A Sustainable Method of Rice Cultivation for Bangladesh: The System of Rice Intensification (SRI)

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Abstract

While the green revolution has contributed significantly to rice production in Bangladesh, it has certain adverse effects as well, like declining soil fertility, organic matter depletion, and environmental degradation, threatening the sustainability of rice production in the country. Among alternative options to overcome this problem, the paper argues for introducing the SRI method in rice production, which has been successfully employed in many countries around the world. Experience of countries that have applied SRI shows that it increases rice yield, lowers production cost, increases profitability and enhances the sustainability of rice production. Drawing on the lessons of other countries and the result of trials in Bangladesh, the paper recommends for adoption of SRI in the country. It also urges the government to come forward with a favorable policy direction in this regard.

1. Introduction

1.1 Rice production in Bangladesh today – Its characteristics and problems:

Agriculture is the primary economic sector of Bangladesh employing 52% of the civilian labour force (Bangladesh Economic Review: 2005). The country is the fourth largest grower of rice, after India, China and Indonesia. Rice is the staple food crop and is grown in 75% of its cropped area. It constitutes 94% of the cereals produced in Bangladesh and provides 75% calorie and 55% protein in the average diet of the people (BRF: 2006). It is the dominant segment of the agricultural sector.

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The Green Revolution, using the seed-fertiliser-irrigation-pesticides technology, has contributed to a substantial rise in rice production, which has more than doubled during the last three decades. However, this growth has become stunted. Green Revolution has brought along with it a lot of serious problems. Irrigated rice production during the Rabi season displaced oilseeds, pulses and spices that led to a serious shortage of these Rabi crops and increased the dependence on imports. Quality of food intake has declined.

The adverse effects of the Green Revolution have been threatening the sustainability of rice cultivation in Bangladesh. Several factors are responsible for this. Increasing use of chemical fertiliser by substituting organic fertiliser, and imbalanced use of chemical fertiliser along with higher cropping intensity have been adversely affecting soil fertility. There has been severe organic matter depletion. Rice productivity has become stagnated or even declined in many cases.

Increasing costs of modern inputs have been reducing the profitability of rice production. Due to the absence of proper regulation of the market, the marketing margin has increased but the farmer's share of the consumer price has declined. Higher relative profitability of some high value crops are also expected to cause a shift from rice to non-rice crops.

Irrigation facilities have substantially increased with nearly two thirds of the cropped area coming under irrigation facilities. However, inefficient water use has not only increased the cost of irrigation, but has created declines in the water table, and the problem of arsenic contamination, thus creating a severe limitation in extending ground water irrigation facilities.

Another problem is the shrinking agricultural cropland due to increased demand for housing, industrialisation and infrastructure development. All the above problems are likely to threaten the sustainability of rice production in Bangladesh unless alternative ways are found to overcome the current problems facing rice in the country.

1.2 Need for a sustainable rice production system

To ensure a profitable and sustainable rice production system in Bangladesh certain conditions would have to be fulfilled.

One requirement is a substantial increase in the yield rate for rice so that higher production can be obtained from a smaller area of land, and excess land can be released for production of higher value crops. A second need is to reduce the cost

of production along with reducing the dependence on high cost modern inputs like chemical fertilisers, insecticides and underground water for irrigation. This is especially needed for the resource poor farmers who constitute the majority of farmers in the country. Thirdly, promotion of an environment friendly agriculture by maintaining and improving soil nutrition would better ensure soil fertility by adding more organic matter and biomass in the soil. Pollution of soil, water and air should also be reduced.

If we can ensure the above, we can improve the profitability and sustainability of rice production, and at the same time, enhance food security.

1.3 Options before us

The policy makers and the rice scientists are now generally in favour of introducing and expanding the use of hybrid seeds to raise rice yields. An alternative and more recent increase in focus is the use of bio-technology in evolving a new rice variety with higher yield by effectively overcoming the complex problems of disease and pest incidence, tolerance to biotic and abiotic stresses such as drought, submergence, heat and cold, etc.; and also for improving the quality of rice to solve the problems of malnutrition and health (Husain, Bose and Hossain: 2003).

These new technologies can increase yield but are highly dependant on costly modern inputs. Especially, the small farmers, who form the majority of all rice farmers, cannot have easy access to such inputs. Besides, increased use of chemical fertilisers, expanded irrigation through exploitation of underground water, and use of chemical pesticides are creating unfavourable impact on soil and water quality, and on environment.

A third option before us is the introduction of the system of rice intensification (SRI) to answer to the needs of Bangladesh. It can help in substantially increasing rice yield, reducing costs and dependence on high cost modern inputs, and in significantly increasing profitability. In SRI, yield increases of 50 – 200% or more have been reported in many countries. Besides increasing yield factor productivity is also increased. This environment friendly system can also help in maintaining and improving soil quality, and enhance sustainability of rice production. It is also easily accessible by small farmers, and can improve food security.

This paper attempts to bring out the potentials of SRI with special reference to Bangladesh, especially to effectively tackle the current problems of rice production and evolve a more sustainable production system.

2. The SRI Method and its Potentials

2.1 SRI and its main features:

The system of rice intensification (SRI) is a method of irrigated[1] rice production management to substantially increase yield by effective interaction of plant, soil, water and nutrient management. It "is a set of insights and principles applied through certain management practices that promote more productive ***phenotypes*** from existing ***genotypes*** of rice, whether improved or local varieties" (Uphoff: 2007). In short, SRI creates an environment both above and below ground that are more favourable for rice plants growth. Its main features are:

- Transplanting young seedlings 10-15 days old instead of the conventional practice of using seedlings aged 30-50 days
- Single seedling carefully and gently transplanted instead of 4-6 seedlings in clumps
- Plants are widely spaced, usually 25x25 cm between plants and rows
- SRI plots are kept moist but not continuously flooded as under conventional practice. Aerobic soil is maintained also by alternative wetting and drying
- Weed control is done preferably by a rotary hoe/weeder to improve soil aeration and remove weeds
- Use of organic fertiliser such as manure, compost, mulches, etc. is preferred to chemical fertiliser. Depending on the availability of organic fertiliser, chemical fertiliser is suggested to be reduced and substituted

Initially SRI started for irrigated rice production because water management was considered as an essential factor for its success. However, recently it is being tried under rain fed conditions in upland areas. SRI concept is now also being tried for producing sugarcane, finger millet (ragi), winter wheat and cotton (*Ibid.)*

2.2 SRI – a paradigm shift from Green Revolution

SRI is initiating a paradigm shift from the Green Revolution (*Ibid.).* The two main strategies of Green Revolution are (a) to change genetic potential of crop plants, and make them more responsive to exogenous inputs, and (b) increase application of such inputs like more water, more fertiliser, more insecticides, etc.

These strategies of Green Revolution were successful in bringing about substantial increases in crop production. In Bangladesh, for example, during the

[1] Recently, SRI concept is also being tried under rain fed conditions in upland areas.

last three decades it helped more than doubling rice production. But this was achieved at growing cost, both economic and environmental. As already mentioned, prices of fertiliser, irrigation and insecticides have increased so much that the profitability of farmers has fallen drastically, especially with diminishing returns from these inputs, and stagnation of yield. Higher yielding varieties of seed are being looked for, and more and more of the costly modern inputs are being used to retain output level.

In Bangladesh, for example, productivity indicators for both fertiliser and irrigation have shown a declining trend of (-) 4.2% and (-) 6.9% respectively (Abdullah and Shahabuddin: 1997). In China where 1kg of nitrogen fertiliser could yield 15-20 kg of additional rice forty years ago, this increment has come down to only 5 kg of additional rice today (Peng, et al.: 2004).

Again, another element of Green Revolution, that is, the increased use of such inputs like chemical fertiliser and ground water irrigation has created adverse effects on degradation of soil fertility and pollution of soil and water. Health hazards are also being created by arsenic contamination of underground water used for irrigation. Increase in the nitrate level in ground water is injurious to health and creates environmental degradation and hazards.

As against these, the principles followed by SRI to increase production and factor productivity emphasise alternative way of managing production to create a congenial environment for plants to grow and realise its best potentials in producing yields. It may bring higher yields even with traditional seed varieties, thus helping retain rice biodiversity. It requires less seeds, less water and less dependence on chemical fertilisers and pesticides. It encourages application of more organic fertiliser and biomass, to enrich the soil and enhance its productivity in a sustainable manner.

SRI is thus an alternative to the Green Revolution method for raising and sustaining production. This is especially relevant for farmers who cannot afford to buy costly modern inputs, and for areas facing water shortages. This ensures plants to develop strong healthy roots, withstand abiotic stresses, and reduce crop losses. This method is not only small farmer friendly but also environment friendly. Its emphasis on use of organic manure and biomass will contribute to improved plant performance through addition of valuable soil organism.

Higher yield and lower costs not only raise profitability of rice production but also increases factor productivity.

2.3 Brief review of progress of SRI in different countries

The SRI was first developed in Madagascar in the early 1980s by Fr. Henri de Laulanie. The world came to know about it only after Prof. Norman Uphoff presented a paper on SRI in a conference on sustainable agriculture held at Bellagio, Italy, in April 1999. A few countries, including Bangladesh, started experimenting on the system on a limited scale since then.

An international conference on SRI was convened in Sanya, China, in April 2002 to advance understanding of how SRI can succeed under diverse conditions between and within countries, responding to different farmer constraints and various objectives (Uphoff et al.: 2002). Reports from 17 countries were presented on various aspects, including benefits and problems faced. By September 2004, the benefits of SRI were demonstrated in 21 countries of Asia, Africa and Latin America. The number of countries participating in SRI trials has so far increased to 28.

Some examples of the recently reported favourable results of SRI are briefly presented below:

- **Indonesia**: Results on farm trials by 1849 farmers over an area of 1363 ha during three years (2003-2005) in Eastern Indonesia showed an average increase of yield by 84% using about 40% less water and 50% less fertiliser. Overall costs were 25% less with net returns increasing five-fold (Uphoff: 2007 *op. cit*.). The Indonesian government Agency for Agricultural Research and Development (AARD) made SRI part of its new national strategy for integrated crop resource management to restore growth in the rice sector. Strong support from top levels of the government has been given for spreading the SRI method.

- **Cambodia**: CEDAC, an NGO, could mobilise only 28 farmers in 2000 for SRI. By 2005, 40 to 50 thousand farmers were using SRI, and the number reached 80,000 in 2007 (Uphoff: 2007a). Average yield increased by 200%. The government of Cambodia has incorporated SRI in its five year national development plan (2006-20010).

- **India**: In Andhra Pradesh SRI trials started in 2003. In all 22 districts the average SRI yields were 2.5 tons/ha higher than the best farmer practices. By 2006the area under SRI increased to 40,000 hectares. The Government of India recommended SRI to farmers wherever feasible. Some other states are also promoting SRI. Government research and extension organisations and NGOs are involved in SRI in other states of India. Recently, the World Bank has approved the Tamil Nadu Irrigated Agriculture Modernisation and

Water-Bodies Restoration and Management Project, under which at least 2,50,000 hectares would come under the SRI method (SRI Update No. 9: Feb 26, 2007)

In the State of Tripura in some areas, whole villages have adopted SRI with 30-50 hectares of contiguous SRI cultivation. By 2006, about 14,000 hectares have come under SRI and the state target for 2007-08 is 30,000 hectares, that is, more than 15% of total rice area. The target has already been surpassed during the 2007 *kharif* season due to concerted efforts made by the State Department of Agriculture. Farmers are given an incentive of Rs. 4,000 per hectare for adoption of SRI (Rao and Rao: 2007). Yield rates are nearly 2 tons/ha more than that under best farmers' methods.

- **Myanmar**: SRI is being promoted by Metta Foundation since 2001 and 40,000 farmers are now participating in SRI. Average rice production increased by 200%. SRI village concept is now being practiced with 10 acre demonstration plots in each village where commercial farming is practiced.
- **Madagascar**: In Madagascar itself more than 2, 00,000 farmers are now using SRI method and the average yield is about three times the national average. It is learnt that due to some social taboos and cultural norms, and a weak agricultural extension department, the spread of SRI was relatively slow.
- **Sri Lanka**: An International Water Management Institute (IWMI) evaluation in two districts found 50% increase in yield, 90% increase in water productivity, 17-27% reduction in cost of production, and 112% increase in net profit (IWMI Research Report No. 75).
- **China**: In the Sichuan province of China, during the 2004 summer, average yield gains under SRI were 3 tons/ha over the usual yield of 7.5 t/ha. Highest SRI yield was recorded as 20.4 t/ha in Yunan province using Hybrid seed. Water savings of 42% were recorded in Sichuan, while in Zhejiang. The incidence of sheath blight, a major rice disease in the area, was reduced by 70%. The Chinese Ministry of Agriculture has listed SRI as one of the technological innovations to be promoted to restore upward growth of Chinese rice yields (Uphoff: 2007a).

The benefits of SRI have been demonstrated in different countries under various agro-eco systems. Since SRI productivity depends "more on biological agents and endogenous soil processes that are enhanced by the alternative management practices, rather than by external inputs, there can be considerable variation in results" (Uphoff: 2007 op *cit*).

Uphoff assessed the performance of SRI with 11 evaluations from eight countries – Bangladesh, Cambodia, China, India, Indonesia, Nepal, Sri Lanka and Vietnam. These are based on more than 4800 comparison trials in diverse locations conducted by a variety of institutions. The summary results indicate that in comparison with farmers' best practices, SRI showed 52% yield increase, 44% reduction in water use, 25% reduction in costs, and 128% increase in net income (*Ibid.* p 15).

3. SRI in Bangladesh

The current needs and problems of rice cultivation in Bangladesh have been discussed in Section 1 of this paper. The SRI and its main features, along with its performance in selected countries have also been discussed in Section 2. Considering the above discussions, the potentials of SRI, the results of trials conducted, the experiences gained, and the problems and issues on SRI in Bangladesh are discussed in this section.

3.1 Potentials of SRI in Bangladesh

- Considering the present problems of rice production in Bangladesh, SRI appears to have high potentials in the country (Husain: 2005 p. 3). These are briefly enumerated below:
- Under SRI, there can be significant seed saving, which may be as high as 80%. This is because single seedlings are transplanted instead of four, five or more seedlings; and wider spacing is maintained between hills and rows
- Since emphasis is put on the use of organic fertiliser and biomass by reducing the use of chemical fertiliser, the cost of fertiliser use will fall. Addition of biomass and organic fertiliser would also improve soil quality and its sustainability
- Use of rotary hoe/weeder for weed control will not only reduce cost of weeding, but would also help in aeration of the soil, enhancing nutrition intake of the plant, its healthier growth, and yield increase
- Under SRI, there is considerable water saving since plots are not kept submerged in water but kept only moist. Alternative wetting and drying of the plots is also practiced in SRI. Efficiency of water use is increased. SRI is especially suitable for areas with scarcity of water
- SRI practice needs much less pesticide. Widely spaced, strong and healthy plants with robust root growth can better resist pest and diseases

- SRI can produce better quality and healthy seeds. Unfilled grains are much less
- High yields and reduced cost substantially increase profitability of farmers
- With substantially higher yields excess land can be released for production of higher value crops
- SRI is easily accessible to resource poor farmers who constitute the majority of farmers in the country
- It will help improve food security and poverty reduction

3.2 SRI experiences in Bangladesh

Trials on SRI were initiated in Bangladesh in 1999 after the Bellagio Conference. The first trials were conducted in farmers' fields by CARE Bangladesh and the Department of Agricultural Extension (DAE), followed by on-station trials conducted by the Bangladesh Rice Research Institute (BRRI). Trials in farmers' fields were found encouraging while the BRRI on-station trials were not so. Prof. Norman Uphoff, Director of CIIFAD, Cornell University, visited BRAC in December 2000 and explained the concept of SRI. BRAC started trials in its own farm followed by SAFE, an NGO, and Syngenta, a private organisation. Initial trials showed positive results. A seminar on SRI was held in BRAC centre on 14 January 2002 where the representatives from BRRI, DAE, BADC, BRAC, CARE, SAFE, Syngenta, PETRRA/IRRI, and Metta Foundation (Myanmar) attended. Prof. Uphoff also participated in the seminar and called upon the participants to examine the potentiality of SRI in Bangladesh through coordinated efforts of the different interested organisations, both government and non-government. A Steering Committee was formed to organise a working group of all institutions working on SRI.

In September 2002, a 'learning and sharing' meeting on SRI was held in the BRAC centre. Prof. Uphoff and representatives of different organisations attended. Dr. Noel Magor of IRRI-PETRRA was also present. The updates on SRI in different countries were presented by Prof. Uphoff and different participants also shared their experiences in different parts of Bangladesh. When the Steering Committee sought donor funds to carry out organised trials, Dr. Magor responded by offering his assistance in getting PETRRA funds for some sub-projects. Three DFID funded PETRRA sub-projects on SRI were selected for implementation during two consecutive *Boro* seasons 2002-03 and 2003-04.

One sub-project was implemented by three NGOs and a private company and participatory trials were conducted in eight Upazilas of four districts namely, Noakhali, Comilla, Bogra and Rajshahi. There were 487 and 791 resource poor farmers who participated in SRI trials during 2002-03 and 2003-04 *Boro* seasons respectively. Acreage increased by 91% during the second year from 41.21 to 78.88 acres, while the number of farmers increased by 62%. Agronomic findings showed substantial increase in the number of tillers, length of panicles and grain weight under SRI in both years. Average yield gains in different sub-project areas ranged from 19% to 37% during the first season and from 23% to 30% during the second season. Cost-benefit analysis showed that gross costs of SRI were lower in both seasons in all areas; and net returns were higher in all areas during both seasons. SRI returns were 32% to 82% higher during the first season while they were 35% to 73% higher in different areas during the second season.

Results varied between areas mainly because of differences in agro-ecological factors. Use of chemical pesticides descased substantially in SRI plots. Among problems faced by farmers were related to irrigation management and availability of organic manure. The overall perception of farmers was positive and encouraging. Many neighbouring farmers started partial adoption of SRI, especially transplantation of younger seedlings, using fewer seedlings per hill and wider spacing (Husain: 2004).

A second sub-project was conducted by a BRRI scientist in partnership with an NGO in Satkhira district. Results of the trials showed very encouraging performance of SRI over both farmers' and BRRI practices (Sarker: 2004). Yields, net returns, and Benefit Cost Ratio (BCR) were highest for SRI practices followed by BRRI and farmers' practices. The following table shows the comparative yields, returns and BCR for the first season. Detailed data on second season were not available.

Agronomic data showed highest panicle development under SRI, followed by BRRI and farmers' practice. Filled grain produced per panicle was also highest for SRI, followed by BRRI and farmers' practice. SRI yields were 49% higher than that under farmers' practice and 4% higher than BRRI method. Though total costs for SRI were marginally higher than the two other methods, relatively much higher yields gave higher net returns under SRI than the other methods. SRI net returns were 49% and 4% higher than those under farmers' practice and BRRI, respectively. All the participating farmers had positive attitude towards SRI and considered it as a very useful method of rice production, especially for resource poor farmers.

Table : Comparative yields, returns and BCR of SRI, BRRI and farmers' methods in Satkhira (2002-03)

Indicator	SRI	BRRI	Farmers' practice
Yield (t/ha)	6.03	5.79	4.06
Net returns ('000 Taka/ha)	51.26	49.22	34.51
Benefit cost ratio	1.9	1.8	1.3

The results of the third sub-project conducted in Comilla, Habigonj and Moulvibazar districts by a BRRI scientist in collaboration with an NGO were relatively less encouraging than in the two other sub-project areas. The sub-project completion report (Latif *et al*.: 2004) and the evaluation report (Latif *et al*.: 2004a) contain some results that are somewhat inconsistent. During the first season SRI yields were about 17.5% higher than that under farmers' practice in Comilla, but in the two other trial areas they were lower. However, during the second season, in Comilla, yields were 20% higher and in another location 13% higher than farmers' practice. In the two other districts also, SRI yields were 6.3% higher than under farmers' practice. The overall relative performance improved during the second season. The reports found cost of production of SRI higher. Labour and irrigation costs were reported to be 19% and 33% higher than farmers' practice, respectively.

The reports state that acceptability of SRI among farmers was mixed. However, opinion for partial or modified adoption of SRI was universal. Some practices such as irrigation management and use of organic fertiliser were difficult. However, it was reported that a great achievement of the trials was that farmers had changed their attitude towards seedling age for transplantation. They started transplanting younger seedlings and were transplanting 35 day old seedlings instead of 60-70 day old seedlings. The evaluation report also states that the DAE and other extension organisations were showing interest to disseminate SRI among farmers as a new method. The reports recommended further verification of the SRI method.

3.2.1 Some recent SRI activities

a. *SRI trials by ActionAid Bangladesh:* During the 2005-06 *Boro* season, ActionAid conducted SRI trials in five districts (Satkhira, Noakhali, Sunamgonj, Kurigram, and Khulna) under its FoSHoL project to improve food security of farmers. Three hundred resource poor farmers participated in the trials out of

which 85 farmers' plots were monitored for evaluation. Many of the plots had adverse agro-ecological conditions. Comparative results between SRI and farmers' practice showed better results for SRI plots (Rahman and Roy: 2006). Average SRI yield was 36% higher, average gross margin and benefit –cost ratio were also higher. Agronomic characteristics showed that SRI plots had more effective tillers per hill and higher length of panicles and relatively less pest infestations. Encouraged by favourable results, Action-Aid has expanded its SRI trial areas during the 2006-07 *Boro* season.

b. *SRI trials by Oxfam GB:* During the 2005-06 *Boro* season, Oxfam GB initiated SRI trials in its River Basin Project (RBP) areas in three northern districts of Bangladesh to test the feasibility of SRI in improving the food security of its resource poor farmers in the remote *char* areas (Husain *et al*.: 2006). Even under adverse agro-ecological conditions, the ten participating farmers received higher yields and profits in their SRI plots than those under farmers' practice. Results showed average yields of SRI and farmers' practice plots were 6.6 and 5.3, tons/ha, respectively. Average yield was 25% higher and profitability 78% higher in SRI plots. Agronomic features showed that non-SRI plots required 174% more seed than SRI plots, and used more than double pesticides. Effective tillers were 38% higher in SRI plots. Farmers faced various problems including cold injury of seedlings, difficulty in irrigation management in the sandy areas, and lack of adequate experience in following SRI practices. Area and number of farmers practicing SRI increased during the current *Boro* season (2006-07).

3.3 National workshops/seminars held on SRI

Three national workshops/seminars have so far been organised on SRI in the country to share the experience of SRI trials in Bangladesh with policy makers, scientists, extension workers - both government and non-government - and farmers. These are briefly stated below, highlighting the discussions and recommendations.

a. ***National workshop on SRI (2003)*****:** This workshop was held on 24 December 2003, sponsored by IRRI/PETRRA sub-projects to share the experience on SRI among policy makers, researchers, extension personnel and farmers, and to develop future plans to carry forward the SRI initiatives. Seven papers were presented, and both group and panel discussions were held. The workshop recommended initiation of integrated and coordinated trials and experiments involving farmers, scientists and extension workers (both GO and NGO) to determine the potentials of SRI in Bangladesh. It also resolved to seek donor assistance for the purpose.

b. ***National seminar on SRI (2005)*****:** A national seminar on SRI was held in February 2005 in which policy makers, scientists, SRI practitioners, including farmers, were present. Two participants from abroad included Prof. Norman Uphoff, Global Coordinator of SRI and Prof. Satyanarayana from the ANGR Agricultural University, Hyderabad, India. Four papers were presented and discussions were held, which broadly indicated agreement on the potentials of SRI in Bangladesh and further coordinated needs for realising its potentials. Recommendations included joint field visits by representatives of DAE, BRRI, BRF and relevant NGO and private sector representatives to assess the SRI field programmes; preparation of a project proposal on SRI, if field visit results were positive; and joint GO and NGO programme for promoting and disseminating SRI.

c. ***Experience sharing workshop on SRI (2006)*****:** This workshop was held in October 2006 in the DAE Conference Room to disseminate the concept and principles of SRI, share the experiences on SRI trials in Bangladesh and abroad, and to seek necessary support from DAE, BRRI and other organisations to promote SRI. Policy makers, scientists, extension workers, NGO practitioners and farmers participated. After presentation of a paper on the concept, principles and progress of SRI in Bangladesh and abroad, lively discussions were held on various aspects of SRI. The discussions are summarised as follows:

- The workshop presentations and discussions helped the participants to have a clear understanding of the concept and principles of SRI
- SRI method not only contributed to higher yields and profit but also helped improve the soil by adding organic fertiliser and biomass, and improved the sustainability of crop production
- To improve the performance of SRI in the country, large-scale demonstration trials should be conducted, and use of simple technology like line markers and rotary hoes/weeders should be expedited
- The discussants also emphasized the need for arranging adequate training to field extension workers - both GO and NGO – and farmers on the SRI method
- The BRRI scientists were asked to find out why SRI produced better results in the farmers' fields than in the scientists' plots
- There was general agreement that for realising the best potentials of SRI in the country, concerted efforts should be undertaken by all concerned – the scientists, extension workers, and farmers. GO and NGO collaboration

should be forthcoming to promote SRI and overcome the problems faced in applying the method

- The participants also expressed dissatisfaction about the lack of interest of BRRI on SRI and hoped that the government should also come forward with a favourable policy directive so that with GO-NGO collaboration action programmes may be launched to promote SRI in the country
- It was also suggested that the SRI project proposal, as a follow up of the favourable findings of the joint GO-NGO field visit undertaken in 2005, should be completed at an early date to seek funds for the SRI National Network to undertake training of extension workers and farmers, and to carry out monitoring and related activities to promote SRI in a systematic way

4. SRI Problems and Other Issues in Bangladesh

The overall experience of SRI trials shows positive results in increasing yield and profitability. The perception of the farmers has also been favourable. However, adoption of SRI has not progressed satisfactorily in the country. There are several problems that hindered progress. There were limitations related to the process adopted in trying and promoting SRI, including lack of policy and material support, weaknesses in consistently supporting the SRI programme, and unfortunate apathy and often opposition by a few BRRI scientists. Problems were also faced in implementing the method properly in the farmers' field. These problems are briefly discussed below.

4.1 Limitations in promoting SRI: The trials on SRI conducted so far in Bangladesh has been sporadic and short lived without any sustained and systematic support to follow up the trials in any area for a few years to enlist the full confidence and motivation of the farmers to change their existing practice they are accustomed with and adopt the new practice. The trials were conducted in tiny little plots of resource poor farmers within the command areas of irrigation schemes, where most of the plots were continuously flooded during the production period. No large-scale demonstrations were conducted in the plots of large farmers to create significant demonstration effect. Trial programmes also had to be discontinued within a year or two due to termination of programmes. Trials were abandoned before the farmers could get adequate training on the SRI method and have proper understanding and gather experience on the method. Thus it was very difficult to create any viable impact. Especially, the farmers need support and guidance to overcome the initial problems and obstacles they face in adopting the method. This could not be provided institutionally.

The SRI National Network Bangladesh (NNB) was formed to act as a catalyst and to coordinate the SRI trials and promotional activities. However, it could not be fully effective in conducting its functions. One reason was the lack of clear cut policy directive from the government Ministry of Agriculture to support SRI programme. Due to this reason, even though many of its officials were in favour of SRI, the DAE could not undertake wholehearted action on promoting SRI. Again, one unfortunate factor was the biased and unscientific attitude of many BRRI scientists towards SRI. Based on inadequate and inappropriate on-station trials they had made hasty generalisations on the potential of SRI in the country. Even though trials conducted by scientists in farmers' fields showed better results than on-station trials, they developed a negative attitude towards SRI. This also had an effect on the government and hindered its required policy decision. Again, the national network had funding constraints in developing a systematic SRI promotion and support programme.

Training of trainers (DAE and NGO field staffs) and farmers, monitoring and evaluation of SRI trials are to be undertaken at the initial stage by the NNB. Training manuals and other training materials need to be prepared and supplied to interested organisations and individuals. All these require adequate financial support to be provided. At present some NGOs like Oxfam GB and ActionAid are providing support for conducting small-scale trials in their project areas. Large scale institutional support is not yet forthcoming. Even with these limitations, the NNB has prepared a video CD on SRI practices and production management, which was dubbed in *Bangla* from an English CD produced in Indonesia.[2] It has also produced some training modules and manuals.

4.2 Some production problems

Cold injury of seedlings is one problem faced by farmers in practicing SRI method during the winter season, especially in the northern regions of the country. This problem is faced in transplanting very young seedlings where cold wave occurs. This results in either damage of young seedlings, or delay in transplantation.

Irrigation management is another problem faced where isolated small plots are selected for SRI trials, especially within command areas of deep or shallow tube wells where most plots using the farmers' practice are kept submerged under water. This problem can be solved only when a community approach is adopted

2 The original CD was produced by ADRA Indonesia who provided support for dubbing the same in Bangla.

and all the plots under the command area of an individual irrigation source are put under SRI method of production.

The third problem faced in the country for practising SRI is the unavailability of organic fertiliser and little or no addition of biomass in rice plots. The easy availability of inorganic fertiliser, use of cow dung manure as fuel due to shortage of fuel wood or alternative sources of fuel, and lack of knowledge on preparation of compost are factors responsible for this.

The fourth problem faced is the hesitation of farmers to practice proper weeding for attaining better results under SRI. In the current farmers' practice they do not go for weeding as they keep their plot submerged under water. It may initially be considered as a costly operation. However, proper weeding by using a rotary hoe would be cost effective. Besides, it would help soil aeration, help addition of biomass and help in healthy plant growth yielding substantially higher crop. Adequate demonstration is needed to convince and motivate farmers about the benefits of weeding.

5. Concluding Remarks

The Green Revolution brought substantial increase in rice production in Bangladesh during the last three decades. However, it also brought along with it various adverse effects that are now threatening the sustainability of rice cultivation in the country. Increasing cost of modern inputs such as chemical fertiliser, irrigation and pesticides has raised cost of production and reduced profitability. At the same time, indiscriminate use of chemical fertilisers without adding organic fertiliser and biomass has been adversely affecting soil fertility, and depletion of organic matter in the soil; inefficient and wasteful use of ground water irrigation has resulted in a decline in the water table in many areas and has created toxic arsenic contamination. These, along with the increased use of pesticides, are creating environmental hazards. Agricultural crop land has also been gradually shrinking due to increased demand for housing and infrastructure development.

Thus to retain profitability and sustainability of rice production, substantial yield increase is necessary along with reduction in the cost of production and making agriculture more environment friendly. One policy option may be the introduction of hybrid seed to raise yield. Another option may be to go for use of bio-technology in evolving higher yielding rice varieties. However, these would increase dependence on high cost modern inputs, resulting in both high economic and environmental costs, which may endanger the sustainability of rice production.

A new policy option may be to introduce SRI in all suitable areas that have the potentiality to raise yield, reduce cost and enhance profitability. It is also environment friendly, can improve soil fertility and increase sustainability of production, and help improve food security. The main features of SRI as described in this paper indicate a paradigm shift from the Green Revolution. SRI does not depend on costly modern inputs, retains and improves soil, and is environment friendly. Principles followed in SRI increase not only production but help improve factor productivity, and increase sustainability of production.

SRI is currently being tried in as many as 30 countries. The governments of some of these countries, including India, Indonesia and Cambodia, have been promoting the adoption of SRI on a large scale. It is unfortunate that in Bangladesh, in spite of favourable results of SRI and the positive perception of farmers, the BRRI has been showing a negative attitude towards SRI and the government has not yet come forward with any positive policy guidelines for large-scale trial and promotion of SRI. Currently, the SRI NNB is involved in collaborating with some NGOs in conducting small-scale trials on SRI with resource poor farmers, often under adverse environment.

Since SRI has the potentiality to play a vital role in increasing national production of rice, enhance food security and help reduce poverty, systematic and coordinated action to promote the method in suitable areas should be undertaken. The government should come forward with a favourable policy direction in this regard. The DAE may be instructed to provide necessary technical assistance, the BRRI should conduct action research in the farmers' field to overcome constraints, and support should be provided to the SRI national network, which is representing both government and non-government organisations related to SRI, to play its role in promoting and coordinating SRI, as a catalyst to promote SRI in the country. The SRI NNB can initially organise training of trainers (TOT) courses for the field staff of DAE, to be followed up by DAE for training and motivating field staff and farmers.

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