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Economic Analysis of the System of Rice Intensification: Evidence from Southern India

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The System of Rice Intensification (SRI) – a new approach to growing rice – is gaining rapid momentum in South India. The present study analyses the efficiency of SRI cultivation in the state of Kerala. The study reveals that the major expenditure in SRI is incurred on labour costs and there is a reduction in the cost of seeds. The average yield under SRI is found to be more than 27 per cent higher than that of rice cultivated under the conventional method. The net returns and benefit-cost ratios are higher for SRI farms due to higher productivity of paddy cultivation. Overall, the SRI farmers demonstrate higher efficiency relative to their counterparts under the conventional method. Training facilities and demonstration trials are needed to be scaled up so that more farmers become aware of the SRI technology.

Keywords: System of Rice Intensification, Technical Efficiency, Stochastic Frontier, Cost-return Analysis, Southern India
JEL Classification: Q16, Q18, Q24, Q25

I. INTRODUCTION

Asia's food security depends largely on the irrigated rice fields, which account for more than 75 per cent of the total rice production (Virk, Khush and Peng 2004). In Asia, 17 million hectares of irrigated rice area may experience "physical water scarcity" and 22 million hectares may have "economic water scarcity" by 2025 (Tuong and Bouman 2001). The introduction of high-yielding varieties, fertilisers, pesticides and irrigation has improved rice yields significantly and expanded the area under which rice is cultivated. However, in the last 20 years yields and the area under rice have stagnated. The two most

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significant reasons for this stagnation are the lack of adequate water for irrigation and the increased costs of cultivation. India will need to produce more rice if it is to meet the growing demand, estimated to be 130 million tonnes of milled rice in 2030. As there is not much scope to increase the area of rice cultivation (due to urbanisation and severe water constraints), the additional production will have to come from less land, less water and less human labour (Gujja and Thiyagarajan 2009).

Traditionally, rice occupied a prime position in Kerala's agriculture. However, area under rice has been declining over the years, with a possibility of extinction of rice farming in the state. Population pressure demands increase in rice production with the limited resource available for agriculture viz. shrinking land, depleting water resources, declining trends in soil fertility and productivity, and depletion of groundwater table (Sita Devi and Ponnarasi 2009). Average rice yields have increased considerably with the introduction of high-yielding varieties and improved crop management technologies. But significant yield gap still exists. Under this scenario, the System of Rice Intensification (SRI) may be a suitable alternative to produce more food with less input. SRI, a new system of rice cultivation developed the in the early 1980s by late Fr. Henri de Laulanie,' is a comprehensive package of practices involving less seed, water, chemical fertilisers and pesticides (Uphoff 2006).

Realising the potential contribution of SRI technologies in increasing rice productivity and resource saving in rice production, the present paper made an attempt to analyse the efficiency of SRI cultivation in Kerala state of Southern India. The specific objectives include: (i) to estimate the costs and returns in conventional and SRI method of rice cultivation, (ii) to study the impact of SRI on resource use, yield and farm technical efficiency, and (iii) to suggest policy measures that will help achieve upscaling and mainstreaming SRI cultivation in the state.

II. DATA AND METHODOLOGY

2.1 Data

The study was conducted in Palakkad district of Kerala, India. Palakkad district was purposively selected for the study as it is the major rice growing district in the state. In Palakkad, drought is a major production constraint, limiting rice production in *Kharif* season. From the selected district, three major paddy growing blocks following both the methods of rice cultivation were selected. Then from each block, two major paddy growing villages following traditional and SRI methods of rice cultivation were selected purposively. Finally, seven farmers each for SRI method and farmers for traditional method of rice cultivation were selected from each village. Thus, the total sample size was 84.

In order to fulfill the objectives of the study, necessary primary data were obtained from the sample respondents by the personal interview method, using a pre-tested and structured schedule. The data included general information of the respondents like age, educational level, family size, land holding pattern, source of irrigation, cropping pattern and animal husbandry. Detailed information on production aspects like area of rice, cultivation aspects, cost and returns were collected.

2.2 Conventional Analysis

Conventional analysis involving calculation of percentages and averages were carried out to interpret the data related to cost, returns, input use, general characteristics of sample farmers, size and distribution of farm holdings, agro-climatic conditions and land utilisation pattern in the study area.

2.2.1 Costs and Returns

To estimate the cost of cultivation of SRI and conventional method of rice cultivation, the approach suggested by the Cost of Cultivation for Principal Crops was used. The total cost was classified as fixed and variable costs. Fixed cost includes land revenue, depreciation on farm buildings, tools and implements and rental value of owned land. The variable cost includes cost of ploughing, seeds, manures and fertilisers, plant protection chemicals, human labour and interest on working capital. Interest on working capital was calculated at the rate at which banks were advancing short-term loans. The prime lending rate during the agriculture year was 7 per cent for crop loan. It was charged for a period of duration of the particular crop. Gross return was obtained by adding value of paddy and value of paddy straw. Net income was estimated as the difference between the gross return and total cost of cultivation.

2.3 Estimation of Technical Efficiency

2.3.1 Stochastic Frontier Production Function

Aigner, Lovell and Schmidt (1977) developed a stochastic frontier model. They decomposed the error term into two parts under what is called the "composed error" model. A symmetric normally distributed component permits random variation of the frontier across firms and captures the effect of measurement, other statistical noises and random shocks outside the firm's control. A one sided error term captures the effect of inefficiency relative to the stochastic frontier. Parameters of stochastic frontier may be estimated by the Maximum Likelihood Method (MLE) if the probability functions for symmetric and one sided components of the error terms are specified.

In the present study, an attempt was made to measure the efficiency of SRI cultivation using stochastic frontier production function. The stochastic parametric method decomposes random errors into error of farmer's uncontrollable factors, dependent variable as well as farm specific inefficiencies. While deterministic and non-parametric methods have drawbacks as it forces all outputs to a frontier yet sensitive to outliers, if large, it distorts efficiency measurements (Ogundele and Victor 2006).

Variations in the technical efficiency of individual farms are due to factors completely under the control of farmers. For the frontier analysis, yield in kg per hectare was taken as the dependent variable and the independent variables included were seed in kg/ha, quantity of fertilisers used (kg/ha), number of irrigations and human labour in hours/ha. MLE method was employed using FRONTIER 4.1 software and the results were obtained in one step process.

A Stochastic Cobb-Douglas Production Frontier was fitted to data as under,

$$\ln YD = \ln \beta_0 + \beta_1 \ln SEED + \beta_2 \ln FR + \beta_3 \ln IRR + \beta_4 \ln HL + V_i - U_i$$

where,

YD = Yield of rice (kg/ha)

SEED = Seed (kg/ha)

FR = Fertiliser quantity (kg/ha)

IRR = No. of irrigations

HL = Human labour (hrs/ha)

V_i = Statistical disturbance term

U_i = Farmer-specific characteristics related to production efficiency

$|Ui| = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4$

where

Z_1 = Age of farmer (years)

Z_2 = Farming experience (years)

Z_3 = Education level of the farmer (1= illiterate, 0= otherwise)

Z_4 = Farmers contact with extension agents (1= illiterate, 0= otherwise)

III. STUDY AREA

Palakkad has no lakes, estuaries or coastal lines. Based on physical features, the district can be divided into two natural divisions- mid land region consisting of valleys and plains and high land region formed of high mountain peaks, long spurs, extensive ravines, dense forests and tangled jungles. The terrain of Palakkad can be divided into four units as low rolling terrain including food plains and terraces, moderately undulating terrain with flood plain terraces, highly undulating terrain (western part of the district) and hilly area including steep slope (North-West and Southern portion of the district). The district has a humid climate with a very hot season extending from March to June in the western part of the district, whereas it is less humid in the eastern sector. The most important rainy season is during South West Monsoon, which sets in the second week of June and extends up to September. About 75 per cent of the annual rain is received during the south west monsoon period. The temperature of the district ranges from 20^{o} C to 45^{o} C.

There are mainly four types of soil such as peaty (Kari), laterite, forest soil and black soils. Palakkad is the only district in Kerala with black cotton soil. The district has also extensive area under brown hydromorphic soils. The crop production, cropping pattern and cultivation practices are also influenced by the problem soils. The soils are generally acidic in nature covering an area of about 4, 00,858 hectares. Among the main workers in the district, agricultural labourers were the dominant class, followed by cultivators. Both these accounted for 42.56 per cent of the main workers, whereas, in the state, their contribution was only 4.47 per cent. This indicates the importance of agriculture in Palakkad district and in the state.

Paddy is the most important crop of Palakkad district and has earned the name "Granary of Kerala." The district accounted for 43 per cent of the total paddy area of the state and contributed to about one third of the total rice production in Kerala in 2009-10 (Leena 2010). Most of the farmers in Palakkad district cultivate paddy for their household consumption. Cropping systems in Palakkad are mainly paddy based; the predominant among them is Paddy-Paddy-Fallow system. Paddy is the single most important crop covering 1, 00,522 hectares area and accounted for about 32 per cent of the gross cropped area in 2009-10.

IV. RESULTS AND DISCUSSION

4.1 General Characteristics of Sample Respondents

The general characteristics of sample respondents were analysed**.** An analysis into age–wise composition of respondents reveals that the younger farmers show greater inclination towards accepting SRI method of rice cultivation. The reason for poor response from the older farmers may be attributed to the strict adherence to traditional practices. The average area under paddy was 1.35 and 1.30 hectares in SRI and non-SRI farms respectively. It could be inferred that sample respondents who practice SRI were small farmers (Table I).

TABLE I
GENERAL CHARACTERISTICS OF SAMPLE RESPONDENTS

Particulars	SRI Farm	Non-SRI Farm
Number of sample respondents	42	42
Average age of head of the family (years)	45.02	55.78
Average size of sample holdings (ha)	1.82	1.54
Average area under paddy in the sample farms (ha)	1.35	1.30
Average area under SRI (ha)	1.28	-

4.2 Economics of SRI and Conventional Method of Rice Cultivation

In order to better understand the economic advantage of SRI cultivation, a detailed economic analysis of SRI method was done and compared with conventional method.

4.2.1 Input wise Expenditure by SRI and Non-SRI Farm

Expenditure incurred on each input was worked out for SRI and non-SRI farms separately and the results are presented in Table II. It could be seen that in SRI, the major expenditure was incurred on human labour and machine labour charges, which accounted for 42.70 per cent and 26.89 per cent respectively. This might be due to frequent weeding using conoweeder. In SRI farms, the cost of seeds occupied a meagre amount (1.05 per cent) as compared to the non-SRI farms (6.40 per cent). It is due to the fact that there is a significant reduction in seed rate from about 30-60 kg/ha to 10 kg/ha in the SRI technology. It could also be noted that the share of cost on plant protection chemicals was low in both the methods of cultivation, viz. 3.77 per cent and 3.67 per cent in SRI and conventional methods respectively.

Further, it could be observed that the total input cost incurred by both group of farmers was Rs. 23,410.43 and Rs. 30,668.61 respectively, which indicates that farmers in non-SRI category incurred 22.66 per cent more cost than those in the SRI category.

TABLE II
INPUT WISE EXPENDITURE INCURRED BY SRI AND NON-SRI FARMS
(Rupees/ha)

Inputs	SRI farm	Non- SRI farm
Seeds	250.48 (1.05)	1,963.78 (6.40)
Farmyard manure	2,318.75 (9.77)	1,900.29 (6.19)
Fertilisers	3,446.46 (15.80)	4,089.67 (13.33)
Plant protection chemicals	893.15 (3.77)	1,125.53 (3.67)
Human labour charges	10,125.00 (42.70)	12,365.63 (40.30)
Machine labour charges	6,376.59 (26.89)	9,223.71 (30.07)
Total	23,410.43 (100.00)	30,668.61 (100.00)

Note: Figures in parentheses indicate the expenditure share of each input to total expenditure.

Farmers of both categories use different nitrogenous, phosphatic and potassic fertilisers. During the survey it was found that the expenditure on Urea, Potash and Factomphos constituted 43.69 per cent, 26.84 per cent and 29.47 per cent by SRI farms and 39.77 per cent, 30.26 per cent and 29.97 per cent by non-SRI respectively, which showed that urea was applied by large number of farmers. Among these three fertilisers, farmers applied large amount of urea to induce the vegetative plant growth of paddy during initial growth. Altogether the expenditure incurred on fertilisers was Rs. 3,446.46 and Rs. 4,089.67 respectively by these two groups of farmers. The total fertiliser cost incurred was about 16 per cent higher for non-SRI farmers, due to moderately higher dose of fertiliser requirement in conventional method of rice cultivation.

4.2.2 Total Costs and Returns

The cost of cultivation and net returns realised per hectare by SRI farms and non-SRI farms are presented in Table III through Table VI.

Variable Costs

The variable costs incurred by the sample farmers are presented in Table III. The variable cost incurred was higher among non-SRI farms with Rs. 32,330.86 per hectare than among the SRI farms with Rs. 25,052.77 per hectare. Cost of human labour accounted for the largest share in total variable costs with 40.41 per cent and 38.24 per cent respectively. The cost of machine labour constituted

25.45 per cent and 28.52 per cent of total variable cost respectively for SRI and non-SRI farms. The cost of fertilisers was 13.76 per cent for SRI farmers and 12.64 per cent for non-SRI-farmers.

The variable cost for non-SRI farms was comparatively high because of greater use of human labourers, seeds, fertilisers and plant protection chemicals. In fact, variable costs incurred by non-SRI farmers was 22.51 per cent higher than SRI farmers.

TABLE III
VARIABLE COSTS INCURRED BY SRI AND NON-SRI FARMS

(Rupees/ha)

Particulars	SRI farm	Non- SRI farm
Seeds	250.48	1,963.78
	(1.00)	(6.07)
Farm yard manure	2,318.75	1,900.29
	(9.26)	(5.87)
Fertilisers	3,446.46	4,089.67
	(13.76)	(12.64)
Plant protection chemicals	893.15	1,125.53
	(3.56)	(3.48)
Human labour	10,125.00	12,365.63
	(40.41)	(38.24)
Machine labour	6,376.50	9,223.71
	(25.45)	(28.52)
Interest on working capital	1,642.43	1,661.45
	(6.56)	(5.13)
Total	25,052.77	32, 330.86
	(100.00)	(100.00)

Note: Figures in parentheses are percentage share of total.

Fixed Costs

Fixed costs are those which do not vary with the level of output. The fixed costs incurred by the sample farmers were estimated and the results are provided in Table IV. It could be observed from the table that fixed costs incurred were somewhat (about 3 per cent) higher for non-SRI farmers as compared to SRI farmers, which accounted for Rs.14,130.72 per hectare and Rs. 13,688.31 per hectare respectively.

TABLE IV
FIXED COSTS BY SRI AND NON-SRI FARMS

(Rupees/ha)

Particulars	SRI farm	Non- SRI farm
Rental value	12,000.00 (87.66)	12,000.00 (84.92)
Land revenue	163.00 (1.19)	165.50 (1.17)
Depreciation on fixed investment	510.10 (3.72)	465.78 (3.30)
Interest on fixed capital	1,015.21 (7.42)	1,499.44 (10.61)
Total	13,688.31 (100.00)	14,130.72 (100.00)

Note: Figures in parentheses are percentage share of total.

Total Costs

The cost of cultivation is presented in Table V. The total cost of cultivation was Rs. 38,741.17 per hectare for SRI farms and Rs.46,461.58 per hectare for non-SRI farms. The cost of cultivation was higher for non-SRI farms by 19.93 per cent. The contribution of fixed cost was 35.33 per cent and 30.41 per cent respectively for SRI and non-SRI farms and contribution of variable cost was 64.67 per cent and 69.58 per cent respectively. Total costs for non-SRI farmers were significantly higher especially because of greater variable costs involved in the conventional method.

TABLE V
TOTAL COST INCURRED BY SRI AND NON-SRI FARMS

(Rupees/ha)

Particulars	SRI farm	Non- SRI farm
Variable cost	25,057.86 (64.67)	32, 330.86 (69.58)
Fixed cost	13,688.31 (35.33)	14,130.72 (30.41)
Total cost	38,741.17 (100.00)	46,461.58 (100.00)

Note: Figures in parentheses are percentage share of total.

Returns

As one expects, the SRI method of rice cultivation produced relatively higher yield when compared to conventional rice cultivation. The average yield of SRI cultivation is 5467.58 kg/ha, which is 27.23 per cent higher than the conventional method of rice cultivation (4297.35 kg/ha). The cost of cultivation was computed separately for the two categories, viz. SRI and non-SRI farms. It could be observed from Table VI that the gross income was estimated to be Rs. 65,706.93 and Rs. 54,370.20 per hectare respectively for SRI and non-SRI farmers. Thus gross income is 17.25 per cent higher for SRI farmers as compared to non-SRI farms. Further, it could be seen that the net income was higher for SRI (Rs 26,956.78) than for non-SRI (Rs.7,908.62) farms. It was mainly due to the higher productivity of paddy in the SRI method. The cost of production of per kg of paddy was lower for SRI (Rs.7.08/kg) than the conventional method (Rs 10.81/kg) of rice cultivation. As a result, not income was higher (Rs. 4.93/kg) for SRI farm as compared to that for non-SRI farms (Rs. 1.94/kg).

TABLE VI
COMPARATIVE ECONOMICS OF SRI AND NON-SRI FARM

Particulars	SRI farm	Non- SRI farm
Mean yield (kg/ha)		
Grain yield	5,467.58	4,297.35
Straw yield	2,225.42	2,366.45
Price of output (Rs./kg)	10.00	10.00
Gross income (Rs./ha)	65,706.93	54,370.20
Total expenses (Rs./ ha)	38,741.18	46,461.58
Net income (Rs./ha.)	26,956.78	7,908.62
Cost of production (Rs./kg)	7.08	10.81
Net income (Rs./kg)	4.93	1.84

It was also observed that the benefit-cost ratio was higher for SRI (1.70) than non-SRI farms (1.17). The SRI farms had realised increased productivity and thereby the returns in paddy crop were comparatively high. The increased grain yield under SRI was mainly attributed to greater number of lengthy productive tillers with increased number of filled grains per panicle. Thus, the cumulative effect for SRI farmers was higher returns compared to non-SRI farmers due to less seed rate, irrigation and labour requirement in weeding.

4.3 Performance of SRI Method of Rice Cultivation

The performance of SRI method was compared with that of non-SRI farms. The partial budgeting technique was employed to arrive at the net gain by SRI farmers over non-SRI farmers and the results are presented in Table VII. It is evident from Table VII that increment in the profit realised by SRI farmers was Rs 18,594.91/ha. From the components of partial budgeting, the added returns in SRI were attributed mainly to increased productivity obtained in the SRI technique. The reduction in cost incurred in SRI method was due to the value of seeds, human labour and plant protection chemicals. However, the cost on farm yard manure contributed to the increase in cost of SRI technology. It is concluded from the partial budgeting analysis that the adoption of SRI technique would provide an additional profit to the farmers.

TABLE VII
PARTIAL BUDGETING FOR THE SRI FARM

Debit	Value(Rs/ha)	Credit	Value(Rs/ha)
Increase in costs		Decrease in costs	
a) Farm yard manure	418.46	a) Seeds	1,713.30
		b) Fertilisers	643.21
		c) Plant protection chemicals	232.38
		d) Human labours	2,240.63
		e) Machine labour	2,847.12
		Total	7,676.64
Decrease in returns	-	Increase in returns	
		a) Grain yield and straw yield	11,336.73
Total increased cost and reduced returns	418.46	Total reduced cost and increased returns	19,013.37
18,594.91			

Note: Net gain for adopters of SRI= Rs. 18,594.91/ ha

4.4 Technical Efficiency of SRI Farm

The technical efficiency of SRI farmers was examined by adopting Maximum Likelihood Estimation (MLE) method using Stochastic Frontier Production function. The stochastic frontier production function model specified by Battese and Coelli (1995) was used to estimate technical efficiency of sample farms selected for the study. A computer program FRONTIER version 4.1, developed by Tim Coelli, Centre for Efficiency and Productivity Analysis, University of New England, Austria, was used for the estimation of Stochastic Frontier Production function. The estimated stochastic frontier production for SRI and non-SRI farms in Palakkad district is presented in Table VIII.

The coefficients (production elasticity) of human labour, fertiliser, seed and irrigation for SRI farmers were significant with the values of 0.466, 0.154, 0.226 and 0.183 respectively. These implied that 10 per cent increase in human labour, fertiliser and seed could increase rice yield by 4.66, 1.54 and 2.26 per cent respectively. The results indicated the importance of these variables in improving yield of rice in the Palakkad district. The inefficiency variables included in the model, such as age, education, farming experience and income, were observed to be non-significant for SRI farms.

TABLE VIII
ESTIMATED STOCHASTIC FRONTIER PRODUCTION FUNCTION FOR SRI AND NON-SRI FARM

Variables	SRI farm	Non-SRI farm
	Regression coefficient	Regression coefficient
Frontier production function		
Constant	0.345	0.739
		(3.802)
Human Labour (hrs)	0.466*	0.205**
	(7.059)	(2.449)
Seed (kg/ha.)	0.154***	-0.416*
	(1.808)	(2.895)
Fertiliser (kg/ha.)	0.226***	0.314*
	(1.517)	(2.004)
No. of irrigations	0.183**	0.141
	(1.854)	(0.594)
Technical inefficiency effects		
Constant	0.139	0.135
	(0.673)	(1.169)
Age (years)	-0.394	-0.560
	(-0.725)	(-0.605)
Education (years)	0.710	-0.175*
	(-0.676)	(-1.857)
Farming experience (years)	-0.945	-0.154*
	(-0.144)	(-1.68)
Income (Rs)	-0.302	-0.179*
	(-0.488)	(-1.69)
Diagnosis Statistics		
Sigma-square (σ^2)	0.0513	0.655***
Gamma (γ)	0.783**	0.999
Log- likelihood	27.08	17.74
LR test	5.31	11.56
Mean technical efficiency (%)	**92.66**	**76.97**

N= 42
Note: Figures in parentheses indicate estimated 't' values.
*** significant at 1% per cent level; ** significant at 5% per cent level; * significant at 10% per cent level.

The values of log-likelihood function for the full stochastic frontier model and the OLS fit are calculated to be 27.08 and 24.42 respectively. This implies that the generalised likelihood-ratio statistic for testing the absence of technical inefficiency effect from the frontier is estimated to be LR = 5.31 by the Frontier 4.1 and reported as the "LR" test of the one sided error. The degrees of freedom for this test are calculated as $q + 1$, where q is the number of parameters; thus here $q = 5$. The value of "LR" test is insignificant because it does not exceed from the tabulated value taken from Kodde and Palm (1986). The log likelihood ratio test indicates that inefficiency does not exist in the data set and therefore, null hypothesis of no technical inefficiency in SRI cannot be rejected.

The estimated parameters of human labour, seed and fertiliser are significant and hence, they play a major role in SRI production. The coefficient of the variable, number of irrigations, is positive and significant. This means that the use of the recommended number would result in an increase in production. The coefficient of fertiliser is also positive and significant, clearly indicating that total amount of fertiliser (NPK) being used is at the recommended level.

The percentage distribution of farms based on technical efficiency is presented in Table IX.

TABLE IX
FREQUENCY DISTRIBUTION OF SRI AND NON-SRI FARMS BASED ON TECHNICAL EFFICIENCY

Technical efficiency classes (per cent)	No. of SRI farms	No. of non-SRI farms
45-50	-	2 (4.76)
51-55	-	1 (2.38)
56-60	-	3 (7.14)
61-65	-	4 (9.52)
66-70	-	5 (11.90)
71-75	1 (2.38)	5 (11.90)
76-80	2 (4.76)	4 (9.52)
81-85	2 (4.76)	5 (11.90)
86-90	3 (7.14)	5 (11.90)
91-95	25 (59.52)	4 (9.52)
96-100	9 (21.4)	4 (9.52)
Total	42 (100.0)	42 (100.0)
Mean technical efficiency	**92.66**	**76.97**

Note: Figures in parentheses indicate per cent of each category to total.

The variation in the levels of efficiency of SRI farm ranged from 75.04 to 97.75 with mean efficiency of 92.66 per cent. The mean level of technical efficiency indicates that, on an average, 7.34 per cent of SRI farm are falling short of the maximum possible frontier level of technology. About 21.4 per cent of the farmers belonged to the most efficient category (96 to 100), while 2.4 per cent belonged to least efficient category (71 to 75). The majority, constituting 59.52 per cent of the farm, belonged to efficiency groups falling between 91 and 95 per cent. Among non-SRI farms, variation in the levels of efficiency ranged from 50.59 to 98.57 with mean efficiency of 76.97 per cent. The mean level of technical efficiency indicates that, on an average, 23.03 per cent of non-SRI farms are falling short of the maximum possible frontier level of technology. Therefore, it was possible to increase the rice yield by adopting the SRI technology.

V. SUMMARY AND CONCLUSION

The major expenditure was incurred on labour charges and the cost of seeds occupied a meagre amount because there was a significant reduction in seed rate from about 30-60 kg/ha to 10 kg/ha in the SRI technology. The average yield under SRI was found to be 27.23 per cent higher than the conventional method. The net returns were higher for SRI farms due to higher productivity of paddy. It was also observed that the benefit-cost ratio was higher for SRI (1.70) as compared to non-SRI farms (1.17). The increased grain yield under SRI was largely attributed to greater number of lengthy productive tillers with increased number of filled grains per panicle. The study shows that SRI can be further adopted and practiced by farmers due to its high yield with reduced water requirements and lower cost. However, there should be an improvement in SRI extension service delivery. The number of training and demonstration trials needed to be scaled up by research institutes so that large numbers of farmers become aware of SRI technology.

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