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RESEARCH ARTICLE

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Productivity, water use efficiency and economics of system of rice intensification in farmers field of Southern Tamil Nadu

R. VEERAPUTHIRAN, R. BALASUBRAMANIAN, B.J. PANDIAN, G. KALIDASAN, M. CHELLADURAI AND V. GANESARAJA

ABSTRACT

Four hundred and thirty one on-farm demonstrations on System of Rice Intensification (SRI) were carried out in 300 hectares of farmers fields in Sivagangai and Madurai districts of Tamil Nadu from 2007-08 to 2009-10 under Tamil Nadu-Irrigated Agriculture Modernization and Water Bodies Restoration and Management (TN - IAMWARM) Project. Two methods of rice cultivation viz., SRI and Conventional were compared. The results of large scale on - farm demonstrations revealed that adoption of SRI favorably influenced all the yield attributes of rice viz. number of productive tillers m^{-2} and numbers of grains $panicle^{-1}$. Superiority of SRI in terms of grain yield was also evident due to 26.7 per cent yield increment by SRI than conventional method of rice cultivation. Higher grain yield coupled with substantial water saving to the tune of 23.6 per cent resulted in higher water use efficiency of rice under SRI method. Higher gross income, net profit and benefit cost ratio were also associated with SRI than conventional method of rice cultivation. The cost of cultivation was comparatively lesser in SRI which resulted in gaining an additional net profit of Rs. 13,981 ha^{-1} as compared to conventional method of rice cultivation.

KEY WORDS : SRI, Yield attributes, Grain yield, Water use, Economics

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INTRODUCTION

Rice is the most water consuming food crop of India and Tamil Nadu. In Tamil Nadu rice crop alone consumes about 80 per cent of the total water available in the state. The present water status demands for the scientific management of available water efficiently to achieve the twin objectives of higher productivity and better water use efficiency. At present, non- availability of labour, escalating input cost coupled with water shortage leads to non economic of rice cultivation. System of Rice cultivation (SRI) is the modern and alternative method of rice cultivation for reduced usage of water and other inputs. The concept of SRI includes transplanting young seedlings early, carefully, singly and widely spaced with soil kept well aerated. The Manimuthar sub basin is one of the sub basins in Tamil Nadu with a drainage area of 16751 ha. This basin comprises of four minor-basins viz. Manimuthar, Virisuliyar, Thirumanimuthar and Palar and spreads over in six taluks in three districts of Tamil Nadu namely Madurai, Sivagangai and Ramanathapuram. The major focus of this study in Manimuthar basin is to promote water saving technologies, to enhance crop and water productivity and to increase the cropped area by diversification. Therefore an attempt was made to study the performance of SRI in comparison with the conventional method of rice cultivation in the Manimuthar sub basin area.

MATERIALS AND METHODS

Four hundred and thirty one on - farm demonstrations on system of rice cultivation (SRI) were carried out in 300 hectares of farmers fields in Sivagangai and Madurai districts of Tamil Nadu from 2007-08 to 2009-10 under Tamil Nadu-Irrigated Agriculture Modernization and Water Bodies Restoration and Management (TN -IAMWARM) Project during September to January. The details of field demonstrations in the study area is furnished in Table l. The available soil fertility status of the study area was

Correspondence to:
R. VEERAPUTHIRAN, Department of Agronomy, Agricultural College and Research Institute, MADURAI (T.N.) INDIA
Email : veeraagri@yahoo.co.in

Authors' affiliations:
R. BALASUBRAMAIAN, G. KALIDASAN, M. CHELLADURAI AND V. GANESARAJA, Department of Agronomy, Agricultural College and Research Institute, MADURAI (T.N.) INDIA

B.J. PANDIAN, Tamil Nadu-Irrigated Agriculture Modernization and Water Bodies Restoration and Management, WTC, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA

Table 1 : Details of field demonstrations of SRI in the study area

Sr. No.	Particulars		2007-08	2008-09	2009-10	Total
1.	Area of demonstrations (ha)		42	175	83	300
2.	Number of farmers		100	211	120	431
3.	Number of villages		6	8	9	23
4.	Name of the variety used		ADT 36 and ADT 39	ADT 36, ADT 39 and ADT 45	ADT 39 and ADT 45	-
5.	Soil fertility status (No. of samples)	N	L M H	L M H	L M H	L M H
			95 - 5 - 0	206- 5 - 0	120 - -	421 - 10 -
		P	10 - 8 - 82	14 – 26 - 171	0 – 0 - 120	24 -34 - 373
		K	6- 9 - 85	10 – 61 - 130	13 -89 - 18	29 – 159 -233

N- Nitrogen, P- Phosphorus, K- Potash, L- Low, M- Medium, H- High

low in nitrogen, high in phosphorus and potash and mainly sandy clay loam in nature. The percentage of soil samples coming under the categories of low, high and high for N, P K were 97.7, 86.5 and 54.1, respectively. Two methods of rice cultivation *viz.,* SRI and conventional were compared by using the varieties ADT 36, ADT 39 and ADT 45. In SRI, the concepts *viz.,* lesser seed rate of 7.5 kg ha^{-1} raised in 100 m^{-2} mat nursery, transplanting of 14 days old seedlings at 25 x 25 cm spacing, irrigating 2.5 cm depth of water after hair line crack formation up to panicle initiation and after that one day after disappearance of ponded water with 5.0 cm water and weeding using rotary weeder at 10, 20, 30 and 40 days after transplanting (DAT) were followed. In conventional method of rice cultivation, use of a seed rate of 30-60 kg ha^{-1} in 800 m^{-2} nursery area, seedling age 21-30 days with a spacing of 15 x 10 to 20 x 15 cm, irrigation to 5 cm depth one day after disappearance of ponded water and manual weeding twice at 15 and 30 DAT were practiced. The total water use was calculated by adding irrigation water applied and effective rainfall. The biometric observation on yield attributes and grain yield were recorded. Water use and economics were also analyzed.

RESULTS AND DISCUSSION

The findings of the present study have been discussed in the following sub heads :

Yield attributes:

The results on yield attributes (Table 2) revealed that SRI showed a favorable influence on all the yield attributes of rice during all the years of study. Adoption of SRI recorded an average of 627 of productive tillers m^{-2} which was 18.3 per cent higher than that of conventional method of rice cultivation (531). The number of grains $panicle^{-1}$ were also higher under SRI than farmer's practice of rice cultivation. SRI registered a mean of 216 grains $panicle^{-1}$ while it was only 185 in conventional method. Similar results of higher yield attributes with SRI than conventional method was reported by Senthil Kumar (2002) and Veeraputhiran *el al.* (2008). Agronomic evaluation studies of SRI conducted at Godavari delta regions indicated higher values of root weight and root volume in all the varieties studied under SRI than conventional method of rice cultivation. This could be the reasons for higher yield attributes under SRI (Raju and Sreenivas, 2008). The yield attributes of rice *viz.*, number of productive tillers m^{-2}, panicle length, number of filled grains per panicle and 1000 grain weight were higher under SRI than conventional method in Kurnool of Andhra Pradesh was also observed by Krishnajie *et al.* (2008).

Grain yield:

The grain yield of rice was substantially increased due to adoption of SRI (Table 2). SRI registered a mean grain yield of 5485 kg ha^{-1} which was 26.7 per cent higher than conventional method of rice cultivation (4329 kg ha^{-1}). Among the periods of study, the year 2008-09 recorded higher grain yield than other periods. Veeraputhiran *et al.* (2008) also obtained 23.1 per cent yield improvement by SRI than farmers practice in Tamirabarani Command areas in Thirunelveli district of Southern Tamil Nadu. Higher yield attributes like number of productive tillers m^{-2} and number of grains $panicle^{-1}$ reflected in the production of higher grain yield of SRI. These results of higher grain yield with SRI corroborate with the findings of Makarim *et al.* (2002) and Ganeshraja *et al.* (2008). Rajendran *et al.* (2003) also registered 48 and 35 per cent higher yield under SRI than traditional method of rice cultivation at TRRI, Aduthurai and SWMRI, Thanjavur, respectively. Similarly Bommaiasamy (2005) reported that planting 14 days old seedlings at 20 x 20 cm spacing with single seedling was a viable establishment

Table 2 : Comparison of SRI and conventional method on grain yield, water use and economics of rice

Sr. No.	Particulars	2007-08		2008-09		2009-10		Pooled Mean	
		SRI	Conventional	SRI	Conventional	SRI	Conventional	SRI	Conventional
1.	No. of productive tillers m^{-1}	617	534	668	556	595	503	627	531
2.	No. of grains $panicle^{-1}$	215	184	221	191	211	179	216	185
3.	Yield (kg ha^{-1})	5437	3992	5877	4663	5141	4331	5485	4329
4.	Percent yield increase	36.2	-	27.7	-	19.2	-	26.7	-
5.	Total water use (mm)	1042	1326	1195	1481	945	1272	1061	1360
6.	Per cent water saving by SRI	21.4	-	24.0	-	25.6	-	23.6	-
7.	Water use efficiency (kg ha^{-1} mm^{-1})	5.22	3.01	4.87	3.05	5.44	3.40	5.18	3.15
8.	Cost of cultivation (Rs. ha^{-1})	19105	21569	20203	22367	21784	25067	20364	23001

technique for SRI method of rice cultivation which recorded 7.2 per cent higher yield than 21 days old seedlings. In Godavari Delta Regions of Andra Pradesh, intermittent flooding in SRI registered an grain yield of 6.34 t ha^{-1} while continuous flooding recorded an lower grain yield of 5.63 t ha^{-1} SRI (Raju and Sreenivas, 2008).

Water use studies:

The water use studies of both the rice cultivation methods (Table 2) clearly indicated the beneficial effect of SRI in terms of water saving and higher water use efficiency (WUE). The total water use of rice including effective rainfall was drastically reduced (1061 mm) due to intermittent and alternate wetting and drying type of irrigation under SRI which was lesser than that of farmers practice (1360 mm).Thus, there was a substantial quantity of water saving by 23.6 per cent over the three years of study was evident due to the adoption of SRI. The higher grain yield coupled with enormous water saving under SRI method resulted in higher WUE of rice in the study area. The mean WUE of SRI was 5.18 kg ha^{-1} mm^{-1} and it was only 3.15 kg ha^{-1} mm^{-1} in conventional method. Similar water saving and higher water use efficiency under SRI was also observed by Veeraputhiran *et al.* (2008) in Thirunelveli District of Southern Tamil Nadu. Raju and Sreenivas (2008) observed 40 per cent lesser water requirement of only 1025 mm along with higher WUE of 6.18 kg ha^{-1} mm^{-1} in intermittent flooding in SRI as against 1482 mm with WUE of 3.79 kg ha^{-1} mm^{-1} under continuous flooding.

Economic analysis:

The economic feasibility of both the method of rice cultivation (Table 2) revealed that the cost of cultivation was comparatively lesser in SRI than that of conventional method. The mean cost of cultivation over the study period for SRI and conventional method was Rs. 20,364 ha^{-1} and Rs. 23,001 ha^{-1}, respectively. Thus it is evident that adoption of SRI was found to reduce the cost of cultivation by Rs. 2637 ha^{-1}. In addition, higher gross income, net profit and benefit cost ratio were also associated with SRI than conventional method of rice cultivation. Averaging the three years of study, SRI registered a total income of Rs. 54,471 ha^{-1} and net profit of Rs.34,388 ha^{-1} as compared to Rs.43,408 ha^{-1} and Rs. 20,407 ha^{-1}, respectively under conventional method. Regarding benefit-cost ratio (BC ratio), higher BC ratio was also associated with SRI (2.68) than conventional method (1.89). Lesser cost of cultivation coupled with higher gross and net income under SRI resulted additional economic benefit. Adoption of SRI gained an additional net profit of Rs.13,981 ha^{-1} as compared to conventional method of rice cultivation. The economic superiority of SRI as compared to farmers practice of rice cultivation was also documented by Veeraputhiran *et al.* (2008). The results of the field experiments at Bhadra Command areas of Banglore showed that monetary benefits in terms of net return and benefit cost ratio were significantly superior in SRI than conventional transplanting method (Hugar *et al.,* 2009). In the field study at Patna the highest net returns of Rs.34,706 ha^{-1} were obtained under SRI whereas lowest returns (Rs. 13,726 ha^{-1}) were recorded under farmers' method (Singh and Batta, 2008).

Thus the results of the on-farm demonstrations clearly indicated that adoption of SRI leads to 26.7 per cent higher yield, substantial water saving (23.6 per cent), higher water use efficiency and better economic benefits which will pave way for sustainable rice production and higher standard of living of the farming community of the Manimuthar sub basin study area.

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