



Economics of System of Rice Intensification (SRI) Vis-A-Vis Conventional Rice Farming in Chittoor District of Andhra Pradesh

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ABSTRACT

The present study entitled “Economics of System of Rice Intensification (SRI) vis-a-vis conventional rice farming in Chittoor district of Andhra Pradesh” was undertaken to study farm management practices in conventional and SRI technology and cost and returns for the two respective methods. In *kharif*, the total cost of cultivation per hectare in SRI and conventional paddy was Rs.27,554/- and Rs.27,021/-, while in *rabi* the corresponding figures were Rs.29,927/- and Rs.28,450/-. The gross income was Rs.36,505/- and Rs.30,006/- during *kharif* and Rs.39,698/- and Rs.32,337/- during *rabi* for SRI and conventional paddy respectively. The net income realised was Rs.8,951/- and Rs.2,985/- and Rs.9,771/- and Rs.3,787/- in SRI and conventional paddy during *kharif* and in *rabi* for the two methods of paddy cultivation. The productivity levels in respect of SRI were higher compared to conventional method.

Key words : System of Rice Intensification (SRI), Conventional farming, Economics.

Rice is the staple food for about 50 per cent of the world's population that resides in Asia, where 90 per cent of the world's rice is grown and consumed. In Asia, India has the largest area under rice (41.66 million ha) accounting for 29.4 per cent of the global rice area. Of the total harvested area, about 46 per cent is irrigated, 28 per cent rainfed lowland, 12 per cent rainfed upland and 14 per cent flood prone. Rice is one of the largest traded commodities in the world with a total quantity touching 16.4 million tonnes. The southeast countries account for about 40 per cent of the rice trade in the world (Mangalrai, 2004).

The green revolution of 1960s was oriented towards high input usage particularly fertilizers, irrigation and plant protection chemicals. As a result of excessive use of these inputs, the cost of cultivation had escalated. This is more so in irrigated crops like paddy. The spectacular increase in production of paddy was restricted to irrigated belts of the country. The skewed distribution of green revolution results and increased costs of cultivation have given alarming signals to the future needs of food security.

At this juncture System of Rice Intensification (“SRI”) came into light. It is no surprise that a simple method that claims to boost

yields at lower cost to farmers is being hailed by many as that solution. Andhra Pradesh is the second State in the country which adopted SRI cultivation. In the State, in *kharif* 2003-04, in all, 167 demonstrations were conducted. The average yield in SRI method was 8250 kg ha⁻¹, compared to 5307 kg ha⁻¹ in conventional method. In *rabi* 2003-04, the performance of SRI was more encouraging with the yield touching 9,910 kg ha⁻¹. Economic analysis of such an important method of rice cultivation throws light on the benefits accrued to the adopters. As such an attempt is made here to enquire into the economic aspects of SRI vis-a-vis conventional farming in Chittoor district of Andhra Pradesh with the following specific objectives.

1. to compare farm management practices under SRI and conventional farming.
2. to estimate costs and returns in SRI and conventional farming.

MATERIAL AND METHODS

The present study was undertaken in Chittoor district of Andhra Pradesh which is one of the very important districts in Rayalaseema region where SRI cultivation is introduced. From the selected district 8 mandals and 14 villages were

purposely selected. From the villages so selected, 30 farmers practicing SRI method were randomly selected. Those 30 farmers were also conventional paddy farmers. The samples represented a substantial portion of the farmers practicing SRI in the district. The data used in this study were collected with the aid of pre-tested schedule designed for the purpose. The data pertained to the agricultural year 2005-06.

TOOLS OF ANALYSIS

The data collected were subjected to conventional analysis to work out the costs and returns of the selected enterprise. Functional analysis was used to estimate factors influencing production of paddy under SRI and conventional method. Averages and percentages were calculated through conventional analysis. This analysis pertained to input use, costs, returns, various cost concepts and income measures.

Cost Concepts:

These were used to estimate cost of cultivation and to derive the farm efficiency measures. The cost concepts *viz.*, cost A_1 , Cost A_2 , Cost B and Cost C were employed in the present study and these are estimated as follows.

Cost of A_1 :

This cost includes value of 1) Hired human labour 2) Owned and hired bullock labour 3) Owned and hired machinery sources 4) Seeds 5) FYM 6) Fertilizers 7) Plant protection chemicals 8) Electricity charges 9) Transportation charges 10) Land revenue 12) Interest in working capital and 13) Depreciation.

Cost A_2 : Cost A_1 + rent paid for leased in land.

Cost B: Cost A_1/A_2 + rental value of owned land + interest on fixed capital excluding the land.

Cost C: Cost B + imputed value of family labour.

Farm Efficiency measures

Farm business income = Gross income – Cost A_1/A_2

Family labour income = Gross income – Cost B

Net income = Gross income – Cost C

Farm investment income = Net income + rental value of owned land + interest on owned fixed capital

RESULTS AND DISCUSSION

Farm Management Practices In Conventional and SRI Method

An attempt is made here to look into the details of farm management practices followed in the cultivation of conventional and SRI method of rice. The purpose is to have an understanding of the practices of both the types of rice cultivation. The comparison is expected to throw light on the managerial aspects that are needed to be acquired and practiced by the farmers in SRI method. In the following paragraphs these aspects are presented in detail.

Conventional Method of Rice Cultivation

Nursery management: Rice seedlings can be raised by three methods.

Dry nursery:

This is practiced in the regions of non-assured water supply, where there is no scope for wet nursery.

Wet nursery:

This is practiced in the regions of assured water supply. Sprouted seeds are broadcasted on soft puddle with a thin film of standing water. Depth of standing water is gradually raised and maintained at 2-3 cm.

Dapog nursery:

In this method nursery is grown on a concrete floor or on a raised bed of soil covered with polythene sheets. This method is usually followed in places where there is assured water supply and when early transplanting is needed.

Seed rate:

Normally 20-25 kg of seed is used for an acre of land.

Transplanting:

Generally 25-30 day old seedlings are transplanted. The usual practice is to pull the seedlings, roots washed, bundled into convenient size for handling. Top few cm of leaves are cut off to reduce evaporating surface and give rigidity to the plants, so that when transplanted the leaves

Table 1. Break-Up of Cost of Cultivation of SRI And Conventional Paddy in *Kharif* And *Rabi* (2005 – 2006)
(Rs./hectare)

Sl.No.	Particulars	<i>Kharif</i>		<i>Rabi</i>	
		SRI	Conventional	SRI	Conventional
A.	Variable costs				
1.	Human labour				
	Owned	4,476 (16.42)	2,878 (10.65)	3,324 (11.11)	3,210 (11.28)
	Hired	5,237 (19.01)	6,409 (23.72)	6,838 (23.84)	6,678 (23.47)
	Total	9,713 (35.42)	9,287 (34.37)	10,262 (34.95)	9,888 (34.75)
2.	Bullock labour				
	Owned	103 (0.36)	50 (0.18)	122 (0.41)	54 (0.19)
	Hired	156 (0.57)	190 (0.70)	277 (0.93)	250 (0.88)
	Total	259 (0.93)	230 (0.88)	399 (1.34)	304 (1.07)
3.	Machine labour	4,057 (14.71)	4,008 (14.82)	4,225 (14.13)	4,149 (14.58)
4.	Seeds	63 (0.23)	1,125 (4.14)	72 (0.24)	1,142 (4.01)
	FYM	2,105 (7.64)	1,831 (6.75)	2,740 (9.15)	2,062 (7.26)
5.	Manures and fertilizers				
	Green leaf manure	1,870 (6.76)	725 (2.56)	2,037 (6.82)	858 (3.02)
	Fertilizers	2,678 (9.62)	2,850 (10.53)	2,786 (9.34)	2,842 (9.99)
	Total	6,653 (24.02)	5,406 (19.84.)	7,563 (25.31)	5,762 (20.27)
6.	Plant protection chemicals	210 (0.74)	475 (1.60)	307 (1.02)	496 (1.74)
7.	Irrigation charges	384 (1.39)	412 (1.52)	396 (1.33)	428 (1.50)
8.	Interest on working capital	1,707 (6.19)	1,668 (6.15)	1,984 (6.63)	1,773 (6.23)
	Total variable costs	23,046 (83.64)	22,513 (83.32)	25,419 (84.94)	23,942 (84.15)
B.	Fixed Costs				
1.	Depreciation	924 (3.35)	924 (3.42)	924 (3.09)	924 (3.25)
2.	Land revenue	12 (0.04)	12 (0.04)	12 (0.04)	12 (0.04)
3.	Rental value of owned land	3,125 (11.34)	3,125 (11.56)	3,125 (10.44)	3,125 (10.98)
4.	Interest on fixed capital	447 (1.63)	447 (1.66)	447 (1.49)	447 (1.57)
	Total fixed costs	4,508 (16.36)	4,508 (16.68)	4,508 (15.06)	4,508 (15.85)
	Total Costs	27,554 (100)	27,021 (100)	29,927 (100)	28,450 (100)

(Figures in parentheses are percentages to total)

do not bend over into the water. 3 or more seedlings are planted per hill and per sq.m the number of hills comes to approximately 33.

Spacing:

The traditional method is characterized by planting seedlings at about 15 x 15 cm or 15 x 10 cm apart.

Weed management:

Weeding is done manually without any weeders. The first weeding is taken up 3-4 weeks after planting, the second weeding generally 15-30 days after the first.

Water management:

Rice plants grow well in shallow ponded water as they are able to effectively transfer oxygen from shoot to the root system for respiration. Water level is maintained at 2 cm depth at planting, 5 cm upto 3 days after planting, 2 cm upto panicle primordial initiation and 5 cm upto 21 days after heading followed by gradual withholding of irrigations. Maintenance of deep submergence at seedling and flowering periods and draining water periodically are the water management practices in conventional method.

Organic manuring:

Rather than organic manuring, application of NPK fertilizers are recommended in conventional method of paddy farming.

SRI Method

Nursery management:

The seed bed is levelled and a thin layer of well decomposed FYM is spread on the bed. On this layer the seed is broadcasted sparsely. The seeds so broadcasted are covered with another layer of FYM and paddy straw. The seed bed is prepared as closely as possible to the main field so as to minimize transport time between removal of seedlings from the bed and transplanting in the field.

Seed rate:

Seed requirement for one acre of land is two kg.

Transplanting:

Only 8-12 day old seedlings are transplanted. The seedlings are removed from nursery with seed, soil and roots intact carefully and planted in the field without ploughing too deep into the soil. Care is taken to ensure that when the seedlings are transplanted that their root tips are not inverted as usually happens during the hurried transplanting done in the conventional method. Only single seedling is planted per hill. In conventional method, a thin film of water is maintained at transplanting. But in SRI, there should not be standing water at the time of transplanting. The number of seedlings per sq.m in this method is 16 as against 33 hills per sq.m in conventional method. The marker and rope are used for making lines for transplantation.

Spacing:

Seedlings are planted in a square pattern at 25 x 25 cm within and between the rows. Leaving wide spaces between each plant ensures that roots have adequate room to grow and the plants will be exposed to more sunlight, air and nutrients. This results in profused root growth and tillering.

Weed management:

Weed management is done with rotary weeders. Different types of rotary weeders are prepared with different sizes suitable for different crop stages. The weeding is done in an interval of 10-15 days. The number of weedings ranged from two to four. Working with rotary weeder helps in greater aeration which results in more root growth, reduced weed competition, more oxygen and nitrogen to roots. Weeds incorporated into the soil with each weeding can add up to one ton green manure per hectare per weeding and also helps to buildup large and diverse microbial population in the soil.

Water management:

Water is not allowed to stagnate under SRI method unlike in traditional rice. Alternate "wetting and drying" is done which gives aerobic and anaerobic soil conditions for better nutrient

mobilization. Unflooded conditions combined with mechanical weeding result in more air in the soil and greater root growth. Higher root growth provides access to more nutrients.

Organic manuring:

The organic manures like green manure and farm yard manure are applied in the field. This results in more plant growth because of better soil health and more balanced nutrient supply.

Following observations are made after comparing the farm management practices of conventional farming with those of SRI method.

Seed requirement is just two kg per acre in SRI compared to 20 to 25 kg in conventional farming. Only 8-12 day old seedlings are transplanted in SRI against 25 to 30 day old seedlings in conventional method. Seedlings are taken out very gently by scooping in SRI, while in conventional method the same are pulled with force, roots washed and bundled. In the former, planting is in square pattern while in the latter it is at random. Only one seedling is planted per hill in SRI, while three or more in conventional farming. Higher dosage of organic manures in SRI, whereas greater use of NPK fertilizers in conventional farming. Weeding is done with the help of rotary weeder in SRI method, while it is manual in conventional method. Maintaining moist condition is followed in SRI while continuous flooding is the practice of irrigation in conventional farming.

It is well to summarise that by opting for SRI, the farmers can clearly save the expenditure on seeds but will be under pressure while handling the seedlings. The workers need to carefully handle, 8 day old seedlings which by no means an easy job. Now it is just that the farmers are in the process of acquainting with SRI method, they need to learn and hone skills in these package of practices as well. They need some time before they acquire the needed skills in this practice, for it is an operation requiring silken touch. Again in transplantation, the marker and rope are the requirements for making the measured lines. A method to which both the farmers and labourers are alien but farmers have no serious complaints except that they should exhibit the patience in drawing the lines. In traditional

paddy, weeding is done using manual labour but coming to SRI method, the role of rotary weeder is more significant. This operation no doubt requires less number of labourers, but the rotary weeder should be operated effectively applying pressure, while moving it and that there are apprehensions that this operation does create some inconvenience to the palms of those operating. An alternative which the farmers desire is a weeder which can be mechanically operated, thus easing out the inconvenience of the operations. With regard to irrigation, the farmers have an easy time relatively under SRI method, as the water requirement is halved. Since the stress is on organic manuring in SRI method, farmers have to double their efforts in procuring the required quantities. Having understood the relative differences in the package of practices and the additional efforts which the farmers have to put forth, now an effort is made to look into the economic aspects of SRI vis-à-vis conventional paddy, so as to exactly assess the relative benefits that are accrued to the adopters.

Cost Structure:

The break-up of cost of cultivation of SRI and conventional paddy in *kharif* and *rabi* season is depicted in Table 1. In *kharif* the total cost of cultivation in SRI and conventional paddy worked out Rs.27,554/- and Rs.27,021/- per hectare, respectively. It was observed that operational costs accounted for a major share in the total costs. Of the total costs operational costs constituted Rs.23,046/- (83.64%) and fixed costs Rs.4,508/- (16.36%). Among the operational costs, human labour stood out as the foremost item of expenditure amounting to Rs.9,713/- and Rs.9,287/- in SRI and conventional paddy, accounting for 35.24 and 34.27 per cent of the total costs, respectively. A sound nutrient management constituting liberal use of organic manures and minimal chemical fertilizers would be highly productive in SRI cultivation. Thus the expenditure on manures and fertilizers was the next important item of cost. It ranged from Rs.6,653/- (24.02%) in SRI to Rs.5,406/- (19.84%) in conventional paddy. Irrigation charges touched an amount of Rs.384/- and Rs.412/- in SRI and conventional farming. The other cost item to follow was plant protection. As explained already in SRI, the

protection costs were nearly half the expenditure incurred in respect of conventional farming. The expenditure towards plant protection measures was Rs.210/- in SRI and Rs.475/- in conventional farming. SRI paddy is tolerant to pests and diseases mainly due to their stronger growth and vigour. Farmers thus could able to reduce the expenditure on agro-chemicals. Seed, the basic input of crop production required an expenditure of just Rs.63/- (0.23%) in SRI. The same expenditure in conventional paddy was Rs.1,125/- (4.14%). Least expenditure on seed is one of the main features of SRI cultivation.

In *rabi* season, the total cost of cultivation per hectare of paddy worked out to Rs.29,927/- and Rs.28,450/- in SRI and conventional paddy respectively. Human labour was the highest cost component among the variable costs with an expenditure of Rs.10,262/- (34.95%) and Rs.9,888/- (34.75%) in SRI and conventional farming respectively. Manures and fertilizers was the next item to follow in terms of expenditure. It ranged from Rs.7,563/- (25.31%) to Rs.5,762/- (20.27%) in SRI and conventional paddy respectively.

Cost of cultivation according to various cost concepts, as depicted in Table 2, reveal that all the costs barring cost C were higher in conventional paddy during *khariif* season, while all the costs were higher in SRI paddy during *rabi* season. The productivity levels in respect of SRI were higher compared to conventional method. Income measures too indicated that these were higher in SRI over conventional paddy, which are in concurrence with the results obtained by Reddy *et al.* (2005).

BREAK-EVEN ANALYSIS

The profitability of farm business can also be studied with the help of a management tool known as break-even analysis. This analysis helps to assess whether the farm business is moving profitably or not. The break-even output indicates the minimum quantity of output required to continue in farm business without incurring loss. The margin of safety which is the surplus over break-even output tells about the profitability of the farm business. Greater is the margin of safety, more are the profits in farm business. The details of break-

Table 2. Comparative Study of SRI and Conventional Method of Rice Cultivation According to Cost Concepts and Income Measures.

Particulars	(Rs./hectare)			
	<i>Khariif</i>		<i>Rabi</i>	
	SRI	Conventional	SRI	Conventional
Cost A ₁	19,506	20,571	23,031	21,668
Cost A ₂	19,506	20,571	23,031	21,668
Cost B	23,078	24,143	26,603	25,240
Cost C	27,554	27,021	29,927	28,450
Main product (Qtls)	58.45	47.92	63.53	51.70
By-product (Qtls)	62.26	52.14	67.95	54.31
Returns from main product (Rs.)	32,147	26,356	34,942	28,435
Returns from by-product (Rs.)	4,358	3,650	4,756	3,802
Gross income	36,505	30,006	39,698	32,237
Net income	8,951	2,985	9,771	3,787
Farm business income	16,999	9,435	16,667	10,569
Family labour income	13,427	5,863	13,095	6,997
Farm investment income	12,523	6,557	13,343	7,359
Returns per rupee of investment	0.32	0.11	0.33	0.13

Table 3. Break-Even Analysis In Paddy Cultivation .

Sl.No.	Particulars	<i>Kharif</i>		<i>Rabi</i>	
		SRI	Conventional	SRI	Conventional
1.	Yield in quintals per hectare	58.45	47.92	63.53	51.70
2.	Price per quintal (Rs.)	550	550	550	550
3.	Fixed costs per hectare (Rs.)	4,508	4,508	4,508	4,508
4.	Variable costs per hectare (Rs.)	18,688	18,863	20,663	20,140
5.	Total costs per hectare (Rs.)	27,554	27,021	29,927	28,450
6.	Variable costs per hectare (Rs.)	319.72	393.63	325.24	389.55
7.	Break-even output in quintals	19.57	28.82	30.05	28.09
8.	Margin of safety	38.88	19.10	43.48	23.01
9.	Per cent of BEO to the yield	33.48	60.14	31.55	54.33

Table 4. Differences Between Means of SRI and Conventional Methods.

Sl.No.	Particulars	Means		t-value
		SRI	Conventional	
1.	Seeds	67.5	1133.5	11.69**
2.	FYM	2,422.5	1,946.5	5.569**
3.	Green manure	1,953.5	791.5	12.428**
4.	Fertilizers	2,732.0	2760.0	1.32
5.	No.of hours of irrigation	390.0	420.0	8.079**
6.	Human labour	9,987.5	9,587.5	1.441
7.	Operational costs	24,232.5	23,227.5	1.49
8.	Grain yield (Qtls)	61.1	50.1	16.496**
9.	Net income	9,472.0	3,481.0	14.856**

even output, margin of safety for SRI and conventional paddy are presented in Table 3.

Kharif

The break-even output in SRI and conventional paddy was 19.57 and 28.82 quintals respectively. It is interesting to note from the results that the average yields in both methods of paddy cultivation exceeded the break-even output. The percentage of break-even output to the yield was 33.48 in SRI and 60.14 in conventional paddy. The margin of safety stood at 38.88 and 19.10 quintals in the respective methods of paddy cultivation.

Rabi

In this season, the break-even output

varied from 30.05 quintals in SRI to 28.09 quintals in conventional paddy. Margin of safety was to the extent of 43.48 and 23.01 quintals in the two methods respectively. The percentage of break-even output to the average yield was 31.55 and 54.33 in the corresponding methods of paddy cultivation.

This analysis clearly proved that that SRI method was more profitable compared to conventional paddy and that in *rabi* the performance of SRI was still better as the results projected. It is a point in favour of SRI method and its contribution to step up the farm incomes.

Paired t-test:

Paired 't' test was carried out on all the important indicators for SRI and conventional paddy. It is evident from Table 4 that differences in the use of seeds, FYM, green leaf manure, number of hours of irrigation, grain yield and net income were statistically significant, while fertilizers, human labour and operational costs were not.

CONCLUSION:

SRI technology helped the farmers to realize an output of 58.45 Quintals per hectare, against 47.92 Quintals in conventional paddy during *kharif* season. During *rabi*, the corresponding figures were 63.53 and 51.70 Quintals respectively. The gross income that was realized was Rs.36,505/- and Rs.30,006/- and Rs.39,698/- and Rs.32,237/- in SRI and conventional paddy for the two seasons respectively. The break-even analysis indicated that break-even output was 19.57 and 28.82 Quintals in SRI technology and conventional paddy during *kharif* and 20.05 and 28.09 Quintals for the two methods during *rabi* season. Margin of safety in

quintals was 38.88 and 19.10 and 43.48 and 23.01 in SRI and conventional paddy, during *kharif* and *rabi* seasons respectively. The percentage of break-even output to the total output was lesser in SRI method compared to conventional paddy.

LITERATURE CITED

- Acharya N.G. Ranga Agricultural University 2004** "*System of Rice Intensification*" (SRI) – A Revolutionary Method of Rice Cultivation, July, 2004.
- Mangalrai 2004** "International year of rice". An Overview "*Indian Farming*" Vol.54, No.8, 3-6.
- Ratna Reddy V, Prudhvikar Reddy, Srinivasa Reddy M and Sree Rama Raju D 2005** Water use efficiency : A study System of Rice Investigation (SRI) Adoption in Andhra Pradesh *Indian Journal of Agricultural Economics*, 60(3) : 458–471.

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