Evaluations of the System of Rice Intensification in Fianarantsoa Province of MADAGASCAR

Bruno Andrianaivo, FOFIFA, Fianarantsoa

The province of Fianarantsoa is situated in the south-central highlands of the country, with elevations between 1200-1500 m above sea level, at longitudes 47°-45° and south latitudes of 21°-22°. SRI was introduced into the Fianarantsoa province in the 1990s by Père Henri de Laulanié with the NGO, Association Tefy Saina (ATS). Dissemination of SRI in the Fianarantsoa region has been done by several institutions and projects: ATS with CIIFAD in the Ranomafana Park peripheral zone, and with the African Highland Initiative (AHI) of the CGIAR system; a Catholic Relief Services (CRS) project with the Fianarantsoa diocese; the Landscape Development Interventions (LDI) project funded by USAID; and FOFIFA in cooperation with CIIFAD, as reported below.

Evaluations

One of the first evaluations was done in 1998 by CIRAGRI, the governmental extension agency. Five types of trials have been done since 2001 under FOFIFA auspices with support from a Rockefeller Foundation grant through CIIFAD:

1. **Density of transplanting** with trials involving different spacing patterns (from 20 x 20 to 50 x 50 cm) and number of seedlings (1 to 3) per hill.
2. **Water control** in combination with different types and frequencies of **weeding**:
   - Water application periodically and shallow vs. continuous deep water.
   - Use of herbicides vs. rotary weeding under intermittent irrigation conditions.
3. Study of **soil management and fertility** comparing **organic and inorganic fertilizer**:
   - Use of **compost** vs NPK.
   - Long-term fertility trial evaluating the residual effects and cumulative effects of **organic matter** on the rice-based cropping system.
   - Evaluation of a **rotational cropping system** alternating an unirrigated, inter-season crop with irrigated rice production, where compost is applied to the former but not the latter.
4. Study of the relationship between **root development of seedlings** and physical soil properties in the nursery.
5. Evaluation of **blast infestation** on two most promising varieties for SRI (2067 and x265) under conditions of high soil fertility.

Experimentation with SRI has been going on for two years, 2001 and 2002. Participatory research started in the first year with experiments on SRI conducted with 10 farmers on their own fields. The next year, those farmer-experimentors became rural animators, and we found that SRI adoption has spread to over 13 hectares located in five valleys. The number of participants has increased to 23 families.

The verification technology trial was carried out at CAPR Tsionjohezaka, a center for professional development in agriculture, where 50 young farmers are trained in SRI methods. All of those activities are located within four valley areas around Fianarantsoa town, are supervised by myself and are undertaken with the collaboration of CIIFAD.

At the beginning in 2001, one local variety (*Vary vato*) and five improved varieties of irrigated rice were tested with SRI methods, both japonica (Yumehika, Omachikane, and 2067) and indica (X265 and Soameva).

Soil types

Major lowland irrigated rice fields in Fianarantsoa region are divided in three types of soil:

- Loamy-clay — with good water management capabilities
- Loamy-sand — usually cultivated as rainfed lowland.
- Peat soil — high organic matter content, with deep water in flood-prone areas.

Climate

The highlands of Madagascar are characterized by a subtropical climate. Annual rainfall average is recorded as about 1375 mm with a maximum at 368 mm. The rainy season occurs during the hot months in the year. The average temperature is over 20°C within that period. It decreases to 14°C in July and reaches 21°C in January. Fianarantsoa region is often affected by cyclonic perturbations during the rainy season.

Results

Average yield in the Fianarantsoa region is 2 t/ha with traditional practices, i.e., transplanting mature seedlings more than 45 days old into flooded paddy soil without any fertilizer application, and weeding just once. Irrigation is continuous with depths of more than 10-20 cm. Typically, the field is left fallow after the irrigated rice crop. Even partial SRI, i.e., using young seedlings with the traditional land preparation and other practices, can give a higher yield, as much as 6 t/ha.

SRI in Fianarantsoa is increasingly linked with the use of compost in rotational cropping where potatoes, beans or other vegetable crops are planted in the off-season *(contre-saison)*. We have attained rice yields of more than 8 t/ha the first year using limited, i.e., intermittent, water application along with other SRI practices. The residual and cumulative effects of the soil organic matter coming from compost applied to the off-season crop occur in the second and succeeding years, when rice yield can increase up to 16 t/ha.

One should not expect that the maximum attainable yield will be achieved with SRI practices in the first or the second year. However, by the sixth year we have measured yields as high as 20 t/ha around Fianarantsoa, on farmers' fields in Tsaramandroso, Talatamaty and Soatanana.

As seen from data in Table 1 on page 142, SRI raises the productivity of labor quite substantially. With a yield of 8 t/ha from SRI practices, a net return calculation shows this to be 5 million Fmg for SRI (about US$770), figuring transplanting as requiring 40 mandays/ha of labor, compared to a return of around 250,000 Fmg, less than US$40, with traditional methods.

Many changes are now occurring with the use of SRI:

- More and more farmers are fertilizing their soil with **farmyard manure or compost**, which promotes positive soil biological processes. Increasingly, compost is being incorporated into the soil for the unirrigated off-season crop that precedes irrigated rice.
- An important and specific result from farmer experience with SRI around Fianarantsoa is a **rotational cropping system** that plants crops, usually vegetables, even twice rather than just once, during the dry season between wet seasons when rice is grown. Increasingly, farmers grow potatoes in their rice fields followed by beans or other vegetables before completing the cycle with an irrigated rice crop.
- Many farmers now utilize **rotary weeders** as well as doing intermittent (alternating wet-dry) irrigation. Also, random transplanting is being replaced by planting in rows or a square pattern.

Learning

Some difficulties have been encountered when farmers using SRI are constrained in their use of compost by not having enough biomass or manure for a large planted area. There is often not enough plant biomass or manure production in the Fianarantsoa region. So farmers need to **develop integrated agro-livestock systems** for maximum production. Or they should take steps to increase the growth of biomass on land around them that is otherwise unused. Leguminous species such as tephrosia and crotalaria grow well in Madagascar even on poor soil.

We found a positive impact on farmer incomes from **diversified cropping with SRI** through development of *rotational cropping systems*. Money from potato and bean production is used to pay for wage labor during land preparation, transplanting and weeding in rice cultivation. Also, the off-season crop contributes to better soil fertility for the following SRI crop.

Prospects

We have been found the utilization of diverse sources of information and experience is important for good technical support. Particularly we should take advantage of the **indigenous technical knowledge** (ITK) of certain Malagasy farmers who are very knowledgeable and good observers. We have found that a participatory research approach involving the effective involvement of farmers and researchers working together is an important strategy for evaluation and dissemination.

The main impediments to be overcome: We need a better understanding of **how to enhance the advantages to be gained from accelerating biological processes in the paddy field.** The fertility of soil is found to be the main factor required for successful intensification of the rice crop, and this depends on a combination of different plant, soil, water and nutrient management practices.

We have found that with certain intensification practices, there can be a problem of **high rate of grain sterility** and sometimes **lodging** of rice plants. This needs to be evaluated further to minimize such problems with SRI methods.

Table 1. Economic analysis of rice production in Fianarantsoa calculated in terms of costs and returns per hectare (monetary values are given in Francs Malgache [Fmg] with US$1.00 = 6,500 Fmg)

		Traditional practices[a]			SRI methodology[b]		
Activities	Units	*Qty*	*Unit Cost*	*Cost*	*Qty*	*Unit Cost*	*Cost*
Nursery operations							
Land preparation	Man/days	6.5	4,000	26,000	3.5	4,000	14,000
Sowing and related activities	M/d	3	4,000	12,000	1.5	4,000	6,000
Removal of seedlings	M/d	10	4,000	40,000	2.5	4,000	10,000
Transport of seedlings	M/d	10	4,000	40,000	2.5	4,000	10,000
Manure cost	Cartload	2	5,000	10,000	1.5	5,000	7,5000
Transport/broadcast manure	M/d	2	4,000	8,000	1.5	4,000	6,000
Rice seeds	Kg	80	1,000	80,000	6	2,000	12,000
Sub-total	Fmg			**216,000**			**65,500**
Field operations							
Plowing	M/d	36	4,000	144,000	43	4,000	172,000
Harrowing	Plower	5	15,000	75,000	5	15,000	75,000
Puddling	Harrower	6	15,000	90,000	6	15,000	90,000
Transplanting	M/d	36	4,000	132,000	40	4,000	160,000
Irrigation	M/d	60	4,000	240,000	25	4,000	100,000
Weeding	Weeder	0	0	0	24	5,00	120,000
Manure cost	Cartload	5	20,000	100,000	5	20,000	100,000
Transport of fertilizer	Cartload	5	4,000	100,000	5	20,000	100,000
Incorporation of fertilizer	M/d	5	2,000	20,000	5	4,000	20,000
Basket cost	Number	10		20,000	10	2,000	20,000
Sub-total	Fmg			**921,000**			**957,000**
Harvest							
Cutting and transport	M/d	53	4,000	212,000	77	4,000	308,000
Threshing and drying	M/d	15	4,000	60,000	89	4,000	356,000
Cleaning and storing	M/d	10	4,000	40,000	26	4,000	104,000
Sub-total	Fmg	**78**	**4,000**	**312,000**	**132**	**4,000**	**768,000**
Revenue from production	Ton	2	850F/kg	1,700,000	8	850F/kg	6,800,000
Total costs of production	M/d	243		1,449,000	251.8		1,790,500
Net return per hectare	Fmg			**251,000**			**5,009,500**

Sources: [a] DIRA, Fianarantsoa, 1998; [b] Data gathered by author, 2002.