REPORT ON THE INDIAN NATIONAL SRI SYMPOSIUM CONVENED IN HYDERABAD, NOVEMBER 17-18, 2006

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SUMMARY

1. On November 17-18, an all-India symposium on SRI was hosted by the Acharya N. G. Ranga Agricultural University (ANGRAU) in Hyderabad, attended by about 200 participants coming from research institutes, universities, NGOs, government departments, and farms all over the country. This event was initiated and supported by the World Wide Fund for Nature (WWF) through its collaborative program with ICRISAT and was co-sponsored by ANGRAU, the Directorate of Rice Research (DRR) of the Indian Council for Agricultural Research (ICAR), and the Society for the Advancement of Rice Research.

2. Posters were submitted, 61 in all, from all over India, ranging from Jammu in the north to the Andaman Islands in the Indian Ocean, reporting scientific research findings and results from field operations. Presentations on the introduction of SRI and results were made from a wide range of agroecological and socio-economic circumstances, ranging from Tripura to Punjab. This year the Tripura state government is devoting 1/3 of its agricultural budget to the spread of SRI.

3. The Minister of Agriculture for Andhra Pradesh, Shri N. Raghuveera Reddy, Chief Guest at the inaugural session, affirmed his government's strong support for the spread of SRI in the state, promising all support necessary and assuring participants that the government would follow up on any recommendations coming from the symposium.

4. Yield increases reported were mostly in the 10-40% range. Negative results were reported from Uttaranchal, while some reports were of 100% or greater increases. It was agreed that SRI should be evaluated according to many other criteria and not just yield: water saving, seed saving, cost reduction, labor saving, earlier ripening, resistance to biotic and abiotic stresses, grain quality, etc. Also, it was agreed that most attention should be focused on *average* results rather than on the maximum results obtained. While it is useful to know potentials, most farmers should be thinking about SRI in terms of the most likely outcomes.

5. Current averages do not reflect the attainable benefits if all of the recommended SRI practices are used, and used correctly. Economic evaluations of SRI should receive more attention. In terms of research, it is important to begin now with long-term evaluations that assess the effects of SRI practices on soil fertility, whether depleting or enhancing this.

6. SRI methods have given the best yield responses with hybrid varieties, and since they also reduce seed requirements, this is a particularly good fit. However, it was also reported that SRI methods give very good results with indigenous (traditional, local) varieties, even as high as 8 t/ha. Responses to SRI vary considerably across varieties, but most varieties are performing better with its alternative methods. Much still remains to be learned about the scope and potentials of SRI and about possible limitations and problems. Practical solutions are being sought to identified problems with many solutions coming now from the farming community.

Background

Work in India with the System of Rice Intensification (SRI), developed in Madagascar over 20 years ago, goes back half a dozen years. It started on a small scale in 1999-2000 when farmers in Tamil Nadu state learned about the new methods from written reports in circulation through low-input sustainable agriculture or organic agriculture networks. Formal scientific evaluation of SRI was begun in 2000 by Dr. T. M. Thiyagarajan at Tamil Nadu Agricultural University through TNAU's connections to Wageningen University in the Netherlands which can be traced back to a Malagasy NGO, Association Tefy Saina, through its collaboration with CIIFAD at Cornell University. These roots of SRI activity in India have been chronicled by Dr. C. Shambu Prasad in a monograph released at the Symposium, *System of Rice Intensification in India: Innovation History and Institutional Changes* (2006), which has documented also subsequent developments (http://www.cgiar-ilac.org/downloads/ references/SRI_India_innovation_institutions.pdf).

SRI activity spread more rapidly during the past three years, particularly since the visit of Dr. A. Satyanarayana, director of extension at Andhra Pradesh state agricultural university (ANGRAU), to Sri Lanka in January 2003. He arranged for demonstration trials in all 22 districts of the state and this led to subsequent dissemination of SRI methodology through university, government, NGO and farmer organization channels. As information about SRI diffused through the web, the internet and other means, SRI work started in many other places: Karnataka, Kerala, Tripura, West Bengal, Orissa, UP, Punjab and other states through diffuse efforts of universities, NGOs, and researchers within the network of the Indian Council for Agricultural Research (ICAR).

In 2005, the International Dialogue on Water, Food and Development initiated by the World Wide Fund for Nature (WWF) in cooperation with ICRISAT supported on-farm evaluations of SRI methods by ANGRAU researchers, while all-India evaluation under the auspices of ICAR's Directorate of Rice Research (DRR) confirmed the merits of SRI methods in many, though not all, locations. This evaluation program supported by WWF to get a better understanding of SRI potentials -- involving DRR, ANGRAU and ICRISAT researchers along with interested NGOs -- continued into 2006. (A blizzard of acronyms is hard to avoid in India.)

With much scattered experience and data accumulating -- and with a growing sense of urgency that water-saving methods of rice production be better understood and more widely utilized, especially if they could contribute to higher production and better incomes for farmers, with beneficial environmental impacts -- WWF with its partners in the Hyderabad area initiated planning for a National SRI Symposium. This was co-sponsored by DRR, ANGRAU and the Society for Advancement of Rice Research (SARR), with ANGRAU serving as the host.

Since plans for the event were finalized just two months before the date set, November 17-18, this was almost an impromptu symposium. Its success was assured by the widespread interest in the subject. There was no need to promote participation because about 200 persons, including many farmers, came at their own expense. With more advance notice, surely more persons would have attended. But this was not intended to be a final word on SRI; rather it was expected to strengthen the growing community of practice that has been emerging in India in recent years.

Inaugural Session

The main assembly hall at ANGRAU was splendidly decked out with flowers, and a huge banner over the stage announced "National Symposium on System of Rice Intensification (SRI) –

Present Status and Future Projects." The international nature of SRI was subtly conveyed by the banner's picture of an SRI field of hybrid rice in Yunnan Province of China, from which a China National Rice Research Institute scientist calculated a yield of 18 tons per hectare. The program was delayed 20 minutes for the late arrival of the Minister of Agriculture, but his inaugural address made it clear this was not just a matter of protocol but a worthwhile delay.

After the master of ceremonies had introduced the guests seated on the stage and the ceremonial oil lamp had been lit to symbolize the opening of the symposium, Nagaratnam Naidu presented all of the guests with huge panicles of rice from his own SRI field, each having 750 grains, he said. (Naidu was the farmer who briefed George Bush on SRI when the U.S. president visited ANGRAU the preceding March.) The welcome was given by **Dr. B. C. Viraktamath**, project director of DRR and chair of the Local Organizing Committee, saying that "everyone knows" that SRI is an effective innovation," but adding that there is "still some controversy" about it. "There is need to know what factors make it work in some places, and not others." He observed approvingly that our Chief Guest, the Minister of Agriculture in Andhra Pradesh, as well as the Chief Minister of AP have been encouraging "all things that help farmers," including SRI.

Dr. Biksham Gujja, policy advisor for WWF and the initiator of the symposium idea, next discussed the background and purpose for this convocation, noting the imperative of water conservation that is animating both environmentalists and agriculturalists because the growing water scarcity is having more and more adverse effects, making rice cultivation with present methods infeasible in many places. Gujja encouraged participants to help find practical solutions to problems that have been identified and need to be solved for SRI to become fully utilized.

Dr. S. N. Shukla, Associate Director-General of ICAR and coordinator for food and fiber crops, emphasized in his remarks that crop yields for rice have been declining, which presents a great challenge to the country. Water shortages are becoming a greater constraint on production. "We can see from data that rice intensification is working, although not in each and every situation." It gives good saving of water. He said that he had himself seen a number of SRI plots where the root systems were large and the panicles had a large number of grains. "Farmers are happy and willing to adopt this technology," adding that SRI is opening up new research areas for scientists.

Dr. A. Padma Raju, formerly Director of Research at ANGRAU and now president of the Society for Advancement of Rice Research, commented on how ANGRAU became involved in SRI evaluation and extension. He suggested that a group approach will be best for extension, and also that mechanization of certain SRI operations will be important for dealing with labor costs and scarcity, such as in Haryana and Punjab. The system should be modified to suit conditions so as to give wide options to farmers. (This is a premise of SRI.)

In my remarks, I asked that SRI not be regarded -- and spoken about -- as a 'technology,' but rather as a methodology, something that is always always to be adapted to local circumstances. SRI is not something to be 'transferred' and simply 'adopted.' Farmer innovations have been key to the progress and success of SRI. Also, SRI offers many different benefits, only one of which is yield, which is not even necessarily the most important aspect. Many other aspects should be evaluated and considered.

Dr. M. Mahadevappa, former vice-chancellor of the University of Agricultural Sciences at Dharwad in Karnataka state and now chair of the research advisory committee of the Directorate of Rice Development (DRD) in Cuttack, commented on how he learned about SRI during a visit to Cornell two years before. He suggested it can reduce inter-state water disputes and encouraged the use of hybrid varieties with SRI because hybrids respond well to these new methods. Also, SRI reduces seed requirements (by 90%) which makes the use of hybrids more feasible.

Mahadevappa said he had recently attended a meeting with the Planning Commission in New Delhi, where it was said "these days there are not many breakthroughs coming in agriculture." He responded that this is not true, mentioning SRI, and urging systematic extension efforts for this. He said that Indian farmers need to exploit the full potential of existing genotypes, which will require efforts to get better water control.

At this point in the program, the Minister of Agriculture, **Sri N. Raghuveera Reddy**, presided over the release of two publications. One was an illustrated manual, *SRI vs. Conventional Rice Cultivation*, by Dr. M. Sudarshan Reddy, Dean of Agriculture, and Dr. P. Punna Rao, Deputy Director of Extension, at ANGRAU, prepared in both English and Telugu. The other was the monograph mentioned above by Dr. Shambu Prasad on *System of Rice Intensification in India*.

The Minister began by affirming the importance and need for promoting SRI in the state. Being himself a farmer, he said, it had come as a surprise that SRI practices produced such remarkable results. He noted that the Indian government this year had had to import wheat even though the country has overall self-sufficiency and surplus. "Something is amiss. It is the responsibility of all of us to see that such a situation is not repeated." With regard to rice, he said that when he recently visited 10-12 countries, he saw that even ones where wheat is consumed are starting to consume more rice. Thus there is need to be raising rice production on a worldwide scale.

He reminded the audience that it takes as much as 5,000 liters of water to produce 1 kg of rice. "When we export rice, we must remember that we are exporting water." One acre of irrigated rice currently requires about 6 million liters of water. In the Punjab, hundreds of thousands of acres have been lost by applying too much water and too much fertilizer. "The soils there are becoming almost useless." If we save water, this will help save our land. "It has been a wrong idea that applying more water will give more production. This is simply not true."

The Minister recalled how his father, 35 years back, had drained his paddy field 2-3 times for several days during the growing season. This was a practical approach to rice management, not scientifically based. With more soil aeration, there will be greater grain filling and the grain quality is better; also the quality of the soil will become better. "With the SRI system, we can achieve all of these goals."

He commented on seed saving with SRI, estimating this at 38 kg/acre. This saving on 40 million hectares would amount to 760,000 additional tons of rice made available for consumption. Also, with SRI, farmers can harvest 10 days earlier. (Farmers in Nepal are harvesting their SRI crops even 20-30 days earlier.) This can save water and give more opportunity to grow other crops. "All these advantages are there with SRI."

He continued, “However, despite all of these positive indications, there is still some resistance to SRI ... We [meaning the government] are trying our best to promote SRI on a larger extent.” He complimented ANGRAU for starting work on SRI in 2003, adding that for the past year and a half, the government has taken responsibility for promoting SRI. It has assisted 33,000 farmers with free seed and also with conoweeders and markets, some given free and others with a 75% subsidy. This year, SRI demonstration plots of 1-2 acres are being undertaken in every *gram panchayat* (local government area). “The results are really, really good” – 30% water saving, production increases, raising average yield from 5.45 t/ha to 7.47 t/ha, a 37% increase.

“Still farmers are not showing much interest. What are the reasons?” The main reason is weed control. The conoweeder being distributed is not meeting the requirements of all farmers, who have different kinds of soil. Also, there is not yet guaranteed water control in many places. And in many places, labor availability is a constraint. He knows this from his own village. Otherwise, wherever these problems have been overcome, “SRI is doing really well, extremely good.”

The Minister commented on the development of motorized weeders to deal with labor constraints. The designs so far are not doing very well.” They are too heavy and expensive. Also some farmers are having problems in preparation of nursery beds. These are the two main problems. Speaking for the government, he said, “We are prepared to spend any amount of money needed to promote acceptance, including giving more subsidies.” (Too bad this is seen as a blanket solution to promoting adoption.) “We are too glad if we can have a solution to this.”

In conclusion, he requested all those present to “show us the way to make SRI more successful. I can assure you that we will implement the recommendations you make, for the larger interest of the Indian nation and specifically for the Indian farmer.” This peroration was greeted with the strong applause from symposium participants.

The Vice-Chancellor of ANGRAU, **Dr. S. Raghuvardhan Reddy**, expressed his support for the SRI enterprise and congratulated the DRR and WWF for taking the initiative to convene this national symposium which ANGRAU was pleased to co-sponsor. “It is an appropriate time to take stock, and to look at farmers’ situation in farmers’ fields.” He commented on the urgent need to overcome stagnation of yield for rice, wheat and other crops. “We need to identify different approaches such as SRI that can be used to benefit farmers and the nation.”

Dr. Viraktamath resumed the chair to bring the inaugural session to a close, and the ANGRAU Dean of Agriculture and Director of Extension, **Dr. M. Sudharshan Reddy**, offered the vote of thanks. We were well behind schedule, but gifts were given to the Minister and all others on the stage with due ceremony, before everyone adjourned for tea, and the Minister left to deal with his other duties.

Introductory Session

The next session was opened by its chairman, **Dr. S. N. Shukla** from ICAR headquarters, with the comment that the potentialities of SRI are very great for improving yield with saving of water and seed, but there are still some practical difficulties to be solved. “Let us try to make progress on their solution.” The session co-chairman, **Dr. T. M. Thiyagarajan** from TNAU concurred.

Mine was the first presentation, on a large topic assigned by the organizers to open the session: "Thoughts on the History, Principles and Practices of SRI, and on its Importance for the Present Scenario." These would normally require several hours, but I had only 15 minutes. I started by reiterating that SRI should not be viewed simply as an alternative technology; rather it is a set of ideas and principles that are still being evolved and adapted. It is hard to stop using the word -- and thinking in terms of -- 'technology.' But we will make more progress with SRI if we can regard it as a system or a methodology still being developed, rather than as a technology.

Second, reinforcing the point I had made previously, I noted that SRI means different things to different people. Most attention has been focused on levels of yield, but this is not the only thing to consider. I listed water saving, resistance to biotic and abiotic stresses, greater milling outturn from SRI paddy, earlier maturity of the crop, higher grain quality and possibly better nutritional value, conservation of biodiversity, even sometimes labor-saving. We should be clear about this multiplicity of criteria and should evaluate SRI accordingly, not being fixated on yield, because farmers often value other goals more highly.

The first question raised after my presentation was why average yield increases in Andhra Pradesh have been only about 15% whereas much higher yield gains have been reported from other countries. (Actually, the increases have been usually in the 30-50% range, but they are not often doubled as often seen elsewhere.) First, I said, most AP farmers are not using the full set of recommended SRI practices, or are not using all as recommended. Those who had taken the SRI scenario seriously were getting yield performance much better than this. But, second, it is true that SRI yield gains have not been as impressive as in many other places. Further, results were quite uneven.

This suggests that many soils in the state have not been managed in ways that are supportive of the biological endowments that can give the desired productivity response to SRI practices. Soils are seldom kept covered with mulch or given other protection; instead they are fully exposed to the tropical sun, which raises soil temperatures to where soils are inhospitable to soil organisms. Moreover, many soils had been supplied with chemical fertilizers and agrochemicals to an extent that there can be inhibiting effects on soil biota, or they induce salinization that is unfavorable for most soil biota. We do not have satisfactory knowledge of all these dynamics, but there is reason to look more systematically and differences in soil biological endowments and processes.

Next there was a suggestion that water savings could be further enhanced with SRI by making greater reductions in water applications, e.g. with drip irrigation. I noted that I no longer consider it not necessary to maintain shallow irrigation after panicle initiation, as originally proposed by Fr. de Laulanié. Rather, alternate wetting and drying may be feasible throughout the crop cycle, making for further saving of water. We need to remember, however, that the water applied is not just for the plant, but also for the soil organisms that are servicing the plant.

The third response was from Jacob Nellithanam, an NGO worker in Chhattisgarh state who has been working with indigenous varieties there, using SRI methods. He said that local varieties have very good potential for growing plentiful, high-quality rice, and he proposed that if SRI is more widely used, there is no need for new varieties in the areas where he is working.

The next presentation was by **Dr. Biksham Gujja** from WWF, who reviewed the water-saving potential of SRI in the context of agricultural and environmental needs. He pointed out that rice is the main food crop in the world, and demand for rice is expanding, particularly in Africa and Latin America. Water withdrawals are increasing for irrigation, and much of this water is consumed by rice. Our ecosystems are degrading, with river systems being damaged. Climates are changing, and the availability of water supplies in the future is uncertain.

Rice is consuming more than 75% of irrigation water in Andhra Pradesh, so increasing water productivity in this sector is crucial. In order to know by how much water productivity is increased and how much water saving actually occurs, we need proper methodology, better documentation and independent validation. WWF is committed to pursuing these issues, and to addressing the question of why farmers are not taking up SRI more rapidly, given its many advantages. Much of the attention has focused so far on gravity-flow irrigation systems, but SRI may be most needed – and may offer the most benefits of cost-saving given greater water control – in rice production systems that are dependent on groundwater.

Gujja in closing said that we should focus attention more on average increases in SRI yields, rather than on the large potential attainable, as this has given some farmers the wrong idea. Some have taken SRI up expecting to make huge profits, and when their results do not live up to expectations, they give it up. Even enabling farmers to get an additional 1 t/ha yield, with less water and lower costs of production, is a big accomplishment, more than most research innovations have provided so far. SRI is particularly suitable to small farmers, though some farmers are using the methods already on a large scale.

I commented on this strategy of communication for SRI, insisting that the high yields reported have all been real yields, not exaggerations, showing the potential that is in the rice plant genome when properly nurtured. Yields as high as 17 t/ha (harvested, not sampled) have been attained in Andhra Pradesh, but these were attained by the most skillful and motivated farmers. Average yields of 7-8 t/ha with SRI, which we have seen in a number of countries, are in themselves a great accomplishment, and all that is needed to satisfy national and international food needs. So I agree with Gujja's suggestion that we focus attention on average yields, though giving the range of yields (low as well as high) is also important information for farmers to have.

A question was raised whether reports of 25-40% water saving have been soil-specific? Unfortunately, few reports on water-saving have addressed soil differences, Gujja responded. WWF wants to support more differentiated quantification. (I didn't have a chance to insert data from an evaluation of SRI in Eastern Indonesia by a Nippon Koei consultant team which used standard agricultural engineering methods of measurement; it calculated 40% water saving as an average across many soil types. Various measurements or estimates of water saving have ranged as high as two-thirds; but certainly, more and more specific assessments should be undertaken.)

K. V. Rao, an engineer who took up farming 20 years ago upon retirement from government service, spoke up to say that in his experience, from making year-to-year comparisons, there is no doubt that lower water applications for rice have contributed to higher yield. Gujja supported this, saying that in the two years of evaluations supported by WWF, it is quite certain that there has been water-saving with SRI, with beneficial effects. What is not certain is by how much.

Dr. B. N. Singh, Director of Research for Birsa Agricultural University in Ranchi, Jharkhand state, spoke next on 'Modified SRI with Hybrid Rice.' He cited high performance using SRI methods with modern varieties such as IR 64, up to 105 tillers on one plant. He said that 8-10 t/ha yields – 20-25% more than with conventional methods – were quite possible with the new varieties, while with hybrid varieties, SRI yields can reach 12 t/ha.

The number of soil-aerating weedings was important, Singh affirmed. His practice is to start weeding at 15 days after transplanting and then to weed every 10 days. This makes a total of 7 weedings for a 145-day variety and 5 weedings for a 130-day variety. With SRI management, there was more root growth and more root biomass, and less problem with green leafhopper and brown planthopper, he added.

His concept of 'modified SRI' was to rely more on inorganic plant nutrition that we have been recommending. He was concerned that a 10 t/ha yield would require more N than organic inputs can provide; he recommends adding 75 kg of nitrogen fertilizer along with 5 tons/ha of farmyard manure and also vermicompost. He welcomed the farmer-driven aspects of SRI and confirmed its water-saving potential. (I learned later that he had learned about SRI some years ago while at WARDA, the West African Rice Development Association, IRRI's counterpart for Africa.)

One farmer said that he agreed that doing more weedings has potential benefit for crop yield, but he is not able to do more than 4 or 5 weedings before the canopy closes. (I wanted to suggest that recommending as many as 7 weedings is something only for experiment stations, not farms. But such numbers will be worked out pragmatically by farmers within the constraints they face and the demonstrated productivity of alternative practices.) A participant from the Punjab said that letting soil dry to the cracking stage is deleterious because of nitrogen loss and water loss. (This, however, was a conclusion drawn from experience with a particular type of soil, e.g., heavy clay soil. Most soils have given positive responses to drying even up to cracking.)

Dr. Shambu Prasad from the Xavier Institute of Management and Business next spoke about the introduction of SRI to India and its implications for promoting pro-poor innovations. He has been studying the process of SRI's spread since 2004, interviewing researchers, administrators, farmers, NGO workers, and consulting whatever documentation he can find on the subject. Some of the conclusions he has drawn are that SRI has been an open, continuously evolving, dynamic innovation, with new entrants coming into the process with each cropping cycle. There has been no uniform pattern across regions, with no single agency leading the efforts in each state. He also said that SRI has been pro-poor, providing greater range of choices to farmers.

It has been particularly significant that knowledge about SRI has been available in the public domain, he said, shared through the internet and the web. People have been able to write to ANGRAU, WASSAN, CIIFAD or other institutions and get a response quickly. There have been multiple identifies of actors, and a blurring of boundaries between public and private sectors. Very salient has been the role of 'champions' for SRI such as Dr. A. Satyanarayana in Andhra Pradesh and also at national level.

Prasad said that the SRI experience has broader implications for agricultural research and for society, "something beyond rice. It has opened up new opportunities for dialogue among various sectors of society." Too often the process of research and extension has been viewed in a linear manner, he said, extending from the CGIAR centers to the national agricultural resource systems (NARS) to the national extension system and through this to farmers or other end-users. He said that he had himself been part of the CGIAR system, on the staff of ICRISAT, so this was a self-critical perspective. The transfer of technology (TOT) model "has served its purpose, but we need newer kinds of models."

This presentation sparked considerable response, in part because Prasad included a cartoon in his powerpoint that some considered a caricature of the process, or simply wrong. There did not appear to be any disagreement on the proposition that in the current era, agricultural research and extension methods need to be more participatory and more integrative of many kinds of actors.

Dr. Ilyas Ahmed gave a quick summary of the first 30 posters that would be displayed during lunch time, of the 61 submitted. The largest number of poster came from Andhra Pradesh, but the geographic range of SRI evaluation reported was from Jammu and Kashmir in the far north to the Andaman Islands in the Indian Ocean. Of the first 30 poster, 22 came from research stations and 8 from 'front-line' field operators. Most studies contrasted the results of SRI with those of conventional methods, but many addressed issues of nutrient management, water management, and the effects of seedling age.

Most yield increases were in the range of 10 to 40%, with water savings of 30 to 50%, and seed saving of 66% or more. Reductions in duration of the crop cycle by 5-15 days were reported, with less pest damage, especially by stemborer. Response to SRI methods was variable across different genotypes. Hybrids responded better than most varieties, and some varieties that did not perform particularly well under conventional methods gave a much better performance with SRI. Ahmed particularly commented on the Tripura experience where a 53% average yield increase was documented, with resistance to lodging from heavy rains. The most frequently mentioned constraints in the posters were: difficulty of transplanting young seedlings 10-12 days old; the increased labor requirements; and weed control.

Thiyagarajan in his closing comments as co-chairman of the session said that to have an informed opinion on SRI, "one really needs to see the plants in the field, to appreciate how differently they grow." There can be some difficulties handling young seedlings from the nursery, transplanting, doing weedings, and controlling water. But farmers have been quite innovative in developing their own markers, weeders, and power-operated implements. He would have liked to see more data provided on the economics of SRI, but he said that he would provide such data in his presentation in the afternoon.

Many changes are being introduced within the SRI framework, Thiyagarajan said, and there is sharing of implements on a community basis. "Many farmers are adopting SRI without any inducement." Many NGOs support SRI because "they are moving with farmers and want to be doing something useful." He appreciated that there are a lot of objections, "but until you have tried out SRI for yourself, you cannot understand it properly." He suggested that SRI may need to be tried 2 or 3 times before the techniques are mastered' "only then can one make objections."

Shukla summarized the presentations in his role as chairman: He liked my stress on the importance of root systems and on the biological activity of microorganisms. “We can all agree that this will affect yields ... this is scientifically proven ... under stress situations, plants with more vigorous roots have more resistance and more potential to survive.” This will apply to other crops as well. He appreciated my agreeing that more research needs to be done and that SRI is still evolving.

Shukla then endorsed Gujja’s ‘modest suggestion’ that we aim for a 15-20% average increase in yield with SRI, rather than focus on the maximum attainable yields. If the economics of this are favorable for farmers, this will be a substantial improvement. Shukla concurred with Singh’s suggestion to combine hybrid rice varieties with SRI production methods, especially given the reduction in seed requirements that SRI makes. Finally, he said said that Prasad’s emphasis on farmers’ role in innovation was very good. In conclusion, he stated that “any means to help farmers should be promoted if scientifically proven, based on scientific principles.”

After gifts were given out, everyone adjourned for lunch. I ate quickly to have some time with the posters. **Dr. P. Nageswara Rao**, coordinator and head of the ANGRAU’s DAATT extension center for Ranga Reddy district, said that, now that SRI merits have been well demonstrated, he is working with communities there to get whole villages to convert their rice production to SRI. This will show how much impact there can be on production and water saving from large-scale use.

I met **Dr. Anuradha Saha**, an assistant professor of agronomy at the agricultural science and technology university in Jammu. She had done SRI trials there and promised to send me her poster electronically, giving SRI results in that remote, high-altitude state. A poster from the Tirupati KVK (extension center) in southern Tamil Nadu, at the other end of India, reported yield increases ranging from 4 to 66% -- 5,250 kg/ha conventional vs. 9,187 kg/ha SRI, and 4,687 kg vs. 6,470 kg in two sets of trials. The calculated benefit-cost ratio for SRI was 2.07, compared to 1.66 using conventional methods.

A poster from the state of Chhattisgarh in the east showed smaller yield advantages, an average of 7.1 t/ha SRI vs. 6.7 t/ha conventional, but it reported also reduced water requirements, greater resistance to stress, and quicker maturation. A poster from the Dharwad agricultural university in Karnataka state in the west showed 61.6 quintals/ha with SRI vs. 39.7 quintals, >50% increase. Harvesting was 10 days sooner, with very few pest and disease problems. This quick sampling showed benefits from different parts of India. (I didn’t see the Andaman Island poster.)

Technical Session I: Research Experiences on SRI in India

I was asked to serve as chairman for this panel which began after lunch, with Dr. Raghava Reddy, ANGRAU’s Director of Research, assisting as co-chair. **Dr. O. P. Rupela**, senior microbiologist at ICRISAT, led off with a report on work being done under the WWF-supported evaluation of SRI in Andhra Pradesh. This involves comparative analyses of microbiological (6), biological (3) and chemical (7) indicators in the soils and rhizospheres of SRI vs. non-SRI plots. In the first two years, data were gathered from the fields of 21 farmers (7 in each of the districts) and in the third year 27 farmers, who were growing adjacent SRI and non-SRI crops.

Sampling was done scientifically in 3 locations for each plot, 3 times during each growing season: before sowing, 60 days after sowing, and at harvest; with samples taken at depths of 0-15, 15-30, and 30-60 cm. They were air-dried for chemical analysis and were carefully handled for the biological analyses to conserve the soil organisms and their products under study. Rupela showed pictures of cultures of siderophore-producing bacteria, phosphorus-solubilizing bacteria, and a beneficial soil organism, pseudomonas, which showed up under fluorescent lighting.

There have been difficulties in drawing firm conclusions from samples taken from farmers' fields because there was no control over the use of SRI practices, or comparison practices. So for the next two seasons, the research is being conducted on the ICRISAT station. But the results from farmers' fields have been informative. There have been no big differences found in the aggregate ranges of soil biota between SRI and control fields but there are significant differences in beneficial organisms: 14-19% more siderophore producers, P solubilizers and pseudomonas. The differences in biological properties were not very great in the rainy season, but much more distinct in the post-rainy season. This would reflect the differences in soil biota when soil conditions are more or less hypoxic.

The most evident differences between the two sets of plots are in the size and color of rice plant roots, shown on a number of slides. There was at least a 22% saving of water on the SRI plots, with almost all producing higher yield. There is need for conducting long-term soil evaluations to see if there are any depletion effects, and to see what if any limits there are on the ability of microorganisms to convert unavailable nutrients in the soil into available form. Rupela suggested in closing that if one views the soil as a total bank account and microorganisms as mobilizers of its resources, then we see that SRI methods change the amount of nutrient resources available.

T. M. Thiyagarajan then reported on his research on SRI at Tamil Nadu Agricultural University, starting in 2001. Not all of the recommended practices initially showed positive results, but the beneficial effect of using single seedlings, rather than clumps of seedlings, was quickly established. Wider spacing gave some benefit, but not as much. There were also significant yield enhancements seen from the use of a conoweeder which aerated the soil. At first it was thought that the effect was due to incorporation of weeds back into the soil as green manure. But subsequent work on soil biology made clear that the soil aeration effect was a strong one.

Evaluating a set of 9 experiments which Thiyagarajan had reviewed, it was possible to see synergistic effects building up as more SRI practices were used as recommended. Yield gain was 10-15.8% in the first experiments, but the advantage moved upward to 48.8% with all practices. The increase in water productivity with SRI, as measured with Parshall flumes, was calculated at 53-77%. The range of yield advantages was 0.6 to 2.3 t/ha, with 40-50% water saving. Yield increases were as high as 4 t/ha on farmers' fields. Like Rupela before him, Thiyagarajan closed by suggesting the need for long-term evaluations to assess nutrient effects over time.

Dr. B. C. Viraktamath, project director of DRR, reported on evaluations of SRI within ICAR's all-India rice improvement program. With declining land, water and labor, as well as diminishing soil health, the rice sector needs to reconsider its practices. Rice takes half of the water devoted to agriculture, and there will be growing pressure from cities and industries to cut water use.

ICAR is therefore looking at a number of alternative management practices – zero-tillage, raised beds, direct-seeding, aerobic rice, and SRI. That SRI can save water with economic benefits for farmers automatically makes it attractive.

Cooperating research stations in different states assessed four treatments: usual practice (S1), SRI with 12-day seedlings (S2), SRI with 25-day seedlings (S3), and normal practice with wide spacing, 25x25cm (S4), considering the results with both hybrids and high-yielding varieties. In general, SRI yields (S2) were 16.6% higher, with hybrids giving 45-48% higher yield while varieties produced only 5-12% more with SRI methods. Younger seedlings gave a clear yield advantage. However, it was also clear that there is considerable variability in yield with SRI. (This probably reflects differences in the respective biological endowments of the different soils on which trials were conducted; however, these endowments were not assessed in the studies.)

Why does SRI give better results? Viraktamath asked. The simplest explanation is that the roots are stronger and healthier. SRI has given better results on acid soils than on alkaline soils, and also on clay loam than on sandy loam. The areas of research that DRR is most interested in are: varietal responses; areas/zones where SRI practices are best suited; quantification of water-saving; effective weed management practices or machinery; soil health and microbial activity with SRI; pest and disease resistance with SRI – both management and mechanisms; and detailed economic evaluations of SRI, calculating benefit:cost ratios. A very good list, I thought.

Overall, DRR thinks that SRI benefits will be location-specific, with considerable variability that perhaps reflects soil biological differences. There is significant variability in the responses of different varieties (genomes), and this should be assessed in detail. There are obvious savings in water and seed. With SRI, improvements in soil health and environmental quality are important advantages. Further research is needed to understand all these factors and how they fit together, contributing to higher yield and to soil health parameters and to various aspects of sustainability.

Bhuban Barah from NCAP raised a question about calculating benefit:cost ratios: how can appropriate weight be given to factors not easily quantified, like time saving, water saving or seed saving? This was acknowledged as an important challenge to researchers. Focusing just on yield is not an adequate approach for drawing conclusions and making recommendations.

Dr. G. Ravi, senior entomologist at Tamil Nadu Agricultural University, reported on his assessments of pest populations and dynamics with SRI. He started by noting that when pesticides are applied to the rice crop, some go into the rice, contributing to human health problems. He was interested in whether there is any change in pest incidence with SRI, with which pesticides are seldom necessary or used. Projections indicated that by 2025, rice output in India will need to increase by at least 30%, which can't be reached by incremental improvements.

At first there was a lot of objection to SRI from the Agriculture Department, but now people have gotten confidence in it, Ravi said; 26 lakhs of rupees have been allocated for SRI by the state government. In Tamil Nadu, they are seeing usually a 2 t/ha increase in farmers' fields. But this can bring second-generation problems, as new pests can come when a new technology is introduced.

Ravi showed pictures of various rice pests. Stemborer and gall midge are less in SRI fields, he said, and also whorl maggot and brown planthopper. But leaf folders and green leafhoppers are often more numerous. When fields are kept unflooded, the biodiversity of arthropods is less, but this means also that predator insects which control pests are more active. Another advantage with SRI is that there are fewer mosquitoes, which are vectors for malaria and dengue fever.

Wider spacing of plants lets more sunlight into the canopy. This changes microclimates and reduces most pest pressures. Also, with wider spacing, farmers find there are fewer rats (something reported by many SRI farmers anecdotally). Keeping soils well-drained reduces populations of brown planthoppers, black bugs, case worms, whorl maggots and, of course, mosquitoes. With more aerated soil, on the other hand, there can be more termites (possibly bad), earthworms (good), root grubs (bad), and nematodes (bad if root-feeding species).

Most farmers who adopt SRI, Ravi said, are very curious and innovative. They are persons who look for new practices, and once they get involved with SRI, they go to their field more often and take more interest in their crop. These human factors are also important in pest management. He described research he is doing with sesbania, a legume, and azospirillum, a beneficial bacteria.

Dr. Aum Sharma in the department of agricultural engineering at ANGRAU spoke about the status and needs of farm mechanization in SRI. Appropriate machinery and implements will improve the timeliness of operations, reduce drudgery, and enhance input efficiency. The operations in SRI for which mechanization has most potential are: marking for well-spaced transplanting, planting, weeding, harvesting and threshing. Research on mechanization should take into account the special needs and time and physical constraints of women.

The redesign of conoweeders to work better in different types of soil will be an important contribution to SRI. No single design will be optimum for all types. Cost and durability are big considerations. A good conoweeder can raise productivity two-fold, while saving 76% of time needed for weeding. Sharma recalled the effort made by WASSAN to evaluate weeders and markets with farmers in 2005. So far the motorized weeder that he has been working on is too heavy for most soils. Also, the cost is too high for most farmers. But this work is just beginning, and future improvements should be possible. Unit costs will come down when production is done on a large scale.

Dr. M. Ganesh, head of the Seed Research and Technology Centre at ANGRAU, spoke about SRI and seed production, starting with the observation that "SRI is a boon for the seed production program" because its seed-multiplication potentials are so great. (One farmer in Nepal told me that he had gotten 21,000 seeds from one SRI plant, grown from a single seed.) Also, seed quality with SRI is very good, with seeds being very uniform and well-filled.

Ganesh characterized SRI nicely, noting that "the contribution of soil microbial activity needs to be taken seriously," citing a quotation from S. K. deDatta's text book on rice. However, he did not say much specifically about how SRI could be used in seed production, or what problems have been encountered in using SRI methods for this purpose. This was the last presentation of the session, and people were ready for a tea break. During this break, **Dr. Shashi Bhushan**, coordinator of ANGRAU's extension centre at Sangareddy, updated me on the extrapolation of

SRI methods to sugar cane production that some farmers in his area have been doing, producing more than 100 tons/acre, practically tripling their previous, more input-dependent yields.

Technical Session II: Experiences in SRI Promotion/Adoption

When the group reassembled in the auditorium, **Dr. P. Punna Rao**, ANGRAU Deputy Director of Extension, reported on ANGRAU's efforts to spread SRI within Andhra Pradesh once its scientists were satisfied of the merits of SRI after systematic evaluation in all of the state's 22 districts in kharif season 2003. "ANGRAU believes strongly that there are six key principles for SRI," he said. "Their use together contributes to synergy," listing the practices that emerged from Fr. de Laulanié's work in Madagascar: young seedlings, single seedlings, wider spacing, water management, soil-aerating weeding, and compost. In rabi season 2004-2005, the average yields of SRI trials being monitored was 7,232.5 t/ha; in kharif 2005, 8,980 t/ha; in rabi 2005-06, 8,072.5 t/ha; kharif 2006 trials are ongoing. One important thing, he noted, is that SRI is being taken up by farmers in all categories, not just by small farmers.

Next, **Dr. B. C. Barah** from the National Centre for Agricultural Economics and Policy Analysis (NCAP) in New Delhi reported on a comparative evaluation of SRI performance and adoption that is being sponsored by his institute under ICAR. It focuses on Andhra Pradesh, Tamil Nadu and Karnataka, although with some attention to other states of India. As this research is still in progress, Barah did not have much to report beyond what was being reported from those states.

Then **Dr. Baharul Majumdar** from the Department of Agriculture in Tripura reported on SRI spread in this hill state in northeastern India, next to Assam. The state government made a commitment for Tripura to become self-sufficient in food grains by 2010 before knowing about SRI. Baharul started working with these new methods in 1999, and by 2002 he had been able to adapt them reliably to a very rainy environment. Annual rainfall in Tripoura averages 2500 mm, with some totals up to 3500 mm, making it difficult to maintain aerobic soil conditions.

In 2002-2003, Baharul was able to get 44 farmers to try the new methods, with good results, and then 88 farmers in 2003-04. (These trial/demonstration plots were 0.2 ha.) With the support of the Chief Minister of Tripura, who came to see the SRI fields, this number was expanded to 440 in 2004-05 and then to 880 in 2005-06. (These plots were 0.4 ha.) Now there is full support from the state government, Baharul said. It has allocated one-third of the state's agricultural budget to SRI promotion this year. In the 2006-07 kharif season, 31,620 farmers used SRI, with a target of 51,105 farmers in the coming boro season. (Some of these will be the same persons.)

The area targeted for boro SRI cultivation is 11,426 hectares. Twenty villages have decided that they will use SRI methods on 100% of their rice area. Baharul showed some splendid slides of the different SRI operations. The most intriguing slide was of palm fronds laid on the nursery bed in imitation of a snake, to frighten birds away – indigenous knowledge that Baharul said works every well. He also showed a tribal woman (most of the population in Tripura is tribal) hauling young seedlings on a cloth sling pulled along the ground, considering this an easy way to transport them from the nursery to her field.

The fields shown were meticulously prepared, planted and managed. With SRI practice, the number of weedings done has usually been three, starting 10-12 DAT. At 75 DAT, the number

of tillers has reached as many as 80 per plant. The yield data presented from Tripura are summarized n the following table. The average increase in yield with SRI is about 60%.

	N	Conventional practices	SRI practices
High-yielding varieties	883	4.0 - 4.5	7.8 - 8.4
Hybrids	97	6.3 - 6.8	7.8 – 8.4
Local varieties	37	2.0 - 3.0	3.8 – 4.3
Local varieties (scented)	12	1.5 - 2.0	3.1 – 3.4

The scented varieties are very much in demand and command a market price as high as 35 Rs/kg. Baharul said that control of weeds and water presented some difficulties at first, but farmers can now manage them fine. The initial labor-intensity of SRI was a challenge the first year, and for some even in the second year; but by the third year, the methods had been mastered and shortcuts have been figured out, so practicing SRI is now quite easy for Tripura farmers. Baharul said that he has not heard of a single case of disadoption of SRI, an issue sometimes raised by skeptics.

Baharul said that he had gotten information and advice from me via email since 2002 and that Dr. A. Satyanaryana had been helping him a lot since 2004. "He personally guided me by cell phone, accepting calls even late in the evening." It was interesting to hear that Christian communities in Tripura have been calling SRI 'Christian rice' because it originated from the work of Fr. de Laulanié. They have traveled as far as 50 km, on their own, to share SRI methods with co-religionists in more remote villages. Other communities refer to SRI in local dialect as 'child rice' or 'baby rice' -- because of the tiny size of transplants. A widespread sense of ownership has developed, Baharul noted, and the state government has sanctioned 8 crore rupees for SRI promotion in the state. One of the pictures that he showed is reproduced below.

When Baharul finished, I reflected on some previous comments that farmers find it difficult to handle young seedlings and do all the SRI practices as recommended. I could imagine a little chagrin and maybe even some envy at seeing the splendid SRI plants of tribal farmers in Tripura, many of whom would have found transplanting in rows something new. Yet it was obvious that they were effectively managing tiny seedlings and planting them in rigorous, symmetrical grids, constructing linear drains in their paddies and doing systematic weeding. The idea that SRI is too complicated for Indian farmers to implement was contradicted by the pictures from Tripura.

I missed much of the presentation on 'Experiences of SRI Promotion in Different States" by **Dr. M. C. Diwakar**, program director for the Directorate of Rice Development (DRD), because I was discussing thesis research plans with two graduate students who had sought my advice. I apologized to him afterwards, and he said that the data he had presented were several years old. DRD would soon have more and more up-to-date data.

Diwakar said that he has been following Baharul's work in Tripura with interest and admiration. His support for SRI has grown out of his own field visits, he said, seeing SRI crops personally and talking with SRI farmers. This confirms the suggestion of Dr. Thiyagarajan at the end of the preceding session. SRI really needs to be seen to be believed. A number of senior ICAR scientists have been reluctant to go out and see SRI for themselves, Diwakar noted, but even half an hour in the field has persuaded some of them.

After concluding remarks by the chairman and co-chairman, there was the ceremonial gift-giving and then a cultural program with excellent Karnatik traditional Indian dancing by a troupe of four women dancers, followed by a program of singing and instrumental music from all over India, north, south, east, west, even an Urdu song from Pakistan. The volume and enthusiasm resembled a rock concert. It helped me understand better how India with its dozens of major languages and cultural domains can cohere peacefully and function amicably in its diversity when there is no subversion by political opportunists or sectarian agitators.

Technical Session III: Farmers' Experiences with SRI Method of Cultivation
This session the next morning was chaired by **Dr. A. Satyanarayana**, introduced justifiably as "the man who was instrumental for SRI" in Andhra Pradesh and even India. Having retired from ANGRAU, he is now working with a private seed company and had returned at 3 a.m. from a trip to Malaysia, in order to be able to participate in this symposium.

I sat next to **Dr. P. S. Bisht**, a professor of agronomy at G. B. Pant University of Agriculture and Technology at Pantnagar in Uttaranchal state (formerly part of Uttar Pradesh state). He explained that he has been working with SRI for several years just from the information that he has gotten from our internet web page. His yields with SRI methods have been 500 kg/ha lower than the control plots where rainfall is higher, but 600 kg/ha higher where there is less rainfall. This is something worth investigating closely, focusing on differences in soil biology associated with the combination of soil chemical and physical characteristics. Bisht said that he already has plans to carry out soil microbiology studies this year through a PhD student.

In his opening remarks, Satyanarayana said that "most important, it is the farmers who took SRI seriously and are cultivating with its ideas for the benefit of the country." When he and others started introducing SRI in Andhra Pradesh, there was a lot of debate in academic and policy circles about its merits, "but farmers just took it up."

"Modern farming has been thoroughly dependent on external inputs. Farmers come to extension agents and ask what fertilizer, what seed they should use. They are not taking much initiative themselves. The result has been that we are spoiling our natural resources, and we risk having more and more crop failures as agriculture gets more and more distant from nature. How can SRI help? By enabling farmers to produce more outputs with less inputs -- less water, less seed, less agrochemicals. Yields can be 100% or more, some even 200% when management is done well."

"What we want to hear today are farmers' experiences. What are the problems they encountered? What are the advantages they achieved? How can we sustain the agricultural system that sustains them?" Satyanarayana introduced the co-chairman for the morning session, **Dr. D. Jagannadha Raju**, now ANGRAU registrar but formerly KVK head at Oondi, "who was an equally strong promoter of SRI, like me, doing extensive experiments to support the message to farmers... one of the pillars of SRI."

Raju said that "all are now convinced about the performance of SRI technology, which has been proved by farmers, with many success stories. But there are some problems, and we want to know the reasons for these. Throughout India, farmers are waiting for solutions."

The first farmer to speak was **K. V. Rao** from Guntur district in Andhra Pradesh, who has been developing bioagents to be used with SRI. He came to know about SRI at a water management meeting in 2003, and was surprised to learn that it is possible to produce 100 bags/acre. He was producing only 10-20 bags/acre on his farm. His first year with SRI methods, he got a yield of 40 bags/acre, even when the crop went 20 days without water at one point during the season.

He attended a seminar in March 2004 in Japan about water management in agriculture where he met Dr. Bas Bouman, water management specialist from IRRI, and told him about his SRI experience. Bouman asked for a report, and Rao said he was able to give a good account because he could get hold of a paper on SRI that I had written with Prof. Robert Randriamiharisoa of Madagascar for a water management seminar at IRRI in April 2002. Bouman's response was to explain all of the problems that he saw with SRI, not showing any real interest.

"Rice is a lazy man's crop," Rao said. During his first 15 years of farming, he focused mostly on his commercial crops, with no special interest in rice. He just told his laborers to plant rice and tend it. But once he learned about SRI and started using its methods, he found the rice crop to be really fascinating. Now he spends a lot of time with it, watching it grow so marvelously, and taking a lot of satisfaction in it. He found that with organic fertilization, the crop can withstand blast, even neck blast. His production improved further when he got a weeder from Japan and was able to make some modifications of it for his soils. This can now be made by any blacksmith.

Rao said that he is able to harvest his crop two weeks sooner than before. His crop has withstood the damage of a cyclone, and he does not get serious pest attacks. Now he is also intercropping

with pulses, and that is very promising. He is using the Vedic soil amendment known as *panchakavya*, made with cows' urine, milk, ghee, butter and manure. He has no problems with stemborers or leaffolders, and the crop is thick and green, even standing up in heavy rain. With *panchakavya*, he is getting all effective tillers. Before with reliance on chemical inputs, there was little profit from rice farming. He concluded with a strong recommendations for spread of SRI.

Satyanarayana added, concerning the biological aspects of SRI, that "microbes will multiply like anything if they have conditions for growth. The plants are then stronger and there is no lodging. We had to go to short-stalked modern varieties because traditional varieties could not tolerate modern practices."

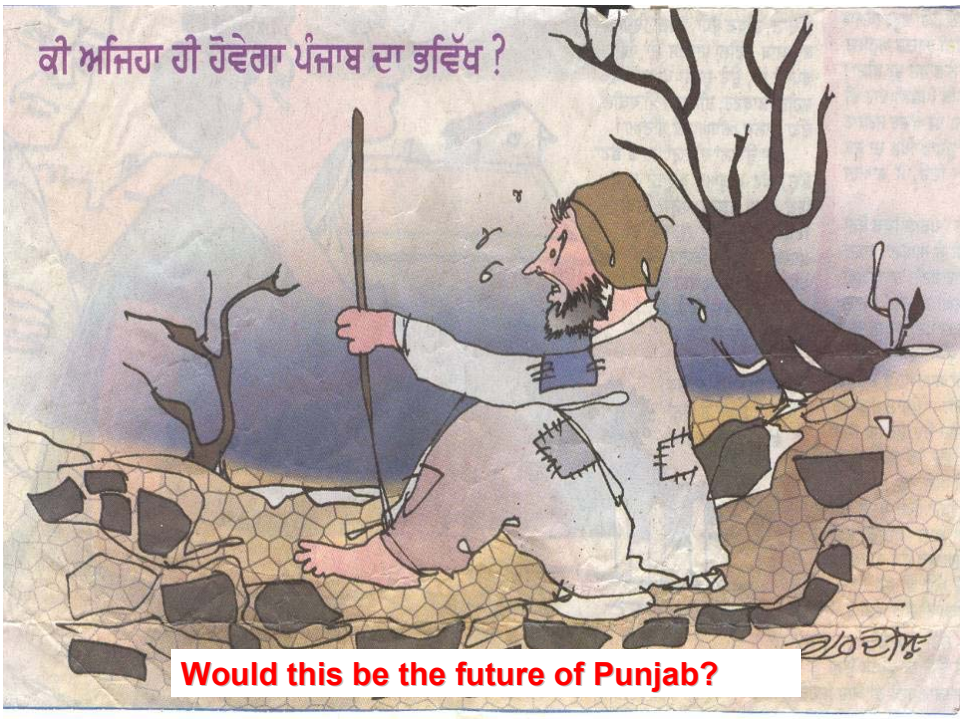
Bhuban Barah (NCAP) commented that K.V. Rao was not just a good farmer but a good scientist, who has been taking in experience from many countries and reading things from the internet, who has become a teacher to fellow farmers. K.V. interjected, "and training agricultural officers also, and agricultural students from Bapatla (ANGRAU's agricultural engineering campus)."

B.N. Singh (BAU) asked about the use of green manures, whether they can be grown in rainfed systems because they are difficult to incorporate without the soil being wet and pliable. Also, sesbania and crotoalaria become woody beyond 50 days. In principle, green manures are an attractive technology, but they face some climatic constraints. He also asked whether any scientific evaluation has been done on these traditional preparations for soil improvement.

K.V. responded that he just incorporates the legumes with the rotary weeder, disagreeing that water is needed for this process. He said also that *panchakavya* has been evaluated by ICAR scientists, and their analyses showed that this product has higher levels of azotobacter, azospirillum, pseudomonas and phosphobacteria than in commercial biofertilizer preparations sold in the market.

Next the symposium heard from **S. Thangamuthu**, a farmer from Tamil Nadu. He started with SRI in 2003, having learned about it from the local KVK extension center. He was attracted to the low seed rate, 3 kg/acre, and used a modified mat method for growing young seedlings, transplanting them at 15 days with 32.5 x 22.5 cm spacing. He used the leaf color chart (LCC) for nutrient management, putting on about 30 kg/acre of urea. He got 25-40 tillers per hill with longer panicles and produced 40% more paddy, 42 bags compared to 30 bags before, with a cost saving of 1000 Rs.

Next, **Shri Kapil Behal**, a tall turbaned farmer from Punjab, made a joint presentation with **Dr. Amrik Singh,** an agricultural development officer with the National Institute for Agricultural Extension Management (known as MANAGE), who had introduced him (Behal) to SRI. Singh has been collaborating with the Punjab Department of Agriculture on SRI evaluation, but mostly the work has depended upon farmer interest with little institutional support. Punjab Agricultural University has yet to take an active interest. Singh's powerpoint presentation began with the picture/cartoon reproduced below:



Then the next slide gave data from the Department of Agriculture, showing the extent and effects of groundwater depletion due to overextraction by tubewells to irrigate rice and wheat crops. The water table has been falling by 1 foot per year, and it is now falling by 3 feet per year

TREND IN DECREASING WATER TABLE LEVEL IN PUNJAB

Year	Affected Area (%)	Depth of Water Table (in feet)
1973-74	3%	30
2005-06	30%	70
2023	Whole of Punjab?	160

The following points were listed under the heading 'The Need for SRI in Punjab':

- Depletion of underground water table
- Degrading soil fertility
- Shrinkage of size of land holdings
- Rising cost of cultivation
- Deficiency of micronutrients in soil
- Developing pest resistance
- Decrease in production and productivity

A table showed the size-distribution of land holdings in the state. Contrary to the popular image of Punjab as having large-scale farming operations, almost two-thirds of farms (over 600,000) are 4 ha or less in area.

The results from five farmers' trials were shown in detail, comparing components of yield. One farmer who has alkaline soil got a lower yield with SRI methods: 2.375 t/ha vs. 3.375 t/ha with

conventional methods, a disappointment. The average results for the other four farmers, however, including one who has 'sticky' soil, were 4.5 t/ha with conventional methods and 7.65 t/ha with SRI, a 70% increase, with the SRI crop ripening 10-15 days sooner. The powerpoint showed different operations, much like Baharul's powerpoint from Tripura the day before. Here is a picture of SRI transplanting.

Slides of the results were also presented, such as the 'classic' comparison picture shown on the next page. The economic evaluation showed net income per hectare with conventional methods to be 11,146 rupees while with SRI methods, net income was 18,198 rupees -- 62% more.

Interesting data were shown on differences in the chemical properties of the soils, although no details were given (just the notation: As tested at PAU Lab):

Element	Conventional	SRI
Organic C	0.48	0.82
P	13.7	22.9
K_2O	84.0	36.0
Cu	0.9	2.08
Mn	11.9	13.18
Fe	33.0	68.40
Zn	0.98	3.10

One slide reported that water saving had been calculated at 50-55%, with SRI plots requiring 13 irrigations rather than 25, and only 2- hour turns to irrigate an acre (with a 4 inch delivery pipe) rather than 4 hours for an acre.

The constraints listed at the end of the presentation were:

- Psychology and attitude – main constraint
- Transplanting can be difficult
- Water management is needed
- Raised-bed nursery is a new concept
- Lack of labour for transplanting & weeding
- Scooping of seedlings can be difficult
- Lack of equipment for marking & weeding
- Sometimes the conoweeder is not working
- Non-availability of enough organic manures
- More labor intensity with SRI, at least to start

Bisht who was sitting next to me make the observations that in the Punjab, "the farmers like SRI but the government is not promoting it." He asked whether the average yields of 7.5 t/ha reported for SRI, compared to 4.5 t/ha with conventional methods, are real? Singh suggested that we ask a farmer who was with us from Punjab.

Shri Behal made a brief presentation on his experience, saying that he had learned about SRI from Singh. He has 50 acres of paddy land, and devoted only 1 acre to SRI at first. His yield had jumped from 4.75 t/ha to 7.85 t/ha. Now he wants to plant a larger area with SRI. "Farmers want it," he said. Satyanarayana observed that although Andhra Pradesh farmers started SRI (actually, some Tamil Nadu farmers were already using SRI by 2003), Punjabi farmers may now take the lead in India. "Just raising the yield of basmati rice by 1 t/ha would be an economic boon."

Diwakar from DRD said that we have not been getting yield improvements through a breeding strategy. If SRI can help us accomplish this, it is a boon for farmers. During a recent visit to the

Punjab, he learned that the state Director of Agriculture was not aware of SRI, "but he is now aware." In Haryana state, there is also need to try SRI because their situation is quite similar.

As there was no farmer from Tripura to speak on farmer experience there, this time slot was give to a scientist from that state who gave a powerpoint presentation, among other things discussing a few of the modifications made there in the original recommendations (this is quite acceptable whenever it enhances performance). Changes in nursery practices have been made to facilitate transplanting. The seed rate has been brought down from 60 kg/ha to 2.5-4 kg. This gives more vigorous seedlings by 12 days with 3-4 side shoots so that they establish very quickly and well.

The biggest problem has been weeds, but because these are a big problem in Tripura with conventional rice cultivation anyway, "weeds are not a new concern." Varieties that are expected to mature in 140-145 days with previous practices are being harvested already by the 115th day with SRI giving higher yields, 5.5-6 t/ha. It has been important to convince the politicians of SRI merits so that they give full support. He showed a picture of the Chief Minister and the Minister of Agriculture, Food and Civil Supplies in Tripura visiting SRI plots.

"Farmers feel empowered, they are doing something scientific. This is a good thing, getting farmers involved in new things." He showed a picture a large recent planning meeting with 400 farmers getting ready for the next cropping season. The presentation ended with a picture of a tribal woman farmer bedecked with family jewelry, an unusual but splendid way to end what was billed as a technical presentation.

Next, **P. S. Bisht** from Pantnagar agricultural university gave his report, which was the only one with negative results. In his on-station trials, SRI had been compared with conventional tillage and with integrated crop management, a production system that incorporates many elements of SRI. The yields reported were 6.52 t/ha with conventional tillage, 5.84 t/ha with SRI, and 5.93 t/ha with ICM. Bisht said he is "not against SRI, but these are our experiences."

Satyanarayana commented that the trials appeared to have varied only crop establishment practices, but SRI encompasses more changes in practices than this. It involves also appropriate methods of soil tillage and aeration plus addition of organic matter so that microorganisms are mobilized. Satyanarayana said that "one needs to do all the principles to make a proper comparison." Bisht acknowledged that they had focused on alternative crop establishment methods and that more evaluation is still to be done.

Then, **Jacob Nellithanam** who has been working with tribal communities in Chhattisgarh and Madhya Pradesh states on grassroots agricultural development since 1988, reported on SRI evaluations made with indigenous local varieties. He said he had been privileged to work with Dr. A. K. Richaria, long-serving director of the Central Rice Research Institute, before his death, and this experience had made him want to conserve rice genetic resources. He has also worked with Narayan Reddy and Alapati Satyanarayana since 2004 to evaluate SRI.

When indigenous varieties are grown with SRI methods, their yields can be roughly doubled from those of conventional practice, reaching 5-6 t/ha, he said. There is also a reduction in the period to maturity, even for photosensitive varieties whose flowering is fixed to the season. One

variety (Doberaj), normally 145-150 days maturity is ripening in 120 days, without reducing yield potential and indeed giving more yield. The quality of this rice is locally preferred and it has a market price 2-3 times that of normal rice. With SRI its yields have reached 7-8 t/ha.

The Madhya Pradesh Rice Research Institute has 20,000 varietal accessions, and Dr. Richaria showed that at least 1,600 varieties could yield >4 t/ha, which was better than improved varieties at the time. Farmer groups are starting to do their own varietal conservation, and the yield enhancement of SRI is giving impetus to this. One village has found the results so encouraging that its residents are promoting SRI among farmers in a larger area. Jacob said they think also that these local varieties enhance nutrition for children in the villages. (But this remains to be established with laboratory analysis.)

The last presenter of the morning was a farmer from Orissa state, **Narayana**, who spoke in Telegu. He said that he had gotten 60 bags/ha with SRI methods last year and even 90 bags/ha in some areas (4.5 and 6.75 t/ha, respectively). This year he expanded his SRI area from 30 cents (0.3 ha) to 10 acres (4 ha). He is expecting a yield of 100 bags/ha this season, using all organic inputs and vermicompost.

Satyanarayana brought the session to a close, observing that both scientists and farmers should be working together on SRI, as on the same team. Scientists understand general principles; farmers value concrete experience most highly. Both should be brought together. He requested all to take an interest in SRI so as to improve theory and practice as quickly and broadly as possible.

Technical Session IV: Institutional and Policy Issues -- and Conclusion

After the tea break, a session on policy and institutional support for SRI began, with Satyanarayana making the first presentation, addressing SRI's implications for achieving a more sustainable agriculture in India. I had to leave during the presentation and to miss presentations by several NGO colleagues, **A. Ravindra** (WASSAN), **G. S. Ramanjaneyulu** (CSA, Centre for Sustainable Agriculture), and Yoganand Mishra (PRADAN, Professional Assistance for Development Action), because an appointment had been arranged for me with the Principal Secretary for the Agriculture and Cooperation Department. I had to miss also the last session, where Dr. Viraktamath of DRR; Prof. Zaharul Karim from Bangladesh (former director-general of the Bangladesh Rice Research Institute and former Secretary of Agriculture for Bangladesh, attending the Indian symposium as an observer); K. Bhoopal Reddy, managing director of the agribusiness AGROS; Ravindra from WASSAN; and Kishan Rao, a farmer using SRI, discussed policy and extension support for SRI.

I had to leave before the symposium ended anyway, in order to catch a flight to New Delhi according to my previously-arranged schedule. The Principal Secretary, **Dr. C. V. S. K. Sarma**, has become a good supporter of SRI, so when K. V. Rao called him that morning to see whether he could meet with us en route to the airport, the Secretary said yes. Accordingly, K.V., Biksham Gujja and I stopped by the Andhra Pradesh state government secretariat about 1 p.m. and had a very fruitful meeting. K.V., one of the most progressive and most active farmers in the state of Andhra Pradesh, had known the Secretary for a number of years.

Dr. Sarma said that he knew my name from reading he had done during Ph.D. studies at the University of Southern California. He greeted us warmly and would have spent more time with us if my schedule weren't so tight. The state government has been trying to promote SRI by providing free weeders and markers to interested farmers, or by subsidizing them heavily, as the Minister had told us Friday morning. I told him I was almost embarrassing to tell him how cheap is a new weeder designed by Govinda Dhakal in Nepal: just 10 Indian rupees, not needing any subsidy and within the reach of any farmer. Moreover, Govinda calculates that it can reduce the labor time for weeding by 60%, so it pays for itself many times over. For many farmers, this will be a real boon.

We discussed the idea of doing an international evaluation of weeders for SRI. A supporter of SRI living in Canada has offered some funds for this purpose to accelerate the dissemination of SRI. Last year WASSAN did a systematic evaluation, by farmers, of a number of different weeder designs, mostly from farmers (http://www.wassan.org/sri/documents/ SRI%20 Implements%20workshop%20report%20by%20ravindra%201.pdf). We want now to get weeders from members within the SRI network worldwide, which can all be collected at one place – presumably Hyderabad – for farmers, both men and women, to evaluate each design according to a number of agreed criteria: ease of use, efficiency, durability, cost, etc.

Those weeders judged to be best for various situations and purposes would be photographed, and proper mechanical drawings would be made. Both photos and drawings would be posted on the Web for anyone in the world to see and download, making it easy for them to be fabricated locally. Free availability of designs would encourage blacksmiths and others to make and sell them competitively, with competition based on price, durability, etc., not on any monopoly value of design because designs would be in the public domain, not private property.

Dr. Sarma said that the Agriculture Department will be glad to assist such an effort, having a number of farms in different parts of the state with various types of soils (a major variable to be factored into the evaluations) and it could also give some financial support. This would help us stretch the private donation being made for this purpose. Access to good, reliable weeders was one of the constraints on SRI spread that was cited most often at the symposium. Biksham said that WWF could also help with this undertaking. Working collaboratively on this should give SRI a real boost.

At the airport, by coincidence, Dr. Shukla from ICAR was also flying back to New Delhi, though on a different flight. We had a chance to converse informally about what has been learned so far and what remains to be done. Compared to a year ago, the climate of acceptance and support for SRI has changed dramatically in India – for the better. The symposium was indeed well-timed and very valuable.

During the symposium I was also able to spend some time with Dr. Zaharul Karim from Bangladesh, who now that he has retired as Secretary of Agriculture is teaching and heading an agricultural development NGO, discussing plans for SRI dissemination in his country. He wants to add his knowledge and contacts to the effort to spread SRI, being a member of the board of the Bangladesh Rice Foundation along with Dr. Muazzam Hussain, the volunteer national SRI

coordinator for Bangladesh. What Zaharul heard and saw at the symposium strengthened his confidence in the new methods.

So there will probably be some valuable spin-off from this Indian meeting for neighboring Bangladesh as well. This is the way that SRI has progressed generally, through personal interest and commitment, feeding into ever-expanding networks of communication, cooperation and friendship. Those engaged with SRI are primarily motivated and animated by a concern with making agriculture in the 21st century more productive and more sustainable. They want agriculture to be beneficial especially for the poor and for the food-insecure, and at the same time to be compatible with the requirements of ecosystems and biodiversity. Only in this way can the soil, water, air and biological resources on which human and other life depend be maintained and reinforced in perpetuity. This latter concern in particular justifies the leadership and support that WWF has been giving on behalf of SRI, not as an 'environmentalist' initiative but as a holistic effort to meet better the multiple needs of the world we live in.