# Impact of System of Rice Intensification (SRI) Practices on Cropping System Resilience to Fluctuating Climate Conditions in Timbuktu Region, Northern Mali, West Africa

Erika Styger

**SRI International Network and Resources Center (SRI-Rice)**, Cornell International Institute for Food, Agriculture and Development (CIIFAD), Cornell University, 33 Warren Hall, Ithaca, NY 14853, USA, **eds8@cornell.edu**

## 1. Introduction

Cereal production covers only 4.5 months of annual household consumption in the Timbuktu region, at the edge of the Sahara desert. Along the Niger River and its seasonally-flooded arms, small-scale, village-based irrigation schemes, 30-35 hectares in size, have become important for food security. Irrigation using diesel motor pumps is costly. Cropping area per households is only 0.3 hectares, driving farmers to increase rice productivity. Since 2007, the NGO Africare and the Regional Government Agriculture Service have worked with communities to adapt the System of Rice Intensification (SRI) to local conditions. In 2007, one farmer achieved a 9t/ha SRI yield compared to 6.7 t/ha in his control plot (Africare, 2008). In 2008, 60 farmers from 12 villages averaged a 9.1t/ha SRI yield compared to 4.9 t/ha in their surrounding fields (86% increase) (Styger, 2009).

Water availability for irrigation depends on the rise and recession of the Niger River, which is determined by the date the rainy season begins and by amount of rain in the watershed. In 2009, when 270 farmers from 28 villages practiced SRI, flooding was delayed by more than one month compared to 2008. Villages that are located at a greater distance from the Niger River need to wait longer for the water to arrive. This creates a natural gradient for when the cropping season will begin (see satellite photo). This poster looks at crop performance and productivity in relation to crop-season timing under SRI and current practice.



The Niger River runs from southwest to northeast. The red line indicates the seasonally flooded river arm. Villages close to the Niger can begin to establish rice nurseries in June (e.g. Bourem), whereas villages further along the river arm must wait for several weeks until the water arrives.

## 2. Methodology

270 farmers from 28 villages, located in four communes (Douekire, Arham, Bourem and Kondi), and two Circles (Goundam and Dire) of the Timbuktu region in Mali, participated as volunteers (no subsidies) in planting SRI plots in collaboration with the NGO Africare and the Regional Government Agriculture Service during the 2009/2010 season. For each farmer data was collected on SRI plot size, field preparation, organic manure and fertilizer application, varieties used, dates and practices for nursery, planting, weeding and irrigation. Harvest was done with 130 farmers (randomly selected, but within each of the 28 villages) on SRI and adjacent conventional plots. Five 1m² squares were placed at random in each of the 260 plots. Grain was harvested separately for each of the five sub-plots, threshed and weighed with a precision PESOLA™ scale. At the same time, the moisture content of grain was measured using a FARMEX MT-PRO™ moisture meter. Number of hills per square meter was counted to determine planting density. 10 plants were randomly selected to count number of tillers and panicles, to measure height of the plants and length of the roots. Also, 5 panicles were selected randomly in each plot. Their panicle length was measured, and number of filled and empty grains was counted per panicle.

## 3. Results

SRI practices combine the transplanting of single seedlings at the 2-leaf stage (1), with wide spacing (25cmx25cm) and planted in line (2), alternate wetting and drying irrigation (2), the use of a cono-weeder instead of hand weeding (3), and the application of organic manure during soil preparation (not shown). Last picture shows SRI field at harvest (4)

**Yield and Yield parameters**

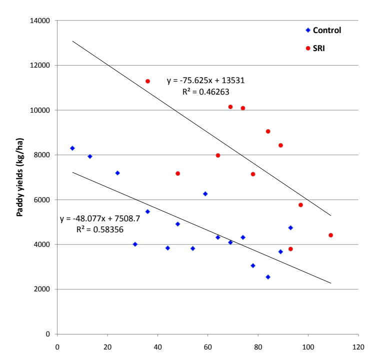
Average paddy yield for 130 SRI farmers was 7.71 t/ha compared to their conventionally grown fields with 4.48 t/ha (72% increase). All measured yield parameters were superior in the SRI plots compared to farmers' fields. (Table 1).

**Yields in relation to the beginning of cropping season**

The range of yields was larger for this season as compared to the previous season (Styger, 2009). For SRI, lowest yield was 2.7t/ha and highest 13.4 t/ha, for farmers' practice yields ranged from 0.3 t/ha to 9.8 t/ha. With the delay of the rainy season, farmers installed their nurseries more than 110 days apart from each other depending on the location along the river arms. Range of planting parameters can be seen in Table 2.

Analysis of yields in relation to the beginning of cropping season shows that yields decline when seeding takes place later in the season, both for SRI and control plots. (Figure 1).

Figure 1: Rice grain yields (kg/ha) in relation to time of nursery establishment for SRI plots and farmers fields *




* Data points are yield averages in 5 day intervals (between 2-10 plot yields/point)

Table 1: Rice yield (t/ha) and yield parameters for SRI and farmer practice plots (n=130, adjusted to 14% grain moisture)

| | | SRI plot (n=130) | | Farmer field (n=130 | |
|---|---|---|---|---|---|
| | | Average | SE | Average | SE |
| Yield | t/ha | **7.71** | 0.26 | **4.48** | 0.16 |
| Tillers/hil | Number | **29.1** | 0.74 | **19.0** | 0.41 |
| Panicle/hill | Number | **27.9** | 0.75 | **17.8** | 0.43 |
| Fertile tillers | % | **95.9** | | **93.9** | |
| Tillers/m2 | | **387** | | **366** | |
| Panicles/m2 | | **372** | | **344** | |
| Plant height | cm | **82.1** | 1.54 | **78.9** | 1.76 |
| Root length | cm | **20.5** | 0.39 | **17.2** | 0.40 |
| Panicle length | cm | **21.8** | 0.22 | **20.1** | 0.21 |
| Grains/panicle | Number | **128.6** | 3.17 | **98.4** | 2.21 |
| Empty grains | % | **17.7** | 1.15 | **21.3** | 0.96 |

Table 2: Planting parameters for SRI and farmer practice plots

| Parameters | units | **SRI** (n=120) | **Farmer Field** (n=120) |
|---|---|---|---|
| Nursery establishment | Date (range) | July 6 - Sept 28 | June 7 - Sept 2 |
| Transplanting | Date (range) | July 22 - Oct 10 | July 22 - Oct 1 |
| Plant age at transplanting | Days (range) | 8 - 17 | 15 - 45 |
| Plant age at transplanting | Days (average) | 11.7 | 27.7 |
| Cropping season length | Days (average) | 127 | 139 |

Yield for SRI reached more than 11t/ha when rice crop was seeded in early July, declining to 5 t/ha when seeded in early September, whereas for the current farming practices highest yields are 7.5 t/ha when rice was seeded in June, declining to 2 t/ha when seeded in September (Figure 1).

The results indicate that farmers, who are obliged to seed their rice late in the season, thus producing under non-optimal conditions, are still able to produce high yields with SRI. When seeding in August, SRI plots reach 6-8t/ha yields, whereas under conventional practices, these yields are only obtained when seeded in June.

The SRI crop cycle for all 130 farmers was 127 days compared to 139 days for the farmers' conventional practice fields (Table 2), allowing farmers to harvest 12 days earlier. A number of villages in the region lost their entire 2009 crop when the conventionally late-planted crop was not able to mature before the cold season started in November.

## 4. Conclusions

Farmers in the Timbuktu region depend on the timeliness and amount of seasonal rise of water to begin seeding their rice crop. In 2009, the rainy season was delayed by more than one month. Farmers had to wait with planting until the waters arrived. The results of our study show that even with a 2-month delay past optimal planting time, SRI farmers were able to secure a similar yield (6-8 t/ha) as rice grown under conventional practices started at the optimal date. Many of the marginal villages where rice was planted very late were still able to produce a good rice crop by applying SRI practices, and so improved food security in the Timbuktu region.

**References:**

Africare, 2008. First Experiences from Timbuktu - Mali. Farmer-led SRI Test in Goundam - 2007/2008. GFSI Project, Africare, Bamako, Mali

Styger, E. 2009. System of Rice Intensification (SRI) - Community-based evaluation in Goundam and Dire Circles, Timbuktu, Mali, 2008/2009. Africare, Bamako, Mali.

**Acknowledgements:** This study is a result of exceptionally strong teamwork among farmers, Africare staff, and the Mali Government Agriculture Service in Timbuktu. I am very grateful to have been part of it. Special thanks go to the funding organizations: the United States Agency for International Development in Mali and the Better U Foundation of Los Angeles, California, USA.