REPORT FROM 2ND INTERNATIONAL RICE CONGRESS,
New Delhi, October 9-13, 2006 – Norman Uphoff, CIIFAD

This report cannot be complete of the Congress because there were so many persons there and so many discussions, not to mention so many formal presentations and posters. The System of Rice Intensification (SRI) was no more than a minor theme, even though the attention that it got was probably an order of magnitude more than at the 1st International Rice Congress held in Beijing in September, 2002. This report covers the subset of discussions and participants concerned with SRI with which or with whom I had contact. It will convey to others the extent, and the ways, in which the dissemination of SRI is proceeding. The attention paid to individuals will give readers a more vivid idea of how SRI is being perceived and received -- how it is being taken up, modified and spread.

Monday, October 9

The Congress opened in the morning at ***Vigyan Bhavan***, a splendid new international conference center in New Delhi. Since my flight from Hyderabad arrived mid-morning, I missed part of the opening session, arriving mid-way through the presentation by the director-general of the Indian Council for Agricultural Research (ICAR), **Dr. Mangala Rai**. As luck would have it, the staff member who managed to get me through the Congress's strict security check even though I was not yet registered seated me next to **Abha Mishra**, PhD candidate at the Asian Institute for Technology in Bangkok, whose had done a poster on her SRI research in Thailand and Cambodia for the Wednesday session. She told me that **Dr. M. S. Swaminathan** in his opening presentation to the Congress had mentioned SRI as one of the opportunities for rice improvement, an auspicious start.

[Note: When I arrived in New Delhi on October 4, en route to Hyderabad, a message from Lucy Fisher at Cornell alerted me about a report just released by a subcommittee chaired by Dr. Swaminathan set up by the Indian government's Groundwater Advisory Council. The report had listed SRI first among five strategies recommended for reducing water demand in the agricultural sector <http://pib.nic.in/release/release.asp?relid=21113>].

When the opening session concluded, I went up on the dais to say hello to that session's chairperson, **Dr. Montek Ahluwalia**, vice-chairman of the National Planning Commission. I know him during his previous time at the World Bank and wanted to mention SRI to him. Dr. Swaminathan came over greeted me warmly, giving me a chance to thank him for the support that he has been giving to SRI. I also saw and shook hands with **Dr. Gurdev Khush**, the former senior rice breeder at IRRI who headed up efforts to produce a New Plant Type and who has been less interested in SRI than some others at IRRI. It was gratifying that on the last day of the Congress when we happened to pass in a corridor, he wished me "best of luck."

Moving into the area for the buffet lunch, SRI colleagues appeared all around. **Dr. Kouang Duongsila**, head of the National Rice Program in Laos, who attended the Sanya conference in 2002 and whom I had been in email communication before the Congress, was also in the line for lunch. **Prof. Janice Thies** from Cornell, who had met Kouang at Sanya, happened to come along as we were talking.

So did **Dr. Tao Longxing** from the China National Rice Research Institute (CNRRI) who has done excellent research documenting phenotypical differences between SRI and 'control' plants. And as we talked, the director-general of CNRRI, **Dr. Cheng Shi-hua**, came by and we chatted briefly. He is co-author of a paper on SRI based on two years of CNRRI evaluation research, elucidating reasons for SRI success. He and the other co-authors have invited me to join in finishing off the paper, an example of the kind of international collaboration that has driven SRI. I also met in the lunch area **Dr. Leo Sebastien**, director-general of the Philippine Rice Research Institute (PhilRice), who was initially quite skeptical about SRI but is now cooperating with the SRI-Pilipinas network. He commented that PhilRice has a standing offer to provide some funding for SRI training and evaluation, but the network has not apparently had time to work out a plan and proposal.

While standing in the line for lunch and talking with Abha, **Rajendra Uprety**, who has spearheaded SRI expansion in Nepal, spotted me and introduced himself. We have been communicating by email practically weekly and sometimes daily for several years as he has led scaling-up of SRI from a single farmer's plot in 2003 to over 2,000 farmers this year in Morang district. But we had never met before. For some time, he and Abha had been in email communication also, without having met. It was a joy to see them meeting for the first time. Rajendra's also had a poster on SRI in Nepal accepted for display at the IRC on Wednesday. I also met **Baharul Majumdar** from the Indian state of Tripura, Rajendra's counterpart there. More will be reported about the Tripura situation below.

Abha, Rajendra and I were joined by **Salina Banu** from Bangladesh, who was working in the wheat program of the Bangladesh Agricultural Research Institute (BARI) at Joydebpur when she first learned about SRI from **Prof. John Duxbury** of Cornell. Her results satisfied her of SRI's merits, but she encountered resistance from her colleagues, she said. Subsequently she received a four-year fellowship to do a PhD degree at IRRI in Los Baños in the Philippines. While there she said she tried to arouse some interest in SRI, but without much success. She was able recently to arrange for a seminar at IRRI by Prof. Duxbury, who talked about results from combining soil solarization and SRI. I expressed to her and to Abha my personal regret is that thus far, women have been relatively underrepresented in our SRI network; however, the two of them are helping to make up for the limited numbers of women in SRI through quality of input. Among farmers, of course, there are many women giving leadership for SRI in the field.

As soon as I finished my lunch (this was a stand-up affair), I was approached by a correspondent for the new agency **Reuters** who asked for 10 minutes to conduct an interview about SRI. After 20 minutes of discussion it was apparent that more time was needed to do a proper story. He asked whether he could e-mail me 10-12 questions, to which I could respond in detail, which seemed the best way to proceed.

Upon rejoining the other participants milling around after lunch, I met **Dr. C. M. Padmavathi** and **Dr. K. Surekha**, members of the Director of Rice Research (DRR) team in Hyderabad evaluating SRI under WWF auspices. I had met them, respectively a senior entomologist and a senior soil scientist, three days earlier at ICRISAT. Their soil-science DRR colleague on the team, **Dr. R. Mahender Kumar**, also came by to shake hands, having met already at ICRISAT.

While engaged in this conversation, **Dr. A. Palanasami** from **Tamil Nadu Agricultural University** (TNAU) came up at the same time as **Dr. Bhuban Barah** from the **National Centre for Agricultural Economics and Policy Analysis** (NCAP). This is an agency operating under the Indian Council for Agricultural Research. As fellow economists, they knew each other already, and both have become involved with SRI efforts.

- Palanasami mentioned that he had served on the water-saving commission noted above that was headed by Dr. Swaminathan. He had helped to get SRI included in the recommendations. He was pleased with the growing acceptance of SRI in India, having first learned about it during my visit to TNAU in May 2002. We had known each other previously through our mutual interest in participatory irrigation management, and I hosted his visit to Cornell in the mid-1980s. Now we have another shared interest: SRI and water-saving. He is now director of the Centre for Agricultural and Rural Development Studies at TNAU.
- Bhuban also commented on the growing acceptance of SRI in Indian research and policy circles. He also got a poster on SRI accepted for IRC presentation. He said that he would like to set up a meeting time and venue to bring SRI colleagues together at his Centre later in the week. This would be a real service for the SRI effort.

As we spoke, **Dr. P. V. Satyanarayana** came by to say hello. P.V. is a senior plant breeder at the Maruteru research station in Andhra Pradesh who had given important support to the initial thrust for SRI in that state, working together with our mutual colleague Dr. A. Satyanarayana. The IRC was turning out to be like a reunion with so many good friends all around.

Dr. Michael Frei from the University of Hohenheim, with whom I had corresponded by email also came over to introduce himself. Michael had done assessments of the nutritional values of traditional landraces of rice in the Philippines, a paper that my Cornell colleague Olivia Vent had found on the web. Michael documented higher levels of vitamins and minerals in local varieties, especially if unmilled (i.e., 'brown rice') or not milled very much. We missed meeting a year ago at the ***2005 Tropentag*** at Hohenheim, where I gave a keynote on SRI. The more he has learned about SRI, the more interested he was in it. Padmavathi, Surekha and I all expressed our interest to Michael in expanding scientific knowledge about how SRI practices might enhance the nutritional value of rice. The WWF-funded evaluation project in Andhra Pradesh plans to do nutritional evaluations of SRI grain, and Padma and Surekha said they will follow up on this.

Tripura: At the plenary session in the afternoon, by chance I sat next to Mahender Kumar of DRR and his friend **Baharul Islam Majumdar**, senior agronomist in the Department of Agriculture in the state of Tripura. Baharul has been a very effective protagonist for SRI in northeastern India. We had corresponded by email for several years, but had never met until briefly at lunch. Baharul got the state government to officially invite me to visit at its expense (from any point in India; international travel could not be paid), but so far there has been no opportunity for me to visit. Baharul's leadership had been sufficient to make rapid progress.

What Baharul has already accomplished in Tripura, a small hill state, is quite remarkable. He first read about SRI in 1999 -- the *LEISA Magazine* article written by Justin Rabenandrasana of Tefy Saina and myself -- and he tried the methods out. Although his yield the first time was not very impressive, he could see that the plants responded quite differently and positively do SRI methods, so he persisted with his evaluations. By 2002 he had mastered the methods and began trying to get SRI trials spread in the state from his position with the Department of Agriculture.

More information on the Tripura experience with SRI is given below in the report on Wednesday's SRI meeting. This year, Baharul informed me, out of the Agriculture Department's budget of 24 crores of rupees, 8 crores are devoted to SRI. This is probably the greatest degree of support for SRI work from any government department anywhere.

This commitment of funds is based on performance, not preconceptions. SRI yields in Tripura have averaged 7.5 tons/hectare, compared with 3.2 to 3.8 tons/hectare normally, with some yields reaching 11 and 13 tons, Baharul reported. I was pleased to learn that many traditional varieties have responded well to SRI methods with a doubling of yields -- from 1.5 tons per hectare usually to 2.7 or 2.8 tons with SRI, and with some yields as high as 3.2 tons per hectare.

Fifteen villages have already decided this year to become "100% SRI," with an area of about 1,500 hectares. Baharul he had recently received a cell phone call informing him that he needs to return to Tripura right after the Congress to participate in training programs planned for these villages. Already 6,000 hectares of SRI rice have been planted in Tripura this season, and he expects that the total will reach 17,000 hectares for the whole season. Next year, the Department of Agriculture expects SRI use to reach 50,000 hectares.

A lot of training has been done at the Zilla Parishad (local government) level, with Members of Legislative Assembly (MLAs) often becoming involved in the work. There have been a few personal problems at household level which Baharul noted, citing the now familiar story of husband-wife conflicts initially over the use of SRI methods, with one or the other threatening to leave the home. But all such cases he knew about have had happy endings. He commented that SRI is referred to in the local language as 'child rice.'

Most significant to me was Baharul's statement that he has not found a single farmer in Tripura who has given up SRI once it has been tried. This contradicts the concern expressed by some skeptics about SRI that it is too demanding or too complicated, and that disadoption will be a problem for the new system. Baharul thinks that within three years SRI methods will be used by most farmers in the state. This is all the more significant because the area is one of high rainfall, and keeping soil aerated during the rainy season is difficult. However, Tripura soils are mostly well-drained, without many low-lying clay soils that are prone to waterlogging.

This is a different response from what I was hearing in Andhra Pradesh -- that in some areas, disadoption is a problem, though not because farmers find the methods inferior; the reasons cited are most often inability to control water or to get access to weeders.

Baharul gave me a copy of the SRI manual for farmers that he has put together in Bengali language. It is one of the most beautiful productions I have seen on SRI (URL). He took all of the photographs himself, showing that he is an excellent photographer like another champion of SRI, Shuichi Sato in Indonesia.

Following the afternoon plenary and a tea break and an awards ceremony, Congress participants were taken by bus to the National Center for Agricultural Science, a new campus built for ICAR, where the opening dinner was held, a very nice affair. Among others with whom I had a chance

to talk was **Behrooz Arabzadeh** from the Rice Research Institute of Iran. He was interested to learn that SRI evaluation was already being done this past season at the Rice Training Center of Iran by Bahman Amiri Larijani, head of its agronomy section. Behrooz said that he would get in communication with Bahman when he returned to Iran.

On the bus back to the hotel, I happened to sit next to **Dr. Jin Yong Choe** from Korea. He is director of the Sustainable Agriculture Cooperative Research and Extension Center in the Institute of Agriculture and Life Sciences at Gyeongsang National University. We have not had any strong linkages for SRI into any South Korean institution. (Dr. Zhu Defeng, volunteer coordinator for SRI in China, has introduced SRI into the DPRK to the north.) Given Dr. Choe's position as professor for sustainable agriculture in his university, he took a quick interest in SRI when I began to explain it to him and said he would be glad to give SRI a try.

Tuesday, October 10

The panel that I attended this morning on **Soil Health** was led off by Prof. Janice Thies from Cornell. She made a very appropriate presentation to introduce this topic, but I found most of the other presentations more focused on chemical and physical aspects of soil systems than helpful. The poster session before lunch had several posters on SRI work that I had not known about, so this was a pleasant surprise. I will discuss posters relating to SRI separately.

In the afternoon, there was a panel on **Water Productivity and Reuse**, to which my presentation on SRI had been assigned. The convener was Dr. T. P. Tuong from IRRI who has been interested in the water-saving aspects of rice for some time, having co-authored an IWMI publication on "More Rice with Less Water" as long ago as 1998. The co-convener of the panel was Dr. A. K. Singh, director of the Water Technology Centre of the Indian Agricultural Research Institute.

[I had first met A.K. at an Asian Productivity Organization seminar in Sri Lanka in 2001 and had gotten him interested in SRI then. He started some on-station research evaluating SRI in 2002 and hosted me for a WTC seminar on SRI in September 2003. I remember A.K. telling me with amusement that the research committee of IARI had refused to let his PhD student evaluate 10-day-old seedlings as part of the experiment; they said that Indian farmers can never manage such young seedlings. This has been clearly contradicted by tens of thousands of SRI users in India.]

I had only 15 minutes for the SRI presentation, rather than the 20-25 minutes that others were given, but I was grateful for any opportunity. The presentation was very condensed, with no time for the more nuanced and qualified statements I prefer to make about SRI. The audience response seemed lukewarm, so I thought that maybe I had 'blown' the opportunity. I forgot that most in attendance would have brought a negative view to their hearing about SRI given the well-known opposition in some rice science circles. On the other hand, the response to the talk Dr. Zaharul Karim of Bangladesh (discussed below) threw a more positive light on it, and that by itself made the effort to get on the IRC program worthwhile. But at the time, my assessment was downbeat despite feedback from Rajendra and Abha.

The panel that I attended in the late afternoon on **Integrated Crop Management** included a paper by **Dr. R. Rajendran** from Tamil Nadu Rice Research Institute on "Research and extension of integrated crop management (modified SRI) approach for enhancing rice

productivity and profit." This reported some good results from that state, highlighting the positive effects of soil aeration by using a conoweeder. He said that "ICM or SRI is moving very well in the southern states (of India)."

A pleasant surprise was that there was no mention of SRI in the paper that **Andrew McDonald** from Cornell presented on "Yield gaps and rice: The context for integrated crop management." Andy has previously been a self-appointed nemesis of SRI, taking the lead on an article published earlier this year in *Field Crops Research* that sought to 'debunk' SRI on the basis of an unrepresentative data base. He included data as representing SRI from trials where as few as 3 of the basic 6 practices had been used. This means, for example, that water control and active soil aeration were missing in most of the so-called "SRI' results -- even though McDonald had claimed that the SRI data he used "closely approximated" his description of SRI. After a long and intense list-serve discussion (debate) about SRI over the past summer, it now seems that Andy has decided to utilize his time more constructively.

It was evident from the lead-off paper on this panel by it convener, **Dr. V. Balasubramaniam** from IRRI, that what is being proposed under the heading of 'integrated crop management" includes the most of the basic practices of SRI: younger seedlings, though not necessarily <15 days; 1 or 2 seedlings; wider spacing, though not necessarily >25x25 cm; reduced water applications; if possible, weeding with the conoweeder for soil aeration, though herbicides are acceptable; more use of organic matter for fertilization, though chemical fertilizers are still relied on as the main source of external nutrients. One of the main items of ICM is use of the leaf color chart (LCC) developed by IRRI to monitor the status of plant nitrogen so as to make timely and optimizing applications of N fertilizer. ICM includes also beneficial practices such as seed selection and seed priming, which are quite consistent with SRI but not part of the original set of practices, and also improvements in post-harvest handling of the crop, clearly advantageous. Since SRI is not a fixed technology, we see no competition or conflict between SRI and ICM. We are glad to see the SRI principles of younger seedlings, reduced plant populations, wider spacing, more aeration of the soil, and improved soil organic matter being more widely adopted.

Wednesday, October 11

On the morning bus ride from the hotel to the NCAS, I happened to sit next to **Dr. Frederic Gay** from CIRAD, the French Agricultural Research Centre for International Development. He is based in Vietnam and knows Olivier Husson, CIRAD staff member based in Madagascar, who was a co-editor for our book on biological approaches to sustainable soil systems. Having heard about SRI, he was interested to know more about it.

At the NCAS before the morning panels started, I happened to meet **Dr. Takeshi Horie**, recently retired as professor of agronomy and rice science at the University of Kyoto in Japan. He is now president of the National Agriculture and Food Research Organization (NAFRO) in Japan, but still supervising the PhD thesis research of Yasuhiro Tsujimoto on SRI in Madagascar. I gave him a copy of the book on *Biological Approaches to Sustainable Soil Systems*, and as he was looking at it, **Dr. Francis Forest** from CIRAD walked by. He is head of the division of CIRAD under which very innovative soil and cropping systems management work is being done in Brazil and elsewhere, and we had met briefly the day before. Francis interrupted us to tell

Takeshi that this was "a very good book," one that he "must read." How nice to have such an unexpected endorsement offered fortuitously.

The morning panel I attended on **Nutrient-use Efficiency** was disappointing in that most of the discussion of soils regarded them, implicitly if not explicitly, as inert. Dr. Anand Swarup, head of the division of soil science and agricultural chemistry, who was sitting next to me agreed that this was a limitation in the analysis. The diagram projected on the screen to frame the panel's discussions made implicit reference to soil organisms under the box labeled 'immobilization,' implying a loss of nutrients (although from another perspective this could be regarded as an accumulation of nutrients -- but that was not how the term is used.) Mostly soil organisms were regarded in negative terms, e.g., focusing on the plant-parasitic species of nematodes which are a small minority of nematodes; most species contribute to plant growth through nitrogen cycling.

In my view, the session missed many opportunities to integrate the biological dimension of soil systems into a consideration of nutrient management. In his paper leading of the session, Roland Buresh from IRRI started by observing that there is great variation in nutrient availability in soils from year to year and from place to place within fields. This makes an *a priori* case that attention should be paid to the populations and activity of soil organisms which contribute significantly to this variability. He and others considered it sufficient to deal with the effects of such variation, not its causes.

At lunch, I was pleased to meet my old friend **Mushtaq Gill** from Pakistan, who had just arrived in New Delhi and who would be my host for the visit to Lahore after the Congress ended. His panel presentation was scheduled for the next afternoon.

The panel on **Integrated Pest Management** that I sat in on after lunch was interesting but did not have much content related to SRI. After the paper on "Approaches to sustainable pest management in rice ecosystems" by Dr. J. Cheng from Zhejiang University, someone asked about the effects of SRI on pests and diseases in China. The session chairman responded that: "There is no SRI in China." I corrected this, noting that the China National Rice Research Institute located in Zhejiang Province has been evaluating and disseminating SRI there and has reported a 70% reduction in sheath blight, one of the main diseases affecting the rice crop in Zhejiang. The chair accepted this clarification.

At 4:15, as many persons interested in SRI as we had been able to identify and notify met in the NCAS lobby from where Bhuban Barah had us ferried in NCAP vehicles to the nearby National Centre for Agricultural Economics and Policy Analysis.

The sheet passed around showed the following persons participating in the discussion on SRI:

- Dr. P. Muthuraman, Directorate of Rice Research (DRR-ICAR), Hyderabad -- sociologist
- Karma Lhendup, Sherbutse College, Royal University of Bhutan -- soil and crop scientist
- Dr. Vinod Goud, WWF-ICRISAT Program -- Global Dialogue on Food and Water
- Dr. L. V. Subba Rao, DRR-ICAR, Hyderabad -- plant breeding
- Baharul Majumdar, Department of Agriculture, Tripura State -- agronomist
- Dr. P. K. Ghosh, Department of Agriculture, Tripura State -- plant breeder
- Abha Mishra, PhD candidate, Asian Institute of Technology, Bangkok -- plant physiologist

- Dr. C. H. Padmavathi, DRR-ICAR, Hyderabad -- entomologist
- Dr. R. Mahender Kumar, DRR-ICAR, Hyderabad -- agronomist
- Dr. P. V. Satyanarayana, Maruteru Agricultural Research Station, AP -- plant breeder
- Dr. K. Surekha, DRR-ICAR, Hyderabad -- soil scientist
- Dr. K. N. Selvaraj, Tamil Nadu Agricultural University -- agricultural economist
- Ganesh R. Joshi, Director of Agriculture, Government of Nepal – SRI administrator
- Rajendra Uprety, District Agricultural Development Office, Morang, Nepal – extension
- Dr. B. C. Barah, Principal Scientist, NCAP-ICAR, New Delhi – agricultural economist
- Dr. B. C. Viraktamath, Director, DRR-ICAR, Hyderabad – organizer, SRI conference
- Prof. P. K. Sharma, Himachal Pradesh Agricultural University, Palampur – soil physicist
- Dr. A. K. Singh, Director, Water Technology Centre, IARI, New Delhi – water management
- Dr. B. N. Singh, Director of Research, Birsa Agricultural University, Ranchi, Jharkhand – research administrator
- Myself

Bhuban Barah opened the discussion by welcoming everyone. He said that the NCAP director was chairing a IRC session at the time or would otherwise himself be present. He was interested in getting suggestions from others on how policy, his area of responsibility, could be improved to support SRI spread. India, he noted, was a relatively late starter with SRI, but "India is now started... Things are moving." He wanted "to expand our family mode" by getting people together and sharing ideas and experience. "We are learning a lot of new things," adding metaphorically, "There will be some hiccups."

Bhuban Barah said that he has been carrying out a small project for NCAP, a pre-project really, on SRI in Andhra Pradesh, Tamil Nadu and Karnataka states. From his interviews, it has been interesting to see the different mindsets toward SRI between scientists such as plant breeders, on one hand, and users, on the other. Somehow in the complicated research designs of the former, "SRI gets lost." He said he was interested to hear what others had to report.

Dr. Viraktamath spoke next because he said, apologetically, that he had to return to the Congress for another meeting. He said he was very glad that there would be next month an all-India SRI symposium, which was being organized very fast, thanks to the initiative of WWF. He solicited suggestions for how to make the symposium successful. SRI needn't be used everywhere to be successful, he said, only where it is appropriate. There are various problems to be resolved, but also very good prospects. He said he was "very much sure" about this technology, which had "lots of plus points," citing economic benefits and water-saving as well as higher yield. He said he was glad that I would be coming back to India to participate in the symposium having been "a motivator for the whole world." I said that I preferred the designation of 'catalyst.'

Bhuban Barah had everyone introduce themselves. Some gave just their position and discipline, other made short reports. Dr. Kumar from DRR emphasized that SRI should be understood in terms of principles more than practices, and they were seeing at least 10% increased in yield with SR, but sometimes 100% and even 200% increases. Dr. Ghosh from Tripura commented that they expected 16,000 hectares of SRI use this season. Normally SRI would not be considered possible in a higher rainfall area like Tripura, but they had made appropriate adjustments.

Abha Mishra commented that she first got interested in SRI from the article in *Nature* magazine in March 2004. She was intrigued by the possibilities and wanted to see how bringing scientific rigor to the subject could resolve the controversy and take advantage of whatever SRI had to offer. For her thesis, she is looking at rhizosphere activities, on the one hand, under controlled laboratory conditions, and at farmer utilization of SRI through participatory action research in Cambodia. It has worked very well to bring various stakeholders together, using factorial designs in farmers' fields with farmers who had participated in season-long IPM farmer field schools. They focused, among other things, on how growing healthier root systems. She already has a M.Sc. in plant breeding and was challenged by SRI to think more about the 'E' in the 'GxE' equation (signifying interaction between genetic endowment and environmental influences). Abha is seeking scientific explanations for the principles of SRI, which if correct should be applicable everywhere; how they should be adapted and how much effect they will have will vary according to local circumstances. One conclusion is that SRI should have most benefit with medium-duration varieties in terms of factor productivity per unit of time.

Baharul Majumdar told a fascinating story of his introduction of SRI in Tripura State. He got the basic process and principles in mind from reading a single sheet, he said. The first year that he tried the methods, he had poor results; but by the 3rd year, he was getting good results in both seasons, both on-station and in farmers' fields. Only one farmer was willing to try SRI at first, but he promised to pay the farmer from his own pocket for any loss incurred. The results were "very encouraging."

The Commissioner of Agriculture in Tripura became very positive upon seeing these results, and they got 44 farmers the next season, and then 88 farmers the third season. These results were so encouraging that he got all of the ministers to visit the plots. Also Dr. M. S. Swaminathan visited SRI plots, along with the Secretary of Agriculture. The Chief Minister himself visited four plots.

In 2005, there were 400 fields, and this year there are already 6,200 hectares under SRI. Almost every village has at least some SRI now. There is a dictum from the government that all officers should assist properly, or their salary will be stopped for three months! Some officers have already been penalized, so everyone knows that this is a serious matter.

They have had to make some adjustments, such as revising the water management strategy for high-rainfall situations. There was tremendous resistance initially from professional agriculturalists who didn't believe the SRI could work as claimed. But when they saw 84 tillers, even 100, attitudes started to change. Farmers' reaction was cautious, as they wanted to wait and see results. But there has been no drop-out once they tried the methods. "Not a single farmer has given up SRI," Baharul said.

In our state, the people will come up with the resources to spread SRI if the government doesn't, he reported further. In one development block, 15 villages have decided to convert 100% to SRI. He has to get back for a big meeting and training session on October 19 that the villagers have set up.

It is important for farmers to understand the principles, not just the practices. Best yields have been with HYVs and hybrids, but local varieties have gotten yields of 3.2-3.5 t/ha, more than

double their usual yield of 1.5 t/ha. He was pleased to report that "farmers are developing things better than I told them!"

Vinod Goud reported on the involvement with SRI of WWF's Dialogue on Water for Food and Environment. It came across SRI being practiced in Andhra Pradesh villages in 2003. It was at first "not sure" about SRI, so it supported systematic evaluation of SRI methods by researchers from ANGRAU, under the leadership of Dr. A. Satyanarayana, in 2004 rabi season. The findings satisfied WWF of SRI's merits, and it encouraged the government of Andhra Pradesh to give more support for the sake of water saving as well as farmers' benefits. Now many kinds of organizations are involved with SRI across India and there is need to get them together to share experience, identify problems and constraints, and to agree upon solutions. That is the reason for the planned national symposium in November.

Karma Lhendup reported on his experience with SRI in Bhutan. He teaches crop and soil sciences at a college of the Royal University of Bhutan and has been initiating SRI this past year. The results are very good. In about 14 days, the plots will be harvested, so for his IRC poster, he only reported estimates based on yield parameters. "To me, SRI is just a matter of modifying conventional practices, so it is not difficult to disseminate to farmers." He added, "I am a newcomer to the SRI movement, so I need to open my eyes."

P. K. Sharma from Himachal Pradesh Agricultural University introduced himself as a soil physicist working within the all-India coordinated research network of ICAR. He learned about SRI from attending a water management workshop at IRRI in 2002, where Prof. Robert Randriamiharisoa from Madagascar and I made a presentation. He was amazed to hear that a farmer in Madagascar could reach a yield of 21 t/ha. They were getting about 4 t/ha in Himachal Pradesh, and never surpassed 5 t/ha.

When they tried SRI at first they couldn't apply all the techniques, having difficulty especially with intermittent flooding. Also they didn't have a rotary weeder, so had to do hand weeding. They found that using farmyard manure increased salinity, and temperatures were often so low that they had to use older seedlings than recommended.

The fourth year, they changed the variety used to a local one, which does well at 1200 m elevation. This is normally a low-tillering variety, with 22-23 tillers but large panicles. Using SRI methods, they have gotten as many as 57 tillers per plant, and there is a 10-15% yield advantage with SRI methods. Wider spacing they find giving more advantage than young seedling. They have a very good crop this year, and the Department of Agriculture in HP is now asking the university for knowledge about SRI.

Even if there were no yield advantage, Sharma said, there there is an advantage from seed saving, and less labor requirement. Also timing of the crop cycle is favorable, as SRI crops mature 7 to 10 days sooner, which is a real benefit. "We are happy with the technology," he said in conclusion. Rajendra Uprety suggested they would get more benefit if they did mechanical weeding with a rotary hoe. When Sharma said they didn't have this implement, Mahinder from DRR said they could supply one.

P. V. Satyanarayana said that a second Green Revolution is needed in India, and he could say as a plant breeder that this was not going to come through breeding alone. "Management is critical... We need an improved agronomic package to maximize yield with minimum inputs." SRI should be part of this second Green Revolution, P.V. said.

He said further that there was a rumor among some Andhra Pradesh farmers that in the 2nd and 3rd years, SRI results come down. This can be a reason for disadoption. Possibly there needs to be more attention paid to potassium and phosphorus constraints. Tiller mortality has been reported as a problem in some places. One plant, with spacing 50x50 cm, had 190 tillers, but only 100 were eventually fertile. What can be done about this? Rajendra said several farmers in Morang District of Nepal have been practicing SRI for four years, and their yields continue to increase, with reduced fertilizer. He said tiller mortality can be minimized by inducing early tillering, which is enhanced by frequent weeding (soil aeration) and shallow planting.

The discussing was going very fruitfully, but we were well past the planned adjournment time of 6 p.m., and some participants had to return to the Congress for planned events. We could not adjourn without taking group photographs, with perhaps a dozen cameras (see picture at end of this report). The group dispersed with a high sense of cameraderie, and the next day, Bhuban passed around a list of participants with everyone's email address so that conversations can continue electronically. It had not been possible to get everyone involved with SRI to the meeting, but this was a good cross-section of the persons who are advancing both the science and practice of SRI.

Thursday, October 12

This morning I stayed at the hotel to meet staff from the NGO known as PRADAN (Professional Assistance for Development Action), which is introducing SRI in very impoverished communities, many of them ethnic minority, in eastern India (West Bengal, Jharkhand, Orissa, Bihar and Andhra Pradesh). **Nivedita Narain** with the central staff in New Delhi had done a MPS degree in International Development at Cornell in the early 1990s, came with PRADAN field staff **Abijit Chowdhry**, **Srihari Chity** and **Monisha Mukherjee**.

Their 'news' was that it looked possible that PRADAN will get support from the Australian Council for International Agricultural Research (ACIAR) for expanding its watershed management program in drought-prone areas of the Eastern Gangetic plains. Possibly SRI can be included in this effort if skepticism among some Australian scientific advisors can be overcome. In its program in Purulia district of West Bengal, farmers using SRI averaged 7.7 t/ha last year, 3.5 times more than their usual rice yields. This should impress ACIAR decision-makers, but it may take a while to get such information accepted given certain preconceptions.

Abijit told me with amusement about a visit to a field office from the brother of a Member of Legislative Assembly (MLA) who had asked agitatedly: "What will I do with all my rice?" He had used SRI methods on 20 hectares, being a big farmer and not part of the PRADAN 'target group,' and his crop, averaging 110-120 tillers, gave a yield of 12 t/ha. Commercial farmers in the area are taking SRI up very fast, Abijit reported. This suggests to me that the soils in this area are relatively well-endowed biologically for responding to SRI methods.

Three areas had been identified by PRADAN staff as ones where some adaptations had to be made.

1. Full reliance on farmyard manure or compost is difficult because collecting and using these organic materials has high opportunity (labor) cost. They are working out combinations of organic and inorganic fertilization to suit local conditions.
2. It seems that the rice plants often have an inadequate supply of nutrients during the reproductive phase, after panicle initiation. They are trying to work on this so that there will be better grain filling.
3. When rains are delayed and the date of transplanting is also delayed, this is affecting plants' growth rate and subsequent yield. Possibly with raised beds or other methods there can be some way to get plants started without being so dependent on the monsoon, but this remains a constraint.
4. Labor constraints are emerging as a problem, one not initially encountered when SRI was being used on a small scale. Now that farmers want to use it more extensively, they will need to find ways to reduce labor needs in order to take advantage of the methods over larger areas.

Purulia farmers using SRI methods have been able at least in some years to make these work very well for them. The PRADAN staff are, together with the farmers with whom they work, are pioneering what I am calling 'rainfed SRI.' This is an important 'new frontier' for SRI because so many food-insecure households do not have irrigation facilities to boost and secure their basic food grain production.

In the panel that afternoon on **Resource-Conserving Technologies**, in his presentation on RCTs being introduced and spread in Pakistan, Mushtaq Gill included SRI as one of the innovations that is showing most promise, even though this is their first year of SRI introduction. Then in his summarization of posters for the RCT session, co-convener **Francis Forest** of CIRAD noted the number of posters that had been submitted on SRI (reviewed below) and gave a generally positive push to this as a resource-conserving technology even though other papers besides Gill's had not considered it. At the dinner that evening, Mushtaq and I sat together and discussed Pakistan experience with SRI and the upcoming visit there.

Posters

All three days, there were a variety of posters reporting on SRI evaluation and dissemination in connection with the different themes of the Congress. Below I give a summary of 15 posters with contact information for anyone who wants to follow up with the poster authors.

Effects of non-flooding farming on carbohydrate allocation of hybrid rice Longxing Tao, China National Rice Research Institute (lxtao@mail.hz.zj.cn)

Tao has done important evaluations of phenotypical features of SRI rice, but in this paper was not evaluating SRI as a production system. Instead he evaluated the effects of different methods of reduced-water irrigation on production of grain carbohydrates. His research showed alternate wetting-and-drying to produce higher seed setting rate and grain weight than either flooding or dry cultivation.

Effect of crop establishment methods and nutrient management on tillering and maturity in lowland rice D.P. Patel, Anup Das, G.C. Munda and U.K. Hazarika, ICAR Research Complex, Meghalaya (pateldpp2001@yahoo.com)

SRI, integrated crop management (ICM) and standard management systems were evaluated. Highest number of tillers per hilll were recorded with SRI, lowest with standard methods. Highest tillering was with 50% NPK and 10 t/ha FYM for SRI, while for ICM the highest tillering was with 100$ NPK and 5 t/ha FYM. Tillering was completed 10 days earlier with SRI than with ICM and standard methods, and the latter had more degeneration of tillers. The SRI crop had earlier heading and maturity by 10-15 days.

Agronomic evaluation of the system of rice intensification (SRI) and conventional rice culture (CRC) with varying nutrient management practices in aromatic rice Dinesh Kumar, Y.S. Shivay and B.N. Mishra, IARI, New Delhi (dinesh_agro@iari.res.in)

In this comparison, SRI was found to need 1/3 to 2/5 less water, but CRC produced significantly higher grain yield. Half compost and half NPK gave better yield than half FYM and half NPK, with both better than only compost, only FYM or only NPK for the same amount of nutrients.

Production of robust seedlings in modified rice mat nursery for enhancing hybrid rice production through system of rice intensification (SRI) R. Durai Singh, V.K. Paulpandi and P. Verramani, Tamil Nadu Agricultural University, Madurai (maduraisingh@gmail.com)

Research efforts focused on developing a modified mat nursery using good seed, low seed rate (3 kg/100 m^2), thin sowing (75g seed/m^2) and adequate nutrient management to produce robust seedlings within 14 days. Results of experimentation showed that seeds fortified with 1% solution of KCl facilitated quick germination and produced longer coleoptiles. More seedling height and root length with higher chlorophyll (SPAD value) were observed with KCl solution, DAP (50 g/m^2), Pseudomonas (6 g/m^2), vermicompost (50 g/m^2), and vesicular-abuscular mycorrhiza (50 g/m^2). Labor use efficiency and water use efficiency were high under this modified mat nursery methods and hence the cost of production was reduced.

Impact of system of rice intensification (SRI) on insect pets and arthropod biodiversity: A case study in irrigated rice ecosystem G. Ravi, R. Rajendran, N. Raju, V. Muralidharan, B. Chandrasekaran and V. Balasubramanian, Tamil Nadu Rice Research Institute, Tamil Nadu Agricultural University, and IRRI (entoravi@yahoo.com)

Wider spacing and frequent weeding with the rotary weeder with SRI were found to have an impact on arthropod populations. Alternate wet and dry irrigation kept aquatic fauna under check, and aquatic arthropods were either meager (wet season) or totally absent (dry season) in SRI fields. From a pest management perspective, SRI ecosystem was found not conducive to the establishment of some of the key insect pests in rice: rice gall midge, yellow stem borer, and brown planthopper. On the other hand, rice leaffolder was higher in SRI fields in all the seasons studied. Darker foliage and broader leaf lamina have been correlated with higher leaffolder damage in SRI fields. Possible long-term perspectives of SRI methods in relation to arthropod biodiversity, pest problems, and pest management strategies were discussed in the paper.

System of rice intensification (SRI): A new methods of rice cultivation – Experiences in Nepal
Rajendra Uprety, District Agriculture Development Office, Biratnagar, Nepal (dadomorang@wlink.com.np)

This poster described how SRI had spread in three years from 100 m^2 on one farm in 2003 to >1400 farms and >100 ha in 2005. Average SRI yield was 6.3 t/ha compared with 3.1 t/ha using conventional methods, with less seed (by 90%), less water (by 40-50%), and no need to use pesticides, thereby lowering cost of production and raising net income. The crop duration (time to maturity) was reduced by 2-3 weeks with SRI methods when young seedlings were used. The area under SRI has probably tripled in 2006 compared to 2005, and SRI shows promise to resolve food security problems in Nepal.

Relative contribution of different components of system of rice intensification (SRI) to the yield of rice (Oryza sativa L.) V. Chellamuthu and V. Sridevi, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Pondicherry (drvcmuthu@yahoo.co.in)

This poster reported results from comparing 12 treatment combinations (young vs. older seedlings; one seedling per hill vs. multiple seedlings; wider square spacing vs. narrower rectagular planting; and conoweeding vs. hand weeding). The SRI combination (young single seedlings, wider spacing and conoweeding) gave the highest yield, 68.25% higher than the control (older multiple seedlings, more closely spaced, with hand weeding). This was not surprising, but the experiment also quantified the respective contributions of components. Young seedling contributed the most to higher yield, other practices being equal (a result consistent with other factorial trial evaluations). The SRI combination produced a net return of Rs. 12,574 per ha, 87% higher than normal practice.

Physiological basis of growth and development of rice under SRI (system of rice intensification
A.K. Thakur, S.K. Chaudhari, R.B. Singhandhupe and R. Singh, Water Technology Centre for Eastern Region, Bhubaneswar, Orissa (amod_wtcer@yahoo.com)

SRI methods were compared with conventional transplanting method (single seedling 25x25 cm^2 vs. three seedlings per hill 15x15 cm^2) – it was not clear what other SRI methods were used. Results indicated that root growth and root exudation rate per hill were significantly higher in SRI plants, which also showed more light interception due to better canopy development. Maximum quantum yield of photo system or florescence efficiency were enhanced in crop grown under SRI methods. Number of tillers and panicles per hill were three times higher, though comparable on unit area basis. Panicle length, grain number per spike, and percent of ripened grains was enhanced significantly unde SRI crop, resulting in a 15% higher yield.

Performance of rice cultivars as influenced by the integrated crop management and its impact on enhancing rice productivity R. Rajendran, S. Anbumani, P. Stalin, B. Chandrasekaran and V. Balasubramanaian, Tamil Nadu Rice Research Institute, Tamil Nadu Agricultural University, and IRRI (rajendrankmu@yahoo.co.in)

"The management system introduced in the name of SRI, later on modified to suit the local conditions of the Cauvery Delta farmer, had shown tremendous improvement in the productivity of rice." Large-scale, on-farm demonstrations of modified SRI, or integrated crop management (ICM), enhanced rice productivity by 1.0-1.5 t/ha on average. ICM plots under intermittent irrigation recorded the highest grain yield, 6.93 t/ha, compared with 4.26 t/ha using conventional methods. Irrigation water saving was 46% during the dry season 2005 compared with continuous flooding. The effects of ICM practices were more pronounced in the dry season owing to more solar radiation and better soil drainage.

Productivity-enhancing and resource-conserving practice in rice: The system of rice intensification as an option B. C. Barah, IARI, New Delhi (bcbarah@yahoo.com)

This poster reported on a detailed farm survey conducted in Andhra Pradesh, Tamil Nadu and Karnataka "where most encouragingly, the government policy makers approved and accepted SRI to implement and popularize among farmers in large scale." About 450 farmers were involved in the survey. Gain in rice yield due to SRI with the hybrid variety PHB 71 and DRRH 1 was reported at 48%. "On the whole, the farmers would adopt the method if it improves production per unit holdings affecting food security and profitability, ensuring income security." In conclusion, "this small farmer-friendly practice will be a boon to rice-growing farmers."

Some scientific and social implications behind the system of rice intensification (SRI) Abha Mishra, Asian Institute of Technology, Bangkok, Thailand (Abha.Mishra@ait.ac.th)

This poster noted that SRI encourages farmer participation in devising practical ways of growing a healthy crop in a sustainable manner, while the science behind SRI is equally challenging, especially in relation to processes below ground level that affect the rhizosphere. Several eleents of SRI practice reflect similarities with cultural techniques recommended in the 'High Yielding Theory' (HYT) of the 1950s. Recent research findings suggest that physiological mechanisms of high-yielding varieties are regulated by cytokinins through higher root activity, which may be enhanced by agronomic regulation such as with SRI. The poster author is conducting both controlled laboratory evaluations of root functioning under SRI conditions and field evaluations with farmer participation, to bring these two streams of SRI activity together.

Comparative performance of system of rice intensification (SRI) under different plant geometries and water regimes with conventional rice cultivation S.K. Singh, R.K. Batta and A.K. Sikka, ICAR-RCER, WALMI Complex, Patna, Bihar (santpatna@yahoo.co.in)

Trials were conducted in the wet seasons of 2005 and 2006 to study this subject, with 10 treatments and 3 replications. Significantly higher grain and straw yield of 7.75 and 10.6 t/ha were recorded under 25x25 cm spacing with 6 cm irrigation water applied 3 days after drying, compared to conventional methods. Also, cost of production under SRI was half the cost of conventional cultivation.

Enhancing rice productivity through system of rice intensification (SRI) Subedar Singh, V. Venkatachalapathi, S.S. Parihar and A. K. Singh, Water Technology Centre, IARI, New Delhi (ss_wtc@iari.res.in)

This poster reported particularly on the effects of different cultivation methods on pest problems. On average, 1-day drainage increased grain yield more than 0.2 t/ha over 3-day drainage. Spacing of 30x30 cm increased grain yield substantially compared to 20x20 cm spacing, and both were more than 40x40 cm spacing. Transplanting 15-day seedlings gave maximum yield compared to 20-day or 25-day seedlings. "Rice under SRI resulted in higher grain yield over control." The reported results from different tillage practices on specific insect pests were very detailed. In general, zero-till transplanted plots had significantly lower pest populations than the other four tillage practices. Future research will focus on the definitive changes in microclimate that bring about population fluctuations.

On-going feasibility study of system of rice intensification (SRI) in Bhutan Karma Lhendup, Royal University of Bhutan, Sherbutse College (lhenkarma@yahoo.com)

A total of four on-going location-specific SRI traisls, both on-farm and on-station, are in progress (1600-2000 masl), to assess the responsiveness of different varieties to SRI practice. The poster gave estimated yields based on yield components (tillers, grains per panicle and expected grain weight), but it will be revised by end of October when the treatment plots, all with three replications, will be harvested. The most favorable combination of variety and SRI practices had an estimated yield >15 t/ha, but final figures will have to await the harvest and exact measurement. It is clear from the results so far that SRI methods can be successful in Bhutan in high-altitude cultivation.

I didn't find the abstract for a poster by Dr. S. Ramasamy from Tamil Nadu Agricultural University which I saw on Thursday and discussed with the author. I was pleased to learn that he was the same person who published an article in 1997 in *Field Crops Research* with Hein ten Berg of Wageningen University showing that rice plants performed better under unflooded conditions, in terms of N uptake and yield, then ones kept continuously flooded. This was one of the first pieces of research that helped me gain confidence that SRI results could be explained in scientific terms. It was good to know that he is now involved in SRI evaluation and explanation.

Concluding Thoughts

The 15 posters on SRI may not be a random or representative sample of SRI experience, but they represented systematic studies by serious professionals from a range of disciplines. Almost all showed positive responses to SRI methods or identified factors that could explain the yield differentials. They were just a few percent of the hundreds of posters presented, but they showed that there is an identifiable and expanding field of SRI research and demonstration.

One of the main difficulties for persons approaching SRI without any prior experience with the methods and their results in the field is to see such ***wide variation in results -- ranging from minimal or even negative responses to spectacular effects***. This does violence to the idea that causation is something regular, predictable, proportional, etc. This view makes two tacit assumptions (a) that rice yield were (only) a consequence of farmers' or scientists' actions, and (b) that these actions are working upon a genome that produces identical copies each time.

This ontological premise is quite untenable is two respects. (1) Phenotypes are always the product of interaction between genetic potential (genotype) and environmental influences. This is

known as the GxE effect, calling attention to the interaction between genetics and environment. This is widely known, but commonly given too little recognition. (2) Plants grow in a close and symbiotic relationship with soil organisms that has co-evolved over >400 million years. One IRRI paper reports that even irrigated rice plants that are (even heavily) fertilized derive only 30-40% of their nitrogen from inorganic sources; 60-70% comes from N fixation and N cycling in the soil (and probably also in the canopy, also known as the phyllosphere).

Accordingly, one should expect that there would be wide variations in plant performance according to soil biological conditions. Soils that are poorly endowed with soil biota would not respond to SRI management methods -- soil aeration, addition of organic matter to the soil in part through exudation from larger root systems that results from young seedlings, wide spacing, etc., not just from exogenous soil amendments. The idea that crop performance is primarily a result of 'our' actions -- rather than primarily due to 'natural' growing conditions that we can, if we are wise enough, bring closer to the optimum for plant health and growth – is widespread but mistaken.

That SRI can give widely varying results -- including some crop failures, just like any other system -- is to be expected if one appreciates the thoroughly biological nature of agriculture in general and of SRI in particular. Most of the presentations that I heard at the Rice Congress gave little thought or attention to such a bio-centric view of the rice production process. There is more attention given to SRI now than four years ago, and it is likely that there will be an order-of-magnitude more attention given to it at the next IRC in four years' time. If the success of SRI continues to accelerate at its present rate, there could several orders more interest and support.

Participants present at the end of an SRI participants' meeting at NCAP, September 11: Front row: P. K. Ghosh (Tripura); Karma Lhendup (Bhutan); C. H. Padmavathi (DRR); K. Surekha (DRR); Back row: P. Muthuraman (DRR); P. K. Sharma (Himachal Pradesh); P. V. Satyanarayana (ANGRAU); Bhuban Barah (NCAP); Vinod Goud (WWF); Norman Uphoff (CIIFAD); Abha Mishra (AIT, Thailand); Baharul Majumdar (Tripura); Rajendra Uprety (Nepal) (Picture taken by R. Mahender Kumar, DRR)