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Farmers Access, Adoption Behaviour and Constraints Analysis in Improved Technology Dissemination: A Case Study on System of Rice Intensification in Bihar

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ABSTRACT

System of Rice Intensification (SRI) is an environment well disposed and novel strategy of rice cultivation which incorporates utilization of less seed, less water and fewer chemicals to obtain higher yield and profitability. A study was undertaken in Bihar to assess the extent of adoption of SRI and its determinants and constraints using primary data collected for the Agricultural Year 2013-14. Tabular analysis, Tobit regression, Garrett's ranking were employed. Adoption index showed transplanting early seedling having highest weightage and poor adoption in all SRI practices. Tobit analysis indicated that access to extension and number of training attended has significant influences on adoption of SRI package of practices. Non- availability of skilled labour was found to be the major constraint in adoption of SRI method. To realize the inclusive and full benefit of SRI technology, the efforts should be directed to enhance the adoption of recommended practices of SRI by all the stakeholders, demonstration of SRI cultivation on farmers' fields, training to farm labourers, standardize the SRI practices and mechanization of SRI operations.

Key words: SRI, tobit analysis, Garrets Ranking, Adoption Index, Adoption Behaviour

INTRODUCTION

The world's population is increasing and it is a matter of great concern to meet the rising demand for food, so food security is a huge challenge for agriculture in recent future. It is estimated that to ensure food security in the rice-consuming countries of the world, rice production needs to be increased by 50 per cent by 2025. There is a need to produce more on less land with less usage of water, labour and other inputs due to high population rise and shrinking resources with fragmented land holdings.. Though India is not a water scarce country, but due to high population growth, severe negligence and over-exploitation of this resource, water is becoming a scarce commodity. On this backdrop, some creative rice production innovations are expected to increase the rice production efficiency with saving of irrigation water (Makadia *et. al.*, 2014). The adoption of new or improved method of production/ cultivation can shift the production function i.e. the production level in old technology can be increased with new technology by using fewer quantities of resources that were used in old technology (Basavaraj *et al,* 2008). There are different extension constraints in modern technology adoption which cited as inadequate demonstration at proper time, irregular visit of Field Extension Officers as perceived by tribal farmers (Rajan *et. al.* 2014). Under this situation, the System of Rice Intensification (SRI) may be a suitable practice to deliver more production with fewer inputs. SRI was developed in Madagascar in the mid-1980s by Father Henri de Laulanie, a Jesuit Priest. SRI is an environment well-disposed and novel strategy which incorporates utilizing less seeds, less water & fewer chemicals (Barah *et. al.* 2009). It, in fact, challenges the received wisdom of rice development in every angle.

SRI method differs from normal method of rice cultivation in terms of nursery management, seed rate, age of the seedlings, transplanting, wide spacing, weeding, water management and manures and fertilizers (Sitadevi and Ponnarsi, 2009). Though Bihar is rice growing and water resource rich state, the state had experienced number of severe droughts characterized by water shortage and downgrading groundwater levels. Under these circumstances, with dual objectives of reducing the demand for water and increasing the yields, the SRI was introduced in Bihar in 2002 Kharif season, as an alternate option.

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METHODOLOGY

The study was conducted based on primary data about socio-economic aspects of sample farmers, which were collected through personal interview with the help of specially structured pre-tested interview schedule. All the technologies of SRI followed by the farmers in the study area were enlisted and farmers' perceptions were recorded. Perception about constraints in adoption, access to training and extension contact were also recorded. Multistage sampling was used to collect primary data for the study. In Bihar two districts namely, Nalanda and Samastipur were purposively selected on account of higher proportion of area under SRI cultivation. A sampling frame of the villages, where farmers are practicing SRI, was developed and three villages from each district were selected randomly. The list of farmers practising SRI and traditional method was prepared in each village. Ten (10) SRI farmers and five (5) traditional farmers were selected randomly from each village. Thus, a total sample of 90 farmers was selected for the study.

Adoption index

Adoption index was developed to study the extent of adoption of SRI technologies. With the help of subject matter specialists, several practices under the SRI were identified. Subsequently, weightage were assigned to each of them which helped in developing an adoption index. The average of score was obtained and standardization of weights by judges (SMS) was calculated which applied to the number of activities identified. Finally, the adoption index was developed by summation of all the scores.

Tobit model

Tobit model was employed to identify the factors which influenced the farmers' decisions for adoption of SRI activities. Tobit model is a statistical model to describe the relationship between the non-negative dependent variable Yi and independent variable Xi.

Tobit model can be described in terms of a latent variable Y*. Yi* is observed when Yi*>0 and Yi* is not observed when Yi* ≤ 0. So the observed Yi is defined as:

$$Yi = \{Yi^* = \beta Xi + Ui, \text{if } Yi^* > 0\}$$
$$\{=0, \text{if } Yi^* \leq 0\}$$

Tobit model is also called as censored regression model because some observation are censored i.e. Yi* ≤ 0.

The factors which were hypothesized to influence the participation of farmers in SRI include education of head of the household (years), size of operational holding (ha), number of family labours, extension contact, number of training attended, proportion of rice income and membership in farmers organization.

Garret's ranking

Garett's Ranking Technique is a noble method which provides change of orders of constraints and advantages into numerical scores. The prime advantage of this technique over simple frequency distribution is arrangement of constraints based on their importance from the respondents' point of view. Also, it is useful where the same number of respondents on two or more constraints may have been given different rank. Garrett's formula for converting ranks into per cent is given by: Per cent position = 100 * (Rij – 0.5)/Nj

Where, Rij = rank given for ith factor by jth individual and Nj = number of factors ranked by jth individual. The per cent position of each rank was converted into scores referring to the table given by Garrett and Woodworth (1969). For each factor, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, the constraints were accordingly ranked. Here, the technique was used to organize farmers' response on constraints in adoption of SRI practices

RESULTS AND DISCUSSION

Socio-economic profile of SRI adopted farmers and traditional farmers

The analysis of socio-economic characteristics of farmers is imperative to understand the major factors affecting adoption, production and continuation of any improved technology like SRI. In this context, Rahangdale *et. al.* (2011) tried to highlight impact of SRI on production of paddy among practicing farmers. The findings revealed that the level of education, land holding, social participation, mass media exposure, extension participation, knowledge level of SRI technology, economic motivation and adoption level were found to be significant with production level of paddy among SRI practicing farmers, where age, farm power, annual income, closeness with extension agent and aspiration level had showed non-significant association with production level of paddy among SRI practicing farmers.
Socio-economic characteristics of the SRI adopted farmers and traditional farmers are presented in Table 1. In case of extent of adoption in SRI, small farmers dominated in the sampling area. Out of the total sample of

60 SRI adopted farmers, 26 small (43.3%), 25 marginal (41.6%) and 9 medium and large farmers (15%) were identified whereas in case of traditional sampled farmers, majority 17 (57%) were marginal farmers, 11 (37%) were small farmers and 2 (6.6%) in case of medium and large farmers.

The average size of holding in case of SRI adopters was 1.41 ha, which in case of traditional farmers was comparatively low i.e. 1.17 ha. In both the SRI and traditional farmers' analysis, the cropping intensity was nearly equal to 187 per cent. Here cropping intensity was invariant to SRI technologies as it was quite same in both the case of SRI and traditional farmers. Rice area under SRI on SRI adopted farms on an average among all categories was 84 per cent, which was dominated by marginal farmers (92 %) followed by small farmers (86 %) and medium and large farmers. The proportional rice area percentage was quite higher among all categories of SRI adopted farmers than traditional ones. There was not much difference in the age of the different categories of SRI adopting farmers and average stands at 43 years. In case of traditional method of rice cultivation, the average age was 44 years which showed little difference in age between the SRI adopting and traditional farmers. It was found that head of the family practicing SRI method of rice cultivation had attained high level of education in comparison to the traditional farmers. This shows that education plays a significant role in the adoption of SRI method of rice cultivation.

Table 1: Socio-economic characteristics of SRI farmers (n=60) & Traditional farmers

n=30

Particulars	Marginal		Small		Medium and Large		Overall	
	SRI	Traditional	SRI	Traditional	SRI	Traditional	SRI	Traditional
Number of farmers *(f)*	25	17	26	11	9	2	60	30
Percentage of farmers (%)	41.67	56.67	43.33	36.67	15	6.67	100	100
Average age of head of the family (Years)	44.08	43.82	43.12	45.64	44.89	49.50	43.78	44.87
Average education of head of the family (Years)	8.24	3.18	8.81	4.36	9.33	4.50	8.65	3.70
Average size of holding (ha)	0.79	0.83	1.52	1.53	2.83	2.16	1.41	1.17
Average area under Rice (ha)	.73	.58	1.31	1.07	2.14	1.41	1.19	0.819
Proportional rice area percentage (%)	92.4	69.87	86.18	69.93	75.61	65.27	84.39	70
Cropping intensity (%)	193.87	189.17	186.78	186.17	183.39	183.97	187.41	187.11

Access to institutions and training by farmers

The details on the institutions and organizations promoting SRI in the sampling area, like the membership of the farmers in these organizations, the training received by the farmers, the extension contacts and access to credit are given in Table 2. In case of SRI farmers, the access to credit was 65 per cent and it showed access to credit was more in case of large farmers; whereas, in case of traditional farmer access to credit was only 43 per cent.

Table 2: Access to institutions and training by SRI farmers (n=60) & Traditional farmers

n=30)

Particulars	Marginal		Small		Medium and Large		Overall	
	SRI	Traditional	SRI	Traditional	SRI	Traditional	SRI	Traditional
Access to credit (%)	64.0	58.8	65.4	18.2	66.7	50.0	65.0	43.3
Access to extension services (%)	60.0	35.3	61.5	36.4	77.8	50.0	63.3	36.7
Access to training (%)	96.0	35.3	100.0	36.4	88.9	50.0	96.7	36.7
Average No. of training attended	2.9	0.4	3.2	0.4	3.2	0.5	3.1	0.4
Average membership of farmer's organisation (%)	76.0	29.4	73.1	45.5	33.3	0.0	68	33.3

The access to extension services was 63 per cent in case of SRI adopters which was much higher than traditional farmers (merely 36 %). Training received by farmerson SRI method was high in case of SRI adopting farmers. The average number of trainings received by SRI farmers was three (3); whereas it was less than one (<1) numbers in case of traditional farmers. Small farmers had a better share in the number of farmers trained followed by marginal and other categories of farmers. Overall 96 per cent of SRI farmers had access to training which was two times more than the traditional farmers. The average membership of the farmer's organization was 68 per cent in case of SRI farmers where was for traditional farmers, it was 33 per cent. There were some points obtained from focused group discussion that the institutional arrangements available in the study area for promoting SRI comprise government department, farmers' society and other individual progressive farmers. The government department helps the SRI adopting farmers by providing various inputs like bio fertilizers, cono-weeders, mat nursery etc.

Adoption index of SRI farming technologies

Adoption index was prepared considering the various SRI package of practices adopted by the farmers in the sampling area. The scale had been standardized by assigning weights to the SRI technologies based on the opinion collected from subject matter specialists. From the Table 3, it is evident that "Transplanting 8-12 days seedling" got highest weightage from the subject matter specialist followed by "planting wider spacing". It also revealed that the overall adoption index was 0.57 and the adoption of SRI technologies increased when the farm size increased. The adoption indices of 'marginal', 'small', 'medium and large' farmers were 0.53, 0.58 and 0.61

respectively. It was clear that all the farmers, when considered together, showed moderate interest in adopting all package of practices but when the individual farmer classes were considered, the medium and large farmers showed a variation from this by showing interest in greater adoption of technology. It was interesting to note that all the farmers, when considered individually as well as together, showed least interest in adopting leaf colour chart and transplanting of 8-12 days seedling, than any other technologies. Planting wider spacing having the greater weightage and it was having good acceptance among all the categories of farmers.

Table 3: Adoption index of SRI farming technologies

n=60

Particulars	Standard weight	Marginal	Small	Medium and Large	Overa
Transplanting of 8-12 days seedlings	0.152	0.061	0.058	0.068	0.061
Planting at wider spacing	0.14	0.101	0.108	0.124	0.107
Careful transplanting	0.128	0.046	0.044	0.057	0.047
Water management(alternate wet & dry)	0.119	0.043	0.046	0.04	0.043
Seed rate (5 kg/ha)	0.116	0.06	0.08	0.077	0.071
Use of cono-weeder	0.103	0.091	0.091	0.092	0.091
Adoption of mat nursery	0.07	0.05	0.051	0.062	0.052
Application of FYM (10 ton/ha)	0.067	0.037	0.041	0.037	0.039
Use of leaf colour chart	0.055	0.013	0.019	0.018	0.016
Use of indigenous marker	0.052	0.035	0.046	0.04	0.04
Overall adoption index	1.000	0.537	0.584	0.615	0.569

Adoption behaviour of SRI adopted farmers

There were several determinants that affect the adoption of SRI practices by the farmers in the sampling area. They were tested using Tobit regression analysis. The dependent variable was the extent of adoption constructed from the adoption index.

Table 4: Tobit coefficient of factors affecting adoption of SRI practices

n=60

Parameters	Coefficients	Standard Error	Probability
Intercept	0.154	0.098	0.116
Education of head	0.005	0.004	0.267
Land holding (ha)	0.003	0.020	0.891
Family labour (No.)	0.014	0.013	0.290
Extension contact (1,0)	0.135	0.031	0.0001*
Training attended (No.)	0.04	0.012	0.0014*
Membership in Organisation (1,0)	0.013	0.026	0.640
Proportion of rice income from total income (%)	0.269	0.130	0.040**
Sigma	0.111	0.010	0.000

Note: * (Significant at 1 % level) ** (Significant at 5% level)

There are several gaps which have to be identified for enhancing farmers' adoption of modern technologies based on farmer's preferences. Kumar and Nain (2013) studied on training preferences in rice farmers in Jammu district where they found plant protection got highest preference (Rank=1.96) followed by manures and fertilisers (Rank=1.88), seed technology (1.85). Here, the factors hypothesized to influence the participation of farmers in SRI practices were education to head of the household (years), size of operational holding (ha), number of family labours, extension contact, number of training attended, proportion of rice income and membership in organization. The result of the Tobit regression analysis was presented in the Table 4. The fitted model was a good fit for the data as the likelihood ratio is 46.77. The results of the Tobit regression indicated that all parameters, *viz.* education, land holding, family labour, extension contact, number of training, membership in organisation, proportion of rice income were positively affected the adoption of SRI. The factors affecting adoption of SRI like extension contact and number of trainings showed highly significant result at 1 per cent level of significance. It was somewhat varied with the result by Ravichandran and Prakash (2015) where variables namely age, education, farming experience, SRI experience, information seeking behaviour, training attended, extension orientation, economic motivation, risk orientation, market perception, innovativeness and attitude were found to be positively significant at 1 per cent level of probability with their extent of adoption of SRI technology. The result also suggested that for an increase of one unit of extension contact would increase the adoption indices of SRI by 0.13 units. As the number of trainings increased by 1 unit, the probability for adoption indices would increase by 0.04 units.

Perceived constraints in adoption of SRI method by farmers

Each technology has its own strength and limitation. Generally, farmers confront a lot of limitations in adoption of new technologies. Several limitations were highlighted by Rakshit *et. al.,* (2016), where lack of resource was major constraint followed by lack of knowledge, lack of institutional support, poor extension system, lack of infrastructure, poor communication, lack of political will. So there is a need to analyse the limitations for user friendly alternate strategy development. Constraints in adoption of SRI method were identified using Garrett's ranking technique and presented in Table 5. The farmers themselves listed the constraints which were then cross checked with the available literature. Each of the farmers ranked the

constraints according to their perception. Top eight constraints according to the perceived priority of the farmers were listed in the table. The results revealed that non-availability of farm labourer was the major constraint perceived by SRI farmers in the study area.

Table 5: Perceived constraints in adoption of SRI method by farmers

Particulars	Garrett Score				Ranking			
	Marginal	Small	Medium and Large	All	Marginal	Small	Medium and Large	All
Non-availability of farm labourer	77.44	71.73	72.56	74.23	I	I	I	I
Poor skilled labour	68.68	65.19	60.67	65.97	II	II	IV	II
Higher seedling mortality	61.08	61.08	67.89	62.10	III	III	II	III
Difficulty in nursery management	52.60	60.50	61.67	57.38	VI	IV	III	IV
Alternate wetting and drying	56.52	56.85	57.11	56.75	IV	V	V	V
Transplanting 8-12 days Seedling	54.56	55.27	50.00	54.18	V	VI	VI	VI
Drudgery in using cono-weeder	41.32	43.23	42.44	42.32	VII	VII	VII	VII
Non availability of FYM	38.80	37.15	38.67	38.07	VIII	VIII	VIII	VIII

The overall Garrett score was 74.23 for the non-availability of farm labourer. This was followed by the poor skilled labour availability, higher seedling mortality, difficulty in nursery management, alternate wetting and drying and transplanting 8-12 days seedling. Drudgery in the use of cono-weeder and non-availability of FYM were not found as serious constraints in SRI farming. This finding was somehow contradictory to earlier finding (Rao, 2011) as most important constraint in SRI method of cultivation in North Coastal Zone was difficulties in 'Nursery management', followed by 'Drudgery in using cono-weeder' and 'Skill in transplanting'.

CONCLUSION

The adoption of SRI technology was not satisfactory and there were many constraints in the process of adoption. Therefore, to realize the inclusive and full benefit of SRI technology, the efforts should be directed to enhance the adoption of all recommended practices of SRI by all the stakeholders. The non-SRI farmers should be made aware of the benefits of SRI adoption through demonstration of SRI cultivation on farmers' fields and awareness camps along with other extension activities of agricultural development. More research efforts should be directed to improve the SRI practices suitable for local conditions for better adoption. The policy makers should formulate more farmer friendly low cost technologies to facilitate adoption of SRI in case of small and marginal farmers which could have great scope in doubling the farmers' income in recent future.

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