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RESEARCH ARTICLE :

An economic analysis of resource use efficiency of SRI and non-SRI in Vellore district of Tamil Nadu

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SUMMARY : 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.Major objectives are to estimate technical and allocative efficiency in traditional and SRI methods of paddy cultivation and to examine reasons for adopting SRI and problems faced by traditional farmers in adopting SRI in Vellore district of Tamil Nadu.Two major paddy growing blocks were selected. From each block, six major paddy growing villages was selected. Totally ten farmers were selected from each village comprising five farmers for SRI method and five farmers for traditional method of rice cultivation and the total sample size was 120. Descriptive statistical analysis, Garrett's Ranking Technique,etc was used the tools of analysis in research. The co-efficient of multiple determination (R^2) was 0.99 for estimated production function of traditional method and it was 0.98 for SRI method. The SRI methods farmers could maximize their profit by using more quantities of seeds, labour, fertilizer, FYM and expenditure on PPC and miscellaneous items as the MVP-MFC ratio for all these resources was more than one.The average technical efficiency for traditional paddy and SRI paddy farmers was 0.88 and 0.99, respectively. The average economic efficiency for traditional paddy farmers and SRI paddy farmers was 0.80 and 0.94, respectively.It could be seen from the table that allocative efficiency (0.91) of traditional paddy farmers was less than the allocative efficiency of SRI paddy farmers (0.95).

KEY WORDS :
Resource use efficiency, Technical efficiency, Garrett's score, SRI, Non- SRI

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BACKGROUND AND OBJECTIVES

Rice commends recognition, as a supreme commodity to mankind, because rice is truly life, culture, a tradition and a means of livelihood to millions.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. (*www.indiastat.com*).

The world paddy production was 614.65 million tonnes in 2015-16, it covering an area of 153.51 million ha with an average yield of 3.87 tonnes per ha. The developing countries contributed about 90 per cent of the total world rice production. India ranked first in area under paddy (36.95 million ha) and second in

terms of production (85.31 million tonnes) during 2015-16 and it stood next only to China in the world with respect to rice production.

But, the yield levels in India were low at 2.05 tonnes per ha compared to other major rice producing countries *viz.*, Japan (6.52 t/ha), China (6.24 t/ha) and Indonesia (4.25 t/ha).

To meet the growing demand, a rapid increase in paddy production is needed. But, there is little scope to increase the area; hence increase in production and productivity with an improvement in efficiency of production act as a technological breakthrough to meet the growing demand. The green revolution of 1960's was oriented towards high input usage particularly fertilizers, irrigation and plant protection chemicals.

Below poverty line of India is about 21.6 per cent during the year 2015-16. For increase the livelihood status of below poverty line peoples and improve the food security in order to boost the rice production in our country.

The launching of HYV programme in India has enhanced the importance of the study of efficiency in crop production. The concept of efficiency is vital to policy makers both at micro and macro levels. It aids in policy recommendations related to land distribution, land ceilings, agricultural education and extension services.

Objectives:

-To estimate technical and allocative efficiency in traditional and SRI methods of paddy cultivation.

-To examine reasons for adopting SRI and problems faced by traditional farmers in adopting SRI in Vellore district of Tamil Nadu.

RESOURCES AND METHODS

The study was based on the input-output data obtained from sample farmers in Vellore districts. For selection of farmers, multi-stage sampling design was employed. In this procedure, at first stage, two major paddy growing blocks following both traditional and SRI method of rice cultivation were purposively selected. From each block, six major paddy growing villages following both the methods of rice cultivation were selected at second stage. In the final stage, ten farmers were selected from each village comprising five farmers for SRI method and five farmers for traditional method of rice cultivation. Thus, the total sample size was 120.

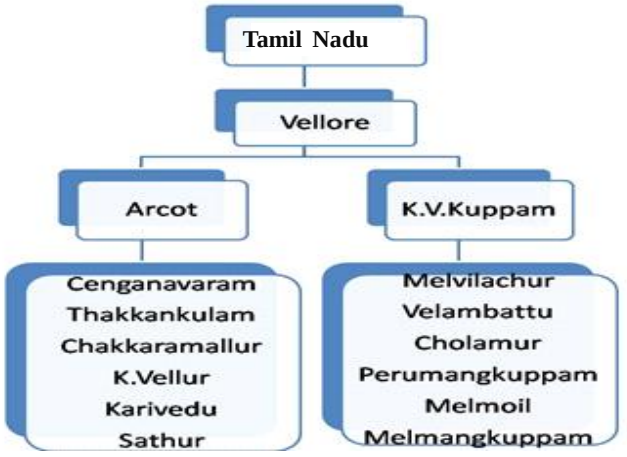

Fig. A: Schematic representation of study area

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads and Tables 1 to 5.

Technical efficiency and allocative efficiency :

The technical efficiency would indicate the ability of a farm to achieve maximum possible output with available resources, while allocative efficiency would refer to the ability to contrive an optimal allocation of given resources. Economic efficiency is a combination of both technical and allocative efficiencies.

Ekanayake and Jayasuriya (1989) opined that a unique 'best practice' input-output correspondence (a production frontier) may be defined and identified as an envelope of the entire range of relationships. All these, other than the best practice relationship, will be inefficient relative to the frontier production function. In practice, it is difficult and sometimes impossible to identify and measure differences in the quality of inputs. Therefore, with only measurable, 'conventional inputs', a technology can be defined with best and inferior practices, where the best practice frontier is an envelope of inferior functions. This enables non-measurable differences in inputs to be captured in a technical efficiency measure where technical efficiency is treated as the deviation from the frontier production.

Shanmugam (1994) argued that technical efficiency would refer to the proper choice of production function among all those activities in use by farms and allocative or price efficiency as the proper choice of input

combination. Technical efficiency, one of the two components of economic efficiency, was defined as the ability and willingness of any producing unit to obtain the maximum possible potential output from a given set of inputs and technology.

Hazarika and Subramanian (1999) remarked that efficiency would be an important factor of productivity growth as well as stability of production, especially in developing agricultural economies. The estimation of technical efficiency in the frontier production function model could help to decide whether to improve efficiency or to develop new technology to raise the productivity.

Mythili and Shanmugam (2005) defined technical efficiency of a farm as the ability and willingness of the farmer to obtain the maximum possible output with a specified endowment of inputs, given the technology and environmental conditions surrounding the farm.Further they studied the technical efficiency of rice farms in Tamil Nadu. The estimated efficiency of *Kharif* season rice was 82 per cent and that of samba season rice was 82 per cent. The estimated mean technical efficiencies of *Kharif* season rice and samba season rice were 82 and 82 per cent, respectively. This study revealed that there was considerable scope for improvement in the productivity of the sample farms.

In the present study, technical efficiency has been defined as the ability of the rice farm to obtain its maximum possible yield from a given set of inputs and technology.

Shanmugam and Palanisami (1993) used frontier production function approach to study the economic efficiency in rice in Srivilliputhur tank in Kamarajnagar district of Tamil Nadu. The results showed that the output loss due to technical inefficiency (26%) was higher than the output loss due to allocative inefficiency (5%). The study indicated that the rice output of "average farmer" could be increased by 26 per cent by adopting the technology followed by the "best practice" farmers. The economic inefficiency revealed that the production could be raised by 29.7 per cent if the technology gaps between "average farmer" and "best practice" farmers were narrowed.

Pouchepparadjou *et al.* (2005) analyzed the technical efficiency of IPM adopted and non-adopted rice farms of Pondicherry. They found that non-adopted farms were operating at high technical efficiency (0.37), allocative efficiency (0.88) and economic efficiency (0.32) as compared to the technical efficiency of 0.35, allocative efficiency of0.27 and economic efficiency of 0.09 for IPM adopted farms. These results clearly

Table 1 : Estimated production function for traditional and SRI rice

Sr.No.	Particulars	Traditional method	SRI method
1.	Intercept	0.160	0.197
2.	Seeds	0.3349	0.0475**
3.	Human labour	0.1319	0.0278***
4.	fertilizer	0.2841	0.0327**
5.	FYM	0.031	0.0250***
6.	PPC	0.1593	0.0453**
7.	Land	0.0091	-0.121
8.	R^2	0.992	0.9800
9.	t value	0.034	1.97

** and *** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : MVP and MFC ratios of resources in traditional and SRI rice

Inputs	Traditional rice			SRI rice		
	MVP	MFC	Ratio	MVP	MFC	Ratio
Seed (Rs.)	168.69	12.50	1.30	1073.6	13.08	82.08
Labour (mandays)	34.54	50.00	0.69	77.69	50.00	1.55
Plant protection chemicals (Rs.)	0.749	1.00	0.749	1.65	1.00	1.65
Land	217.38	3457.38	0.06	-2333.6	3457.9	-0.67
FYM	272.72	248.43	1.10	1183.9	253.13	4.68
Fertilizer	34.20	12.11	2.82	42.68	12.1	3.52

showed that IPM adopted farms have greater potential to boost output through the use of best practice technologies of IPM.

In the present study, allocative efficiency is defined as the ability of a farm to contrive an optimal allocation of given resources in rice production and is measured by equating 'the marginal contribution of the resources to output value' to 'the factor cost'.

Descriptive statistical analysis :

Descriptive statistical analysis such as mean, percentages, range, standard deviation were used to study the socio-economics characteristic like age, education, experience, size of holding, family size, cropping pattern, awareness about SRI rice, etc.

Garrett's ranking technique :

Garrett ranking technique is widely used to rank the qualitative judgments and opinions about a phenomenon. This technique was used to rank the sources of information on SRI rice, the reasons for cultivation of SRI rice, and problems faced by the farmers in SRI rice cultivation.

In the Garrett's rank scoring technique, the respondents were asked to rank the factors or problems and these ranks were converted in to per cent position by using the following formula:

$$\text{Per cent positition} = \frac{100\,(R_{ij}-0.5)}{N_j}$$

where, R_{ij} = Rank given to the i^{th} attribute by the j^{th} individual

N_j = Number of attributes ranked by the j^{th} individual.

By referring to the Garrett's table, the estimated percent positions were converted into scores (Garrett, (1985).). Thus, for each factor, the scores of the various respondents were added and the mean score was estimated. The means thus obtained for each of the attributes were arranged in a descending order.

Technical and allocative efficiency in traditional and SRI methods of paddy production:

One of the major objectives of the study was to analyze technical, allocative and economic efficiency in traditional and SRI methods of paddy in the study area. For this purpose, the popularly used Cobb-Douglas production function was fitted (Cobb and Douglas,1928). The co-efficient of multiple determination (R^2) was 0.99 for estimated production function of traditional method and it was 0.98 for SRI method. The high and significant

Table 3 : Technical, allocative and economic efficiency of rice cultivation

Sr.No.	Particulars	Traditional rice	SRI rice
1.	Technical efficiency	0.88	0.99
2.	Allocative efficiency	0.91	0.95
3.	Economic efficiency	0.80	0.94

Table 4 : Percentage positions and their corresponding Garrett's score values

Rank	Per cent position	Garrett's ranking table
1.	100(1-0.5)/5 =10	75
2.	100(2-0.5)/5 =30	60
3.	100(3-0.5)/5 =50	50
4.	100(4-0.5)/5 =70	40
5.	100(5-0.5)/5 =90	24

Table 5 : Total score and Garrett's score for different factors

Sr.No.	Problems	Rank				Total No. of respondents	Total score	Garrett's score	Rank
		1	2	3	4				
1.	Lack of skilled labours	20	10	18	22	60	4200	70	1
2.	Lack of awareness	10	15	23	12	60	3800	63	2
3.	Lack of training	18	22	10	20	60	2500	41.6	5
4.	Absence of risk bearing ability	15	23	10	12	60	3200	53.3	4
5.	Lack resources	25	16	11	8	60	3600	60	3

F values indicated that the Cobb-Douglas production function was adequate in explaining 83 per cent of the variation in output in traditional method and 85 per cent of the variation in SRI method due to variations in the resources included in the model. The constant returns to scale was noticed in both the methods since sum of elasticity co-efficients was nearly one. An examination of production parameters of Cobb-Douglas function for traditional method indicated that paddy output was positively and significantly conditioned by all variable inputs except land for which the positive relation was no doubt observed but was statistically not established.

The elasticity co-efficients in the case of SRI method indicated that the paddy output was significantly and positively influenced by all resources except land. Paddy output was negatively influenced by land but the relationship was statistically not established (Barah, 2009).

To analyze the scope for intensification of resources in both methods, the marginal value products (MVP) of resources are compared with the respective marginal factor cost (MFC).The MVP-MFC ratios for traditional methods indicated that there was a scope for increased use of seeds in the short-run keeping the use of other resources at a constant level. This was also true for variable resources like fertilizer and FYM as MVP-MFC ratio for these resources was more than one. Nevertheless, MVP-MFC ratio for labour, expenditure made on PPC and miscellaneous items and land use were less than one and positive indicating that profit could be optimized by using less quantity of labour and bringing down the area under paddy. The SRI methods farmers could maximize their profit by using more quantities of seeds, labour, fertilizer, FYM and expenditure on PPC and miscellaneous items as the MVP-MFC ratio for all these resources was more than one. However, MVP-MFC ratio for land was negative indicating that SRI paddy farmers could increase their profit by reducing the area under paddy.

The technical efficiency in traditional and SRI method was worked out by using Timmer method. The average technical efficiency for traditional paddy and SRI paddy farmers was 0.88 and 0.99, respectively. The amounts of various resources that would have been required for the farmers to produce existing level of output at the highest level of technical efficiency were worked out and these levels of inputs are called as frontier level of input use. The frontier level of input use was compared with actual levels of input use to get an idea as to the amounts of various inputs that could have been saved if all the farmers were to operate at highest technical efficiency level (Shanmugam, 2003 and Singh and Nareshkumar, 1998).

It could be seen from the table that allocative efficiency (0.91) of traditional paddy farmers was less than the allocative efficiency of SRI paddy farmers (0.95). In both the methods farmers were operating at less allocative efficiency than the technical efficiency. In other worlds, allocative inefficiency was higher than the technical inefficiency in both the methods of paddy production. The average economic efficiency for traditional paddy farmers and SRI paddy farmers was 0.80 and 0.94, respectively. Though the technical efficiency of SRI paddy farmers was marginally less than the technical efficiency of traditional paddy farmers, the economic efficiency was more for SRI paddy farmers comparatively because of high allocative efficiency level of SRI paddy farmers compared to that of traditional paddy farmers (Gundurao *et al.*,1985; Hatta, 1967 and Radha *et al*., 2009).

Examine problems faced by farmers in adopting SRI in Vellore district of Tamil Nadu :

High labour requirement was the major constraint in practicing SRI method. Especially during transplanting and weeding days sample farmers faced the dearth of labour availability. The SRI method was a labour intensive method of paddy cultivation. The next major constraint in SRI method was high weed infestation. The specific constraint pertaining to the study area was poor drainage condition especially during heavy rainy seasons. The other constraints expressed by the sample farmers were manual conoweeder operation and high cost of cultivation.

Conclusion :

It could be seen from the table that allocative efficiency (0.91) of traditional paddy farmers was less than the allocative efficiency of SRI paddy farmers (0.95).The average technical efficiency for traditional paddy and SRI paddy farmers was 0.88 and 0.99, respectively.

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the technical efficiency of traditional paddy farmers, the economic efficiency was more for SRI paddy farmers comparatively because of high allocative efficiency level of SRI paddy farmers compared to that of traditional paddy farmers.

It can be concluded that besides the less resource use, the profitability (return per rupee) in SRI rice cultivation is higher *vis-a-vis* conventional method. Hence the farmers have to be educated and empowered through training and demonstrations. The efficiency level (both technical and allocative) in SRI is higher compared to conventional methods. The quantities of seed, fertilizer and PPC use was more in traditional paddy cultivation whereas human labour, bullock labour, machine labour and FYM use was more in SRI paddy cultivate on MVP-MFC ratio for labour, expenditure made on PPC and miscellaneous items and land use were less than one and positive indicating that profit could be optimized by using less quantity of labour and bringing down the area under paddy.However, MVP-MFC ratio for land was negative (due to "economics of size") indicating that SRI paddy farmers could increase their profit by reducing the area under paddy.The SRI methods farmers could maximize their profit by using more quantities of seeds, labour, fertilizer, FYM and expenditure on PPC and miscellaneous items as the MVP-MFC ratio for all these resources was more than one.

The relevance of garrett's ranking analysis indicated that difficulties in management practices like water management and intercultural operation, lack of water availability and unavailability of skilled labour were major constraints to SRI method adoption. Hence, appropriate interventions like empowering farmers through training and demonstrations with proper guidance from extension personals has to be made for larger adoption in the study area.

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REFERENCES

Barah, B.C. (2009). Economic and ecological benefits of system of rice intensification (SRI) in Tamil Nadu. *Agric.Econ. Res. Rev.*, **22**: 209-214.

Cobb, C.W. and Douglas, P.H. (1928). A theory of production. Supplement, Papers and Proceedings of the Fortieth Annual Meeting of the American Economic Association. *American Econ. Rev.*, **18**(1) :139–165.

Ekananayake, S.A.B. and Jayasuriya,S.K. (1989).Adjustment and the role of specific experience: Evidence for Sri Lankan rice farming. *Australian J. Agric. Econ.*, **33** (2): 123 -124.

Garrett, H.E. (1985). *Statistics in psychology and education.*, Valals, Feter and Simons Pvt. Ltd., Bombay 27-65 pp.

Gundurao, D.S. Bisaliah, S. and Krishnaswamy, H. S.(1985).Technical change and efficiency gain in dry landagriculture: An economic study. Margin NCAER, pp. 37-38.

Hatta, S. (1967). Water consumption in paddy field and water saving Rice culture in the tropical zone. *Japanese J. Tropi. Agric.*,**11** (3): 106-112.

Hazarika, C. and Subramanian, S. R.(1999). Estimation of technical efficiency in the stochastic frontier production function model- an economic application to the industry in Assam. *Indian J. Agric. Econ.*,**54** (2) : 201-211.

Mythili and Shanmugam, K.R. (2003). Technical efficiency of rice, groundnut and cotton farms in Tamil Nadu, *Indian J. Agric. Econ.*, **58** (1): 101-114.

Pouchepparadjou, A., Kumaravelu, P. and Achoth, L. (2005). An econometric analysis of green technology adoption in irrigated rice in Pondicherry union territory. *Indian J.Agric. Econ.*, **60**: 660-676.

Radha, Y. Reddy, K. Y. Rao, G. S., Chandra, S. R. and Babu, G. K. (2009). Water-saving rice production technologies in Krishna Western Delta Command of Andhra Pradesh – An economic analysis. *Agric. Econ. Res. Rev*.,**22** : 397-400.

Shanmugam, T. R. and Palanisami, K.(1993). Measurement of economic efficiency – Frontier function approach. *J. Indian Soc. Agric. Stat.*,**45** : 235-242.

Shanmugam, T. R.(1994). Measurement of technical efficiency in rice production. *Margin.*, **26**: 756-762.

Shanmugam, T. R.(2003).Technical efficiency of rice, groundnut and cotton farms in Tamil Nadu. *Indian J. Agric. Econ.*,**58** (1) : 101-114.

Singh, A J. and Nareshkumar, R. (1998). A study into technical efficiency in rice cultivation in Punjab. *Agriculture Situat. India*, **54** : 747-750.

WEBLIOGRAPHY

www.indiastat.com.