System of Rice Intensification in the context of Nepalese rice production

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Nepal is an agricultural country. Still more than 65% of its population is engaged in agriculture for their livelihood. Agriculture contributes 39% of GDP. Among agricultural crops, rice is main crop, cultivated on nearly 1.54 Million hectares of land. Total production of rice in 2002/2003 was 4.13 million tons, with average productivity of 2675 kg/ha. These data show that the productivity of rice in Nepal is not high (the world average is about 4000 kg/ha), and there is lot of possibility for making increments in productivity and total production.

Behind the low production of rice there are various factors such as older-generation seeds (most farmers have used their own seed for decades), low doses of chemical fertilizer, little use of improved cultivation practices, less care for plant protection, etc. Still, most rice growers are depending on compost and FYM as fertilizer use is still very low. [NTU: but this may not be all bad; SRI experience indicates that compost and FYM are better sources of nutrients than is chemical fertilizer -- why reinforce the stereotype that using compost and FYM is 'backward' while 'fertilizer use' is progressive? I think this is a wrong perception] Generally farmers use more then 60 kg of seeds/ha, transplant very old seedlings (30-45 days old), and plant many seedlings, 8-10/hill. These all factors are responsible for low productivity of rice in Nepal.

I read an article of Dr. Norman Uphoff on SRI published by LEISA, a Dutch NGO. In this I found many things which might be useful in Nepalese context. So I contacted Norman for more information about SRI. After collecting some good information, last year I started SRI in Morang district of Eastern Nepal. Last year there were two small plots less then 100 square meters with some practice of SRI (young seedlings, spaced planting, less water, and some weeding but no compost). We got more then 7 metric tons/ha yield with healthy plants (less diseases and pests). That result encouraged us and we disseminated knowledge to farmers about SRI through training, a monthly newsletter, and personal and group contact.

This information created a sensation among the farmers, and we found many farmers wanted to try this technology. But still farmers didn't fully believe in this technology. Most farmers wanted to visualize these results on another's field to gain confidence. But some innovative farmers tried the methods on their early rice. Three farmers planted early rice using SRI methodology. Two among them got nearly 6 metric tons/ha productivity with some practice.

One farmer, Mr. Udaya Narayan Nepal, planted 3 plots, with three different ages of seedling (8 days, 9 days, and 18 days). His land is upland with no irrigation facility, very low content of organic matter, and without compost. Despite these conditions, vegetative growth of his crop was very good. Tiller number reach up to 130/hill. All his neighbor who were teasing him initially become astonished to see his crop. Mr. Nepal was excited, expecting to harvest a bumper crop according to his tiller number. When the tillers reached panicle initiation stage, he was unable to provide irrigation to his rice and wilting symptoms appear in some plots. I too was very sad to see his crop. But even after this evident water stress, his crop produced a nice crop with up to 63 panicles/hill and up to 362 grains/panicle. We both became very happy with the nice result after the crop harvest. Details of production results are as follows:

S N.	Particulars	Plot no.1 Sundarpur-7	Plot no.2 Sundarpur-7	Plot no.3 Ithari-1
1	Rice variety	Bansdhan	Bansdhan	Bansdhan
2	Land type	Upland	Upland	Upland
3	Plot size (square meters)	400 sq.mt..	350 sq.mt.	400 sq.mt.
4	Date of seed sowing	April 13, 2004	April 13, 2004	April 13, 2004
5	Date of transplanting	April 21	April 25	April 30
6	Seedling age	8 days	12 days	17 days
7	Planting spacing (cm)	40 x 25	40 x 25	40 x 35
8	Number of weedings	3	3	2
9	Average tiller number (130 maximum)	107	98	78
10	Insect attack situation	Normal	Normal	Normal
11	Disease situation	No disease	No disease	No disease
12	Number of fertile tillers/hill Maximum Minimum Average	 59 18 37.8	 63 11 37.4	 50 10 31.9
13	Number of grains/panicle Maximum Minimum Average	 295 77 201.5	 362 69 167.9	 407 85 265.3
14	Fertilizer application	250:22:11 kg/ha NPK	250:22:11 kg/ha NPK	22.5 kg/ha N only.
15	Compost use	No compost	No compost	No compost
16	Date of crop cutting	August 31	August 31	September 5
17	Productivity mt/ha.	8.75	7.50	9.25
18	Average productivity of same variety with improved practices	4 Mt/ha		
19	Average productivity of same variety with farmers' practices	2.5 Mt/ha		

After completion of these demonstration/trials, the following conclusion can be summarized.

1. **Less water enhances tillering:** We found that if we keep our field in moist but somewhat dried condition (without standing water) this enhances tillering. Seedlings 15-20 days old also can produce many tillers. One of our farmers planted 20-day-old seedlings with SRI methods in moist soil conditions and his crop at 45 days reached 45-65 tillers/hill. If we maintain stagnant water on rice fields, the tillering rate will decrease. This finding needs to be investigated further in the coming season crop with replication.
2. **Young seedlings:** Young seedlings have immense tillering capacity, especially if the seed rate is also reduced (in this case, by more then 90%). For seedling production, a dry seedbed (like a vegetable nursery) is better then a puddled one. In some places we use solarization for nursery bed preparation by covering the nursery bed by a plastic sheet for 3 weeks. This enhances seedling growth and decreases nematode and other insect/disease incidence.
3. **Sufficient moisture during panicle initiation and flowering stage:** Moisture during panicle initiation and flowering stage promotes more fertile tillers as well as larger panicles with more grains. Our first and second plots had smaller panicles (with less grains) and less fertile tillers/hill (less then 50%) due to water stress condition during flowering stage, which produced less yield compare to the third plot. In the third plot, there were fewer tillers/hill (maybe due to the older age of seedlings), but at flowering stage, the moisture condition was somewhat better compared to other two plots because of the rainfall pattern the past season. This third plot produced more fertile tillers/hill, larger panicles (up to 30 cm) with more grains/panicle (up to 407 grains), and higher yield. With upland rice production, farmers to not have control over the rainfall timing. In irrigated systems, they should be able to provide small amounts of water as needed throughout the plants' growth cycle, with special attention to the panicle initiation and flowering stage.
4. **SRI crops can tolerate water stress conditions better than normal crops:** As mentioned above, we were disappointed and depressed to see the crop during the flowering stage due to water stress. Generally in such conditions, rice plants cannot produce many panicles and give very low yield. But our SRI plots produced more then 8 mt/ha. This showed that the SRI crop could tolerate water-stress conditions because of its long and well-developed root system.

5. **Organic matter content in soil:** For a better crop using SRI, we need organic soil amendments instead of more chemical fertilizers. Organic soil has more water moisture-retention capacity, and also root development will be better in such soil.
6. **Square system is better then rectangular system of planting:** For transplanting rice, the square system is better for overall development of crop and production. For Indica type rice, spacing should be more than 35 cm in both directions if we are going to use young seedlings. For Japonica and short-duration varieties, it must be keep 25 cm or less in both directions. We used SRI with one 87-day variety, and it produced 12-27 fertile tillers/hill with 40x25 cm spacing and with good-sized panicles, but production was not so high. So closer spacing could in that case produce better yield. Next year we will try it with different spacings.
7. **Further steps:** We need to acquire more information and explore systematically the condition-specific potentialities of rice plants. We need to conduct several studies in collaboration with farmers. We also need to communicate/disseminate more information on SRI and its crop results to other part of the country through organized efforts.

Why SRI will useful for Nepal?
At present, Nepal has:
Rice cultivation area: 15,44,660 ha. (with more then 9,00,000 ha. having irrigation facilities)
Productivity of rice: 2675 kg/ha. (national average for 2002/2003)
Seed requirement: 92679.6 Mt. (at the rate of 60 kg/ha)
Area of rice cultivation in hill and mountain regions:
4,39,157 ha. (with 1,85,509 ha having irrigation facilities)
Food deficit in hill and mountain regions: 4,04,468 Mt.

By using SRI we can
Save seed for consumption: 77,233 Mt. (21,958 Mt. in the hill and mountain regions)
If we introduce this technology on only in 10% of land and increase yield by only 1 Mt/ha (SRI potential is 2-3 times more than the present productivity), we can produce more:
In Nepal as a whole: 1,54,466 Mt.
In hills and mountain region: 43,915 Mt.

We need more food for our difficult hill and mountain areas. Food supply is very difficult in these areas from outside due to lack of transportation facilities. Supply there of modern inputs (improved seeds and chemical fertilizers) is also very difficult and costly. SRI has potential for more production based on locally available inputs. So this technology will be a good opportunity for this country to alleviate its food crisis in the hills and mountain areas as well as to increase production of rice in whole Nepal.