On-Farm Evaluation of a Novel Low-Input Rice Production System in Panama

Marie-Soleil Turmel[12*,] León Franco[3], Candelario Pérez[3], Horacio Hernández[3], Eric González[3], Joann K. Whalen[1], Benjamin J. Turner[2]

Background

This case study evaluates the potential of the system of rice intensification (SRI) to increase rice yields while reducing water consumption on subsistence farms in the province Veraguas in Panama. The aim of this project was to provide practical information on SRI to farmers in this province of Panama and to develop agronomic recommendations for SRI based on both farmers' experiences and scientific findings. The results presented in this case study are part of a larger country-wide evaluation of SRI.

Poverty is endemic in the rural areas of Panama where 45.8% of the population is living in poverty and 23.6 percent is living in extreme poverty. The rural poor are concentrated in areas with degraded soils having low agricultural productivity. Farmers have limited access to mineral fertilizers and agricultural inputs. In many regions, agricultural production is also limited by water availability. If the rural population are to meet their demand for rice, a staple food, while preserving soil and water resources, new low-input solutions that can lead to stable, locally-produced rice supplies are necessary.

The system of rice intensification (SRI) is an emerging low-input method of rice production that has the potential to increase yields while reducing water, seed and mineral fertilizer consumption [1, 2]. Developed in Madagascar in the 1980s, the first SRI experiments outside of Madagascar began in 1992, leading to its adoption in some parts of Asia, Africa and more recently Latin America.

The SRI method utilized early transplanting, wide row spacing, organic fertilizer use, and intermittent wetting and drying of the soil, rather than thje prolonged flooding practiced in conventional rice paddy systems [3]. Previous studies have found that mineral fertilizer and water inputs can be reduced by up to 50% with SRI [1]. In the SRI system, fields are irrigated when they begin to dry (every 3-10 days depending on the climate and soil) in contrast to flooded paddies that are irrigated continuously. SRI has been found to increase yields significantly compared to the conventional system when implemented on strongly-weathered low fertility soils (Acrisols and Ferralsols), and to attain high yields of 7-10 t/ha in more fertile soils (Gleysols, Luvisols) (Turmel et al. 2010, unpublished data).

[1]Department of Natural Resource Sciences, Macdonald Campus of McGill University, 21 111 Lakeshore Road, Ste-Anne-de-Bellevue, Quebec, H9X 3V9, Canada

[2]Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancon, Republic of Panama

[3]Patronato de Nutricíon, Santiago, Veraguas, Republic of Panama

*Corresponding author (msturmel@gmail.com) (M-S. Turmel)

Farms Sites

Working with Patronato de Nutrición, a Panamanian NGO, we identified 5 farms in rural Panama where subsistence farmers are producing rice as their staple food. Patronato de Nutricion's goal is to organize and train subsistence farmers associations and cooperatives to produce food efficiently and sustainably. The farms were located in the mountainous regions of Veraguas, a central province of Panama, north of the Azuero Peninsula. Soil characteristics for each farm are shown in Table 1.

Table 1: Plant-available nutrients and soil properties of farms in Veraguas, Panama

Farm	Texture	pH	P	K	Ca	Mg	Mn	Cu	Zn
			---------------------------mg/kg-----------------------------						
San Juan	Sandy Clay Loam	5.2	15.8	78.3	302	33.3	89.8	1.9	2.1
La Puente	Sandy Clay	5.2	44.5	12.8	235	19.6	2.3	3.6	3.5
Barrigon	Clay	5.6	3.7	112.0	2131	424.6	86.7	3.0	0.9
Cocuyal	Clay	5.8	26.1	165.4	1420	363.1	148.6	4.0	2.8
La Mata	Clay	6.4	6.3	21.4	1267	226.4	35.0	1.9	0.7

On-Farm Trials Comparing SRI to the Conventional System

We held a half day workshop at each farm where we discussed SRI methods with the farm communities. All participating farms were provided with rice seed (a locally developed variety, IDIAP 38, which is suitable for flooded and aerobic soils and grows well in acid soils), a specialized SRI weeding tool, and a notebook containing instructions about the system.

Each participating farm cultivated a plot of approximately 10 x 10m using SRI methods. The SRI trial plot was situated adjacent to a rice plot of equal dimensions where they used the conventional method. The farmers participating in this study are currently using a conventional system recommended by the governmental agriculture department, which involves flooding the soil continuously throughout the growing season and transplanting seedling at an average of 20 days of age and a spacing of 20cm.

The SRI method included transplanting seedlings 10 d after emergence at a spacing of at least 25cm, using organic fertilizer, and promoting aerobic soil conditions by flooding the plot approximately once a week. The farmers used only organic fertilizer (chicken manure, household compost, waste from coffee production) and the same amount of fertilizer was applied to the conventional plot and the SRI plot.

One the main challenges of changing from a flooded to an aerobic rice production system is weed control. In Panama, continuous flooding is often used to control excessive weed growth, although manual control with machete is still required several times throughout the growing season. SRI farmers in Madagascar and parts of Asia have adopted the use of a manually-operated weeding tool with rotating blades that uproots and incorporates weeds into the soil, thus reducing the weed population and adding organic matter.

As part of this study, the SRI weeding tool was evaluated to determine its effectiveness in controlling weeds in SRI. Each farm was provided with an SRI weeding tool which was to be used at least three times during the establishment of the rice crop.

After the harvest, each group was given an oral questionnaire about SRI. Questions were asked about water savings, weed control, transplanting, and future adoption of SRI.

Results and Discussion

Yield

Rice was planted in September 2009 and harvested in January 2010. Yields ranged from 0.6 t/ha to 3.6 t/ha in the conventional system, and from 1.2 t/ha to 5.2 t/ha in SRI. Yields increased substantially with SRI in 3 of the 5 farms and were similar to the conventional system in the remaining two farms. In Barrigon, the yields increased by 36% and in Cocuyal and La Mata, yield was increased by 92% and 98%, respectively (Table 2). Yields were 8% and 6% lower in San Juan and La Puente, respectively; however, the actual reduction in yield was only 1.8 and 2.3 kg per 100 m^2 plot and was not considered an economic loss by the farmers, considering their potential water savings.

Table 2: SRI and conventional rice yields and water savings with SRI. The yield differences and percent yield increase with SRI are also shown.

Farm	SRI Yield t /ha	Conventional Yield t /ha	Yield Difference SRI-Conventional (t /ha)	Increase in Yield	Water Savings
San Juan	2.79	3.02	-0.23	-8%	86%
La Puente	1.70	1.81	-0.11	-6%	86%
Barrigon	4.94	3.63	1.32	36%	71%
Cocuyal	5.22	2.72	2.49	92%	71%
La Mata	1.21	0.61	0.60	98%	86%

Water Savings

All farms maintained sufficient soil moisture in the SRI plots by irrigating once or twice a week, in contrast to the conventional plots that were irrigated continuously to maintain flooded conditions. SRI reduced water consumption by approximately 71-86% across farms (Table 2). All farmers viewed the water savings with SRI as beneficial to their community.

The farmers reported that reductions in water consumption on their farm would benefit the community by liberating more water for other agricultural activities such as bean production. They also reported that water may not be as abundant in future years, and thus is it important to have a rice system that is productive with less water. They also viewed the SRI water management as beneficial because fertilizer loss though water runoff would be reduced compared to the flooded conventional system.

Weed Control
Weed control was not considered a problem in SRI. Farmers reported that there were more weeds in the SRI plot than in the conventional plot (due to lack of continuous flooding), but they were able to control weeds easily with the weeding tool.

All farms reported that the weeding tool was effective in controlling the weeds, and several farms even reported that they saved time using the weeding tool. It was important to transplant the seedlings in straight rows with 25cm spacing so that the weeding tool could pass through the rows. Weeds growing extremely close to the rice plants still had to be removed by hand. All farmers planned to continue using the weeding tool in the future.

Seedling Transplant
Most farmers did not report any problems with transplanting the younger seedlings or with using wider spacing. Two groups (Cocuyal and Barrigon) reported that it took more time to plant in perfectly straight lines, but overall it was advantage because the weeding tool passed readily between the rows. Two groups (La Mata and San Juan) reported that it was easier to handle and transplant the smaller rice seedlings compared to the larger plants used in the conventional system.

Conclusion
The case study demonstrates that is it possible to increase or maintain rice yields in rural Panama using SRI, a low-input organic system. SRI has the potential to increase yields by up to 98% while reducing water consumption by as much as 86%. A specialized SRI weeding tool can effectively control of weeds in the SRI.

The main advantages of SRI, as perceived by farmers, are increased yield, water saving, and time saving (using the SRI weeding tool). Based on the results of this evaluation, we expect that these farms Veraguas, Panama, will continue using SRI and recommend SRI to other producers in other parts of the country.

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