



Africare



The System of Rice Intensification (SRI) – First Experiences from Timbuktu - Mali

Farmer-led SRI test in Goundam - 2007/2008

What is SRI?

The System of Rice Intensification, known as SRI, is a methodology for increasing the productivity of irrigated rice cultivation by changing the management of plants, soil, water and nutrients without relying on external inputs. It has been raising yields by 50% to 100%, and sometimes more, with reduced requirements for water, seed, fertilizer, and crop protection. To date, the effects of the SRI methodology have been empirically demonstrated in 28 countries, including most of the rice producing countries of Asia and many others in Africa and Latin America.

The Six Principles of SRI

1. Single seedlings are transplanted.
2. Age of seedlings between 8-12 days.
3. Wide spacing: 25cm x 25cm or wider, planted in lines.
4. Minimum water application during vegetative growth period keeping soils moist but well-drained and aerated: through small daily water application, or alternate wetting and drying.
5. Weeding with a simple mechanical hand weeder every 10 days for 4 times, to aerate soil and incorporate weed biomass into soil.
6. Application of organic matter (manure, compost, or mulch), instead of fertilizer.



Mahamadou Hamadou at harvest in his SRI field

Benefits from SRI, based on worldwide experience to date (Uphoff, 2007a)

- Higher yields by 50-100% or more.
- Use of 80-90% less seed.
- Water saving of 25-50%.
- Reduction in fertilizer use by 50-100%.
- Higher plant productivity: more tillers per plant (30-50 or more), more and larger panicles with more and usually heavier grains.
- Higher milling outturn: 15% more milled rice per volume of SRI rice (fewer unfilled grains, fewer broken grains).
- Fewer pests and diseases: diminishing the need and use of agro-chemicals.
- Higher grain quality: less starchy and less amylose content.
- Improved resistance to lodging and to extreme climate events, due to improved root systems.
- Shorter crop cycle: by 1-3 weeks.
- Lower production costs: on average about 20% per hectare.
- Higher factor productivity: in terms of rice yield, per unit of labor (per hour/day), per volume of water, and per investment of capital.
- Environmental benefits: reduced water requirements, and less reliance on agrochemicals enhances soil and water quality.



Left: rice plant from control plot
Right: rice plant from SRI plot



Left: SRI field, **Right:** Control field, two weeks before harvest. The SRI field had a 7 to 10 day shorter life cycle.

First experience with SRI in Goundam, Timbuktu Region

The *Goundam Food Security Initiative*, implemented by Africare (with funding from USAID), undertook a first round of SRI demonstrations during the 2007 cropping season in farmers' fields in Bagadadji and Douegoussou villages located in the Goundam circle of the Timbuktu region. Farmers installed and managed the fields with technical advice from Africare's agronomist and field agents. Three field visits were organized during the growing season for farmers from surrounding villages of and for personnel from the Government of Mali's agricultural services.

The Goundam circle is among the most food-insecure areas in Mali. Due to the very low annual rainfall of 150-200mm, farmers practice recessional agriculture along river branches, ponds and lakes seasonally flooded by the Niger River. The amount of the flooding determines the amount of land under agriculture, which is highly variable from year to year. Yield levels under this cultivation system are low, with deep-water rice producing, on average, 750kg/ha, and sorghum from 600 to 900 kg/ha. In recent years, Africare has worked with local farmers to build village-based small-scale irrigation schemes of 30-35 hectares that can be irrigated by one diesel motor pump. Using these irrigation systems, farmers can maintain full water control and develop irrigated cropping systems with potential for much higher and more reliable yields than traditional recessional agriculture. 80-100 farmers share the land under irrigation in such schemes, thus the average irrigated crop area available per household is only about one-third of a hectare (0.83 acre). Obtaining maximum yield from these small landholdings is essential to reduce poverty in the area. Irrigation is one of the best ways to improve food security in the region. At 4-6 tons/ha, rice yields are much higher, and there is much potential and scope to both extend the amount of land under cultivation and to increase yields.



Field visit 70 days after transplanting

As detailed below, test results were positive: the SRI plot yield was 34% higher than the control plot. Both those farmers who participated in the SRI tests and those who visited these first SRI trials expressed great interest in testing SRI methods on their own fields next season. In addition to increased yields using SRI, farmers are also attracted by the reduced costs of using this method, which further increases their incomes. Cost reductions result from using less seed, less water (thus, less expenditure on diesel fuel to operate the motor pump), and by the preference for organic manure over chemical fertilizer. In addition, small field size and complete water control favor the rapid adoption of SRI.



Following the field visit, farmers share their observations about SRI

SRI test methodology

This report covers the field test in the village of Douegoussou, where SRI was compared to the conventional method of rice planting in the field of Mahamadou Hamadoun, Imam of the village. The field owner was responsible for managing the field and Africare staff provided technical advice, most importantly during the field preparation, transplanting, and crop management. Africare technical staff and farmers also collected data on crop development and harvest. Villagers joined voluntarily to undertake fieldwork: soil preparation, transplanting, weeding and harvesting. An overview of SRI methodology is provided below in Table 1.

Table 1: Methodology of farmer-led SRI test in Douegoussou, Timbuktu, Mali, 2007/2008, compared to local cropping techniques (Control)

| | SRI | Control |
|--------------------------------|-------------------------------|-------------------------------|
| Nursery establishment | August 2 nd , 2007 | August 2 nd , 2007 |
| Transplanting | August 18, 2007 | August 27, 2007 |
| Harvest | January 3, 2008 | January 4, 2007 |
| Rice Variety | BG 90-2 | BG 90-2 |
| Plot dimension | 0.12 ha | 0.12 ha |
| Age of transplanting | 16 days | 25 days |
| Number of leaves | 4-5 | 5-8 |
| Number of plants/pocket | 1 | 2-3 |
| Plant spacing | 25 cm x 25 cm (in lines) | 23cm x 23.5 cm (not in lines) |
| Plant density | 160,000 plants/ha | 183,7500 plants/ha |
| Manure application | 800 kg/plot (6.7t/ha) | 0 |
| Fertilizer application (kg/ha) | 40 kg DAP, 100kg Urea | 40 kg DAP, 100 kg Urea |
| Hand weeding | 6 times every 20 days | 6 times every 20 days |
| Irrigation | 12 times | 12 times |



Transplanting rice at a spacing of 25cm x 25cm in lines



Transplanted seedling: 16 days old

Results

The SRI plot performed better in all the yield parameters compared to the control plot. The results are presented in Table 2.

Table 2: Results of farmer-led SRI test in Douegoussou, Timbuktu, Mali, 2007/2008, compared to local cropping techniques (Control)

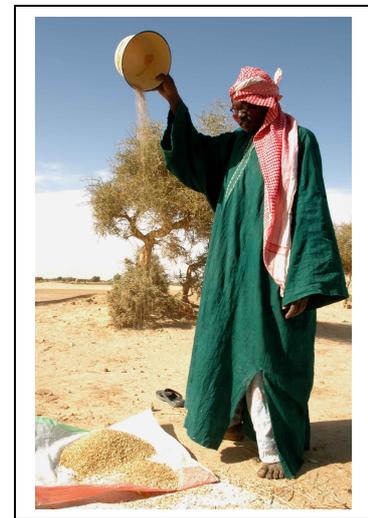
| Yield Parameters | | SRI | | Control | |
|--------------------------|-----------|-------------|---------------|-------------|-------------|
| | | Mean | SE** of means | Mean | SE of means |
| Yield | t/ha | 8.98 | 1.02 | 6.69 | 0.71 |
| Tillers/plant 70-90DAT* | Number | 45.5 | 1.84 | 35.4 | 1.38 |
| Tillers/plant at harvest | Number | 24.4 | 2.8 | 20.0 | 1.07 |
| Panicles / plant | Number | 21.4 | 1.65 | 15.4 | 1.28 |
| Fertile tillers | % | 88 | | 77 | |
| Panicle length | cm | 21.4 | 0.5 | 20.1 | 0.6 |
| Grains / panicle | Number | 113 | 6.16 | 80 | 9.3 |
| Plant density | Plants/ha | 146,500 | | 183,750 | |

* DAT: Days After Transplanting; ** SE: Standard Error

The SRI plot reached a yield of 8.98 tons/ha, which was 34% or 2.3 tons/ha higher than the control plot. Note that the yield in the control plot was also very satisfactory at 6.69 tons/ha, a result of thorough crop management. The yield of the control plot was well above the average yield of the 2007/2008 season in the Africare project zone, which was 4.17 tons/ha. This was lower than in previous years, mainly due to a one-month delay in the start of the rainy season. During the 2006 season, average yields were 6.0 tons/ha, and in 2005 5.8 tons/ha.



Harvesting sample plots each 2m x 2m: plants from each plot were collected individually and number of total tillers and fertile tillers counted for each of the plants. 6 sample plots were harvested from SRI and 6 plots for the Control.



Mahamadou Hamadou threshing rice from a harvest plot

All of the yield parameters performed better under SRI. This includes the number of tillers per plant (24.4 for SRI, 20 for Control), the percentage of fertile tillers (88% or 21.4 panicles per plant for SRI, and 77% or 15.5 panicles per plant for Control), the panicle length (21.4 cm for SRI compared to 20.1 cm for Control) and higher numbers of grains per panicle for SRI with 113 compared to 80 for the Control. The crop cycle was 7-10 days shorter with SRI compared to the control. During harvest, the control plot showed notable presence of larvae (resembling the sorghum webworm), found between tillers (although no major damage was observed), which was not present in the SRI plot.

Economic calculations on costs and income from SRI vs. conventional rice production in Goundam; based on secondary data¹

An analysis based on local input costs indicate that production costs for SRI can be reduced by 30% when water use is reduced by 25%, and by 46% with a total water saving of 50%. With two scenarios of SRI yield increases by 40% (SRI+40%) and 60% (SRI+60%) compared to conventional cropping, incomes will increase by 70% for SRI+40%, and more than double for SRI+60%. Additional income per hectare will be between 273,000 CFA (USD 620) and 566,300 CFA (USD1290). For those farmers cultivating one-third of a hectare, this will be from USD 207 to USD 430 per household.

In Goundam and Dire there are approximately 17,200 rice producing households, with a total population of 80,000 people. Total land area use for rice cultivation is estimated to be 6060 ha, but increases each year. Conceivably, if all households were to apply SRI, the additional income could reach from 3.5 to 7.4 million USD/ year. If half the population would apply SRI, this could amount to be an additional 1.75 to 3.7 million USD/year.

Conclusions and recommendations

This first SRI field test under farmer conditions was very satisfactory and produced a yield of 9 tons/ha compared to the control plot yield of 6.7 tons/ha. Although this increase of 2.3 tons/ha or 34% in yield is a good beginning, we believe that there is scope for significant improvement, given that some technical recommendations could not be followed effectively during the first trial. The most important challenges were i) proper leveling of the field, ii) transplanting of young plants in lines (people were not used to it), iii) lack of conical weeder that could aerate the soil, and iv) proper irrigation management.

Recommendations for improvement of SRI field management based on difficulties encountered in the first season are discussed hereafter.

- Improve field preparation and plot leveling: this allows for the water to be more evenly distributed in the plot, and thus reduces the amount of water needed. A pre-irrigation can be done allowing to remove first generation of weeds before transplanting

¹ See Literature section below, including data from GSFI project

- Reduce age for transplanted seedlings to 8-12 days, which is younger than the 16 days in the first season test. Once farmers are familiar with the technique to transplant small seedlings and plant in line, it will be easier for them to work with younger seedlings. A well-leveled field will also facilitate transplanting.
- Improve nursery techniques. It is recommended to raise the seedlings on raised beds--not as traditionally done on irrigated plots--and to follow the technical recommendations for SRI nurseries.
- Increase spacing: Traditional spacing in the control plot was 23cm x 23.5cm, which is not much smaller than the tested SRI spacing of 25cm x 25cm. It is recommended to test a spacing of 30cm x 30cm next season and compare it with the 25cm x 25cm.
- Use conical weeders to provide some soil aeration and reduce the time for weeding. This has significant yield improving effects, but could not be applied this season.
- Adjust irrigation: Elsewhere it is possible to use 25-50% less water for irrigation when applying SRI. In this first season, the farmer applied the same irrigation management to the SRI and control plot. This was mainly due to the considerable additional workload to apply different irrigation management to two small plots. It is recommended to regroup a few fields for SRI next season that benefit from the same irrigation canal, which would also allow tracking the amount of water used for irrigation in order to better calculate cost.
- Experiment further with fertilization options. In this first test, the farmer applied the best-practice fertilization with small amounts of DAP, Urea and organic matter. This was certainly part of the yield increasing effects also of the control plot compared to the zonal average. It is recommended to further experiment with fertilization, especially by replacing fertilizer with organic amendments.
- Collect economic data: Some economic calculations were done based on regional data and on data from SRI experiences elsewhere in the world. It is recommended to collect specific data on the costs of production. Costs of irrigation (due to less water used) are likely to be considerably reduced, and if farmers are aware of it, may be an important incentive to apply SRI.

Literature consulted

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<http://ciifad.cornell.edu/sri/> : SRI home page



The SRI Pioneers of Goundam, Timbuktu (2007/2008 season).
Come see us next year for the latest SRI developments!

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