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System of Rice Intensification National Network Bangladesh (SRINNB) Enhancement of Food Security and Climate Resilient Livelihood Opportunities for the Farming Community in Bangladesh - An Exploratory Study Report

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Abstract

The System of Rice Intensification (SRI) was initiated in Bangladesh in 1999-2000 when the government's Department of Agricultural Extension (DAE) and CARE-Bangladesh introduced SRI to a few groups of farmers in Kishoregonj. The average SRI yields in that first Boro season were 6.5-7.5 t/ha, which was around 20% higher than farmer practice. The SRI movement started in 2000 after Prof. Norman Uphoff visited Dhaka and spoke on the benefits of SRI to representatives of agricultural-related organisations and NGOs in the BRAC Head Office. The objectives of SRI NNB are to enhance crop intensification, production, and income for the farmers. The crop intensification initiative of SRI NNB followed the farmer participatory action (PAR) research approach for involving the farmers in undertaking field experiments, observation, analysis, and adoption processes to increase farm productivity and income. Though SRI practice was initiated about two decades ago in Bangladesh, it didn't expand much throughout the country. The farmer-to-farmer extension took place in localized proximity. Institutional management support and resource allocation are considered to be inevitable to expand the benefit of SRI among the farmers. It is expected that farmers might exercise the SRI principles in other crops as well. The recent emerging impact of climate change is to be addressed together with SRI practice and appropriate climate smart technologies in Bangladesh to improve food security of the poor and marginal farmers.

Keywords: Farmer participatory action, Climate smart, Food security, Marginal farmers, Learnings

Introduction

The Agriculture sector plays an important role in overall economic development of Bangladesh. This sector, provides employment about 41 percent of the labour force and provides 14.74 percent to the country's GDP Achieving the target of self-sufficiency in food is one of the avowed goals of the present Government. To attain this, the Government has placed highest importance on the overall development of the agriculture sector. To achieve this the Government has taken a number of steps. These include expansion of small irrigation facilities, reduction of water logging, production of improved quality and high-yielding varieties of seeds and their preservation and distribution. Food availability, access and utilization remain challenged considering Bangladesh's unique context and the emergence of issues such as climate change, food prices crises, food safety and nutrition concerns. There has been increase in rice production in Bangladesh over the last few decades, but catastrophic climate impact has been affecting production. With the highest consideration for the development of agriculture and the welfare of the farmers, the government is continuing its all-out efforts for the overall development of the agricultural sector in the light of Vision 2041, 8th Five-Year Plan (July 2020 - June 2025), National Agriculture Policy 2018, National Agricultural Extension Policy 2020, National Agricultural Mechanization Policy 2020, Master Plan for Agricultural Development in the South, Sustainable Development Goals, Delta Plan-2100 and other planning documents (Bangladesh Economic Review, 2022). The initiative and progress are somehow facing difficulties due to negative impact of climate change and rise in agricultural input costs.

The history of SRI in Bangladesh dates back to 1999-2000 when the Government's Department of Agricultural Extension (DAE) and CARE-Bangladesh introduced

SRI to farmers in Kishoregonj district. The average SRI yields in that first *Boro* season was 6.5-7.5 t/ha, which was around 20% higher than farmer practice. This yield performance was observed to be encouraging to the farmers to take forward the SRI practice and dissemination continued to spread in the surrounding areas. The SRI movement formally started in Bangladesh in 2000, when Prof. Norman Uphoff visited Bangladesh and a meeting was held in BRAC Head Office with representation of some government and NGO organisations. Initially, an SRI working group was formed which later on turned into a Steering Committee and started trials on SRI in small scales with the participation of some government and non-movement organisations. PETRRA-IRRI provided funds to conduct participatory action research on SRI in 2002 in different parts of Bangladesh for two years. Oxfam also funded SRI trials in its river Basin Programme in northern Bangladesh from 2005 for four consecutive *Boro* seasons.

The SRI National Network (SRI NNB) was formed in 2006 to further strengthen promotion and coordination of the SRI programme. It was constituted with representatives from NGOs, Department of Agricultural Extension (DAE) and the Bangladesh Agricultural University (BAU) to support implementation of rice intensification. The partner NGOs were supported in collaboration with BRAC and Padakhep to train up and promote the improved technologies among the farming communities. The expert team of SRI NNB imparted training and provided field follow up support to the farmers' groups in different parts of the country. The financial assistance received from CIIFAD (Cornell International Institute for Food and Agriculture Development), Cornell University was also very useful for the SRI NNB to take forward the SRI programme. Later on, RDA and ADRA joined the SRI NNB for promotion of SRI in Bangladesh.

Institutional arrangement of SRI initiatives in Bangladesh

As mentioned above, in January 2000, an SRI Working group was formed by representatives of different government agriculture related organisations and NGOs interested in SRI, in a meeting hosted by BRAC at its headquarters, where Prof. Norman Uphoff was present. Later, the group formed a Steering Committee, which was composed of BRRI, DAE, BRAC, CARE, and Syngenta Bangladesh Ltd. This brought together public sector, NGOs and other private sector development institutions. At a follow-up steering committee meeting, plans were made for a systematic two-year evaluation of SRI, which was 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.

The SRI Steering Committee started implementation of the River Basin Programme (RBP) of Oxfam in 2005. The project conducted 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. SshRI cultivation guidelines (manual) and brochures have been printed adequately for distribution to the various organisations and farming communities.

The SRI Steering Committee, followed by the SRINNB organized a total of five national workshops during 2003 – 2010 where the participants from NGOs, DAE, BRRI, BAU and farmer leaders attended. The national workshops were graced by the agriculture minister and senior government officials. A number of 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. In 2012, a national dialogue was held at BRAC 'to review and evaluate the SRI trials and promotional activities in Bangladesh to find out impediments and scaling up promotion of SRI, and provide recommendations for promoting SRI in a co-ordinated manner' by BRAC and Bangladesh Rice Foundation. A follow up meeting was held at the Bangladesh Agricultural Research Council (BARC) where the recommendations of the dialogue were discussed and confirmed. One of the recommendations was that henceforth the participating organisations would provide their own fund in implementing their SRI programme and another recommendation was to seek fund from different sources. It was also resolved that SRI NNB would continue to monitor, evaluate and document the results of the partner organisations' SRI programme

All these SRI initiatives created awareness among the farming community to increase their farm productivity. Both government and NGOs have been working on crop intensification in an environmentally friendly manner. The recent impact of climate change has made the farming community, policy makers, extensionists to address the issue of salinity, excessive rainfall, early or late floods, cold effects and change in seasons with new initiatives.

Objectives of the new initiative

- Improve productivity and income of the rice farmers through intensification and integration of other cropping practices in an institutional approach.
- Conduct action research trials in the farmers' field to observe, learn and disseminate the findings among the farming community at local, regional and national level by the partner NGOs.
- Linkage and network development with the implementing partner organizations, research, academic institutions and relevant international agencies.
- Sharing of the results with the national and regional level policy makers, researcher and extensions agencies.

Methodology

The crop intensification initiative of SRI NNB followed farmer participatory action research approach (PAR) for involving the farmers to undertake field experiments, observation, analysis and adoption process to increase farm productivity and income. The farmers were organized into groups of around 25 members to plan, implement, observe and share findings with the community farmers, project staff and extension personnel. The key programme objectives were to enhance benefits from sustainable increases in productivity, increase benefits from improved and equitable access to markets, strengthened resilience and adaptive capacity, reduce gender disparity in access to and control of resources and decision making, improve policies and institution's role to directly contribute to build up farmers' capacity in participatory research.

Sharing of crop intensification initiative and technical capacity development

SRI NNB organized and conducted a number of workshop and training events for sensitizing the government and NGOs those are working with agricultural productions on the importance of rice intensification to improve productivity in a sustainable manner. DAE, BRAC, Padakhep, POSD, Uttaron, ADRA, SAFE and some other organizations participated in learning and implementation of system of rice intensification among the farming community (see annex-1). The extension staff of these various organizations received training prior to train and assist the farmers for implementing SRI in their field. Though initially the journey was not smooth, application of action research approach and demonstration process was observed to be useful in learning and evaluating the performance of the crop intensification initiative with the farmers in various parts of the country.

Learning topics of the initiative

The learning topics were selected considering the existing problems of crop production and availability of feasible technologies from research institutions. The following learning topics were covered during the crop intensification training held at various location of the programming areas. In this respect detailed schedule was prepared combining field practices in the training sessions.

- Importance and opportunities for system of rice intensification in various locations of programming area
- Improved cultivation practices of rice production – seedling raising, transplanting, fertilization, irrigation management, Insect-pests and diseases management and challenges
- Identification/characteristics quality seeds
- Good quality seeds with selection, processing, preservation, germination test, etc.)
- Sources/availability of quality seeds (markets, organizations, etc.)
- Farmer-led research design for winter and monsoon seasons.
- Regular monitoring and evaluation of the action research performance.

Design of the Participatory Action Research (PAR) on SRI with farmer groups

The design of the PAR for crop cultivation was done in a manner to follow participatory process with considerations to ensuring **ownership**, **partnership**, **equity** and **scaling**. After receiving the technical training from SRI NNB resource team and other relevant research and extension

resource persons, the farmer groups designed PAR trials for their own field. The respective partner NGO provided intensive field follow-up to support the farmers where the SRI NNB resource team visited from time to time to observe and encourage the farmers.

The respective partner NGO personnel attended on the job training events with the farmer groups to learn the facilitation process of the PAR process. This learning event created an opportunity to physically participate to implement the experiments with the farmers. The initial sessions helped them to building their understanding and confidence level as how to facilitate the implementation of the experiments with the farmers. This farmer and field staff learning environment created a congenial atmosphere among the farming community.

The farmers were supported by on-the-job training for practically doing and learning by the SRI NNB and respective NGO field personnel. The direct participation of the staff in field trials setting and subsequent follow-up encouraged the farmers to undertake the initiative with much care and management.

Implementation of PAR on SRI with the farmer groups

The technical information was accommodated into PAR module format in order to make it participatory and subsequent facilitation in the farmer groups. The programme personnel and the farmers worked jointly in setting up the experiments in the field. The following learning topics were facilitated with the farmer groups.

The farmers received on-the-job training on system of rice intensification process from the respective partner NGO staff in the real field situation. The training included from seed-to-seed production technology of rice cultivation in SRI practice. They learned about how to grow seedling for SRI field and transplanting of tender age seedling of around 2 weeks old in the main field. Farmers generally transplant around 6 – 7 weeks old seedling during the winter season as it does not grow fast during this season. But transplanting of 2–3 weeks old seedling in the rice field was a big challenge due to change in their long tradition of practice. The rice farmers had to face criticism of other neighbouring farmers about the poor visibility of the tiny seedlings in the transplanted field. It was observed that some SRI farmers damaged the transplanted field and replanted with 7-8 weeks old seedlings. It was, however, a miracle to them when they saw emergence of many tillers with vigorous growth of plants after the 3rd week of transplanting in the SRI field. The farmers applied adequate amount of organic manure and along with the chemical fertilizer. The farmers were happy to see the growth of the SRI rice field better than their traditional field. Finally, they noticed higher grain yield and straw in the SRI field.

SRI practice in farmers' field: Farmers were cultivating rice in traditional methods since long but after experiencing higher yield and income, they have adopted this practice in their farming system following wider plant spacing, application of organic manure, using mechanical weeders, and AWD as means method of irrigation. The popularity of SRI is increasing rapidly among the farmers due to its higher production, better market price and also due to nutritive grains size, shiny color and more biomass production for the cattle. Farmers have adjusted the principles of SRI in their rice production practices.

3. Findings of SRI trials and demonstrations

PETRRA-IRRI project: Substantial increase in rice yield was found in the PETRRA-IRRI project. The trials were conducted in various locations in different districts by the partner organizations. The result was encouraging, as seen in **Table-1.**

Table-1: Yield (t/ha) status in SRI and farmer's practice by organisation, *Boro* 2002-03

Particulars	BRAC	POSD	SAFE	Syngenta
SRI method	8.3	6.8	7.7	7.1
Farmers existing method	5.8	5.6	6.5	5.0

Source: PETRRA-IRRI report 2004.

Oxfam GB Bangladesh: SRI trials were done in the River Basin Project areas of Oxfam during 2005-6 *Boro* season in three districts (Kurigram, Gaibandha and Lalmonirhat). Results showed average yield of SRI and non-SRI plots were 6.6 and 5.3 ton/ hectare. SRI plots had 25% higher yield. Profitability of SRI was also 78% higher. Trials continued for four consecutive *Boro* seasons showing better results.

BRAC: BRAC joined the SRI programme as a partner from the beginning of the SRI initiative. Initially, they started demonstration of SRI method with few farmers. Thereafter, they participated in PETRRA-IRRI funded SRI sub-project during 2002-2004 undertaken by the SRI steering committee as a partner organization. This also showed more benefits under the SRI method of rice production. SRI trial status revealed that SRI farmers received higher production (22%) and income (30%) more that the farmers' normal practice (**Table-2**).

Table-2: Comparative costs, returns and BCR under SRI and farmers' normal practice (2007)

Method of production	Yield / ha (kg/ha)	Gross revenue*/ ha (taka)	Total cost/ha (taka)	Gross margin/ha (taka/ha)	BCR
SRI	7483	93, 537.50	36, 038.13	57, 499.37	2.60
Normal practice	6134	76, 675	32, 730.38	43, 944.62	2.34

Source: BRAC SRI demonstration report 2007.

Under the Agriculture and Food Security Programme of BRAC, SRI demonstration project was undertaken in 12 districts of Bangladesh from northern and southern parts of the country. It was a 3-year programme during the dry season from 2013 to 2015. Mainly small and marginal farmers were organized into block production system. A total of 52 blocks were formed. In three years, a total of 6,693 farmers were brought under the SRI programme. Benchmark survey was conducted to select the interested farmers in SRI programme. A comparative study was conducted between SRI, non-SRI (BRRI recommended method) and farmer's practice. Both HYV and Hybrid rice varieties were used in the SRI programme. In 2013 BRRI-28 rice variety yielded 16% higher under SRI than non-SRI and 52% higher than farmer's practice. Hybrid rice *Shakti*-2 variety showed 5% higher yield in SRI practice over non-SRI and 17% over the farmer's practice. In 2014, Hybrid rice variety (*Sathi*), SRI yield was 7% higher than non-SRI and 29% higher than farmer's practice. In case of BRRI Dhan-28 SRI yield was 5% higher than non-SRI and 27% higher than under farmer's practice. In 2015, BRRI-28 yield under SRI 8% higher than non-SRI and 21% higher than in farmer practice. Hybrid *Sathi* SRI yield was found 11.5% higher than that of non-SRI and 20% higher than under farmer's practice.

Lastly, the Monash University of Australia, in collaboration with BRAC Research and Evaluation Division (RED), conducted an action research programme on SRI in a number of locations in Bangladesh to determine the effectiveness of SRI on yield and income of the farmers. The study found that the SRI results were positive for increasing yield and income of the participating farmers. Another significant result of the study was that farmer participation increased with increase of the intervention period.

SRI by Rural Development Academy (RDA), Bogura: Experiments were conducted at RDA demonstration farm during three crop seasons of 2012-13. In *Boro,* BRRI *dhan*

28 was used in both SRI and farmers' practices. In SRI technique, 14 days old seedlings were transplanted (single plant) and in farmers' practice 28 days old seedlings were transplanted in January, 2013 with spacing of 25 cm x 25 cm. In *Aus*, *Parijat* variety was used under both SRI and farmers' practices. In SRI technique, 14 days old seedlings were transplanted (single plant) and under farmers' practice 17–20 days old seedlings were transplanted during May-June, 2013 with spacing of 25 cm x 25 cm. In T. Aman, *BRRI Dhan 49* was used in both SRI and farmers' practices. In SRI technique, 14-day old seedlings were transplanted (single plant) and in farmer' practice 20 days old seedlings were transplanted on 28August, 2013 at the spacing of 25 cm x 25 cm.

Highest yield of 6.00 t/ha of *Boro* was obtained from the SRI trial plot against 4.86 t/ha under farmers' practices[2]. The yield was 25.92% higher in trial plots (SRI) compared to farmers' practices (**Table-3**). Higher gross return (TK 119,985/ha) and gross margin (Tk. 42,602/ha) were also recorded from SRI trial plots. Gross margin of SRI over farmers' practice was 24,511 Tk/ha.

Table-3: Yield and yield contributing characters of *Boro* under different management practices at RDA, Bogura during 2012-13

Treatment	Plant height	No. of effective tiller/ hill	Length of panicle (cm)	No. of grains/ panicle	1000 grains wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Yield increase over FP (t/ha	Yield increase over farmers practice (%)
Trial plot (SRI)	110.88	24.32	26.69	172.50	26.08	6.00	6.55	1.26	25.92
Farmers' practice	108.75	22.05	24.87	165.07	23.73	4.86	5.96		
t value	4.32	5.40	5.11	5.12	6.55	6.23	5.0		

Source: Report on Comparative Performance of SRI and Farmers' Practice During Boro, Aus and Aman Rice seasons 2012- 2013, RDA Bogura

Later on, RDA undertook a five-year project with larger coverage to introduce modern farming technologies in 200 sites in 40 districts for increasing rice and other crops, to increase irrigation water use efficiency, and improve the soil fertility through utilization of *Trichoderma* enhanced composting and improved mechanization, following SRI principles. The results were highly encouraging.

Currently, RDA has been implementing a two-year project (2022-2023) in five sub-districts of five districts with funding support and research collaboration of the National Graduate Institute for Policy Studies (GRIPS), Japan, to assess the impact of mechanized SRI in Bangladesh relative to conventional SRI and as well as standard rice management practice. SRI practice may expand faster if it is found feasible.

ADRA Bangladesh: ADRA Bangladesh has been implementing SRI in Bangladesh for about a decade in Mymensingh and Manikganj regions of the country to improve food security of the farming community in collaboration with Department of Agricultural Extension (DAE) of Ministry of Agriculture following Participatory Action Research (PAR) approach with the farming community

ADRA programme staff provided training to farmers and organize SRI demonstration in participation of the rice farmers. The farmers observed the method of demonstration in the field and the result was shared during crop harvest time with the community farmers. The farmers observed the yield performance of the SRI and control field. The higher yield of the SRI field encouraged the farmers for adoption of SRI method in their own field. The SRI plots were maintained with alternate wetting and drying irrigation water and used manual rotary weeders. The overall yield from the SRI field was around 25% higher than the control plots, whereas production cost almost same but the farmers opined that they might be able to reduce production cost due to use less irrigation and seedlings in the SRI field.

The farmers of Mymensingh area experimented SRI practice under ADRA WEP project and they found 25% in yield increase in the SRI fields compared to farmer practice (**Table-4**).

Table-4: Rice variety and yield per hectare from SRI demonstration plot during 2016 – 2017

Union	Village/Area	# of Farmer	Land Area	Rice Variety	Yield in MT/ Hector		Diff in MT
					SRI practice	Farmer practice	
Gouripur S	Bakerkanda	40	2.26	BRRI-Dhan-28	7.20	4.75	2.45
Bokainagor	Betendor	19	1.93	BRRI-Dhan-28	7.11	5.95	1.16
Bokainagor	Batta/Pathantola	22	1.94	BRRI-Dhan-28	6.95	6.00	0.95
Ochintapur	Dariapur/Chorakona	28	1.90	BRRI-Dhan-28	7.20	5.62	1.58
Gouripur S	Palandor	10	0.40	BRRI-Dhan-28	6.75	6.06	0.69
Ramgopalpur	Sreedor	15	0.75	BRRI-Dhan-28	6.86	5.20	1.66
Moilakanda	Surjokona	4	0.16	BRRI-Dhan-28	6.63	4.76	1.87
Total/Average		**138**	**9.34**		**6.96**	**5.48**	**1.48**

Source: WEP Gouripur, Mumensingh

Experimentation and adoption of climate smart Agriculture (CSA) approach

The farmers have been experiencing the negative impact of climate change for about a decade or so by facing early flood, excessive and untimed rainfall, heavy cold effects, etc. It is directly affecting their crop production and incurring yield loss. In this situation they started thinking of experimentation, evaluation and adaptation of CSA technologies for addressing the negative impact of climate change. The farmers started looking for options as how to integrate additional crops to creasing rice field productivity and income. SRI NNB supported the farmers to try with CSA technology in their rice field to increase production and income. The staff of partner NGOs were trained with the specific learning topics (see annex-2) to go for PAR and decide the effectiveness of the various technological options for the certain area's feasibility. The following sequence was followed while experimenting the technology in the field.

Integration of crop diversification initiative in the rice field

The objective of this initiative was to create an opportunity for the group farmers to learn on how to design and implement varietal trials with rice and vegetables (gourds, okra, red amaranth, Kangkon, etc.) to grow on plot dikes. The exercise allowed them to learn an ideal vegetable soil bed or pit preparation before sowing seed. The group farmers were explained the purpose of doing these experiments. The facilitator encouraged the farmers to follow proper plot preparation and seed sowing for the vegetables they already selected. This exercise helped the all the group participants to learn together for designing and conducting of action research of various vegetable during the different cropping season of the year to maximize cropping intensity and production. This initiative helped the farmers for learning and producing of different vegetables along with rice production.

The farmers organized learning sharing session to evaluate the performance in terms of yield and economic return. They mentioned to get enough for family consumption and making increased income for their family. A technical guideline was prepared and shared with the field personnel as how to implement the trial and demonstrations in the field

with the direct participation of the farmers. The initiative ensured famers participants in all steps of implementation process to develop ownership of the initiative among the farmers.

Dike cropping: Producing of various vegetable crops in the rice and other crop field dikes getting popularity for utilizing the space of rice field dikes. Farmers have been growing various suitable vegetable during the monsoon and winter season on the rice field dikes.

The productivity of rice field may be increased by intensification of feasible and economically viable cropping opportunities. A farm family will continue to receive higher rice yield through adoption of SRI practice and at the same time will harvest vegetable for family consumption also may generate income from the sale proceeds. Farmers experienced producing of creeper vegetables like gourd, beans, spinach and other vegetables that can be grown on some trellis support. They mentioned that the crop field dikes are enriched with nutrition for which they produce more. Farmers also mentioned that they can consume vegetable from the dikes round the year if planned properly.

Some farmers have little widened their dikes by taking land from inside their plot, which allowed more space for growing vegetable in profitable manner. Presently considering vegetable land scarcity in the homestead area or even interference of large trees, farmers found dike cropping as feasible option to produce vegetable in a successful manner. This type of vegetable production is climate smart technology that suits quite well to grow in the winter season without any bag or tower and during the rainy season it can easily withstand erosion in case of excessive rainfall or waterlogging for some time. Farmers found it useful for them as they can produce vegetables without interrupting the rice production in their field. This type of vegetable production technique is getting popularity for the farmers who can't grow vegetable properly in the homestead area due to shade of large trees or scarcity of land.

Vermi-compost: Vermi-compost was found to be very useful and an essential element for crop production among the farmers. Some farmers were trained to produce vermi-compost in a proper manner and make business out of it. The compost performance was measured with and without compost, where the farmers were impressed at the higher yield in the vermi-compost applied field. Now vermi-compost evolved as an agri-enterprise by the producers to make packets and selling to the farmers. Advertising strategy has been done in the farmers' field day and other social events to popularize vermi-composting for higher production. This environment friendly approach is getting remarkable acceptance among the farming community and growing up as an enterprise. A good number of farmers are now producing vermi-compost considering its high demand and reasonable market price for earning revenue.

Lessons learnt and innovations in SRI Bangladesh

Adjustments and modifications considering Bangladesh context:

- **Seedling age:** During the winter boro season, it was not possible to maintain seedling age below 15 days for transplantation due to its poor growth. The farmers have to wait for another week or more for seedling uprooting and transplantation.
- **Planting spacing:** Farmers in some cases made adjustment in plant spacing after seeing the results at different spacing conditions. This adjustment they made considering the soil fertility and duration of the rice variety.
- **Irrigation management:** The farmers take irrigation on seasonal contractual basis and accordingly they have tendency to take more water in the transplanted field due to the fear that if any mechanical problem of the pump machine arises, they may not get water during needs. Hence, it remained as a barrier to comply with the SRI principle but farmers have been realizing this issue and trying to address it.

Mechanization in SRI practice:

- RDA Bogura has been experimenting mechanized transplanter for transplanting single seedling method of rice production. The positive results of the findings might be promoted to reduce farmers' transplanting time.

SRI NNB Progress at institutional level and future plans

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. There has been consensus in the national and regional level workshops to take forward SRI practice country-wide by combing the issues of climate change impacts. The future plan of SRI NNB is to address SRI and climate change impacts in a co-ordinated effort with the research and extension agencies with government and NGOs on the following aspects.

i. There is strong need to move forward to improve our rice production system. Since SRI has shown advantages in ensuring higher production and distinct cost economies, so we need to show its suitability to our farmers in Bangladesh.

ii. The appropriate strategies need to be identified and experimented in the different areas of the country to address the emerging problems that have been hindering crop production and farmers' livelihoods.

iii. 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

iv. Collaboration to be strengthened with the research institutions to provide the appropriate technologies to the affected farming communities with consideration to their own agro-ecological and socio-economic conditions.

v. The group approach of irrigation management, use of mechanized seed transplanter and harvester would be considered to promote in the next SRI programmes.

vi. Training of farmers and field workers on SRI practice and technologies to address climate impacts should be provided in a planned manner to the implementing partners in collaboration with SRI NNB.

vii. SRI NNB will ensure training, monitoring and reporting support to the personnel of implementing partner NGOs for learning and practicing of SRI. In this respect necessary guidelines (manual) and brochures to be prepared and printed adequately for distribution to the various organisations and farming communities.

Conclusion

Though SRI practice was initiated about two decades ago in Bangladesh it did not expand much throughout the country. Farmers to farmers' extension took place in localized proximity. Institutional management support and resource allocation is inevitable to expand the benefits of SRI among the farmers. It is expected that farmers might exercise the SRI principles in other crops as well. A vibrant initiative with proper action research approach might expedite the learning and expansion of SRI practice among the farmers. The recent impact of climate change is an emerging concern among the farmers for adequate

crop production due to change in temperature, rainfall, cold effect, salinity in the coastal region and flood prone areas (flash and seasonal). Participatory action learning opportunity combining the research institutions and extension agencies might yield better to support the farming communities to withstand the climate change negative impacts.

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