulled up from flooded nurseries and often treating the roots roughly, knocking off soil and exposing them to the air and sun. SRI spaces rice plants more widely, reducing plant populations dramatically, and does not depend on continuous flooding of rice fields. It uses less seed, less chemical fertilizer and inputs, and promotes soil biotic activities in and around plant roots, enhanced through liberal applications of compost and through weeding with a rotating weeder that aerates the soil. These changed practices with lower inputs counter-intuitively lead to improved productivity with yields of 7-8 tons/ hectare, about double the present world average of 3.8 t/ha.

Rice is the main food crop in Bangladesh, occupying 75% of the cropped area. Under the circumstances stated above, the country needs a sustainable system of rice production that gives higher yields with lower costs. We need a crop management system that can reduce dependence on high-cost modern inputs, improving soil quality, and being environment-friendly. SRI has demonstrated potentials in Bangladesh that meet these requirements. In recent evaluations, it has given 25-50% higher yield, and sometimes even more, with fewer requirements of water, fertilizer and agrochemicals, and 50-100% greater profitability because of higher yield and lower costs.

A review of SRI activities and progress in Bangladesh

In 1999-2000, the government's Department of Agricultural Extension (DAE) and CARE-Bangladesh introduced SRI to farmers with whom they were working in Kishoregonj district. The average SRI yields in that first *Boro* season were 6.5-7.5 t/ha. At the same time, a Bangladesh Rice Research Institute (BRRI) researcher at its Comilla research station who received a paper on SRI tried it on-station and found that a yield increase of 1 t/ha could be attributed solely to the change in methods. Since rice yield increases had been stagnant for some years, and BRRI was under some pressure to raise yields, this attracted some attention, although most researchers continued to be very sceptical.

In December 2000, Prof. Norman Uphoff, who was in Bangladesh for other CIIFAD business, visited Kishoregonj and gave seminars on SRI for CARE-Bangladesh, BRRI at its Gazipur headquarters, and BRAC office in Dhaka. These institutions, plus the DAE, became the core institutions involved with SRI in Bangladesh. BRAC also began doing its own evaluations of SRI.

In January 2002, a meeting of organisations interested in SRI was hosted by BRAC at its headquarters. They formed a Steering Committee composed of BRRI, DAE, BRAC, CARE, and Syngenta Bangladesh Ltd. which had also started trials on SRI methods and found them beneficial, particularly for seed multiplication. This brought together public sector, NGO and private sector institutions.

In September 2002, a workshop was organized by CARE-Bangladesh on behalf of the national working group, convened at the Bangladesh Agricultural University (BAU) at Mymensingh. At a follow-up steering committee meeting, plans were made for systematic, two-year evaluation of SRI, which could be funded by the PETRRA project managed by IRRI/Bangladesh and financed by DFID. These studies have provided a thorough base of knowledge for understanding the advantages that SRI methods can provide.

During 2002-03 and 2003-04 *Boro* seasons, PETRRA/ IRRI provided funding support to carry out action-research trials in several areas of the country with the participation of some selected NGOs and BRRI researchers. The overall results were positive, and farmers achieved substantially higher yields under SRI practice except in case of BRRI trials in Comilla. The BRRI-Satkhira results showed SRI results to be better than both farmers' and BRRI methods, but BRRI-Comilla did not find much encouraging results. It was unfortunate that on-station BRRI results were not encouraging. Except for BRRI-Comilla, the BRRI-Satkhira and all other evaluating organizations including NGOs, Syngenta and DAE got higher yields in farmers' field with SRI methods. It has been learned that farmers in the Satkhira region, where the successful trials were conducted by a BRRI scientist in collaboration with a local NGO *Uttaran*, are still following SRI methods on their own initiative. Likewise, in other areas where initial trials were conducted, many farmers have adapted SRI methods under their own initiative. DAE also introduced SRI under the name of *Ekchara paddhoti* (single seedling method) in selected areas.

The first national workshop on SRI was held in December 2003 in Dhaka. The inaugural session was chaired by the Executive Chairman of Bangladesh Agricultural Research Council (BARC), Dr M. Nurul Alam. The then State Minister for Agriculture, Mr. Mirza Fakhrul Islam Alamgir, MP, attended as Chief Guest. Seven papers were presented by researchers, extension specialists, and NGO officials. SRI farmers also narrated their experience. The workshop felt that a better understanding of the principles of SRI would be necessary to promote SRI methods in the country, and it was recommended, among other things, that an integrated and coordinated approach be followed involving farmers, researchers and extension workers (GO/NGO) in conducting SRI trials. It also recommended seeking donor assistance in undertaking SRI promotional activities.

Though SRI was found to have continued with farmers' initiative in different locations, there was no coordinated central organization to effectively play roles of extension, training and motivation to disseminate its benefits throughout the country. A second national workshop on SRI was held on February 22, 2005 in the DAE Conference Room, Khamarbari, Dhaka, attended by the Minister of Agriculture and with significant farmer participation.

Institutional support for SRI was further revived in Bangladesh in a meeting held on 15th July 2005, with SRI Steering Committee representatives and Oxfam GB Bangladesh. It was decided to carry out action-research trials on the potentials of SRI through partner NGOs in the country. It was agreed that Prof. Muazzam Husain, Convenor, SRI Steering Committee, would lead a team to facilitate the implementation, initially on a pilot scale in some Oxfam GB River Basin Project (RBP) areas during the *Boro* season (2005-06).

The third and fourth National Workshops on SRI were sponsored by Oxfam GB Bangladesh and were held in October 2006 and February 2008, respectively. In both these workshops, recommendations were made to proceed with the promotion of SRI in Bangladesh with GO-NGO collaboration. The fifth experience sharing national workshop on SRI was held in April 2010 at the BRRI in Gazipur, which also recommended, among other things, on a coordinated GO-NGO programme for the promotion of SRI in an integrated manner.

Results of Oxfam GB Bangladesh-supported SRI trials

Oxfam through its River Basin Programme (RBP) had initiated SRI trials with the *char* dwellers in the northern part of the country during 2005-06 *Boro* season and continued for three consecutive *Boro* seasons. Each year, the results of the trials were encouraging as reflected by an increase in both area and farmer participation. Trials were also conducted during the fourth year with support from *Padakhep*, a partner NGO of Oxfam GB.

SRI NNB provided training, monitoring and reporting support to the personnel of partner NGOs of Oxfam GB Bangladesh. SRI cultivation guidelines (manual) and brochures have been printed adequately for distribution to the various organisations and farming communities.

Impact of RBP at Farmers' level:

- SRI method of rice cultivation created an awareness and interest among the farmers especially in the *char* and *haor* areas of Kurigram, Gaibandha, Jamalpur, Sariatpur and Kishoregonj districts. The farmers of these areas experimented with SRI and received better results.

- The positive results of SRI attracted many neighbouring farmers to adopt SRI method of rice cultivation. Many farmers found utility in its reduction of seed needs by more than 60%, increased production, and less pest/ disease infestation.

- SRI practice has been gaining popularity with various farmers associations such as *Grameen Unnoyan Samitee* (GUS) in Netrokona and BARD (Bangladesh Action for Rural Development) in Kushtia, and some others.

Institutional arrangement of SRI activities

SRI initiative in Bangladesh is now coordinated by an institutional body named SRI National Network Bangladesh (SRI NNB). This has succeeded the former SRI Steering Committee. This association has an executive committee with membership from Government institutions like the BRRI and DAE; the Bangladesh Rice Foundation; development organisations like BRAC, ActionAid, and SAFE; and individuals actively interested in SRI. Prof. Muazzam Husain has been serving as Coordinator for SRI NNB. The Secretariat for SRI work has been set up at Bangladesh Rice Foundation (BRF) now located at House 6/20 (Ground floor), Block E, Lalmatia, Dhaka. BRF has been playing an advocacy and supporting role to institutionalise SRI with DAE and Government.

Progress at institutional and policy levels

There has been progress at the institutional level to understand and take forward SRI initiatives with the Government and NGOs. Top-level officials of the Department of Agricultural Extension (DAE) are now supportive to promote SRI among the farmers throughout the country. The 4th National Workshop was held on February 13, 2008 at BARC, Dhaka, in which the then Honourable Adviser, Ministry of Agriculture and Ministry of Water Resources, Dr. C. S. Karim, was the Chief Guest, and the then Secretary of Agriculture, Mr. M. Abdul Aziz ndc, was Chairman. The workshop came up with some specific recommendations, which are considered favourable for SRI promotion in the country.

i. The valuable discussions in the workshop provided a guideline to move forward to improve our rice production system. Since SRI has shown advantages in ensuring higher production and distinct cost economies, we need to show its suitability to our farmers in Bangladesh
ii. GO-NGO collaboration should be strengthened to promote SRI in a right manner. We must all help farmers' organisations to adopt SRI in an appropriate way

iii. The BRRI should have an open mind and do more research on SRI to make recommendations to our extension workers and farmers to adapt the system in an appropriate manner. Research is needed to devise ways and means to overcome the constraints and bottlenecks of SRI in the country under its own agro-ecological and socio-economic conditions.
iv. Necessary technical support should be provided by the Government through the DAE to expedite the promotion of SRI
v. Training of farmers and field workers on the SRI method should be provided in a planned manner by the DAE in collaboration with SRI NNB, which would enable them to properly understand and apply the SRI principles in the farmers' field

MoA issued a memorandum to DAE for implementing SRI with field demonstrations. But no fund allocation was made in this respect for implementing this by the DAE personnel. As a new initiative, it would cost some money for training of DAE trainers/field staff, training of farmers, demonstration setups, organizing farmer field days, etc. However, DAE top officials are willing to promote SRI in farmers' field. In this regard, six Upazilas from four districts were selected for setting SRI demonstrations. Twenty-five Sub-Assistant Agricultural Officers (SAAO) from these six Upazilas, and another 20 higher-level DAE and CERDI officers were trained in two separate batches in June 2008 at CERDI campus, Gazipur. The training was conducted by SRI NNB, which also shared the major part of the cost from its limited funds. It would not be possible for the SRI NNB to conduct any further training programmes without financial support from some institution.

BRRI has been instructed by an official memo from MoA to undertake necessary research on SRI so that the existing problems can be overcome at the farmers' level. This would help to expedite promotion of SRI among farmers. In the meantime, one Senior Scientific Officer (SSO) of BRRI set up experimental plots on SRI at BRRI, as part of his Ph.D. programme. Field research has been completed. Trials were continued for three years, ending during the 2009-10 *Boro* season. The results appear to be highly encouraging.

Also at the Bangladesh Agricultural University (BAU), one Professor of Agronomy started experiments on SRI and has come up with highly encouraging results. Students have been conducting research at M.S. and Ph.D. levels on SRI, and BAU has been planning to continue SRI trials in future.

Recent events on SRI:

Experience-Sharing National Workshop on SRI held at Bangladesh Rice Research Institute (BRRI)

On 28 April 2010, the fifth experience-sharing national workshop on SRI was held at the BRRI. The Honourable Minister for Agriculture, Begum Matia Chowdhury, was the Chief Guest, and Dr. Wais Kabir, Executive Chairman of the Bangladesh Agricultural Research Council, chaired the workshop sessions. Policy makers, scientists, extension personnel, and representatives from various national and international organisations participated. Papers presented and discussions testified to the potentiality and success of SRI method in the country. The workshop recommended an integrated and coordinated programme approach by government (research and extension) and non-governmental organisations (national and international) for promotion of SRI in a planned manner. The SRI NNB would play a coordinating role in this respect.

SRI trials by partner organisations

It is gratifying to note that DAE and various other development organisations have shown interest to collaborate with the SRI NNB and provide support for the promotion of SRI in Bangladesh. For example, Padakhep, a national development NGO and BRAC have started adopting the SRI method during the *Boro* season (2010-11). DAE has established demonstration plots at farmer level in six upazila under Kushtia district during the Aus season, 2011. In addition, one enthusiastic SRI promoter, Mr. Hashem Zaman, has

also started using the SRI method in rice production in Naogaon district in northern Bangladesh. He conducted SRI trials during the 2009-10 Boro season in 3.3 acres of land, while during the 2010-11 *Boro* season SRI method was used for producing both aromatic varieties and BRRI *dhan* – 29 in 33.3 acres. SRI NNB has provided training to the Extension staffs of the BRAC programme and to extension staff and some farmers of the DAE programme. During the 2011-12 *Boro* season, Proshika, a national NGO also started demonstrations on SRI in three districts.

Padakhep initiates SRI method in seed production

Padakhep, a national development NGO has adopted the SRI method in 45 acres of its rice seed production areas during the *Boro* season (2010-11) in Dinajpur district. As a partner organisation of Oxfam GB, Bangladesh, some *Padakhep* staffs have gained wide experience in implementing and managing the SRI method. The *Padakhep* top management also has favourable attitude towards SRI.

BRAC Share Croppers Development Programme starts SRI demonstration

During the 2010-11 *Boro* season BRAC set up SRI demonstration plots in eight *Upazila* (Sub-districts) of eight districts under its Sharecropper Development Programme. Out of ten areas selected two areas had to be abandoned due to severe cold injury to young seedlings. The average grain yield was 7.48 t/ha under SRI method and 6.13 t/ha under normal practice. BRAC leadership is also considered to be favourable to the SRI method and can play a very valuable role in promoting SRI in Bangladesh. It continued SRI demonstrations during the *Boro* season 2011-12 also.

DAE undertakes SRI demonstration during Aus season, 2011 in Kushtia

During a discussion session with the Director General, DAE, the matter of initiating demonstration of SRI method by DAE in different suitable areas was raised by the Coordinator, SRI NNB. The DG proposed to start SRI demonstration immediately during the *Aus* season in Kushtia and asked the Deputy Director, DAE, Kushtia to arrange the same in consultation with the SRI NNB. The DD was very enthusiastic about the proposal and a training session and field visit was arranged. A two member team went to Kushtia and conducted SRI training to 27 field staff (SAAO) and 13 farmers. Field visits were also made to discuss different aspects of SRI, motivate interested farmers, and advice on the suitability of selected plots. Finally demonstration plots were started in six upazila with five farmers' plots in each upazila. Progress was monitored. The DD informed that the performance of the trials was good. However, he has been transferred to Ishwardi as Principal of the Agricultural Extension Training Institute (AETI) there. He promised to continue his support to promote SRI.

Proshika initiates SRI trials

Proshika, which earned reputation for its initiative in organic farming, started demonstration trials on SRI in three districts, Manikgonj, Naogaon, and Rangpur during the 2011-12 *Boro* season. The results were encouraging except in Rangpur where transplantation was made very late in the season. They are expected to continue the trials next year.

Future plans for expansion of SRI activities by the SRI NNB

It is planned to develop collaborative programmes with both governmental and non-governmental organisations for the promotion of SRI as a method of environment-friendly sustainable rice production in the country, and to help improve food security in the country. The activities would include research, extension and motivational programmes. Some aspects of the programme deserving immediate action include the following:

Wider dissemination of the principles of SRI: Extensive media coverage may be obtained for this purpose along with associated promotional measures.

Training on SRI: SRI NNB will provide training to DAE and other organization personnel interested in SRI learning and promotion among the farming community. One limitation of the SRI NNB is that it has resource persons but no financial capacity to do this. Decision has been made recently to prepare a coordinated SRI development programme and seek financial and institutional credit support for farmer level replication of SRI and in conducting training, monitoring and evaluation, and research programmes of SRI NNB.

Learning video on SRI: The SRI NNB has dubbed one SRI video prepared in Indonesia for free distribution among organisations/individuals interested in practising SRI methods. Since the agro-ecological conditions in Bangladesh differ from those of Indonesia, it is felt necessary to develop a video on SRI in the country for better learning and encouraging farmers.

Field visit, monitoring and evaluations: SRI NNB plans to make field visits to observe and monitor the SRI activities being implemented in DAE, NGOs, and other organizations. Evaluation reports are also to be prepared, especially to overcome any constraints for SRI adaptation.

Strengthening action research: Field evaluation reports would form the basis of action research. This would involve strengthening the research activities in collaboration with various organisations. In addition to the BAU and BRRI, research support from other Agricultural Universities would also be sought.

Support for SRI NNB: The SRI needs assistance and support for effectively conducting its functions. Assistance was provided by Prof. Norman Uphoff from CIIFAD in 2007 to the SRI NNB, which was spent for SRI promotional activities and overhead costs during a period of three years (2007-10). In addition, Oxfam GB, Bangladesh provided funds for implementing the SRI trials in its River Basin Project areas for three years (2005-08) and for holding Experience Sharing National Workshops during that period. The 2010 National SRI Workshop was co-sponsored by the BRRI and *Padakhep*.

With expanding scope of work, the SRI National Network, Bangladesh (SRI NNB) also feels that its infrastructural facilities need to be expanded to improve its capacity to perform its functions effectively. Institutional support including grant of funds would be required for the purpose of implementing the different SRI promotional programmes. An informally federated and coordinated organisational structure has been envisaged. It has already formed a Programme Committee to chalk out development plans and programmes for strengthening SRI NNB and help in seeking effective institutional support from different potential sources. A draft proposal has been prepared, which will be finalised after consultations with the partner organisations.

It is stipulated in the new proposal for SRI promotion that the partner organisations would contribute necessary funds to carry out their own part on the coordinated programme. Funds would be would also be sought from donors and other fund providing institutions especially to conduct action research, monitoring, evaluation and reporting, and other promotional activities to be coordinated by the SRI NNB.

Pictorial Presentation of SRI Activities in Farmers' Field

SRI National Network Bangladesh