DRAFT FOR FINAL REPORT OF MADAGASCAR SRI CONSORTIUM TO THE RF FOR GRANT, 1999 – 2003

ATS – ESSA – FOFIFA – CIIFAD/CU

I. ACTIVITIES UNDER THE GRANT: EVALUATION OF SRI PRACTICES AND POTENTIALS ON FARMERS' FIELDS

FOFIFA activities under the Rockefeller grant extended from 2000 to 2003, having started a year earlier with CIIFAD support, with three years of experiments related to SRI, designed and carried out on farmers' fields especially in the highland region of Madagascar and then dissemination efforts in the fourth year.

- 1999-2002, there was evaluation of the potential of SRI practices in Fianarantsoa province, followed by some technology verification trials
- 2003, dissemination of SRI results extended from Fianarantsoa to Antananarivo province.

The objective was to increase rice yield by looking for the best technical practices on rice intensification in diverse agro-ecological conditions. In 1999 in the Ranomafana region, there was one experiment for cultivation in an upland area, using mulch on rainfed rice field to find an alternative to slash-and-burn cultivation before RF funding became available. From 2000 to 2003, six experiments on SRI for irrigated lowland areas were conducted on farmers' field to assess alternative combinations of practices:

1. *Transplanting density :*
   Changes in chemical, physical and biological properties of soil occur under intensive rice cropping conditions. During the transplanting of seedlings in paddy fields, spacing between hills may need to be varied according to soil fertility and rice variety. As treatments for these trials, three seedling densities (1, 2 or 3 per hill) were evaluated with four spacings (20, 30, 40, or 50 cm in a square pattern). Current SRI recommendations are for 1 seedling per hill, but possibly with different soil conditions or varieties, this may not be optimal. Wider spacing is recommended with SRI, but what exact spacing will give optimum yield likewise depends on these factors.

2. *Water control*
   Correlation between the development of roots system and the upper vegetative part of rice plant has been known for a long time. Some effects of soil moisture such as aerated soil vs. saturated soil were studied. The triald were focused on the influence of a stable water level for the evolution of plants' growth and development, as well as for root development, tillering capacity, and finally panicle formation. Four water levels were tested (dry, shallow, deep, and very deep water) at three periods (vegetative phase, reproductive phase, or continuously during both the vegetative and reproductive phases).

3. *Weeding control*
   Soil aeration and suppressing weeds seem to be the result of using a rotary weeder four times on the rice field during the tillering stage. An experiment comparing the use of herbicide, manual weeding, and mechanical weeding was done to assess their labor cost and efficiency for weed control. The effect of timing of herbicide application on young seedlings was studied also.

4. *Soil fertility and fertilizer for rice*
   In general, paddy fields in the highland of Madagascar have low fertility without any amendments of fertilizer. Phosphorus deficiency is common with these soils. An experiment was done comparing the efficiency of compost and chemical fertilizer, respectively, for increasing rice productivity. The rice intensification program is oriented to the integrated use of inorganic and organic fertilizers.

5. *Rotational cropping system on irrigated lowland area conditions.*
   Usually only one crop a year is grown in the highland, given temperature constraints, so paddy fields are left in fallow, uncultivated for six month after the harvest of rice. Recently we have become concerned with factors stimulating uptake of nutrients (mainly N, P, and K) by roots of rice plants, for example *mycorrhizal associations* in the rhizosphere, establishing a symbiotic nutritional system between roots and fungus in the soil. We conducted a trial on the rotational cropping of potatoes and irrigated rice in the paddy field.

6. *High-yielding varieties.*
   Fertile soil with rice intensification can involve sometimes disease problems certainly due to high rates of nitrogen application to the soil. A set of trials was done using tall (indica) and short (japonica) varieties that were, respectively, sensitive and resistant to blast. The purpose was to assess the health and productivity of plants bred for high yield.

II. FINDINGS: EVALUATION OF SRI PRACTICES AND POTENTIALS ON FARMERS' FIELDS

Some adjustments of SRI practices can be suggested based on findings from the FOFIFA trials during the three years of experimentation.

1. *Young seedlings no more than 8 days old can be used even under temperate climate.*
In the nursery, the young sprouted seeds need warm cover for accelerating their growth. Seedlings with 2 leaves can be obtained within 8 days by spreading over the seeds some powdered chicken manure, after putting on a thin layer of rice straw, and putting on top a plastic cover. Every morning, pull off the plastic cover and sprinkle the bed with water and then after 4 days, pull off all covers over the seed bed which will begin to show the first leaf of seedlings.

2. *The short length of their roots makes easier the transplanting of young seedlings.*

In the seedbed, experimental results showed that seedlings with roots only 3 cm in length can be obtained on compacted soil surface. So it is fast and easy to transplant such young seedling, and the number of labor-days needed is reduced to 23 man-days for transplanting one hectare of paddy field. This makes SRI similar to the conventional practice (SRA) in the matter of labor cost.

3. Seedling density in transplanting should necessarily be one per hill.

Our experimental results showed that the number of seedlings per hill did not have a significant effect on rice yield, given the soils and the variety used in the trials. Other trial have showed a significant difference between 1 and 3 seedlings per hill. For example, factorial trials conducted for the University of Antananarivo at Morondava and Anjomakely in 2000 and 2001, where the number of trial plots was 288 and 240, respectively, showed an average yield increase, other practices being equal, of almost .5 t/ha for 1 seedling/hill vs. 3 seedlings/hill. Nevertheless, in the trials conducted by FOFIFA under this grant, transplanting 1, 2 or 3 seedlings per hill gave essentially the same grain yield. Whether 1, 2 or 3 seedlings per hill will be most productive can vary with variety and soil characteristics, so what will be best practice should be determined by experiments for each circumstance. Spacing between hills did give a highly significant difference (see Tables 1 and 2 in Appendix).

The best density of transplanting depends on soil fertility and also on each plant type. For instance, when transplanted at a spacing of 30 cm in a square, a tall variety like *Mailaka X265* can give the best yield. Beyond this optimum, there is evidently a decrease of yield. Either plant lodging occurs with narrow spacing 20x20 cm or there is underutilized soil surface with large spacing 50x50 cm.

4. Mailaka X265 *appears to be the most suitable variety for the agroecological conditions in highland Madagascar.*

This Indica variety has:

- Good capacity of tillering with SRI management, with more fertile tillers (panicles).
- Good (efficient) response to fertilizer supply
- High yielding performance.

5. *Aerated soil due to careful water management applying a minimum of water, supported by weed control measures and rotational cropping, gives best results.*

Experimental results showed that aeration of the paddy soil is important for root development and plant nutrition. An average grain yield at least 8 t/ha was fairly consistently obtained by using new intensification methods such as practicing:

- Vegetable cropping in intervening dry season followed by intensive rice cropping in wet season.
- Water management with a system of alternating dry soil and wet soil by irrigation.
- Weed control and simultaneous aeration of soil by practicing weeding with a 'rotating hoe' 4 times before canopy closure.
- Biological fertilization of soil by use of good compost which is applied earlier on the potato crop that is grown preceding rice.

APPENDIX

Table 1. Effects of seedling number transplanted on grain yield (t/ha) of rice variety *Mailaka X265*

Spacing (cm)	1 seedling	2 seedlings	3 seedlings
20 x 20	10.4	9.2	8.8
30 x 30	8.2	7.5	8.8
40 x 40	7.3	6.8	7.5
50 x 50	5.5	6.1	6.9
Average	7.8 *a*	7.4 *a*	8.0 *a*

Table 2. Effects of different densities of transplanting on grain yield (t/ha) over three years (1999 – 2002).

Spacing - Seedling No.	1999	2001	2002
20x20 – 1	10.4*		
20x20 – 2	9.2*		
20x20 – 3	8.8*		
Average 20x20 cm	9.4 *a*		
30x30 – 1	8.2	10.5	5.4
30x30 – 2	7.5		8.9
30x30 – 3	8.8	12.5	12.9
Average 30x30 cm	8.1 *b*		
40x40 – 1	7.3		
40x40 – 2	6.8		
40x40 – 3	7.5		
Average 40x40 cm	7.2 *b*		
50x50 -1	5.5	7.9	
50x50 -2	6.1		
50x50 -3	6.9		
Average 50x50 cm	6.1 *c*		

p.p.d.s 0.01 = 1.1t/ha

* Appearance of plant lodging

Table 3. Data recorded on demonstration plots of Indica rice variety *Mailaka X265* transplanted at 1, 2 or 3 seedlings per hill.

	1 seedling	2 seedlings	3 seedlings
Hill no. /0.009 m^2	1	1	1
Hill no./m^2	11	11	11
Panicle no./hill	21	41	60
Weight (g) of full grain/hill	53	87	126
Full grain no./hill	1938	3380	4674
Weight (g) of 1000 grains	25	25	26
Grain number/ panicle	69	82	78
Yield (t/ha)	5.4	8.9	12.9