The System of Rice Intensification
Agro-ecological opportunities for small farmers?

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Besides Madagascar, where it was developed in the 1980s, the system of rice intensification (SRI) is now showing, also in other countries, that it can be more productive than other methods for growing irrigated rice.

A full description of the SRI methodology can be found in the ILEIA Newsletter 15.3&4, pp48-49 with additional information in ILEIA Newsletter 15.4, p.12.

Encouraging results

A recent communication from Sri Lanka reported SRI yields between 9.3 t/ha for a traditional variety (*Rathhel*) and 17.8 t/ha for an improved variety (BG-358) (Gamini Batuwitage, Additional Secretary, Ministry of Lands). Communications from Cuba have reported yields of 9.1 and 9.6 t/ha for first-time users of SRI, working from written instructions (Rena Perez, Advisor, Ministry of Sugar).

SRI gives healthy plants and higher yields
Photo: Association Tefy Saine

Trials with SRI during 2000 at the national agricultural research station at Sapu, The Gambia, gave yields between 5.3 and 8.5 t/ha (Mustapha Ceesay, former director of Sapu station). Two analyses of SRI yields on farmers' fields in two different areas of Madagascar over a five-year period, involving over 1,000 farmers, showed an average of 8 to 9 t/ha (data from Association Tefy Saina around Ranomafana, 1994/95-1998/99; and from a French-assisted project on the rehabilitation of small-scale irrigation systems around Antsirabe and Ambositra during the same period).

Results with SRI practices naturally differ from place to place, between seasons, and across varieties. There is surely also a skill factor involved in how well farmers observe their fields and how carefully they manage the plants, soil, water and nutrients.

Agroecological management - the key

Agroecological management requires attuning practices to crops and conditions, rather than applying a fixed set of practices. The latter "technological" management assumes that the most determining factors are genetic, rather than the management of interactions between genetic potential and environmental conditions which guides an agroecological approach to crop production.

SRI has revealed for rice –and possibly also for other crops- that there exists a substantial genetic potential that can be effectively tapped by adjusting the agronomic management practices. Association Tefy Saina, which has pioneered the work on SRI in Madagascar, has shown that SRI practices will double production for practically all of the rice varieties, local or improved. Indeed, the highest yields with SRI methods have come from "improved" varieties: a World Bank 1996 report on rice in Madagascar, noted that four farmers in the Andapa region who used SRI methods with the high-yielding variety (HYV) IR-46, developed by the International Rice Research Institute, averaged 13.7 t/ha, with one farmer reaching 16.5 t/ha. Similar high yields were obtained in the Ranomafana area with x265, derived from IR-15, and 2067, descended from Tainung-16, a Chinese HYV. Note that the government research agency FoFiFa reported the average yield from 2067 as 5.6 t/ha, with a 'maximum observed yield' of 7.7 t/ha. In the 1998-99 season, a farmer near Soatanana, in his sixth season using SRI, had a yield of 21 t/ha with 2067, more than 10 times the national average (CIIFAD 1999, p.47). Based on these results one may well question whether, indeed, research in genetic engineering can be as effective in raising yield levels as research in agronomic management.

Is genetic modification necessary?

Thus the SRI experience leads one to two very different conclusions:

1. There appears to be ***a large genetic potential in existing rice varieties*** that can still be tapped through agroecologically sound practices. This would imply that genetic modification efforts are not necessary, at least for some time to come, if increasing food production and lowering costs of production are the main objectives. Farmers at Namal Oya in Sri Lanka found not only that SRI methods raised their yields from 2.9 t/ha with conventional

methods to 8.5 t/ha, but they also calculated that it reduced their costs of production, from 6 rupees/kg to 3 rupees/kg.

2. Agroecological methods of crop production appear to give ***better results with genetically-improved varieties***. Some varieties have a greater potential for tillering, root growth and grain filling than others in response to wide spacing, aerated soil, and other SRI practices. Quite likely, though we have not been able to evaluate this systematically, some varieties would also have better pest and disease resistance, or greater drought tolerance, when grown with SRI practices. This implies that there is still considerable potential for conventional breeding and selection to identify varieties that are specifically adapted and responsive to SRI practices.

The question of whether *transgenic* research is justified or needed is different from whether *genetic improvement* should be undertaken. There may be risks with the former that are as yet inadequately assessed, and one can reasonably object to companies with criteria of success based more on private than on public interests directing and driving the process of genetic modification. Such 'broad-spectrum' objections don't apply to conventional genetic improvement towards SRI adapted varieties.

SRI Field. Photo: Association Tefy Saine

Soil health - essential for increasing yield

A different line of criticism of GMOs would be that a preoccupation with genetic changes deflects efforts from studying and improving what may be the most important factor in increasing yield: the management of natural resources. As we work with SRI and try to explain differences in plant response to the different management practices, our attention is increasingly directed to differences in soil quality, or more metaphorically, in soil *health* as understood in terms of soil biological activity.

There has been much concern about the conservation of biological diversity in recent decades. Almost all efforts have focused on above-ground flora and fauna. We think that soil biodiversity - the vast and complex communities of bacteria, fungi, mycorrhiza, actinomycetes, protozoa and nematodes as well as earthworms and other soil 'megafauna' - holds the key to high productivity with SRI methods.

Given such high yields from some of the poorest soils in the world, one would expect yields to decline over the years. This is certainly to be expected when only low-quality organic material is applied, rather than nutrient-rich chemical fertilizer. Yet, farmers find that their yields usually increase from year-to-year. This we think is due to increases in the variety and number of micro-organisms playing different roles in plant nutrition such as biological nitrogen fixation and phosphorus solubilisation.

SRI is not necessarily an 'organic' methodology; it can be used with agrochemicals. But the systematic evaluations we have done so far show that continuous use of compost gives higher yields than does NPK fertilizer. Also, pest and disease problems under SRI are usually not serious enough to warrant the use of biocides, and thus a 'healthy' soil can be maintained, which in turn further reduces the need for chemicals.

Optimal use of resources

Much research and evaluation remains to be done on SRI. It will not be appropriate or feasible in all rice-growing areas, e.g. there needs to be sufficient irrigation and drainage infrastructure to control water applications and maintain well-drained soils. Although the SRI practices may have the potential to double or triple the production of rice in the world, this is not a reasonable goal or use of the methodology. Rather it should give small farmers additional opportunities to raise the productivity of their land, labour and water resources, while trying to meet their staple food requirements.

Ultimately, productivity is what is most important to farmers: how to get the most from their limited land, labour, capital and (increasingly) water. Understanding *the sources and biological processes* that lead to increased productivity should be a researcher's overall priority, while working closely with farmers. We think that SRI confirms the general value of an agroecological perspective, and that this should increasingly guide agricultural research, not only for rice but also for other crops (Stoop et al. 2002).

Further genetic research will be more beneficial if it is linked to agroecological theory and practice, not assuming that gains in productivity are due only or even primarily to genetic improvements.

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References:
- CIIFAD (1999). **Annual Report, 1998-99**. Ithaca, NY: Cornell International Institute for Food, Agriculture and Development.
- **Stoop, Willem, Norman Uphoff, and Amir Kassam (2002).** A review of agricultural research issues raised by the System of Rice Intensification (SRI) from Madagascar: Opportunities for improving farming systems for resource-poor farmers. ***Agricultural Systems* (in press).**

Non-GE approach to salt tolerant rice

As the problem of salty soils grows, so does the search for salt tolerant rice. In parts of Northeastern Thailand rice harvests are seriously decreased due to salinity. Much of the research in the last years has relied on molecular biology to find salt-tolerant genes and move them to the desired plant species. However, Chalermpol Kirdmanee of the National Centre for Genetic Engineering in Thailand has a breakthrough that is not based on transgenic plants. By searching through the country's rice "gene bank", a collection of 7000 indigenous varieties, Chalermpol selected 4 that can withstand high levels of salt. He says, "We can't grow genetically modified organisms in Thailand, so I wanted to find something that farmers could use." He credits the country's rich biodiversity with his progress.

The newly selected rice strains are part of a larger project to find salt-tolerant plants for Northeast Thailand. In a four-year field experiment conducted by Chalermpol's lab, salt-tolerant grasses and trees reduced the level of salt in the soil from 10% to less than 0.5%.

Source: "Salt of the Earth" by Anne Marie Ruff, The Far Eastern Economic Review