An NGO Perspective on SRI and Its Origins in MADAGASCAR

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Association Tefy Saina is a small NGO that works on training for rural development in Madagascar. It was established in 1990 with the assistance of Father Henri de Laulanié, S.J., a trained agriculturalist, in order to carry on and further develop his three decades of work for agricultural and rural development in Madagascar.

The name of our Association means "to develop the mind." This name indicates that development must involve, above everything else, the whole person, and not just certain skills but also the capacity for thinking, so that each person takes responsibility for himself, for others, and for his or her environment.

Since its creation, our Association has set itself the principal and urgent task of developing and diffusing the System of Rice Intensification in Madagascar which Father de Laulanié formulated over several decades of working with farmers to help meet people's food needs.

Rice—An Essential Food

Rice is the most important food crop in Madagscar. In our Malagasy language, we say "to eat means to eat some rice." Malagasy people think that unless you have eaten rice, you have not had a proper meal. So Madagascar has one of the highest levels of rice consumption per capita. However, this level has been declining. Sixty years ago, Malagasys had 150 kg of milled rice per capita each year; now they have no more than 110 kg. Such a decline could be due to increased affluence, but in Madagascar this reflects a growing population size and very low yields. Annual rice production needs are 2.5 million tons to feed 15 million inhabitants.

In rice farming, two methods coexisted in our country before the introduction of SRI. First, there were traditional methods, inherited from our ancestors and passed from fathers to sons without specific training. This system is characterized by planting randomly very mature seedlings, sometimes two or three months old, putting several seedlings in each hill, even up to 10 plants per hill. The paddies are kept always inundated with water.

In the past 60 years, improved methods known as le Système de Riziculture Ameliorée (SRA) have been introduced in the country: transplanting plants 3 or 4 weeks old in rows; 1 to 3 seedlings per hill; and into paddies kept similarly saturated with water. With these methods, it is strongly recommended to utilize chemical inputs like fertilizer. Even with the spread of SRA, however, the average national yield has remained only about 2 tons per hectare (t/ha), very low productivity.

The Discovery of SRI

SRI was developed mostly through the long and hard efforts of Fr. de Laulanié, but its crystallization was in fact partly by accident (Laulanié 1993). After coming to Madagascar from France in 1961, this wonderful and inspiring man worked very closely with farmers and with rice plants to try to help Malagasy peasants improve their agricultural practices and results.

Fr. DeLalaunié had trained in France before World War II at the Institut National Agronomique (INA) in Paris, but only after coming to Madagascar did he begin to learn about rice. He worked alongside farmers to learn what they knew about rice, without any preconceived ideas about how rice should be grown.

At first, he worked with the improved methods (SRA) described above and taught them to farmers. But being open-minded, he noted two things:

- Rice plants have very great tillering potential under the right conditions; and
- The best harvests of rice are obtained with soil aeration.

He started transplanting single seedlings per hill, which he saw practiced in some regions of the country, and he recommended that farmers follow this method. He also saw that some farmers did not keep their fields continuously flooded but rather they dried their fields out for certain periods of time, with beneficial effect. In order to utilize more fully the push weeder that extension agents were promoting at the time for row-

planting, he tried planting rice plants in a square pattern. This way, the rotating hoe (*houe rotative*) could be used perpendicularly in two directions, and the wider spacing also encouraged plant growth.

In December 1983, at Antsirabe where he had established a training center for young peasants, Fr. de Laulanié made the breakthrough that launched SRI when he asked his students to plant seedlings that were only 15 days old. There was a prolonged drought that year, and when there was some rainfall, Fr. de Laulanié thought it would be less risky to transplant the tiny seedlings than to count on there being enough rain again when they reached the maturity that was normally used, 30 days. The students being young did not challenge the priest, but probably none of them believed that planting such young seedlings could be successful.

Father de Laulanié wrote later about this experiment: "The results struck like lightning as a technique that I had considered to be an exception became the rule for our paddy cultivation. I had never harvested so much rice before. The tillering reached 20-30 tillers per plant, which was fantastic." He subsequently recommended that rice farmers adopt this new method of transplanting very young seedlings, only 15 days old. He talked about this method to the government's research and extension services and to technicians at private training centers for rural development. But nobody was willing to believe him that this practice gave such good results.

Indeed, agronomists and other specialists in rice science said the reported results were not possible, that they were above the biological yield ceiling for rice. They rejected this new system without themselves ever undertaking any trials to test what he was suggesting. Peasants generally listened to the priest's talk in silence. He could feel that they did not want to change the long-standing practices in which they strongly believed, having inherited their accustomed techniques from their ancestors.

Father de Laulanié in making his recommendations at first did not have any theoretical justification to support his ideas. He had to wait until 1988 to give this system a solid scientific explanation, as discussed below. Mostly he had to rely on the cooperation of young peasants who had themselves seen the results of rice cropping with SRI methods, and on a few groups of isolated peasants here and there and on religious congregations of women who were willing to persevere with this system. The progress was very slow.

Father de Laulanié encouraged those working with him to undertake trials with seedlings even younger, only 12, 10, even 8 days old, with larger and larger spacings to see what would give best results. Those willing to make these changes in conventional practice were not disappointed, because the new methods could usually double their traditional yields and sometimes give even more. They initially called this new rice farming method "eight-days transplanting."

The Katayama Model of Rice Tillering

As noted already, a theoretical base of scientific explanation was missing for Father de Laulanié to convince those who challenged his empirical results. This unfortunate situation continued until 1988 when he happened to read a book on rice from France. In this book, Moreau (1987) presented a model of rice tillering that had been developed more than 50 years before by the Japanese researcher, T. Katayama (1951). According to this model, tillers emerge in a sequence that is governed by a sequential pattern, defined in terms of regular time intervals known as "phyllochrons." The duration (or length) of a phyllochron depends, among other factors, on temperature, the number of degree-days, and seed variety. For rice, a phyllochron varies from 5 or 6 days to 8 days or even more.

The Katayama model of tillering presented by Moreau is a genealogical table that is complex and not easy to understand.[1] So Father de Laulanié spent two years studying it and transforming it into a simplified table that is amenable to some statistical analysis. We refer to this now as the "Katayama-de Laulanié tillering model." It shows that three phyllochrons (growth periods) after the main tiller emerges, i.e., during the fourth phyllochron, a first primary tiller issues from the base of the main tiller, and then a second primary tiller emerges in the fifth phyllochron, etc.

Tillering development follows an exponential law that is evident once one understands the function of phyllochrons, though only with rice plants that are growing in aerated soil so that their roots are not dying back. It is this degeneration, common with continuously irrigated rice, that causes what is conventionally called "the maximum tillering stage" to precede panicle initiation. With SRI practices, maximum tillering and panicle initiation generally coincide.

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[1] *The full Katayama table can be found on pages 223-226 in Volume I of the English translation of the Japanese encyclopedia of rice science edited by Matsuo et al. (1997).*

When growth is not constrained by sub-optimal environmental conditions, the total number of tillers will follow what is known in biology and mathematics as a Fibonacci series, where each stage's number equals the sum of the preceding two stages (see middle row of table below). This model operating through 12 phyllochrons of growth is summarized in Table 1. With ideal growing conditions, it is possible for rice plants to continue their tillering into a 13th and even 14th phyllochron of growth, exceeding 100 tillers or more.

Father de Laulanié wished to meet Katayama, and in 1992 he asked the Japanese Ambassador in Madagascar to help make contact so that he could explain this model of tillering development and get feedback and corrections from the originator of the model. Unfortunately, it turned out that Katayama had died several years earlier.

Agronomic consequences of model

For Father de Laulanié, the agronomical consequences from this model were evident:

1. The autonomy of tillers was reaffirmed. All of the tillers have their own leaves and their own roots.
2. There is evident solidarity among tillers: the formation of new tillers depends on the support of existing ones. Normally, five tillers can beget three new ones, with an average ratio of 5:3, or about 1.66.
3. A reasoned calculation of the best transplanting dates is possible with the tillering model. Transplanting should be done during the second phyllochron, or at latest during the third, to permit rice to recover more quickly from its trauma and stress of transplanting. Below are the transplanting dates worked out for Madagascar. Rice farmers can better schedule their work planning by using this table.

Transplanting dates

Altitude	0–500 m	500–1000 m	1000–1500 m
Best age of plants	6–11 days	7–13 days	8–15 days

Conditions for SRI Practices

Father de Laulanié considered two sets of conditions as defining SRI practice, recognizing that people are the most important factor for agriculture. Citing Fukuoka, Father de Laulanié liked to say: "Agriculture is an art. The farmer is an apprentice, and the plant is his teacher." He added: "Dear farmers, look at and listen to your rice, because it only knows truth [about how it can grow best], and only it can tell this to you."

Essential elements

The first essential part of SRI concerns *water management*. Given the fact that rice is not an aquatic plant, traditional water management, which is really minimum management because it tries to keep fields continously flooded, should be changed. SRI uses a minimum of water. The rice should have all the water necessary for its physiological and nutritive needs, but no more. Any excess of water is prejudicial. The best water for irrigating rice is rain water because it is oxygenated; if it is raining, there is no need to irrigate. To obtain greater profit, paddies should be kept drained during the day, with water added at the end of the day or at night as necessary to maintain soil moisture.

The second essential aspect is the *transplanting of very young seedlings* that still have only two tiny leaves, one by one, and with wide spacing. They should be transplanted very carefully so there is minimum trauma to the root. Rice farmers should determine the spacing that is best for themselves. They are advised to try the following distances: 25 x 25, 33 x 33, 40 x 40, and 50 x 50 cm, and then choose which is best for them under their soil and other conditions.

Additional elements

The following practices are beneficial for any crop and not only good for SRI:

- *Early weeding*: This activity should begin 8-10 days after transplanting and then be done every 10 days during the first month of vegetative growth. If farmers can do more weedings, they can often get even

Table 1. Katayama – de Laulanié model

Phyllochron	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Tillers/phyllochron	1	0	0	1	1	2	3	5	8	12	20	31
Total number of tillers	1	1	1	2	3	5	8	13	21	33	53	84

better results because this aerates the soil. However, farmers have to decide for themselves how many times to weed.

- *Fertilization*: Fr. de Laulanié was not against use of chemical fertilizers, but he found that using organic manures or compost, which are less expensive for cash-limited farmers, can contribute greatly to soil biological activity.

Competition for the Best Rice Yields

To launch more systematic efforts to promote SRI and to offer Fr. de Laulanié appropriate opportunities to train technicians on these methods and sensitize the authorities in charge of rice production in Madagascar, Association Tefy Saina organized six annual meetings between 1990 and 1995. The 1993 meeting recommended annual competitions to give awards for the best rice yields. These would be organized at two levels, national and regional, under government responsibility. Prizes should be awarded for the national competition by the President of the Republic. These competitions would be special occasions to boost SRI and to encourage small farmers to change their mentality vis-à-vis technological innovation, so they would more easily accept and adopt new profitable techniques like SRI. On such an occasion, the State would be honoring and giving more value to small farmer efforts. All that would promote development.

Fr. de Laulanié and we had a bet that these competitions could speedly increase rice production in Madagascar. But results were deceiving. Lacking the necessary support from the government and financial backers, these competitions have not reached their objectives. From 1994 to 2001, only 10 regional competitions were held, with 695 participants having yields ranging from 6 t/ha to 17.5 t/ha, which received the award. The average national rice yield in Madagascar is only 2 t/ha.

Training on SRI in Villages and in Schools

From 1990 to now, we have carried out itinerant training sessions on SRI in rural villages for small rice farmers. To diffuse this system of rice cultivation, Fr. de Laulanié did not hesitate to teach Katayama's model of tillering to small farmers, even if their reading, writing and arithmetic were not strong, so that there would not be any mystery about SRI effects. For us, this pedagogical approach has been always fruitful. Recently Catholic Relief Services in Madagascar has developed a set of illustrated cards to teach about SRI, working in seven dioceses across the country. They are hoping to be successful in this way.

Training sessions on SRI were given in rural schools in the Fianarantsoa region. The pupils learned the techniques rapidly, as if they were games, and without difficulty. Their first experiments in 1991 at Isorana were quite successful. They obtained easily 7.7 t/ha, which was truly unexpected by their parents and neighbors. Indeed such an yield was unheard of anywhere, so that students became the teachers of their parents. From these training sessions on SRI in rural schools, a Green Secondary School was created in the Isorana region after 1995. In October 2001, we were pleased when a "Laulanié Green University" was established in Antananarivo.

Research Confirmation

Tefy Saina began cooperating with Cornell University through CIIFAD in 1994, trying to help farmers in the peripheral zone around Ranomafana National Park find alternatives to the practice of tavy (slash-and-burn agriculture). This started a fruitful collaboration both gathering and analyzing data to understand what could be attained through SRI and why.

From 1997, the students from the Faculty of Agriculture (ESSA) at the University of Antananarivo began working on SRI through the interest and support of Prof. Robert Randriamiharisoa. His students in agronomy have undertaken SRI surveys covering many SRI factors. Up to now, five theses have been researched and written on SRI. This work has established that biological nitrogen fixation (BNF) in SRI is a reality.

Since 1999, Bruno Andrianaivo, a senior staff member of the agricultural research agency FOFIFA, has undertaken studies to evaluate SRI in farmers' fields around Fianarantsoa. He was the first government researcher to accept that SRI has something to offer the farmers of Madagascar. These were all important steps for gaining knowledge about SRI because from the early 1990s, scientists in our country were opposed to it, some vocally.

SRI Results

SRI has given some fantastic yields for farmers in Madagascar. The results we report come from all the country's regions including many different ecological zones (see Tables 2 and 3). SRI has worked very well everywhere in this diverse country. On the east and west coasts, two rice crops a year are possible. Moreover, around Fianarantsoa we have seen some success with ratooning, with results reaching 60-70% of the preceding harvest. This is very profitable as it saves labor for sowing and transplanting.

These are data for farmers from whom we could gather precise measurements. The exact number of SRI adopters in the entire country is unknown since collecting data is extremely difficult in Madagascar. Tefy Saina does not have the resources required to cover such a vast country (593,000 km^2) with its very deficient road system.

In 1992, we had the optimistic hypothesis that the number of adopters might double each year, through efforts to boost SRI. With 1,000 adopters in 1992, we should have reached 1,000,000 adopters by 2002. This would represent most of the rice-farmer population of the country. Unfortunately, the effort has not progressed that well because of a lack of financial means. It is hard to understand why financial backers have not been more interested in the method. Nevertheless, the Ministry of Agriculture estimates that about 10% of the rice farmers are now using SRI, which amounts to nearly 100,000 farmers.

Problems Suggested with SRI

Problems with SRI that are often expressed in Madagascar are given in Table 4 on the next page. Some are real, but others are not. The table suggests how Fr. de Laulanié would respond to these concerns and how he would propose dealing with them.

Conclusions

Given that SRI can considerably increase rice yields, it is unfortunate that its adoption has not been more rapid in the country of its origin, Madagascar. But we are glad to see it beginning to spread there more rapidly now, and to have more and more scientists gaining confidence in it, so farmers will be encouraged to take it seriously. The spread to other countries validates the worthwhile nature of the methods.

Table 2. Examples of yields above 15 t/ha

Farmer Nº	Localisation	Year	Surface (ha)	Spacing	Panicles/ hill	Grains/ panicle	Yield (t/ha)
1	Ampampana	1993	0.105	25x25	29	134	17.00
2	Bezaha	1993	0.25	25x25	26	130	15.00
3	Tsaranoro	1996	0.30	33x33	50	192	23.43
4	Soatanana	1998	0.13	50x50	70	260	21.00
5	Betafo	1998	0.10	30x30	33	172	16.60
6	Ambano	1998	0.12	25x25	28	152	16.18
7	Manandona	1998	0.25	25x25	31	111	15.23
8	Anjazafotsy	1998	0.03	25x25	29	138	15.23
9	Morondava	1999	0.50	25x25	30	130	17.50

Table 3. Some examples of SRI utilization on the High Plateau

	Harvest		
	1996	1998	1999
1. Region: Antsirabe			
Farmers (number)	47	47	data
Surface average (ha)	0.082	0.264	not
Harvest/farmer (kg)	541	2,724	collected
Yield average (kg/ha)	6,600	10,320	
2. Region: Antananarivo			
Farmers (number)	29	24	26
Surface average (ha)	0.113	0.165	0.153
Harvest/farmer (kg)	655	1,444	1,582
Yield average (kg/ha)	5,800	8,750	10,340

Table 4. Dealing with problems suggested with SRI

Problems	Responses
1. Soil depletion is a danger.	1. Research remains to be done on this. In the meantime we say: every year, please note your yields. If there is a pattern of decline, use more compost.
2. Water management and control is difficult for SRI.	2. In principle, it should be possible to make any area suitable for SRI if some investment is made for better control and drainage of water.
3. SRI is only feasible on a small scale and is really a "garden" kind of rice cultivation.	3. Actually, in Madagascar, most rice farmers have only 0.3-0.5 ha. Farmers who have such small land holdings need to find a way to get the very highest yield possible from what little land they have. Also, as the scientific bases for SRI become better understood, its principles and practices should be adaptable for larger-scale use.
4. SRI practices are very difficult for farmers to master.	4. In rural development, any technical skills can be acquired within several years. We must be patient. Increasing farmer skills is a goal of development.
5. SRI requires much labour intensity.	5. This is true, but only initially. In fact, SRI can become labour-saving after farmers have mastered the necessary skills.
6. SRI requires spending a lot of time in the fields, so a farmer who needs to hold down another job to earn money to support his family cannot do this at same time with SRI	6. This is also true. But if money is scarce in the rural economy, farmers should invest their limited labor time so as to get the highest possible returns from their land, labor and capital. SRI can help farmers accumulate capital, even little by little, because their labor productivity is higher.

We thank Prof. Norman Uphoff who has been helping us in spreading SRI outside Madagascar and salute his perseverance. If not for this, nobody else except Malagasy people will know about this method of wonderful rice cultivation. We thank also his CIIFAD colleague Glenn Lines for his persistent support to validate and extend SRI.

We thank most, of course, Fr. Henri de Laulanié. We in Madagascar are very grateful for his life and work. During all his life in our country, he devoted himself to improving the conditions of rural people. We are trying to carry on his efforts to advance and develop both the spiritual and material well-being of all the small farmers.

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