

REPORT ON VILLAGE VISITS IN TRIPURA STATE OF INDIA TO ASSESS PROGRESS WITH SRI, OCTOBER 6-9, 2007 – Norman Uphoff, CIIFAD

SUMMARY

The following report shares with anyone interested what was learned from four days of field trips in Tripura following the 2nd all-India SRI symposium hosted by the Tripura state government. Below is a summary of the main observations and conclusions deriving from the village visits.

1. SRI spread is proceeding rapidly because of (a) **good results** from use of the new methods, and (b) **effective leadership** from within the government bureaucracy and from the political system at state and local levels. Two years ago (2005), there were *less than 1,000 farmers* using SRI methods. Now (2007), there are *over 70,000 SRI farmers* in the state.
2. Farmers in Tripura are getting **1-3 tons/ha more yield** with reduced requirements for water and seeds and with lower costs of production. In Rajnagar Agricultural Subdivision which we visited, there were only 24.5 ha of SRI cultivation in 2004-05; in 2005-06, the SRI area was almost 100 times more -- 2,300 ha. Yields with SRI have averaged 6.8-6.9 t/ha in Rajnagar, more than twice the usual average yield there -- 3 t/ha or less. Such increases, plus reductions in water, seeds, cost and even labor, are giving farmers strong incentive for SRI expansion.
3. Personal impetus for SRI expansion came first from a researcher in the state's Department of Agriculture, Dr. Baharul Islam Majumder, whose efforts received strong support from the Secretary of Agriculture and then from the Minister of Agriculture and Chief Minister. During field visits we were continually impressed by the knowledge, dedication and deftness of DOA extension staff in their interaction with farmers. Also, support has been forthcoming from local governments (PRI) at all levels in the state, reinforcing political and technical efforts. **Institutional infrastructure and policy support** have thus been major factors in SRI spread.
4. It was impressive to see SRI being used by **marginalized households**. In one village that we visited in South Tripura, whose mostly tribal households two years ago did not even do row transplanting, SRI production is averaging 6.5 t/ha instead of the usual 2.5 t/ha there. One-quarter of the households are practicing SRI, and all said that they will try it next season. In a mostly tribal village in West Tripura that we visited during the symposium's field trip, 79% of the households are using SRI on 56% of their total rice area. Their SRI yields in kharif and rabi were 5.8 and 7.0 t/ha, respectively, compared to 2.9 and 4.4 t/ha with usual methods.
5. A bonus with SRI -- on top of the higher yields reported above and in this trip report -- is that SRI methods are producing **more useable rice** for human consumption. From questioning villagers, we figured that when SRI paddy (i.e., unmilled) rice is processed, it produces on average **18% more milled rice (in kgs) per bushel after milling**. This is because SRI paddy contains *fewer unfilled grains* (less chaff) and has *fewer broken grains* (has less shattering). This is a significant windfall especially for poor, food-insecure households. Farmers should thus receive a higher price from buyers for the paddy they produce with SRI practices.

6. One unfortunate thing we learned from villagers is that **rice biodiversity** is losing ground in Tripura, as few traditional varieties are still cultivated. These have been displaced by the government's 'rice replacement program' which encourages the purchase and planting of new varieties. There is interest in and preference for local varieties, which can perform very well with SRI methods. Systematic evaluation of their response to SRI techniques could help to make indigenous varieties popular again -- before they disappear.
7. While farmers find that SRI requires more labor input in their first season with the methods, it is becoming more common that SRI is **labor-saving** by their second or third season. We also visited a village, South Mirza, where the rate of **effective tillering** was calculated as 85%. One way to support SRI extension is to call farmers' attention to the visible, often dramatic differences in **root growth** between SRI and usual rice plants (see picture below). While farmers easily see and know about differences in tillering with SRI, few inspect and monitor their SRI plants' roots. This should be encouraged, possibly supplemented by something like a Root Color Chart (RCC) to assess whether aerobic soil conditions are being maintained as recommended. A separate picture report to accompany this narrative is being prepared.



Baharul Majumder holding up three conventionally-grown rice plants on left, and a single SRI rice plant on right. These were taken from adjacent fields in North Bharat Chandra Nagar village in South Tripura District.

Following the 2nd National SRI Symposium for India, held in Agartala, the state capital of Tripura, October 3-5, 2007, I was fortunate to have a chance to spend several days in field visits organized by the agriculturalist who has given state-level and field-level leadership to the spread of SRI in that state, **Baharul Islam Majumder**, senior official in the Department of Agriculture. He had invited me previously to visit Tripura to review and reinforce his efforts, but this was not possible before. Once I came to Agartala, I was pleased to see how and why SRI is spreading rapidly in this small state of 10,000 sq. miles surrounded by Bangladesh and the state of Assam.

Baharul began personally evaluating SRI in 1999-2000, and by 2002 he had acquired enough experience with and confidence in the methods to begin trying them out on farmers' fields. Because Tripura has, on average, very high rainfall (2500 mm annually), special attention had to be given to methods that ensure adequate soil drainage. Baharul began with 44 farmers in 2002, and by 2005 this number had grown to 880. The demonstrable good results persuaded the state government to give official backing and funding to SRI dissemination. In the 2006-07 kharif/aman season, the number of SRI farmers jumped to 31,620, thanks to a massive extension effort coordinated by Baharul and backed by state government funds and authority. SRI use rose to about 50,000 in the following rabi season.

This year, the number of farmers using SRI methods is over 74,000 farmers, so the rate of uptake of SRI has been more rapid here than anywhere else I know of, surpassing 10% of total paddy area. This made me interested to learn directly about the Tripura experience on the ground. As part of the Symposium program, the Department of Agriculture organized a series of field trips (see my report from the Symposium for sketches of SRI in three village visits). With me for four days of additional field visits were my wife Marguerite, who has been a source of great support for SRI for many years, and Karma Lhendup, lecturer in the College of Natural Resources of the Royal University of Bhutan, who has begun introducing SRI in that country.

Saturday -- October 6

Having spent the morning with SRI colleagues from Bangladesh who had come to participate in the Symposium and to learn about SRI experience and progress in India, after lunch several staff of the Department of Agriculture (DOA) took Karma, Marguerite and me to see SRI fields about 10 km northeast of Agartala city and to talk with SRI farmers in communities there.

At the first village, **West Nowabadi** in Jirania block, we walked through a tract of paddy fields where about half the area is under SRI. A number of farmers quickly gathered, and we started talking with one young farmer in his first season with SRI. He was pleased with the tillering of his crop, but he had no results to report yet. So the conversation shifted to an older, wizened farmer who was in his second SRI season.

We calculated that his yield in last year's previous kharif season had been 60% more than his usual yield, going from 3.6 t/ha to 6 t/ha. He was very pleased with these results. When I asked if SRI required more labor, he said: "Yes, the first season it takes more. But then the labor needed for SRI comes down with experience." He said that this season he had needed less labor than with his previous methods, confirming that SRI methods can become **labor-saving** for farmers while giving them also other benefits.

As we walked along the path to other fields and other farmers, we noticed that the leaves of rice plants along the road were mottled with dark brown spots. What kind of disease was affecting the crop? It was explained that to keep cattle from grazing the rice, farmers had sprayed motor oil on the plants near the road. That this was ineffective became clear, however, as everyone made room for a very large bull being driven along the road by a small boy; the bull stopped before he got to us and took a leisurely mouthful of the rice within reach.

Next we met a woman farmer who was also in her second season and was more than pleased with the performance of her SRI crops. She too had gotten a 60% increase in yield. When I asked if she had been discouraged by the appearance of her SRI field during its first month, when only a few small seedlings thinly spread could be seen, she confirmed that she had been worried initially. But once profuse tillering began, she said she had no more qualms, a recurrent story.

This farmer was using, and was particularly pleased with, the biofertilizer she had gotten from the Department, a combination of azotobacter, azospirillum and phosphorus-solubilizing bacteria (PSB). When I questioned whether the biofertilizer was responsible for her crop improvement, she staunchly defended it. When I raised the possibility that farmers could be trained to produce their own biofertilizer locally, something that the M.S. Swaminathan Research Foundation is doing in southern India, she was quick to say that she would like to try this herself. The extension staff with us said that they would contact the MSSRF and follow up on this idea, being keen to see the use of biofertilizers expand in their areas.

At the next village, **West Nuwagoan**, a large group of farmers was waiting for us. Our polling of farmers indicated that with SRI methods, most had seen their yields go from 15-17 mons/kani to 30-35 mons/kani. Converting these local units of measurement (1 mon = 40 kg; 1 kani = 0.16 ha) meant that yield had gone from about 3.5 t/ha to over 7 t/ha, more than a doubling of production.

Seeing SRI and 'normal' fields side by side, I asked if someone could pull up a plant from each field for us to look at the roots. The request seemed puzzling to farmers at first, but one climbed into the fields and with difficulty pulled up one SRI plant and fairly easily pulled up a clump of regular plants. The disparity was very evident. The latter clump of four plants had roots that were short and dark, while the single SRI plant roots represented a volume 6-8 times greater. Even in the dusk of evening the latter were seen to be lighter colored. This demonstration elicited much comment and excitement.

I asked if they had ever looked at their plant roots before? No, was the answer. Our colleagues from the Department were somewhat chagrined that they had not thought to use such a simple 'extension method' previously, because it is an easy and persuasive way to show farmers the effects of SRI methods and the benefits of stopping their continuous flooding.

We discussed the merits of having a Root Color Chart (RCC) similar to the Leaf Color Chart (LCC) that IRRI has developed to assess plants' nutritional status with regard to nitrogen. The LCC tells farmers when it will, or will not, be beneficial to apply additional N fertilizer. A RCC would give them instant feedback on whether they are managing their water well, since dark-

colored roots indicate hypoxic soil conditions, i.e., if they are applying too much water or have too little drainage.

The third village visited, **East Nuwagoan**, was a 'seed village,' where farmers are cooperating with the Department to do seed multiplication. Thus they are more accustomed to meeting technical requirements and innovating. There was a large expanse of SRI fields, about 30 ha, all well-maintained. They also reported a doubling of yield with SRI methods in previous seasons. That being 'progressive' farmers had paid off was evident by the very nice farmhouse we were taken to near the fields we observed, for refreshments of coconut milk, bananas and cookies.

The bedroom we were seated in was that of newlyweds, with a wedding dress hanging on the wall and a welcome banner still displayed. As not many farmers could fit into the room with us, our conversation was mostly with Department staff who are very interested in biofertilizers and in biologically-informed management of plants and soil. In the three villages that we visited, there was evident acquaintance and amicable relations between government staff and farmers.

Our questions about farmers' difficulties with SRI practice usually identified weed control as the biggest challenge. Giving farmers better access to weeders -- and to ones appropriate for their different soil conditions -- is a challenge that the state government needs to address. Farmers said that young seedlings were difficult to manage at first, but they could learn the technique fairly quickly.

October 7 – Sunday

Next morning at 9, we traveled south from Agartala with Baharul to Sonamura subdivision, the area where Baharul was born and grew up on the border with Bangladesh. We passed many areas where we could see yellow flags flying over paddy fields, indicating that these had been planted with SRI methods, but we could see also considerable clustering. Baharul explained that this was part of the Department strategy to use its time and resources efficiently and to get reinforcement effect among farmers. Baharul said there is more demand for SRI training than the Department can meet, and farmers are starting to adopt it by imitation, coming to Department staff and asking for a SRI flag to fly over their fields. Posting yellow flags inspires farmers to become part of the SRI movement, he said.

There is now pretty consistent experience that while the labor requirements for SRI are increased in the first season, they reduce in the second, and by the third season, the labor needed for SRI is usually less than with conventional methods. This we were told by farmers at North Maharanipur on Thursday. In particular, the transplanting process can be much speeded up with experience.

We stopped at **Indiranagar** in Melaghar block on the way to Sonamura, where there were about 50 flags flying over a large expanse of paddy fields. Farmers here were in their third year (sixth season) with SRI. Their main constraint is the labor required to do enough weeding. Yields have gone from 14 mons per kani (3.36 t/ha) to 30 mons or more (7.2 t/ha). The farmer who spoke for the group was the most enthusiastic SRI cultivator, having increased his SRI area to 5 hectares. He volunteered that "if government assistance is withdrawn, we will continue," referring to the

subsidy of 4,500 rupees per hectare that the Department gives as a kind of demonstration reimbursement (popularly called a subsidy) to support farmers' transition to SRI methods.

He said that with SRI, they have no lodging of rice plants, and there are fewer pest and disease problems. They can get much more rice from each single seed planted. I asked whether there are any noticeable changes or improvements in the eating quality of SRI rice. After consultation among themselves, the farmers said no difference. Most mill their own paddy, paying the miller a fee for each bushel milled. Before they would get 23 kg of milled rice from each mon of paddy (40 kg), a return of less than 60% because of chaffiness and broken grains. Now, they said, they get 25 kg back, which is 8-9% net increase in production on top of their higher paddy yield.

As we walked along the road, we saw signs on adjacent fields: "SRI Demo Damaged by Recent Flood." The weather this year was quite disturbed, and there was extreme and unusual flooding in September, with fields under several feet of water for a week or more. One farmer pointed out that the SRI plants were, however, recovering better than conventional plants, starting to ratoon, i.e., put out a new set of shoots. He said 30-day-old seedlings gave less ratooning. Even after three floodings, SRI plants recovered faster, presumably because of their better root systems.

One farmer reported that they have concluded that in the boro (winter) season, it is better to use 30x30 cm spacing, while 25x25 cm spacing is better in kharif (summer). This shows that farmers here have grasped and accepted SRI's basic but counterintuitive argument that *output can be increased by reducing inputs*, something still not understood by most persons. Farmers here are alternating rice with vegetables, a good practice to enhance soil fertility. The drains that they have put into their SRI paddies are perhaps a step toward permanent raised beds for both crops.

As we drove to the next village, Baharul said that they now hold district competitions to reward the best SRI performance, with the winner getting a television set (as in Cambodia). The highest yield has been 11 t/ha, and all of the winners so far have exceeded 10 t/ha. All villages in the region now have at least one SRI demo plot of a quarter hectare.

Farmers used to just plant their rice and then leave it to grow, Baharul said, doing perhaps one weeding or two, before coming back for harvest. Most of the rice here is rainfed. Now, with SRI introduced, farmers take their rice-growing more seriously, paying attention to the crop and doing more to enhance its growth. While this takes more of their time, they are drawn to do this by the attractive performance of their plants. This is something I have heard from many farmers in different countries, as SRI establishes a kind of a bond between farmers and their rice plants.

The next community visited was **Kulubari** in Baxanagar block very near to Baharul's home. We were received by a line of neatly dressed schoolgirls, overseen by proud teachers, who gave all of us flowers as we entered the school assembly room. Baharul introduced us to a village elder who cultivates a half hectare of paddy. He said that with SRI, his harvest had gone from 16 mons to 32 mons.

We walked to his field not far from the school, and I asked him to pull up one of his SRI plants to compare the root system with that of a conventional rice plant in the neighboring field. (These

plants if put back into the field after inspection will resume their growth.) Farmers were amazed to see the difference between a single SRI plant and the comparison clump of three plants. I suggested that Department staff use this regularly as an extension method. On the way back to the center of the town, we passed small SRI posters pasted on fence posts and walls: *Less seed -- Less fertilizer -- Less water -- Less pesticides -- Less labor -- Less costs -- More harvest -- More income*. These seem pretty compelling arguments for at least trying out SRI methods.

Farmers here do not have permanent irrigation facilities, so they rely on rainfall in the summer (kharif) season – and still they are getting very respectable SRI yields. In the winter (boro) season, they depend on seepage water, they said. Out of the 180 hectares in this village, 60 hectares are already under SRI. Farmers asked Baharul (probably for the umpteenth time) when will the Department provide them with irrigation.

At another field where we stopped, the farmer who owns it went into the paddy and pulled up a plant without being asked. He counted 62 tillers at 50 days after transplanting. I told them that we have a report of an SRI rice plant in Afghanistan with 120 tillers at 96 days. The farmer said that with SRI, all his panicles are uniform and bigger, just what is desired. I asked whether more labor is required for harvesting. They said that even with doubled yield, the time for gathering the panicles for threshing is not much increased. However, more time is required for transporting the harvested grain, of course.

I asked about milling outturn from SRI paddy. Farmers said they used to get about 24 kg of milled rice from 1 mon (40 kg), similar to the first village. Now they get 29-32 kg, 25-30% more. Such a large increase is hard to imagine even with better grain filling and less shattering, but a farmer who was walking with us and who owns and operates a local rice mill confirmed this is occurring.

In the center of the town, a farmer had brought a huge rice plant he pulled up from his field, perhaps to show that they could do almost as well here as in Afghanistan. With a hundred persons standing around, he counted 87 tillers on the plant, 65 days after transplanting. A Department officer commented that this plant was grown “even on sandy soil.” I responded that SRI is “changing the rules” for paddy production. Previously, it was thought that clay soils are best for growing rice, because they are low-lying and often water-logged whereas more elevated, better-drained soils could not retain standing water.

Our experience with SRI, however, is that rice plants grow well on well-drained soils – provided that farmers can provide sandy soil with enough organic matter. These soils can maintain more aerobic conditions that benefit both plant roots and aerobic soil organisms. What qualifies as ‘good rice soil’ is thus changing, with the proviso that soil organic matter must be maintained.

Back at the school, we met the vice-chairman of the block panchayat, who was introduced as having been very supportive of SRI efforts in the area. He said that he has a small paddy holding that is sharecropped and being cultivated with SRI methods. His production has increased, he said, and there is more involvement of the farming community. This block is self-sufficient in rice and sells a surplus to the rest of the country, although it imports some seed from Bangladesh.

The international border is only a few hundred meters from the schoolhouse. Baharul said that there has already been some diffusion of SRI methods across the border, informally of course, because they can see the use of single seedlings spreading on the Bangladesh side.

I asked about use of traditional varieties in the area. I was told there has been a big push by the government for 'seed replacement,' getting farmers to buy and use improved varieties of seed instead of their own. However, this has had the effect of crowding out the use of local varieties. The purpose of replacement has been to get higher yields, but traditional varieties can perform well with SRI methods, and since they command a higher market price, SRI can make them more profitable than HYVs or hybrids, which involve more costs of production.

Our third stop was along the road near **Sonapur** in Kathalia block. On one side of the road, there were many yellow flags stretching far into the distance. The SRI rice plants looked reasonably vigorous, although when we did a comparison of root development, the SRI plant's root system was not as much better than the conventionally-grown plant's as seen elsewhere. Since this was a low-lying area, there was probably poor or uneven drainage.

We saw fewer SRI plots on the other side of the road. Why? We were told that in the summer there is water stagnation in that area, so farmers do use SRI methods there in this kharif season. They use the new methods there in boro, however. The farmer from whose field we had gotten the SRI plant, Badal Debnath, said that he used to get 15-16 mons/kani (3.6-3.8 t/ha) with usual methods; now he gets 30 mons with SRI. Some farmers in this area have gotten over 37 mons with the new methods (8.9 t/ha), we were told.

When asked about labor requirements with SRI, Badal responded as we heard from others: in the first season, these are more; in the second, they are less; and by the third season, there is labor-saving. "If weeding is done as recommended, it is less. Weeding should be done first at 10-12 days after transplanting, and then repeated at the same interval. If one delays beyond this schedule, the labor needed is increased" because weeds get better established and require more effort to remove. Finding labor available in a timely way can be a problem for farmers here.

I asked Badal if he knows that weeding is done for soil aeration? He answered that there is "more nutrient uptake if you disturb the soil." I asked about establishing his nursery on a raised bed, and he said that he has done this, with good results. One of his SRI plants had 95 tillers. He used a watering can to supply water to the nursery, rather than keep it flooded. Transplanting requires more labor with SRI, Badal said. Otherwise, everything is okay. Rotation of crops, rice with vegetables, is good. Pests and diseases are less.

Badal's concluding request was for Baharul and the Department to give the farmers here reliable irrigation. They manage now only with rainfall but could do much better with permanent irrigation facilities. We can do nothing in the short run to meet this need, so we could only wish them success with SRI methods under present conditions – which they appeared to be achieving.

The last visit of the morning was to several fields at **Shantinagar**, also in Katalia block, where there were many SRI flags, but we could see that some fields had more than a single flag. Thus,

the yellow flags can be a matter of decoration, or pride, rather than each denoting an individual SRI plot. The farmer here, Priyabrata Pal, possibly prompted by an extension staff member, pulled up a plant to show me the roots. They were fairly large, but there was black coloration in the culm, the ground-level part of the plant from which the tillers grow upward and the roots grow downward. A band of black color at the base of the tillers indicated necrosis due to lack of oxygen in the tissues, making the tillers soft and the plant vulnerable to lodging.

I called farmers' attention to this color change, from green to black, explaining that this means the plant has been inundated too long. Farmers said they cannot control water here because their crop is rainfed, not irrigated; and this season there had been a lot of rain, which affected all the rice crops adversely, not just SRI. I explained that my comment was not intended as criticism but as a diagnosis. The plant had 22 tillers, and a Department officer said that some here had 32, which is good given the unfavorable growing conditions.

From their previous season experience, farmers knew that with SRI, panicles are longer and more numerous, and that yield is improved. Priya said that this is the first time he is doing SRI, and he is satisfied with the result. Previously his maximum number of tillers per plant was 12. Unfortunately, the Department did not have enough biofertilizer supply this season, so he was not able to enrich his soil this way. As at the previous stop, the farmers in Shantinagar asked the Department staff for irrigation facilities.

From this village, we drove to one of the many large lakes in the region, Rudrasagar, where we had lunch at a government circuit bungalow. Afterwards we were taken by boat across the lake to see Neer Mahal, a 'water palace' built in the 1930s by a former ruler of Tripura state, Maharaja Bir Bikram Kishore Manik Bahadur, on an island in the lake as a summer retreat 58 km from Agartala. It has not been well maintained over the six decades since Tripura was incorporated into the Indian state, so the tropical climate had made it look more ancient than it is. However, rehabilitation has started on what could become an attractive tourist destination.

That evening upon our return to Agartala, Marguerite and I were invited for 'high tea' with the Chief Secretary, **Dr. Shashi Prakash**, head of the Tripura state administration, and his wife. It was a very high tea, with good Indian food. Conversation ranged widely as the Chief Secretary had studied political science and still remembered well one of his texts written by a Cornell professor. After this, the Secretary of Agriculture, Dr. Ayyangar, hosted a splendid dinner at the state government house with about 50 staff of the Department. Considerable enthusiasm was expressed by many in attendance for the improvements that SRI is making in Tripura's agricultural sector.

October 8 – Monday

We began a two-day field trip to the Southern District of Tripura at 8:30, reaching the village of **Barabhiya** in the Matabari block of Matabari subdivision, 50 km from Agartala, about 10. A majority of the households here are ethnic Bengalis, but about one-third are tribal.

Where we stopped, 35 farmers were cultivating Swarna variety on 9.5 hectares in a large block of paddy fields, with yellow flags flying to the left and to the right. The total cultivable area in

this local government unit is 165 hectares. Farmers started with 14 hectares of SRI in the 2006-07 kharif season, and then 18.5 hectares in the following rabi season. This kharif season, the extent under SRI has gone up to 65.5 hectares, about 40% of the total rice-growing area.

Farmers in this area had to cope with a drought around the time of planting, and then with three floods during the season. These stresses probably contributed to the leaf roller attack that they experienced. However, their crop looked quite good. Chemical pest control methods had been used to contain the leaf roller, but farmers also constructed bird perches from bamboo throughout their fields. This is a traditional method of insect control, predating SRI use, but now it is being used more systematically, local Department officials told us.

There were two dozen farmers waiting to meet with us, one-third of them tribal women, who Baharul said are very keen SRI farmers. There were no other women because in ethnic Bengali households, women do not do the rice cultivation. They take over operations at harvest time to do the threshing and processing. For the tribal women to participate in our meeting there had to be translation from English into Bengali, then into the tribal language, Kokbarok, and then back. Since Baharul knows all three languages, he could speed up the process.

What are the main differences that you see with SRI? I asked. A male farmer responded quickly: "With conventional methods, we transplanted 4-5 plants together and got 5-6 effective tillers, while with SRI we transplant one plant and can get 50-55 tillers. Pest and diseases are less. Spacing is 10 inches by 10 inches (25x25 cm). It is necessary to have good drainage in the field. Weeding is easier. Seed rate is reduced. Previously we used 10-12 kg per kani (60-72 kg/ha); and now we use just 800 grams (4.8 kg)." Here, in contrast to some other villages, farmers are taking a favorable view of mechanical weeders.

What are other differences? I asked. Another man said: "Inputs are less, especially seed and fertilizer, and pests and diseases are almost nil." This did not square with the leaf roller attack they had had earlier in the season, but I did not contradict him. A woman spoke up, saying: "Seedbed preparation is much easier. For one kani, we need only 2 kg of seed, sown on a seedbed 1 meter by 10 meters. There is very good growth of seedlings this way." She added that they mix 4 kg of paddy husks into the seedbed soil to make it easier to work with. "Drainage channels are put into the field every 10 rows... One farmer here got a yield of 13 mons of paddy from half a kani." This amounts to a yield of 6.24 t/ha.

Is transplanting more difficult? I asked the women. Their response was that once they get used to the methods, there is "less drudgery," according to Baharul's translation. But are the small seedlings difficult to handle? I asked. One woman responded no, gesturing to show how they lift the seedlings up with a trowel. Her smile expressed evident enthusiasm for the method.

I asked if they have found any difference in the cooking and eating qualities of the SRI rice that they produce? The women consulted among themselves and said no. (A Department official whispered to me that these households have been growing rice organically for many years, so maybe that is why they perceive no difference.) One woman affirmed that SRI does not require more labor, saying that she can manage by herself without hiring any labor as she did before.

One farmer mentioned that sometimes the weeder cuts some of the plants' roots – “but then they have more tillers.” I reported to the farmers how in West Timor, Indonesia, one first-time SRI farmer had what he thought was the misfortune: his SRI crop grazed by a horse when it was about 30 days old – but he got a yield of 12 t/ha. In the Philippines, some farmers deliberately cut their rice back at about 30 days. Although this delays their harvest, they get more yield. This is a practice that some farmers might experiment with.

What varieties are farmers using? Mostly Pooja and Swarna (modern varieties). As I probed to learn about any traditional varieties that might still be grown in Barabhiya, it became clear that households here have practically given up producing local rices, perhaps under pressure from the Department of Agriculture's seed replacement program. Traditional varieties have in effect been blamed for the state's low average paddy yields, so one apparent way to raise yields – the standard by which Department performance is assessed – is to get farmers to change varieties. Someone said that old varieties are no longer grown because it is no longer possible to get seed for them.

Do the people here like the old varieties? I asked. There was hesitation to respond at first, but one of the elders said: “Yes, they are more delicious.” There was assent all around. Baharul encouraged farmers to try SRI practices with any remaining local varieties as these methods usually boost yield substantially. Farmers said that they would try to do this.

I asked whether they have tried SRI concepts with any other crops, stressing that SRI should be regarded as a set of ideas rather than as a fixed technology. Baharul elaborated on the benefits of promoting soil organisms to enhance the fertility of the soil. This can be done by soil aeration and by adding organic matter to the soil. Describing microorganisms and their abundance in the soil in local language was not easy, but Baharul had farmers' full attention.

Would they continue using SRI methods if there were no more payment from the Department? The answer was a firm yes. I thanked the farmers for the effort they are putting into so many demonstration plots here in Barabhiya. Did they have any questions for me? This seemed to be misunderstood, because a farmer stood and said that he is “very much satisfied” with SRI and “will continue it.”

I said that we expect SRI to continue to evolve and welcome farmer innovations to make it better. “Please think about the ideas that we have discussed this morning and improve them if you can.” One young farmer, Narayan Devnath, apparently too shy to talk about his innovation previously, came forward to say he has tried out SRI ideas with ash gourd. He used very small seedlings on one plot and older seedlings on another one of the same size, each 400 m². He got definitely more yield from the first one, he said. This is the kind of farmer initiative to improve cultivation that we want to have with SRI. It was a good point on which to conclude the visit.

The next stop was in **Dakshin Bagma** panchayat area, where the total cultivable area is 185 hectares, of which 45 hectares were under SRI in 2006-07 kharif season and 55 hectares in rabi. This kharif season, the area under SRI has reached 64.9 hectares, 35%. Most farmers are using

12-day seedlings, but a few have transplanted at 11 or 10 days. Spacing is uniformly 25x25 cm, and most are applying biofertilizers as well as organic and inorganic fertilizers. The norm for SRI is to do three weeding, farmers said.

In the area we were visiting there were 30 hectares of SRI rice on one side of the main bund we traversed, and 25 hectares on the other side. There were very long bamboo bird perches installed in most of the fields, up to 8 meters in length. We met the chairman of the village panchayat, Ms. Sandhya Rani Das, on a field bund. She said that when she was first told about SRI by DOA officials, she was “afraid very much.” But she accepted their advice, adding that many meetings were necessary to persuade farmers here to try out SRI. (Weekly meetings for two months, a Department official with us explained.)

After the fields had been planted with the new methods, for the first several weeks they looked very unpromising. Some farmers came to Ms. Das to express their worries about the crop, doubting that it would give any yield. Ms. Das said she had to assure them that the panchayat would give them food if their crop failed. In fact, their yield was about 30 mons/katta (7.2 t/ha). In two years, over one-third of the land in this panchayat area has been switched over to SRI.

I asked about milling rates, and Ms. Das said that whereas they previously got 20-25 kg of milled rice from 1 mon of paddy, they are now getting 27-30 kg with SRI, an average increase of about one-third. Since most farmers here get their own paddy milled for a fixed fee, rather than selling it to a merchant or trader who will do the milling himself, this increase benefits their own households directly. This ratio needs to be studied systematically and documented so that this ‘bonus’ from SRI practices is properly validated and becomes more widely known.

The next visit before lunch was to **Chhataria**, where farmers are growing SRI on 9.9 hectares. When we inspected the roots of an SRI plant, we saw that their growth was good, but there was some sheath blight. The varieties grown here were all modern ones, Pooja and Ranjit. Baharul pointed out some bubbling in the mud which indicated soil microbial activity, probably induced by the biofertilizer used.

We gathered under and around a large tumeric tree near the paddy fields. What was their first reaction when they were told about SRI? I asked. “When we first heard about SRI, everybody was afraid,” was the response. They could not imagine single plants performing better than bunches. But we tried this with the help of Department staff, they said, and “when we saw the results, we became very confident.” The area under SRI in this kharif season is double that of the previous year. In the rabi season, SRI yields were also doubled, they said. What yields are they getting now? 29 mons, almost 7 tons per hectare.

What is the milling rate with SRI paddy? They used to get 25 kg of milled rice from 1 mon, now they get 28 kg, a 12% increase. One farmer said that grain weight is also more with SRI, because of more aeration, more sunlight, and more microbial activity. (He had learned the Department’s messages very well.) “The soil becomes greener,” he added.

I asked whether they have used SRI ideas with other crops? One young man was guided from the edge of the group to the center to tell us about his experiments with brinjal (eggplant). He raised the seedlings on a plastic sheet, on which he put 3 inches of soil and farmyard manure. He sowed the seeds not very densely, and the roots were kept intact when he transplanted the seedlings. Now they are one and a half months old, and the young plants' leaf color and size is better. "The roots should not be injured," he said, adding that he transplanted the seedlings at 25 days, later than planned, because of the unusual amount of rain this year. We encouraged him and others to keep up such experimentation.

When asked about growing local rice varieties, there was not much response. The village chairman said that he is growing Gigaj, which is eaten as a snack food –popped or puffed rice fried on a skillet rather than being boiled in water. He had used conventional methods with Gigaj this season, but said he would try it with SRI methods next year.

From Chhataria we drove to the subdistrict center, Udaipur, formally known as Radhakishorepur because it was established by a ruler with this name long ago as the first capital of Tripura. There we had lunch at the government circuit bungalow as a steady rain began. This delayed our resumption of visits after lunch as we waited (hoped) for the rain to stop. But when it seemed likely to continue, we set out for **South Mirza**, about 45 minutes away.

As we approached this village we saw large expanses of SRI. This was one of the first areas where SRI methods were introduced in Tripura, and many farmers are now in their fifth season. Sixty-two farmers are cultivating 15 hectares with Swarna variety. Despite the rain, we walked along bunds to get into the middle of a large area with healthy, large and uniform plants. Many farmers here have widened their SRI spacing to 37x37 cm, 50% more than initially recommended, because they have found that their soil fertility is improving.

This wider spacing reduces plant population by half (8 vs. 16 per m²), but farmers are satisfied that this year's crop will yield them at least 8 t/ha. One scientist from the Directorate of Rice Research in Hyderabad had visited South Mirza a few days before, and he calculated the **rate of effective tillering** to be around 85%. This is attributable to the additions of compost and farmyard manure and also to the use of biofertilizers along with some chemical fertilizer. Large SRI root systems putting exudates into the soil over the past few years have also had a positive effect on fertility.

There had been a heavy rainstorm in Mirza the night before, strong enough that some trees had been blown over. In some plots, we saw a little lodging, though not to a serious extent. Most fields had not been affected. After the visit to the fields, we sat on the verandah of the Das family, which had been the 'SRI pioneers' in this village. Haradhan Das, the village chairman, had planted the first SRI field with his son Ritan Das, whose wife and children were also with us.

We asked Ritan's mother, Usha Rani Das, about her initial attitude toward SRI. Had she scolded her husband and son? "That happened in many other places," she responded, "but not in this household." Others confirmed that she had been supportive from the outset. In one place, the

villagers told us, a husband and wife had quarreled when the man tried SRI, and even took up living separately for a while. But after one month, they were reconciled, we were told.

I told them the story of one farmer in Cambodia whose wife left him when he used SRI methods for the first time, publicly calling him “a fool.” But she came back within 6 weeks. So far as we know, there have always been happy endings to such stories. The Das family was amused to hear about a Cuban father-in-law who felt disgraced by his son-in-law’s SRI field and who had gone into it at night to transplant additional seedlings, to make it look like a more ‘normal’ field.

A few years earlier, Haradhan Das said he had started growing ‘true potato seed,’ which involves a number of practices similar to SRI – careful water management, younger plants, etc. – so SRI concepts were congenial to him. There was a lot of interest in my discussion of how biomass, visibly growing abundantly throughout the village, could be converted into compost by having more labor-efficient tools and implements.

With the rain still not subsiding, we reboarded the vehicles. As we were departing, Haradhan made the generous comment that farmers in his panchayat area are all very keen to improve their agriculture and make innovations, so the success with SRI here is due to them. In fact, as Baharul explained, no start could have been made without the Das family’s initiative and steadfastness. They are obviously a better-off household, but have played a valuable role on behalf of the wider community.

The rain continued steadily as we drove farther south, through large areas of protected forest. Although average rainfall in the state is 2,500 mm, here it is probably 3,000 mm, and this year Baharul said it is probably 1,000 mm more than usual. It was dark by the time we reached the small town of **Kanchannagar**, where Baharul told us SRI got its first start in Tripura state. A dozen persons who had waited for us for several hours were gathered in the marketplace.

Baharul had persuaded Abu Sarkar, a landowner in Kanchannagar, to let him use some land for SRI. He promised Abu Sarkar that he could have the SRI yield without any cost to himself and if it was less than usual, Baharul would compensate him for any shortfall. Baharul trained a DOA staff member, **Raju Majumder** (no relation), who was among those waiting to meet us, in SRI methods so he could supervise and assist the process. Even so, there was initial reluctance. However, the results were good enough that now there are 42 hectares of SRI rice in this immediate area.

Raju had a handwritten page of data to show us on the yields achieved with the different varieties here in Kanchannagar. The average increase was 1-2 t/ha. Baharul was pleased to point out that a number of traditional varieties (marked with T below) were performing very well with SRI. Moreover, they command a better price in the market, especially Kalikhasa, an aromatic rice.

Variety	Conventional (Paddy/ha)	SRI	Price (Rs/kg)
Jaya	4.0	6.2	13-14
Swama	4.2	6.5	13-14

Pooja	4.3	6.6	14
Binmali (T)	2.25	3.5	15-20
Kalikhasa (T)	2.2	3.6	30-35
Gigaj (T)	2.3	3.4	Not sold
China-IRRI	3.0	5.2	13-14
Paisam (T)	3.75	5.9	18-19

Last year, some farmers here grew also ‘white khasa’ which performs similarly to Kalikhasa (the name means ‘black khasa’) and gets a similarly high price. There was a lot of interest expressed in traditional varieties, more than some other villages we visited. After another half hour of driving, we reached the subdivision center, **Belonia**, where we spent the night at the government circuit bungalow, treated like visiting royalty – and were served Kalikhasa rice.

October 9 – Tuesday

Next morning we left the circuit house at 8 to make a number of village visits in Rajnagar Agricultural Subdivision in the southwest corner of South Tripura District, which borders on Bangladesh. The briefing book given us the night before, complete with color pictures and data tables, informed us that there were 20,521 farming families in this subdivision (subdistrict), and that most of the agricultural land here is cultivated with paddy rice. Normal rainfall is 2270 mm, and already by mid-September of this year, they had received 2939.7 mm of rain. In the two previous years, total rainfall was less than average, a little over 1900 mm.

The data provided on SRI, together with pictures to illustrate them, gave this overview:

	Area under paddy (ha)	Paddy production (MT)	Average yield (MT/ha)	Area under SRI (ha)	SRI paddy production (MT)	Average SRI yield (MT/ha)	No. of families involved
2005-06	15,613	49,976	3.009	24.5	170.079	6.942	122
2006-07	15,632	50,976	3.261	2,300	15,669.9	6.813	5,335

The briefing book indicated that the Department’s SRI target for this year was 3,000 hectares. So far this year, the area under SRI is 961 hectares, less than expected because of the initial drought and then heavy rains. The local officials said otherwise they could easily have reached 1,500 hectares. Even so, they expect to have enough SRI uptake in the coming boro season to reach the goal of 3,000 hectares. This will mean that 20% of the rice area in Rajnagar is under SRI.

The reason for the officials’ confidence was that between 2005-06 and 2006-07, the area under SRI went up almost 100-fold while the more than doubling of yield was maintained. By last year already, about one-sixth of the total rice area was under SRI, so the impact of SRI adoption in the subdivision was evident, adding a quarter ton per hectare to the subdivision’s average yield. The briefing book contained two ‘case studies’ that are reproduced at the end of this report. Since SRI contributed 30% of the subdivision’s paddy production last year, from 15% of the paddy area, this means the average yield from the rest of the area using ‘normal’ practices was 2.6 t/ha.

We reached **Debipur** village a little before 9, where we saw dozens of yellow flags spread across the rice paddies. Baharul introduced us to the chairperson of the block panchayat, Ms. Sheuli Lodh, whom he said had been very helpful in getting SRI demonstrated and taken up here. Indeed, at most stops, he introduced us to local government officials with the same compliment. We met also the vice-chairman of the panchayat, Ashish Datta.

Because it had rained heavily the night before, the bunds we had to walk along were muddy and slippery, to reach the hillock from which we could view the expanse of SRI paddy fields. SRI cultivation in Debipur started with just two plots in 2005-06; this season there are 35 hectares of SRI paddy cultivated by 75 farmers. Most are now in their third year with the new methods, actually in their fifth season. It was commented that this village is in the constituency of the state's Finance Minister, who had chaired the opening session of the National SRI Symposium six days earlier. Farmers' enthusiasm for SRI could explain why he accepted the organizers' invitation to participate.

I asked the farmers with us what is their biggest problem when using SRI methods, but none were suggested. One of them, Babul Pal, said instead that mostly they are getting good results; his own yield has gone from 480 kg/kani to 960 kg. Another farmer commented that they are getting higher SRI yields in the boro (winter) season than in kharif (summer). I asked them why this should happen? Farmers responded, correctly, that in the winter, when there is no rain, there are fewer clouds and thus more sunlight, and also that with less rain there is more microbial activity and growth in the soil. The extension staff with us should have felt very proud about this answer which showed that they had done a good job explaining SRI to these farmers.

I asked farmers again about what problems they are having with SRI. They said there is not enough biomass available so they have difficulty applying as much compost as is recommended. When I pointed out the huge amount of vegetation growing all around us, it turned out that by 'biomass' and 'compost' they mean farmyard manure. Here was a point that the extension staff had missed, so we discussed how plant material can be converted into compost. I asked about their rate of milling outturn from SRI paddy, and farmers said that it had gone up from 22-23 kg per mon to 26-27 kg, a bonus of 18% on top of their higher paddy yield.

After making our way back to the road, we drove to another stop and ascended another hillock to look over another expanse of SRI fields, this time without muddy bunds to traverse. Here there were 25 hectares of SRI paddy, not all flagged. I asked a farmer with us about labor requirements with SRI, and he said they are "more." When I asked if these were with experience, he said yes, but did not agree that they become less than with conventional cultivation. The consensus was that it takes 5-6 laborers more per hectare for the whole cultivation process, but that this is more than repaid by the increased yield with SRI.

Since weeding is the operation that takes most time, I asked what benefits they get from weeding in addition to eliminating weeds? One farmer quickly answered: getting air into the soil. Another added: getting rid of bad gases in the soil, a consideration that we have not stressed in our literature, so this must have been explained by the extension staff.

Baharul asked farmers whether they would continue using SRI methods if the government's payment scheme for demonstration plots (also known as 'subsidy') is withdrawn. The most outspoken farmer in the group, who answered, gave a convoluted response, obviously reluctant to give up the payment. But by the end of his response, he said simply that they would not stop if there is no payment.

I asked if there were any problems they would like to discuss. One farmer said that although they get very good tillering, 60-65 tillers per plant, only about half of these are effective, forming panicles of grain. I said that they may be applying too much nitrogen fertilizer. We have found this to be a problem in several countries. With all or mostly organic fertilization, we see effective tillering rates up to 80-90%.

The most outspoken farmer said that he had put on 35 kg of urea as a top dressing after flowering, and had advised other farmers in this area to do the same. This prompted Baharul to ask him: on what basis did you make this recommendation? This contradicted the advice given in SRI training applying no more than 40 kg total N, and all before panicle initiation. (This is one-quarter of the DOA's previous recommendation of 160 kg for conventional paddy cultivation.) The farmer who had been quite assertive previously backed down on this point (and when we left, shook hands very vigorously, so he took Baharul's admonition in good grace).

We reconvened in a local schoolroom near the road, for some tea and conversation. About 35 farmers assembled, with the only women being Ms. Sheuli Lodh and Marguerite. Women here do not participate in rice cultivation, we were told; only in threshing. The question of most relevance to everyone here was whether SRI can be applied where there was water inundation. The answer was no -- rice plants will not do well if deprived of oxygen in their root zones, although SRI methods may still be beneficial if the flooding is not for too long. If the young rice plants can be established several days before the flooding they can tolerate it for some time and will give better results than older seedlings. However, the roots need at least some time to get established, to hold the plant in the ground when flooding occurs.

I suggested further that where soils are saturated, farmers can make improvements in their production by using SRI methods on raised beds, a technique used in Indonesia, where individual SRI farmers are cultivating in the middle of larger irrigation systems with most of their neighbors still doing continuous flooding. The Nippon Koei evaluation of over 12,000 on-farm comparison trials showed an average yield increase of 3.3 t/ha, including many farmers who have no water control but who can benefit their plants by land management.

I emphasized that SRI is not a technology but rather a set of ideas, which we encourage farmers to apply to their own conditions, including also to other crops. Sugar cane is grown in this area, so I described how SRI farmers in Andhra Pradesh have gotten tripled yield of sugar cane by adapting SRI concepts and practices: wider spacing, soil aeration, using more organic matter, etc.

From Debipur, we drove to **North Bharat Chandra Nagar**, 45 minutes away. There we were welcomed by a line of schoolgirls, dressed up in their best small saris and with foreheads decorated, who presented us with flowers. We sat on plastic chairs looking out of their expanse

of SRI fields while drinking fresh coconut milk. These farmers started SRI in 2005-06 and are in their 5th season, having missed the previous boro season entirely because of drought. They have irrigation supply unlike many other SRI farmers, but their yields are not as good as many others. Their yields with SRI have increased from 500 kg/kani to 840 kg i.e., from 3 t/ha to 5 t/ha.

A two-thirds increase is of course very respectable, and the farmers said they are quite satisfied with this. Baharul explained that it was not possible previously for the Department to supply them with biofertilizer, but from now on they should have access. One farmer said that he had gotten a yield of 6.35 t/ha, and another said his yield was 5.62 t/ha. We discussed the application of urea, and about not applying it after panicle initiation, which can reduce effective tillering. One farmer said he had gotten 80-85 tillers per plant, but only 40-42 were effective, a familiar story when inorganic nitrogen is used.

There is a natural tendency to think that if something is good, more of it is better. But SRI has been showing everyone that less can produce more – fewer seeds, smaller plants, less water, more yield. Roots are the one thing that it is certainly better to have more of. Farmers brought an SRI plant and a clump of three conventionally-grown plants up from a nearby field for inspection. The contrast was as dramatic as ever (see picture on page 2). We pointed out the need for farmers to monitor root growth, looking at color as well as size, to know how well their SRI practices, and particularly water management, are being implemented.

I asked about milling outturn and was told that they are get 8 kg back from 12 kg of paddy, a 66% rate of return, compared with 7 kg before, an increase of 14%. I asked about difficulties in using SRI methods. Someone said transplanting small seedlings is difficult. But two boys about 8 years old were brought before us, petrified to have so much attention suddenly from the whole village and from visitors. We were told that they had done all of the transplanting of their father's SRI field. Was it difficult? I asked. With a little shyness, they responded that it was easy. I told the assembled group about a report from Cambodia where three farmer's sons, 8-10 years old, had transplanted his SRI field of 0.9 ha in one day.

We took leave and headed toward Rajnagar town. En route, Baharul told us about one village in the subdivision, inhabited by immigrant households from Manipuri, where SRI rice is selling in the market for 1 rupee more per kilogram. He didn't know why, whether people liked chemical-free rice or preferred the taste or cooking qualities. I told him that in Indonesia, 'organic SRI' is now selling for a 60% premium in the Bandung area, and production and consumption of organic SRI are starting to expand in that country, as well as in Cambodia, where SRI farmers can get a price premium of 15%.

At a village near **Rajnagar** we met with five farmers who are each cultivating a hectare or more of SRI paddy. Again we were greeted by schoolchildren with flowers. However, this community was evidently much poorer than the others we visited, judging by physical appearances, teeth, skin, hair color, as well as clothing. Agriculturally, this was a plantation area with 2,200 hectares of cashew trees. As seen in other countries, it seems that the estate mode of production can have an impoverishing effect on the surrounding area.

Nikunja Bihari Das said that he has 10 kani of SRI rice (1.6 ha). This was his sixth season and he had seen his SRI yields increase over time, from 6.75 t/ha the first year to 7.5 t/ha last year. Before, his paddy yield was around 3.75 t/ha. He said also that his labor requirements are decreasing; now he needs only 1-2 more laborers per kani, mostly for the increased weeding. This season he wanted to do SRI on a larger area, but was frustrated by the weather, constrained by the three floodings they experienced.

I asked about milling rate with SRI. He said it was 9 kg of rice from 12 kg of paddy, a 75% rate, the highest we had been told about, reflecting perhaps a high grain-filling rate and little chaffiness. Before they got 6.5 to 7 kg from 12 kg of paddy, so the increase was more than 30%. Another farmer volunteered that with SRI, insects are less and also there are fewer diseases.

We asked the women listening into our conversation whether there are any taste differences with SRI. They said yes, the grains are softer and tastier, with more oil content. When we probed about the 'softness,' the explanation offered was that in traditionally-grown rice, the grains are not of such uniform size. So when this rice is cooked, not all grains get equally cooked. With SRI, on the other hand, grains are more uniform, and it is easier to cook them all to the same extent. This is something I have never heard discussed about SRI, warranting further evaluation.

From the village we drove into Rajnagar town, where we visited a **Farmer Field School** being conducted by the Department of Agriculture with about 45 farmers from three villages. Baharul said that the Department has begun enlisting experienced SRI farmers to assist in training and supervision. Called *Krishak Bandhu* (farmers' friend), they receive a small fee in compensation for spending time to visit new SRI farmers and give advice on nursery construction, transplanting techniques, etc.

I was asked to speak to the group, so started by asking what farmers know about SRI? Most raised their hands. Can anyone explain what is SRI? One farmer who said he has not yet practiced the methods himself told us: one plant per hill, weeding every 10 days, good field drainage. What age of seedling? 8 to 12 days, planted 10 inches by 10 inches. A good answer. One farmer said that he tried SRI last season on his field and got 15 mons instead of 10, with less seed and less water. This would explain why farmers were interested to attend the session.

The local panchayat chairman arrived and was seated at the front of the room with me. He made a few remarks, saying "We will try our best to spread this SRI... We will try to motivate the farmers." With Baharul's assistance and elaboration in Bengali, I discussed the contribution that soil organisms can make to improving soil fertility and yields.

When this was finished, I asked if the farmers had any questions for me? One farmer asked: is SRI being practiced in the U.S. too? I had to explain that the way American farmers produce rice makes SRI in its present form not very relevant to them. (I didn't say some even seed their large fields from airplanes.) But the principles are relevant for them also, so I expect that within a few years, when they have seen the results from developing countries where we are concentrating our effort, American rice farmers too will begin using less seed, less water, more organic matter, etc.

I suggested that agricultural production in tropical areas like Tripura is currently disadvantaged by having low levels of organic matter in most of their cultivated soils, because organic matter is easily diminished with warm temperatures and high humidity, plus heavy rainfall. Ploughing accelerates this process. However, these regions have an advantage in that vegetation grows profusely wherever there is rainfall, high temperatures and soil moisture. If farmers can devise tools and implements to help them acquire, process, transport and apply organic matter to their soils, incorporated as compost or added on the surface as mulch, they should be able to improve the productivity of their agriculture.

I noted that what we are learning from SRI is relevant to agriculture everywhere. In this century, we will have to use our agricultural land more intensively and productively, as there will be less and less land per capita. We will also have to use our water more beneficially, as it is becoming scarcer and more unreliable. Energy costs will be higher than before, making mechanization and chemical fertilizer more expensive. So we need to rethink our agricultural production systems, and probably SRI can help to make them more productive and more sustainable.

After good-byes, we were taken to the local government circuit bungalow for lunch. Afterwards the panchayat chairman joined us and restated his support for SRI efforts. He said that in this block, they produce 11,000 tons of rice in excess of local needs, contributing this to the state's food supply. With SRI methods they can produce even more surplus. Together the state government, panchayati raj institutions (local government) and farmers can do this, he said.

From Rajnagar town, we drove to the village of **Dimatali**, populated by displaced tribal households from the state of Orissa and Purulia district in West Bengal. Purulia coincidentally is the leading SRI district in the Gangetic plains. There, SRI users went from 5 in 2003 to 1,780 three years later, attaining average yields >7 t/ha with rainfall only, under guidance from the NGO PRADAN.

As elsewhere, we were met by schoolchildren, these ones bearing large orange flowers looking like hydrangeas. Here too physical appearances indicated severe poverty, but the villagers were proud to show us their rice accomplishments. We walked along the concrete border of a lined irrigation canal into their paddy fields, seeing 21 hectares of SRI paddy cultivated by 78 farmers.

Paddy yields have gone from 420 kg/kani to 1080 kg (from 2.5 t/ha to 6.5 tons). The milling rate, more important to these farmers than most others we visited during the trip, has gone from 7 kg per 12 kg to 8 kg milled rice, an increase of 14% on top of their paddy yield increase. What about pests and diseases? These have become less, although this year with the heavy rainfall, including three floodings of the fields, the diseases were more than in some previous years.

The farmers accompanying us estimated that their labor inputs are about one-third more for SRI, 20 laborers per kani instead of 15. Most of this increase was due to their doing three weedings with the mechanical weeder rather whereas before they did just one hand weeding. Did they like using the mechanical weeder? Yes, was the response all around. This village was another one where the recommended weeding is viewed positively rather than as a burden.

Baharul asked them to pull up an SRI plant so that we could look at its roots, something they had not done before. They were pleased to see the large root system on the single SRI plant that a farmer brought. Baharul joked that he had brought us 10 plants, but the farmer insisted that this was only one. It had 42 tillers at 70 days' growth in the field.

Because all the surrounding fields were cultivated with SRI methods, it took the farmer some time to get a conventionally-grown plant for comparison. The first field that he tried, we could see him struggling to pull up the plant he had chosen to uproot – until someone called out to him that this was also an SRI plot. As usual, showing farmers the comparison between plants' root growth was worthwhile because it reinforced what had been said about the importance of weeding and soil aeration. The clump of three plants conventionally grown with flooding had only 17 tillers, seven times fewer tillers on a per-plant basis.

Here farmers were growing all modern varieties. What about traditional varieties? There were looks of puzzlement. Someone said that seeds for these varieties are no longer available. I suggested that they try to find some seeds of traditional varieties and try these out with SRI methods. Given the large seed multiplication effect of SRI, as much as 3,000 times, they could quickly begin producing their own seed.

At the local panchayat office where we had a conversation with some of the farmers, I suggested that they try out traditional varieties with SRI, and also that they experiment with wider spacing now that several seasons of SRI practice may have improved soil fertility, and try doing extra soil-aerating weeding to see if these enhance plant performance enough to justify the extra cost.

Because we had an appointment to meet the Minister of Agriculture at 6 pm back in Agartala, we had planned to leave by 3, and it was already past this. This was one of the most encouraging field visits because one could see how important SRI productivity gains are to marginalized households, who were purposefully striving to make a better future for themselves.

With skillful but stressful driving by the DOA driver, we reached the state government secretariat with just 5 minutes to spare. The Minister, **Tapan Chakraborti**, received us very graciously even though we had not had time to change into presentable clothing after the field visits. Since he serves also as Minister for Industries and Commerce, Health and Family Welfare and Preventive Medicine, and Information Technology as well as for Agriculture, he has evidently quite broad-ranging interests.

Minister Chakraborti gave us an hour of his time and expressed full support for the SRI effort in Tripura, and also appreciation for Baharul's leadership on this. Marguerite had wondered beforehand whether the Minister knew much about SRI, but this question was answered by the large SRI poster that he had hanging on the wall next to his desk. His and his government's support has been very necessary for the SRI dissemination effort to proceed so far so fast. But SRI performance has in turn been very valuable to the government, making attainable its pledge to make Tripura state self-sufficient in foodgrains by 2010.

We discussed incentives that could be used to further spread SRI use, such as:

- paying farmers a higher price for their SRI paddy when they sell it -- because their paddy will give millers a higher milled-rice outturn;
- training agricultural laborers in SRI methods, particularly transplanting and weeding, so that more skilled workers are available -- and giving these laborers a certificate that entitles them to a higher daily wage in recognition of their higher productivity, which will benefit their landowning employers;
- instead of giving out weeders and markers free or selling them at a subsidized price, establishing and supporting local manufacture of these implements which producers can sell to farmers for a low down-payment, with the balance paid off after harvest -- when their use has been more than repaid by the higher yield.

We thanked the Minister and his government for the initiative that they have taken to capitalize on this opportunity to improve agricultural performance and achieve social objectives as well. The reason for convening the 2nd National SRI Symposium in Tripura was to expose Indian scientists, NGOs, officials, farmers and others to the potentials of SRI being actualized under field conditions. The field trip on October 4 gave all the participants some exposure to the Tripura experience; but the follow-up visits that Marguerite, Kama and I could make October 6 through 9 gave a much richer picture of the actions and reasons moving SRI forward in this state.

ANNEX: Case Studies Reported in Rajnagar Agricultural Subdivision Report on SRI

#1: Sri Tapan Sen of Hrishyamukh G.P. (local government) under Rajnagar Agri Sub-Division was habituated in traditional practice of cultivation of paddy in 0.8 ha area having a productivity of 5.1 MT per hectare. During Aman (season) 2005 he participated in a FFS (farmer field school) and came to know that the total cost of cultivation, specially the cost of inputs, in SRI practice is much lower as compared to traditional practices, but results in more net return.

Accordingly he applied SRI practices on cultivation covering 0.16 ha out of total area of 0.8 ha with variety Pooja. In this case, 88 number of tillers was found in SRI field as compared to 13-15 tillers found in control plot. Finally 53 number of effective tillers was found in SRI field as compared to 8 number in traditional plot. In SRI field, 10.6 MT yield was obtained as compared to 5.16 MT in conventional plot.

After observing the results during Aman 2006, he took additional 1.2 ha of land on rented basis and cultivated the complete area (2.0 ha) through SRI practices with variety BR-11 at which 71 number tillers per hill and 43 number effective tillers were found, and the yield was 8.6 MT/ha. Finally, this package of cultivation practices is promising return to change the present status of livelihood of the farmer in such remotest localities.

#2: Sajal Roy is a successful SRI grower living in Nihamagar, Belonia, South Tripura. He has passed Class IX in schooling and has a total holding of 1.2 hectares. His cropping sequence is paddy-paddy. After attending an awareness camp on SRI, Roy applied SRI practices in his complete land of 1.2 hectares during Aman 2006 with variety MTU-7029 (Swarna). He obtained

78 number of tillers per hill with effective tiller number of 47, and yield obtained was 9.3 MT per ha.

During Boro 2006 Roy covered the same area with variety Krishnahamsa. In this case, total number of tillers per hill was found to be 75, with effective tiller number 45. The yield obtained was 8.4 MT per ha. During Aman 2007, he covered the same area through SRI practices with variety Pooja, but it is not harvested yet.

Roy stated that he is obtaining additional 3 MT production per ha with investing the same cost. He also persuaded the farmers in adjacent locality to stabilize their socio-economic condition and attain food security with SRI.

TABLE SUMMARIZING DATA FROM VILLAGE VISITS

Village Name	Prior Yield (t/ha)	SRI Yield (t/ha)	Increase in Yield	Increase in Milling Rate	Area under SRI (ha)	Comments
N. Maharanipur (Oct. 4)	3.54	6.32	78%	n.a.	100/180	Less labor; 50% less time needed for weeding
Maiganga (Oct. 4)	3.92	6.16	59%	n.a.	100/248	Production costs reduced by 15-20%
East Howaibari (Oct. 4)	3.76	5.45	58%	n.a.	n.a.	Already 2/3 of paddy area is under SRI
West Nowabadi	3.6	6.0	60%	n.a.	n.a.	Dramatic differences in root system growth
West Nuwagoan	3.5	7.0+	100%	n.a.	n.a.	Seed-multiplication village using SRI
Indiranagar	3.36	7.2	114%	9	n.a.	Better recovery after serious flooding (3x)
Kulubari	3.85	7.7	100%	27	60/180	Farmers showed us an SRI plant with 87 tillers
Sonapur	3.7	7.2	95%	n.a.	n.a.	Top yield of 8.9 t/ha thus far with SRI; one SRI plant with 95 tillers
Barabhiya	3.26	5.76	77%	n.a.	65.5/165	Weeding is considered easier with SRI; ideas used with ash gourd
Daksin Bagma				26%	64.9/185	Milled rice from 40 kg paddy is up from 20-25 kg to 27-30 kg
Chhatariya				12%	n.a.	Application of SRI ideas to eggplant (brinjal)
South Mirza				n.a.	n.a.	Have increased spacing to 37x37 cm; effective tillering 85% (DRR)
Debipur	2.88	5.76	100%	18%	n.a.	Evident importance of local govt. support
North Bharat Chandra Nagar	3	5	66%	14%	n.a.	One farmer had yield of 6.35 t/ha
Village near Rajnagar	3.75	7.5	100%	30%	n.a.	Getting 9 kg rice from 12 kg SRI paddy
Dimatali	2.5	6.5	160%	14%	n.a.	Tribal village; farmers like to use weeder
Rajnagar Subdistrict						Data provided for the subdistrict (2 years)
2005-06	3.009	6.942	131%	n.a.	24.5/15,613	SRI yields are raising
2006-07	3.261	6.813	108%	n.a.	2300/15,632	district average yield
Average	3.48	6.66	91%	18%		

October 4 visits are discussed in the report on the 2nd National SRI Symposium, Oct. 3-5, 2007.