Draft: to be reviewed
by meeting participants

REPORT OF WORKSHOP ON EXPERIENCES WITH *THE SYSTEM OF RICE INTENSIFICATION* (SRI) IN BANGLADESH
BRAC Centre, 14 January 2002

ATTENDING:

BADC (Bangladesh Agricultural Development Corporation): Md. Ghaziul Haq, Manager
BARC (Bangladesh Agricultural Research Council): Ali Muhammad, CSC in charge
BRAC (Bangladesh Rural Advancement Committee): Aminul Alam, Deputy Director; A. M. Muazzam Husain, Research Specialist; M. G. Sattar, Research and Evaluation Division; Md. Taslim Reza, Senior Agronomist; Md. Abubakar, Sector Specialist; Paresh Ch. Mandul, General Manager, ECP; Gunendra Roy, Program Coordinator; Firdousi Naher, Research and Evaluation Division
BRRI (Bangladesh Rice Research Institute): N. I. Bhuiyan, Director of Research; A. B. S. Sarkar, Senior Scientific Officer
CARE/Bangladesh: Mir Ataur Rahman, Technical Coordinator, Agriculture and Natural Resources; Manjurul Karim, Technical Officer; Niharkumar Pramanik, Project Officer
Cornell University: Norman Uphoff, Director, Cornell International Institute for Food, Agriculture and Development (CIIFAD)
DAE (Department of Agricultural Extension): Md. Wasiuzzaman Akonda, DCD/IADP; Md. Anis Uddin, Crop Production Specialist
IRRI (International Rice Research Institute): Noel Magor, Representative, PETTRA; Hahmid Miah, Consultant
Metta Development Foundation, Myanmar: Humayun Kabir, Agricultural Advisor
SAFE (Sustainable Agriculture and Farming Enterprise): Gopal Chowhan, Coordinator
Syngenta: J. C. Saha Choudhury, Director, Technical and Regulatory Affairs; A. B. M. Ziaur Rahman, Trial Officer

Dr. Aminul Alam presided at the opening session on behalf of BRAC which was hosting the workshop. After he welcomed participants and invited self-introductions, which were given all around, he asked Prof. Husain to introduce Prof. Uphoff, who gave an overview of the workshop subject, the system of rice intensification (SRI). This first part of the report presents in brief the business of the workshop and then its conclusions. This is followed by a summary of the discussions that records main ideas and highlights.

CARE: Reports on SRI experience were given during the rest of the morning, first by Mr. Manjul Karim from CARE/Bangladesh, reporting on its evaluation of two factors in the SRI methodology: age of seedling and spacing between plants. Yields from trials on farmers' fields in this boro season were 7.1 t/ha in Rajshahi and 5.6 t/ha in Kishoreganj. The average gross margin was 10,000 Tk/ha more than in control plots in Rajshahi, and 4,000 Tk/ha more in Kishoreganj.

The conclusion from CARE's work with SRI thus far is that farmers have been impressed with the increased production and income from their test plots and are expanding their use of the practices. CARE efforts with SRI have been focused in Kishoreganj and Rajshahi, but are now extending to Mymensingh.

DAE: Mr. Wasiuzzaman, formerly deputy DG for Department of Agricultural Extension in Kishoreganj but now reassigned, reported on his work with farmers experimenting with SRI in Kishoreganj. He said that they described it as a "miracle rice," with increases in yield, grains per panicle, etc. At first the trial plots looked very unpromising. "The DDG has gone mad," some said. But then the accelerated growth began and people were happy.

The DAE results in Kishoreganj also showed that 8 t/ha is an attainable yield in Bangladesh with SRI methods. DAE now is trying to expand experimentation to 21 districts in Bangladesh. In Wasiuzzaman's listing of advantages and disadvantages with SRI, it was noted that there were relatively few of the latter, and many of the former; he confirmed this in the experience in Kishoreganj, complementing what was reported by CARE.

BRRI: The results of trials at Ghazipur station were reported by A. B. S. Sarkar, evaluating factors of age of seedling and spacing, comparing SRI with farmer practice, BRRI recommendations and IRA. SRI was not found to produce better results than the other methods, though it was acknowledged that the trials were conducted only with NPK fertilizer, not using compost with the SRI practices. BRRI trials done at Comilla have produced better results, producing 6-7 t/ha and as high as 10 t/ha. These results were higher than those at Ghazipur.

Syngenta: The representative from Syngenta, Mr. J. C. Saha Choudhury, reported on his company's experience with SRI methods, which he characterized as "a breakthrough in modern rice cultivation." When Syngenta first received information on SRI, it studied this and tried to implement it, finding that indeed the methods are suitable and beneficial. It would like to get this to the farmers' level in two years' time.

The advantages that Syngenta has reported with this system are:
1. Seed saving
2. Land saving (for seedbed)
3. No additional inputs needed
4. Irrigation water saving
5. Optimization of land, labor and inputs
6. Yield increase.

In particular, Syngenta thinks that this is the best technique for seed production, and it is in the business of marketing seeds. There is less cost and more yield, and labor costs get reduced as experience is gained.

After discussion, it was agreed that the methods did not need to be (and indeed should not be) standardized, since we should preserve the continuing adaptation and evolution of these methods, including an active role for farmer experimentation and evaluation.

BRAC: This report was given by Md. Taslim Reza, senior agronomist, who has been working with the SRI evaluation, conducted on 10 acres of land in Hobigonj district. The average production with SRI was 5.92 t/ha compared to 4.62 t/ha using normal practice. The cost of production was 11,598 Tk versus 9,482 Tk, with a difference in profits of 2,202 Tk. vs. 1,443 Tk. This represented a 50% increase.

The bright sides of SRI were reported as:
1. Less requirement of seed than traditional practice.
2. Number of effective tillers is higher.
3. Grains per panicle are also higher.

Overall production was 26% higher than with the traditional method.

Limitations given were:
1. Labour requirement is higher than traditional practice.
2. Organic fertilizer is not usually available.
3. Weed growth is more than traditional practice.

BRAC is planning to expand to 30 acres of land in three areas this next season to demonstrate SRI practices. There was earlier a plan for expanding to 400 acres this season, but BRAC thinks it better not to hurry the process, so there are no failures that could set back the effort. BRAC would like to have commercial production within two years. It is working with 30,000 farmers in its seed production and distribution activities, so there could be very rapid spread once everyone is satisfied with the method's benefits.

Metta Development Foundation: The report from Mr. Humayun Kabir on experience with SRI methods among farmers in the hill tribe areas of northern Myanmar was received with much interest, because these are farmers who have not been doing modern rice cultivation before. This past season, farmers participating in the farmer field schools supported technically by Metta Foundation have been able to get 4-5 t/ha with their evolved methods, compared to 2 t/ha by traditional means, while the SRI yields have been 6 t/ha.

Also, the farmers are taking up careful seed selection and are using indigenous microorganisms (IMOs), a local adaptation of Effective Micro-Organisms, a technology from Japan. Techniques for seedbed preparation and transplanting are also being used very efficiently.

Dr. Bhuiyan had to leave before the workshop was concluded, but he offered these observations before leaving.
1. SRI methods should be tested in many different places in Bangladesh, keeping complete and comparable records, so we can learn what practices work best where.

2. We should develop appropriate approaches for all the different environments, which means that we need to have an effective network among different organizations so they can share information.
3. There should be a strong monitoring team that can observe practices and results in different places and help to synthesize learning. (It was suggested after Dr. Buiyan left that perhaps BRRI could provide a lead in this.)
4. It would be good for Bangladesh to send a team of researchers and NGO personnel to Madagascar or Myanmar to observe SRI methods where they are being used most effectively to see what can be learned this way.

There followed about an hour of discussion, reviewed in the section below, leading into a set of recommendations that emerged from the workshop.

Recommendations:

1. There should be a **working group** on SRI formed, to include organizations from the government, the NGO sector and the private sector, and eventually the farmer sector. Any organization interested in contributing *to the evaluation of SRI methods and to their refinement and application in Bangladesh* is welcome to join.
2. To guide the efforts of this working group and to act on its behalf a smaller **steering committee** should be constituted. Organizational representatives from BRRI (Dr. Buiyan), DAE (Mr. Wasiuzzaman), BRAC (Prof. Husain), CARE (Mr. Ataur Rahman), and Syngenta (Dr. Saha Choudhury) were proposed, and Prof. Husain was asked to serve as chair, at least in the initial phases.
3. After about a year's time, working group members will **review how well this set-up is working** and they can make any changes in structure, procedures and membership of the steering committee that are thought useful for the purposes stated above.
4. Specifically, the steering committee was recommended by the larger group to initiate a process to **seek support from the PETRRA project** for research and evaluation on SRI because the objectives of this group are so consistent with the aims of the project, to eliminate poverty through rice research.

SUMMARY OF DISCUSSIONS

Prof. Husain in introducing Prof. Uphoff described SRI as a very promising technique of rice cultivation, one which has the potential to increase the output of rice with less inputs but requiring better management. If this method can be made successful in Bangladesh, it will make a revolutionary difference in the rice production system because rice needs could then be met at lower unit cost of production, requiring use of land and possibly releasing land for other crops.

The purpose of this workshop, he said, is to bring together scientists, NGOs, external personnel, with all expecting to learn from each other and aiming to develop a program of cooperation and collaboration that can evaluate and promote SRI under Bangladesh conditions. All the relevant players are present at this meeting from the government side (BRRI, DAE, BADC, BARC), from the NGO sector (BRAC, CARE, SAFE and others),

and even from the private sector (Syngenta). It should be possible to come up with relevant recommendations and to pursue them effectively.

Prof. Uphoff thanked BRAC for accepting the responsibility to host this event and thanked all participants for coming. He noted that one sector was missing, however -- the farmers, but in the future we can try to involve them more directly and will need to involve them more actively if SRI is going to make a contribution to Bangladesh's development. He noted that of the dozen or more countries where SRI has now been introduced and is being evaluated and disseminated, Bangladesh has probably achieved the strongest and most widespread institutional support as can be seen from the broad participation in this meeting.

He made a presentation on the system of rice intensification, its principles and methods, and presented some data from factorial trials in Madagascar that demonstrate the synergy among practices. This interaction among practices has enabled farmers there to raise their yields from an average of 2 t/ha to about 8 t/ha, without requiring the use of new seeds or chemical inputs, either fertilizer or pesticides. He noted that since some of the highest yields, in the 15-20 t/ha range, were achieved with high-yielding varieties, the SRI approach should be regarded as compatible with plant breeding improvements. While chemical fertilizer can raise yields with SRI methods, the biggest improvements in yield, especially over time, have come with use of compost.

He noted that crop responses to SRI management methods vary widely, for some reasons we know and others we do not. In a number of countries it has been seen that the methods give higher yields on farmers' fields or in NGO programs than on experiment stations under the management of researchers. This has not been explained, simply observed, also in Bangladesh. There are many things still to be learned about SRI methods; it is a work in progress, raising more questions than it provides answers. A summary of his remarks is given in an appendix to the report.

Dr. Bhuiyan, director of research for BRRI, commented that this report on SRI is very encouraging. In his 30 years of work with rice, he has seen a lot of different ways tried to improve production, many of them difficult to operationalize. He suggested some issues that he thought might impede acceptance of this methodology. It is widely believed that rice is a hydrophilic (water-loving) plant, and thus people may not accept not keeping their rice paddies flooded. Also, the alternation of wetting and drying of the soil causes large losses of N. So while the possibility of saving water is an attractive aspect of SRI, it might contribute to losses of N which would be unfortunate.

Also, Bangladesh is a very diverse country, with many different farming conditions, and there are large seasonal differences. SRI may not be well-suited to all regions and all seasons in Bangladesh. Aman is a difficult season for flooding, so small transplants may not succeed in this season. Also, already in boro, without SRI methods, some yields can reach 10 t/ha with best management practices, so farmers may not take to SRI if it requires more labor. In boro season, seedlings are slow-growing because of the cold, so maybe 8 to 12-day seedlings are not practical then. There are thus a number of issues that

need to be resolved before SRI is taken up on a large scale. Despite these questions, BRRI is interested in SRI and wants to work with partners in Bangladesh and abroad to evaluate it.

Prof. Uphoff provided some information from French research showing that the rice plant's adaptation to flooded conditions, by forming air pockets (aerenchyma) in the roots, is a sub-optimal adaptation. This can be seen if one compares rice roots of any variety grown under flooded vs. unflooded conditions, though the implications of this have been scarcely researched.

Rice can survive in saturated soil, but it does not thrive in this. About three-quarters of the roots of irrigated rice plants are in the top 6 cm of soil; they do not grow deeply into the soil where they can acquire more nutrients and a greater variety. Also under flooded growing conditions, by the time of panicle initiation when the process of grain formation starts, about three-fourths of rice roots have degenerated (attributed mistakenly to "senescence"), whereas in well-drained soil, there is no such loss. It has been a big gap in the literature to ignore roots and their functions so much.

Regarding the loss of N through wetting and drying of soils, while there is such loss from a soil chemistry perspective, this ignores soil biology. Under aerobic soil conditions, one can have with rice, as with other gramineae species, associative biological nitrogen fixation (BNF) contributed by microbes in, on and around the roots. This has been shown to be as much as 150 to 200 kg/ha of N with sugar cane, and it appears that with SRI plant/soil/water/nutrient management practices there is similar significant BNF with rice. So biological processes and contributions could more than compensate for soil chemistry effects. However, these matters need to be researched more thoroughly, since just as there has been little research on roots, there has been very little on soil biology. He noted that in the leading textbook on rice, there is not a single reference to roots in the index.

He acknowledged freely that it may not be possible to have enough water control and well-drained soil conditions in some places or in some seasons in Bangladesh, in which case SRI methods will be less productive. But the principles should still be considered to see whether they could be adapted to achieve higher yields than at present. The first question is whether we can advance the state of scientific knowledge regarding rice; then we should adapt practices to achieve the most productive results possible.

Noel Magor from IRRI commented that his organization has been working on duck-rice production systems in Bangladesh in which there are some similarities with the SRI system, in particular that the increases in productivity are apparently associated with longer and deeper root development due to some stimulation from the ducks. Prof. Husain added that the system should at least be evaluated because with lesser need for chemical inputs, it could be more sustainable and more ecologically friendly.

CARE/Bangladesh: Manjurul Karim reported on evaluations of SRI done under CARE's LIFE-NOPEST project in Kishoreganj and Rajshahi. His written report is available. The following just gives some of the highlights. The evaluation focused on two components

of the SRI methodology: the effects of variations in spacing and in age of seedlings. 115 farmers in the two districts participated in the evaluation, 70 of them with control plots that could be analyzed.

CARE learned about SRI through its participation in the 1999 Bellagio conference on sustainable agriculture. Sylvie Desilles brought back the conference paper on SRI. Aman 1999 was the first season when the methods were tried, and only 11 farmers participated. The yields were not very impressive, only 3.21 t/ha average (2.91-4.74 t/ha range), because the planting had been done late. Farmers were nevertheless impressed by what they saw of the plants' performance using SRI methods. In boro 2000, 74 farmers used the methods, with an average yield of 9.5 t/ha, 30% more than the yield with farmers' alternative practices. In aman 2000, the yield was 4.08 t/ha, a 19% increase over alternative practices. Data from boro 2001 are not yet compiled.

In the evaluation trials, yields were 7.1 t/ha in Rajshahi with 30x30 and 35x35 cm spacing, and 5.6 t/ha in Kishoreganj. The yields on control plots were 5 t/ha in both places. In Kishoreganj, farmers found some problems with their water management, which reduced their yields. They are still learning about SRI, and there is interest in continuing. The benefit-cost ratio using SRI methods was calculated at 1.6:1, compared to 1.2:1 for the control plots. At the margin, this represents a three-fold increase in favor of SRI. The limitations of the trials were: some of the plots were kept dry too long in Kishoreganj; there was lack of supervision by CARE staff; less weeding done than recommended; and transplantation was not done at same time for all treatments and control plots, leading to different harvesting periods.

At the farmers' evaluation workshops that CARE held, 133 farmers participated. Their conclusions were:

1. Only land that can be drained and retained should be used for SRI.
2. Land preparation should be done carefully to ensure that seedlings are transplanted into a very level field.
3. Clay soil is less suitable for SRI, because of drying and cracking problems.
4. Boro season is better for these practices than is aman; water should be applied just to keep the soil most, not saturated or fully cracked.
5. There is enough mortality after transplanting that provision should be made for replanting.
6. Vigorous weed growth increases the cost of production; the last weeding should be done by hand to avoid elimination of old roots.
7. Some farmers suggested that 2 seedlings per hill could be optimal.
8. Uprooting the seedlings from the seedbed, without injuring roots, is difficult.
9. The best spacing is 30x30 cm.
10. Some SRI plots yielded less due to wind flow during flowering stage (the plants grow taller).
11. Some suggested to increase the age of seedlings to more than 10 days for easier transplanting.
12. Due to late transplanting, stem-borer infestation was higher in some SRI plots.

13. Some farmers applied urea after PI stage, which increased the percentage of unfilled grains.

There are now 80 farmers in the program, and the number is expected to expand. CARE work on SRI is now being extended to Mymensingh. There are also two other CARE projects besides the LIFE project that are carrying out SRI but their work was not reported. Practically all who have participated in the trials have accepted the results as superior, Karim concluded. Despite the poor start the first season, the 11 farmers who participated continued and are now using SRI on a larger share on their rice fields. CARE does not provide any financial incentives to farmers, only technical support.

DAE: Mr. Wasiuzzaman learned about SRI through a paper sent around from the DG of DAE at the end of T. aman season in 1999, encouraging district directors to try this new method. He reported the "small story" of his experience in Kishoreganj district where he was formerly deputy director. At first he was not interested. He had worked in the DAE for 32 years and was "not a scientist." He was born and brought up in the DAE, so to say; he was just an extension man who was used to working with farmers.

When he was asked by the DG to experiment with SRI, he saw that this involved nothing costly, new or complicated, just some changes in practices, like using a small seedling. He had never considered such practices. Farmers' approach is usually cautious toward new things, but they were curious when they heard about SRI.

From their first experience in Fakundia, Kishoreganj and Karimganj, this was seen as a "miracle rice." The yield, grains per panicle, etc., all increased. Boro 2000 was very good, and it was adapted for the following rabi season. In this effort, "our scientists are farmers," though they work with a lower level of precision than other scientists. He reviewed the basic principles of SRI much as Prof. Uphoff had presented them, but with some different wordings.

Farmers have gotten the idea of planting their seedlings in small, scattered nurseries very close to their fields so that they can lower labor costs and have less mortality. Some even grow the seedlings on banana leaves or gunny bags that they can easily transport to the field to reduce time between uprooting and transplanting.

The first year there were 53 plots with SRI, 20 to 2,000 square meters. (Now there are more, he added.) Their seeding rate was 1.5 to 2 kg/ha, and they weeded 3-4 times. At first farmers said, "The DDG has gone mad," when they saw the tiny seedlings spread out over the fields with no standing water. They said the land would go to waste. But once the growth of the plants started accelerating, they took a different attitude. One things that farmers noticed was that there was less pest attack.

Wasiuzzaman presented a list of advantages and disadvantages from the farmer viewpoint:
1. Higher yield -- 1.5-2 t/ha higher compared to general practice.
2. Seed rate is less, so there is saving of seed.

3. Less labor is required. [This was queried because SRI has been reported usually as requiring more labor, being labor-intensive, but that is not farmers' experience here.]
4. Less pest and disease problems.
5. There is negligible area needed for seedbeds
6. No heavy irrigation is required.

On the disadvantage side, he listed:
1. Need to replace any damaged seedlings after transplanting.
2. Timing of transplanting must be maintained; it should not be after the 12th day.
3. If transplanting is delayed, so is the harvest date, and this gives more pest problems.
4. Water control is not possible in some or many plots, and this lack of control interferes with SRI success.

They have now two years of records. They have had 8 farmers with over 8 t/ha, and one with 9 t/ha. Wasiuzzaman invited BRRI to work with DAE on this and also offered to work with NGOs. He said he was sure that SRI will flourish in Bangladesh, but with cooperation among all the stakeholders, the time will be shorter. He added his belief "as an old extensionist," that "farmers are really the best scientists." There was a question from BRRI about the DAE data showing as many as 800 tillers per square meter. This was much more than had been attained in the BRRI trials. The figure was confirmed.

Dr. Bhuiyan said that 1.5 to 2 t/ha higher yield with these methods is a great addition. He said that the Bangladesh research system is still learning about these methods, and BRRI will be glad to work with DAE on this. "We need to learn the science behind this activity." He suggested that since this is so promising, the various stakeholders should together set some targets for what dissemination could be achieved for the next five years and work toward these.

Wasiuzzaman said that the DAE is not working with SRI only in Kishoreganj but wants to expand this effort to 21 districts in Bangladesh. It is already starting to increase around Comilla and Janakpur.

Someone commented that the listing of advantages and disadvantages showed mostly the former, and not very many of the latter. Wasiuzzaman agreed. There was some disagreement on the idea of "setting targets," saying that farmers will decide for themselves on expansion. But it was agreed that cooperation among the government, NGO and private sector parties would be beneficial. There should from now begin a sharing of all reports on SRI experience, so that everyone can learn from each other.

BRRI: Abu Bakar Siddique Sarkar reported on BRRI's experiments and evaluations of SRI at its Ghazipur center. The factors assessed were:
1. Spacing: 20x20cm, 30x30cm, 40x40cm and 50x50cm
2. Age of seedling: 10 and 15 days
3. Fertilization: NPK, with no compost

The trials did not show any increase with spacing, as 30x30 and 40x40 were the highest, and 20x20 was the lowest. But the differences were not significant. The trials were

analyzed in terms of yield components, which showed the same pattern as yields. Grain weight was not affected. In general, SRI practices in these trials were on a part with farmer practices, and less than either BRRI's recommended practices or the IRA system.

There have also been SRI trials done at the Comilla station which gave better results, using 18-day seedlings, 40x40 spacing and 1 plant per hill. The yield was 6-7 t/ha, with one yield as high as 10 t/ha reported. But this was not the result obtained at Ghazipur.

There were also trials conducted using SRI practices with vitavax and without vitavax, and with solarization of soil and without. For this they used a seedling age of 39 days, one per hill and 30x30 spacing. With solarization and vitavax, yield was 6.1 t/ha.

In the discussion that followed, it was noted that no compost had been used in the Ghazipur trials, and that this could have affected the results. Also, the depth of transplanting was asked about; SRI recommends shallow planting, but research station laborers are used to plunging seedlings down into flooded soil, which could have affected the growth of young plants. This question could not be answered. Kabir reported from his experience with SRI in Myanmar that deep transplanting reduces tillering.

Dr. Bhuiyan noted that the research system is lagging behind on SRI and is still in a learning process mode. He said that he is glad to see the NGOs working on this, and their results and the farmer satisfaction are very encouraging. He commented that he had said for a long time that farmers are the best economists -- they know cost of production and net returns very well -- and they are also the best scientists. He was glad to see the results from CARE and DAE.

The question that he raised was, how expandable is this system? That we do not know. He suggested that this is already in an extension mode, where we should try to learn the science as we go. If this is being taken up by farmers, it must have something to offer. We should not go on for another five years just testing this. That was why he suggested some targets be set.

BRRI has done experiments using compost, though not with plants grown by SRI methods. They see that the nutrient supply is released very slowly. They found that adding 5 t/ha of dry matter over a 15-year experiment could reduce the need for chemical fertilizer by 30%. But these are very complicated relationships, and more evaluation should be done.

Syngenta: Mr. J. C. Saha Choudhury made a presentation on what he called the Syngenta Method of Rice Cultivation (SMRC), saying that his company was pleased to participate in exchanges on SRI, as it had been able to achieve significant improvements in production using SRI methods.

Syngenta in its rice promotion had been following the BRRI cultivation practices as a whole, but when it got information on SRI, it tried this system and found it suitable and beneficial. It expects that this can be taken to the farmers' level in two years' time.

The changes made in the BRRI method included reducing the seedbed size, from 1:20 to 1:80, with the seed rate only 80 g/m^2. One wants to avoid dense sowing in the seedbed. They transplant the seedlings at 15-15 days, uprooting them very gently.

Syngenta regards it as very important to transplant the seedlings within 30 minutes. These are living plants, but farmers often remove them roughly and even strike the roots to remove materials. There should be no standing water in the paddy field during transplanting, with the soil just muddy. And for best results, one should not transplant the seedlings deeply. One should reserve some extra seedlings for gap filling during the first weeding if this is necessary.

For weeding, they favor two hand weedings after top dressing, or chemical weeding. Syngenta has not gone in for the more labor-intensive use of the mechanical hand weeder. They agree that there should be no standing water before panicle initiation, and the water management method is alternate wet-dry conditions, with 1-2 inches from early booting to the hard dough stage.

In boro 2000, with 12 day seedlings, 50x50 cm, the yield was 4.9 t/ha; with 25x25 cm, the yield was 5.61. In aman 2001, 30x30 spacing, the yield was 6.15 t/ha. Syngenta is satisfied with these methods and wants to go to the farmer' level in its commercial operations.

The recommendations that Syngenta would make based on its experience with SRI are:
1. 12-15 day-old seedlings
2. Transplant at 30x30 cm
3. Do weeding and harrowing
4. Maintain careful water management

Syngenta thinks they should remove the traditional cultivation practices, and Saha Choudhury concluded that we should create awareness among farmers about this evolution of rice culture in Bangladesh. He suggested that there should be some standardization of SRI, based on experimentation, by BRRI.

This last suggestion was met with some disagreement, pointing out that SRI was a methodology rather than a technology, so by its nature, there should be appropriate "pluralization" of SRI rather than "standardization." Also, one of the features of SRI that NGOs found beneficial was its emphasis on farmer experimentation, so that farmers themselves became more interested in the change and adaptation of practices.

Also it was said that farmers come up with some very interesting adaptations, ones that scientists might not think of. So standardization would become sterilization of SRI. This view was accepted, though it was agreed that a more active role of BRRI in evaluating variations in SRI practice would be welcome. What should be sought is consensus rather than standardization, preserving an active role for farmer adaptation.

There was some discussion whether it was appropriate for Syngenta to be referring to this system as "the Syngenta Method of Rice Cultivation" (SMRC), as it was billed in the multimedia presentation. The techniques being recommended are those that were presented in the paper from CIIFAD about the Madagascar system that Syngenta had worked from to test the system. Saha Choudhury said that Syngenta was not claiming it had invented this system, but it was using this reference to SMRC as a way to describe the method in shorthand terms. CARE suggested the term SRI be used generally, though it can cover some variation in practices so as to suit local conditions.

It was asked whether Syngenta has done any cost-benefit analysis of SRI methods yet. The answer was, not yet, but there is very evidently a basic improvement from the saving of cost, so it is beneficial whether the yield is higher or not.

Dr. Bhuiyan suggested that the name for this method is not important. If it is good for farmers, it should be used. Also, it should not be necessary to standardize this, but rather to get a better understanding of what makes it work. Also, we should focus on what are the problems with this method? What are the obstacles to adoption? For example, having to transplant a tiny seedling can be a difficulty for farmers. Is it possible to use older seedlings without production loss? Or can we improve training for farmers to handle small seedlings? The method appears quite beneficial, but it should have further testing and refinement.

As the time had reached 1 o'clock, when lunch was scheduled, the workshop adjourned, holding the presentation by BRAC, scheduled for the morning session, until afternoon.

BRAC: Mr. Taslim Reza, senior agronomist for BRAC, made this presentation. Last year, BRAC used the methods on 10 acres in Baniachong thana, Hobigonj district, 18 km from Dhaka. BRAC had already planned to cultivate 72 acres there for commercial purposes using traditional methods. It took a while to acquire skill in transplanting the young plants, and this part of the operation took considerably more labor than otherwise. The local people considered the system to be totally unique.

The number of effective tillers in these trials averaged 28, compared to 21 with normal practice, and grains per panicle were 206, compared to 175. Average production was 26% higher, but a calculation of costs of production and returns found that the level of profit with SRI represented a 50% increase.

It was noted in the discussion that BRAC was undertaking these trials on relatively large scale, and on leased land rather than in farmers' fields. This might affect their results. Prof. Uphoff commented that in a number of countries it has been observed that SRI methods have given higher results when used on farmers' fields than on experimental stations in the hands of researchers, a reversal of the usual observation.

BRRI asked whether all of the costs of production had been included in the calculation, for example, BRAC supervision time. This had not been calculated or included because

they were trying to find out whether this could be cost-effective for farmers, who would not have such infrastructure.

Mohammed Abubakar from BRAC added his personal experience with a small experiment done during aus season. Because he saw that they were using a lot of labor for transplanting the young seedlings with SRI method, he had the idea to use germinated seedlings at 14 days, transporting them to the field on a tray and transplanting into soil that is rich in organic matter, 2 per hill. After 10-15 days, the growth was very impressive. The average number of tillers per plant was 45 vs. 18-20 in the other fields.

The yield was very good. They got 80 kg from the small plot after drying, which was calculated to be a yield of 11.4 t/ha. Normally the maximum one can get in aus season there is 8 t/ha. Abubakar said that labor for transplanting with SRI can certainly be reduced, to even 10% less than present methods, because there are so many fewer plants. If a tray is used, with a sand medium so that it is easy to pull up and separate the young seedlings, transplanting can be very quick. The seed rate can be as low as 2 kg/ha.

There was discussion whether direct seeding could be used, or sprouted seed? These practices can encounter problems when there is flooding, of course. It was suggested that there be experimentation with different methods of crop establishment, including direct seeding. The few trials done in Madagascar (by farmers, on their fields) have been encouraging. It was emphasized that in any case, careful handling of the young plants is very important.

Prof. Uphoff reported on a visit to one of the most innovative farmers using SRI in Sri Lanka, who uses a mixture of soil, sand and chicken manure in his seedbed and is able to extract and plant seedlings with practically no trauma. He saw a paddy where seedlings had been transplanted the day before with just two small leaves having a third leaf sprouting by the end of the day after transplanting, indicating there was no set-back in growth as is usually seen with conventional transplanting methods, halting growth for 7-14 days.

Humayun Kabir commented from his experience with SRI in Myanmar that when seedlings are grown in a dry seedbed, there is no problem of getting seedlings up. The seedbeds are planted very near to farmers' fields so there is no delay in transplanting. A number of adaptations are coming up.

Metta Development Foundation: Mr. Kabir was invited to report more on experience in Myanmar, where he is currently serving as an agricultural advisor to the Metta Foundation. This NGO is working with farmers in the northern part of the country in the Kachin tribal area. He said that he could report somewhat different experience, though the resulting yields were quite similar.

The north has been suffering from long-term warfare and much displacement of the population for many years. The area was previously a sugar-cane plantation, and farmers had had negative experience with chemical inputs. Overuse had left the soil in terribly

bad condition. Farmers were even "angry" about use of chemical inputs since they think fertilizer use has destroyed their fields. There are some areas where development programs, e.g., UNDP, cannot enter, because of local hostility.

The other problem is that they do not have enough water to grow rice as they would like. There are poor irrigation facilities, and water is the limiting factor, not land. Farmers want to improve their soil, and thus are interested in the use of organic inputs. Also, the Buddhist monks are interested in "sustainable agriculture."

The International Institute for Rural Reconstruction, an international NGO based in the Philippines, which Kabir worked with previously, started work on sustainable agriculture in the Kachin area under the auspices of the Metta Foundation. It set up 30 farmer field schools (FFS) along the lines of the FAO Asian program for integrated pest management. This approach was accepted by the farmers. They were also interested to try SRI when this was described to them.

Existing yields are about 2 t/ha, similar to those reported in Madagascar. With SRI methods, they have been able to average 6 t/ha, whereas with the FFS methods developed so far, they would get 4-5 t/ha. The first year they tried SRI, they planted about a month late, so the yield was disappointing, about 2.5 t/ha only. But farmers could see that the method of plant management produced more vigorous, more healthy plants, and they were thus keen to try SRI method the next year, which gave very good results.

The SRI introduction has been a very big success thus far. Thousands of farmers have visited the SRI fields at the FFS centers. "You cannot imagine how they rush to the SRI fields when they visit the centers," Kabir said. They are especially enthusiastic because of the water saving possibilities.

The elements most important are:

1. Use of quality seed and seedlings -- this is increasingly understood, and by itself this can improve yield by 10-20%
2. Better seedbed preparation
3. Reducing the seeding rate -- this is a big saving for these farmers who are very poor
4. Transplanting in lines -- which is a new practice compared to traditional methods
5. Preparing compost using IMOs -- indigenous microorganisms

The SRI method is very compatible with use of IMOs which are being tested and promoted. Farmers are developing their own low-cost means of acquiring, multiplying and applying microorganisms in their fields to enrich soil fertility. These organisms can enable farmers to produce compost more quickly, accelerating the decomposition. To make IMOs, they cook rice or corn and cover it with paper to collect lots of organisms. These are multiplied with sugar and then mixed with rice bran.

What are the challenges they face? Seed selection is stressed. Farmers are now trained to first harvest the best panicles to use as seed in the next season, and farmers are using a high-density salt solution to sort out good quality from poor quality seeds. This is more

feasible because with SRI one uses only a small amount of seed, 20-30 grams/m^2, not the 80 grams that Syngenta is using. This means there are 200,000-250,000 seedlings per hectare, not so big a number any more. Farmers prepare their seedbeds close to their field and now have a very smooth operation.

Cultivating the soil is obviously very important. They try to weed every 10 days, using what they call "the Japanese weeder." The soil is mostly very poor and hard. Leveling the field is one of the more challenging practices, because this affects seedling mortality. Also, planting at the proper (shallow) depth is very important. They find that if the seedlings are placed at the optimum depth, there is great tillering.

The biggest challenge is the labor constraint, but this would apply equally to any method of more modern production since the farmers in Kachin are not used to in-line planting, either rows or square pattern.

Dr. Bhuiyan commented that this three-fold increase in yield is very amazing. He apologized that he had to leave at 3 o'clock for another appointment, but he offered the points given in the summary above before leaving, saying that BRRI needs to learn more about SRI and will be glad to cooperate with others in this.

Discussion: At this point, the workshop having heard the various reports went into a general discussion mode, to consider the scope and limitations of SRI, steps for follow-up, and formulation of a work plan in which the different stakeholders could play their best roles.

Dr. Miah from IRRI said that he had been very interested in the discussion and had learned a lot. He had gotten some orientation to SRI a year ago at Kishoreganj. The SRI results were apparently very impressive, with as many as 75 effective tillers per hill. But in that case, they did not find any difference in actual yield, so we have to look at what are the factors that can ultimate producing higher yield, since this is our objective.

He suggested that SRI should be particularly good for seed multiplication, because from one seed you can get 12,000. [In Sri Lanka the multiplication rate has been as high as 32,000 as one farmer produced 1,632 kg from one half kilogram of seed.] He had some doubt about how suitable it would be for commercial methods. He had not seen any yield differential but some savings in cost.

Costs are very important, Dr. Miah added, as we need to look at economic comparisons, not just agronomic ones. Can we reduce costs with SRI, maybe through mechanization of transplanting or weeding? Probably there should be some combination of SRI and BRRI methods. It might be possible to reduce labor costs with dry seeding. BRRI has aleady produced several simple weeders that can be modified to suit different soil conditions. Probably also there should be different combinations of inputs for small and big farmers. There should also be tests that control for variety and vary SRI practices.

Regarding limitations of the SRI system, Dr. Sarkar from BRRI suggested that there are still a number that need to be worked out:

1. Land leveling, which can be difficult for our farmers, and which is necessary for young transplanted seedlings to survive.
2. Raising seedlings in the boro season; possibly some use of the tray method can solve this problem since only a small amount of seedlings is necessary.
3. To raise yield, one has to achieve a maximum number of effective tillers, and in some trials, there has been prolific gross tillering but disappointing effective tillering. We need to understand nutrient management and other factors to ensure grain filling.
4. It seems that 30x30 cm spacing is the best, with 15-day seedlings. Whether there should be only 1 seedling per hill deserves further study, as there can be less mortality and more overall tillering with 2 per hill.

The IRRI representative, Dr. Magor, wanted to reinforce a point made earlier, that the success of this system will depend on farmer adaptation, not just adoption. In the BRAC evaluations, for example, it might be better to try the SRI method already with farmer groups rather than try to evaluate it first on its own farms. A lot can be missed by such a top-down approach. There can be a lot of sophisticated research done at village level. BRRI can work with groups of farmers to tap a potential we usually don't see unless we develop mechanisms for this.

Dr. Kabir from Metta Foundation affirmed this from his experience and expressed satisfaction at seeing such a diverse group coming together to consider how Bangladesh can take advantage of the potentials within SRI. His suggestions were three:

1. Consolidate experience and knowledge among the parties, especially examining what are the ingredients for success.
2. Identify the remaining constraints and challenges which inhibit use of these methods.
3. Support factors that are favorable to the use and spread of SRI. These efforts should be given focus in a kind of action plan.

Dr. Saha Choudhury from Syngenta added that from their observations, SRI is particularly good for the marginal farmers. If there are some constraints, we should find some ways to solve them. Seedling age, spacing and transplanting methods should be modified for the different seasons. This suggests that multilocation trials and evaluations are very important.

Dr. Anis Uddin from DAE said that there are some results from different parts of Bangladesh in different seasons, but only in a few specific places are the data very systematic. There has been some SRI activity in 20 more districts, but without reports. DAE has as many as 40 ongoing projects. There could be SRI trials in a number of these.

Taslim Reza from BRAC commented that if farmers do not use a technology, we should try to figure out why. Training should be oriented to farmers' needs. In his experience, SRI is a good system. He saw this last year from his experiments. But the problem is to communicate the methods more widely. He suggested that production of videos would be a most effective means for supporting SRI dissemination.

A listing was made of constraints that should be examined:

1. **Age of seedlings** needs to be evaluated more, because transplanting very small ones is difficult, and in the cold season, getting them to grow is difficult. Possibly direct seeding could be evaluated as an alternative to transplanting young plants. Maybe some transplanting methods will make it easier to deal with young plants.
2. **Organic fertilizer** is often in limited supply, either from manure or from biomass. So methods for efficient production need to be considered. Possibly activities to grow more biomass, e.g., leguminous shrubs, in waste areas could help solve this problem.
3. **Nurseries** are important for this method. How can these be best established? Can they be substituted for by tray methods? How large should they be, and where?
4. **Flooding** during the aman season is a particular problem for SRI with its young seedlings. Can anything be done to make them more secure?
5. **Water management** especially during the aman season presents some challenges. There needs to be coordination among farmers for best SRI results so that fields are assured of water and do not get or stay inundated. This requires some group action.
6. **Seedling mortality** can be an issue in some places and some seasons, especially in boro. What replanting rates or strategies can deal with this should be addressed.
7. **Fertilizer recommendations** should be reconsidered. Sometimes a combination of organic and inorganic sources is best. There is not a lot of systematic work on this.
8. **Weeding** can be the main constraint for SRI. It may be easiest to introduce this system in areas where farmers are already using the push-weeder, e.g., in the east.
9. **Commercial sale of seedlings** is a possibility where shortage of seedlings is a constraint. In some places farmers are already starting this, though not of SRI-age seedlings. Tray systems might be developed to facilitate this.
10. **Leveling of land** remains a problem for SRI, and this should be addressed, to see what kinds of simple implements could improve this.
11. **Cropping patterns** need also to be considered and possibly adjusted so that SRI can fit into crop cycles more profitably. Rice production should not be promoted without consideration of other farming activities because it does not get conducted in a vacuum.

These various constraints and possible solutions can all be understood in terms of how to deal with land, labor, water and capital constraints for farmers. Obviously, there is a long "agenda" of knowledge needs to improve SRI practice for Bangladesh and to make it more acceptable here.

Dr. Sarkar said it would be well to make a working group including the various organizations present, which could take some decisions on their behalf and could seek donor support for coordinated efforts. Dr. Magor added an idea that the PETRRA project managed by IRRI and funded by DFID might be an appropriate source of support for collaborative SRI work. Someone would need to submit a Concept Note to the project to start the process, and the project would need to be advertisement for proposals, since these are funded on a competitive basis. One or more of the organizations present at the workshop, or other partners, could then submit a proposal, to be vetted by the project's technical committee.

The purpose for which SRI work would be undertaken would be in line with PETTRA's objective, which is to contribute to poverty elimination through rice research. The groups at this workshop can now provide evidence to show the committee reviewing proposals that this approach has much promise for resource-poor farmers, who are the intended beneficiaries of PETRRA-supported activity.

It was suggested that a working group be formed, with a smaller steering committee that can take initiative on behalf of the larger group. For the steering committee, from the government sector it was suggested that BRRI and DAE be represented, and this was accepted. From the NGO sector, BRAC and CARE were proposed as the organizations with the most SRI experience and the broadest capacity to promote SRI. It is hoped that a large number of NGOs will be joining the larger working group. From the private sector, Syngenta was the obvious choice. In a year's time, the larger working group can review the work of the steering committee and can make any changes desirable, rotating membership if thought appropriate.

To launch the steering committee, Dr. Buiyan and Mr. Wasiuzzaman were suggested from the government side, Prof. Muazzam Husain and Mr. Mir Ataur Rahman as NGO representatives, and Dr. Saha Choudhury from the private sector. Prof. Husain was proposed to serve as chair of the committee and convenor of the group, at least to begin. He gave his address for others to be in contact with him: Dr. Muazzam Husain, BRAC-RED, 75 Mohakhali, Dhaka 1212 -- e-mail: bracamr@bdmail.net and phone numbers are 9881265 or 8224180, both extension 2709.

The tasks of the steering committee in the months ahead will be:

1. To **arrange for a working group meeting** in about six months' time, about June, after this boro season is finished and there will be results and experience to report and evaluate from this present season;
2. To **promote consistency and comparability among trials and reports** done by the various working group members;
3. To **disseminate information to and among working group members** regarding SRI means and results; Prof. Uphoff will provide information from other countries;
4. To **communicate with farmers** through the various member groups (though this will not be the major activity until more evaluations and results are in hand);
5. To **establish links with the donor community** and to explore and mobilize donor funding; and
6. To **coordinate among participating organizations and institutions** in any way deemed fruitful for the objective of evaluating and promoting SRI as it can best work under Bangladesh conditions.

Prof. Uphoff, who had been taking notes, volunteered to draft a report of the workshop to be circulated among participants for any corrections or additions. The steering committee will aim for a March meeting, to begin plans for a working group meeting in June.

There was a specific recommendation agreed to by all present, that the steering committee should initiate a proposal, though an initial concept note, for funding from the

PETRRA project in light of the potential impact that SRI could have on poverty in Bangladesh through rice research. The duration of funding under this project can only extend through March 31, 2004, but this could give support for three seasons of research. Prof. Husain will get this process initiated on behalf of the larger working group.

APPENDIX: Comments on SRI by Prof. Norman Uphoff

The System of Rice Intensification (SRI) is not a *technology*, i.e., not a fixed set of practices, but rather it is a *methodology*, with a set of concepts and insights that justify certain practices.

SRI is an *evolving* methodology, one that changes as we gain more knowledge and experience with SRI. Farmers are already modifying some SRI practices, and scientists are learning more and more about SRI all the time. SRI still raises more questions than it provides answers. The purpose of his visit is not to *promote* SRI but rather to *encourage experimentation/evaluation*. There is increasing evidence from a growing number of countries that SRI offers real opportunities to raise production in ways that are more equitable and environmentally benign.

SRI is really *a set of principles for improving plant performance* with probably broader relevance than just for rice. SRI approach can be summarized as:

(1) Rice performs better with
- (a) WIDE SPACING and
- (b) CAREFUL TRANSPLANTING of
- (c) YOUNG SEEDLINGS.

(2) Rice performs better in SOIL that is
- (a) WELL-AERATED during the vegetative growth period, through
  - (i) careful water management and (ii) mechanical weeding, and
- (b) IMPROVED MICROBIOLOGICALLY through compost and different *plant/soil/water/nutrient* management.

SRI practices are counterintuitive, i.e., "not logical" because with them, "less can be more." While the results appear "too good to be true," there is growing evidence that they are correct.

- Smaller/younger seedlings produce more grain, in conjunction with other practices, having more potential for root growth and tillering;

- Fewer seedlings per hill produce more tillers, roots and grain, because of decreased competition;

- Fewer seedlings/m^2 produce more tillers and grain, for same reason;

- Less water during the growth period leads to more grain production;

- Fewer or no external inputs give more production, no chemical fertilizers, insecticides, herbicides, etc.

- Less capital expenditure needed for external inputs; may need to invest more in hiring labor; in terms of equipment, need only to have or have access to a mechanical weeded (for best results).

What is more?

- Labor inputs -- for careful transplanting, more frequent weeding, making and applying compost

- Skill in management -- careful observation, experimentation and evaluation.

SRI can be reduces to three basic principles, which get implemented in various ways according to local conditions:

A. Young transplants -- carefully handled to avoid or minimize trauma to plant

B. Wide spacing -- should be optimized for local conditions -- not to be maximized

C. Aerated soil -- to support microbiological diversity for healthy and fertile soil

Yield is commonly taken as a summary measure of success, but it is not really the objective of SRI. The best measure of success is increases in the productivity of:

- Labor -- yield per hour or per day
- Land -- yield per hectare or per acre
- Water -- yield per cubic meter
- Capital -- yield per thaka expended

We want to make better use of these factors of production, through more skillful use and by *"capitalizing on the power of biological processes."* Although SRI appears to stress intensification, its real objective is diversification

- redeploy resources to more beneficial uses
  -- devote less of land, labor and water to production of staple food, and
  -- devote more to production of crops that are *higher-value and more nutritious*.
- lower the price of rice through productivity gains for rice, which will benefit the poor most.

Farmers are most concerned with their costs of production -- how to lower them? SRI can do this, contributing to both:

- Profitability -- a private concern, and
- Sustainability -- a societal concern

What if a household has binding labor constraints? It would be well-advised to use SRI methods on less than the full area of its land, to get higher returns from its labor, land, and water.

Farmer changes made in SRI since 1994:

A. Age of seedling -- experimenting with only 4-5 day-old seedlings (some claim these are better) -- we still recommend transplanting seedlings at 8-12 days, but interesting question.
B. Use of a "rake" for marking transplant lines -- instead of using strings or ropes to lay out straight, evenly spaced lines -- a wooden rake, with "teeth" 25 or 30 cm apart, to be drawn in perpendicular directions across the muddied field, is unquestionably better than strings.
C. Alternating wetting and drying of soil rather than maintaining moist but well-aerated soil -- saves labor, with little sacrifice of yield depending on soil. (An increasing number of Malagasy farmers rotate wetting and drying their field with SRI, flooding them for 4-5 days [average 4.4] and then draining them and keeping them dry for 4-5 days [average 4.8]).
D. Spacing always needs to be optimized, after experimentation; important to remember and to inform farmers that spacing usually can be wider as soil improves over time.
E. Application of compost to previous crop, rather than to rice crop -- get more benefit for both crops, with slow decomposition of compost good for rice

SRI is not just for producing more rice -- also for human resource development. SRI is not a static methodology. Some may have some concerns with sustainability of the system because of its higher yields. Soil depletion is possible -- this is an open question. Soil improvement is also possible. Maybe SRI will lead us to some new understanding about soil nutrition. Already able to attain yields over 20 t/ha in Madagascar on what are "poor soils" when analyzed in chemical terms. Yields tend to improve over time -- with wider spacing becoming more productive.

Need to focus on -- for agriculture in general, but particularly for SRI rice: (a) soil biology and (b) roots. Probably less than 10% of soil research has focused on biological aspects and dynamics, and even less than 5% of plant research has dealt with roots. There has been a great neglect of these obviously important aspects of productivity and sustainability. The System of Rice Intensification calls our attention to both domains as likely areas to explain the very high yields that its management practices can achieve.