Article

More Crop per Drop of Water: Adoption and Dis-adoption Dynamics of System of Rice Intensification

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Abstract

For efficient use of water, there is a dire need to manage acute water scarcity in agriculture through the adoption of sustainable water management technologies. To produce more crops per drop of water, the System of Rice Intensification (SRI) technology is being promoted. We undertook a case study in the state of Kerala, India, to examine the factors influencing adoption and dis-adoption of SRI. The humid and tropical climate of Kerala is conducive for rice cultivation. However, over the years, the area under rice cultivation in Kerala has been declining. In this context, SRI technology has emerged as a prominent tool to achieve increased rice production and thus productivity. The study reveals that factors such as experience in farming, income from off-farm and non-farm sources, size of landholding and contact with agriculture extension officers are significant determinants of adoption of SRI technology. On the other hand, factors such as difficulty in water management and early transplantation, non-availability of skilled labour and difficulty in using the cono weeder cause the dis-adoption of SRI. We suggest that, in addition to promoting SRI technology, it is also imperative to develop effective irrigation facilities and promote participatory irrigation management to produce more crop per drop of water. Many farmers who discontinued SRI technology cited the lack of institutional support and capacity building as the factors influencing their decision. Therefore, the state government needs to focus on these aspects so that not only dis-adoption can be minimized significantly, but more farmers can also be encouraged to adopt the technology in the coming years.

Keywords

Agricultural sustainability, small farmers, water management, Kerala.

Introduction

Rice is the staple food of more than half of the world's population, including 640 million undernourished people living in Asia (International Rice Research Institute, 2010). Asia's food security depends largely on irrigated rice fields, which account for more than 75 per cent of the total rice production (Virk, Khush, & Peng, 2004). Rice production is a water-intensive activity, but since many rice-producing countries are facing water scarcity (Seckler, Barker, & Amarasinghe, 1999), water-saving strategies have become a priority in order to increase rice output (Baker, Dawe, Toung, Bhuiyan, & Gerra, 2000). The situation is not different for India, too. As rice is likely to play a major role in fulfilling India's food security needs in the coming years, the country may not be in a position to feed its population if the present growth rate and the current trend in the productivity of rice continue. The area production and productibity of rice during the year 2012–13 was 427.53 lakh hectares, 105.24 million tonnes and 2,462 kh/hectare respectively (Department of Agriculture and Cooperation, 2014). At the current rate of population growth (1.98%) Indian population is expected to touch 1.63 billion by 2050. Considering that about 60 per cent of

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the cereal requirement will be rice, it is estimated that about 136 million tonnes of rice will be required for an expected population of 162 million by the year 2050 for consumption purpose alone (Directorate of Rice Research, 2013; Central Rice Research Institute, 2013). There must be a phenomenal increase in the productivity of rice, and such an increase has to be achieved in the backdrop of declining and deteriorating resource base like land, water, labour and other inputs. In addition, it must be achieved without adversely affecting the quality of the environment (Chandrasekaran, 2008). Currently, several emerging technologies that are aimed at boosting paddy yield happen to be, in effect, water-saving technologies. The System of Rice Intensification (SRI) is one such well-known water-saving technology which improves yield with less water, less seed and less chemical inputs than most conventional methods of rice cultivation. For instance, SRI technology requires 25–50 per cent less water than conventional rice cultivation methods (World Wildlife Fund, 2007).

SRI is a new system of rice cultivation that increases rice productivity with a comprehensive package of practices involving lesser quantity of seed, water, chemical fertilizers and pesticides (Uphoff, 2006). The concept was developed in Madagascar in the early 1980s by late Father Henri de Laulanié and could be adopted with suitable modifications to any ecosystem. It was observed that the SRI technology could double the production of paddy per hectare (ha) by using only 5 per cent of the usual seeds, 50 per cent of usual water, 50 per cent of manure, and 80 per cent of labour (Vishnudas et al., 2007). Experience in rice cultivation suggests that farmers who grow irrigated rice by means of flood irrigation have been wasting large volumes of water for centuries, even millennia. With SRI, it has been demonstrated that more rice can be produced by using less water, provided that concurrent changes are made in the way plants, soil and nutrients are managed (Uphoff & Randriamiharisoa, 2002). Considering the importance of SRI in producing more crop per drop of water, there is a dire need to promote this technology for efficient use of available water.

Krishi Vigyan Kendra (KVK), Trivandrum, started promoting SRI as a new rice production method in Kerala since 2003. The humid and tropical climate of Kerala is conducive for the cultivation of rice, and traditionally rice has occupied a prime position in its agriculture. However, the area under rice cultivation has been declining over the years, with a possibility of eventual extinction of rice farming in the state. It is evident that the production–consumption gap of rice in the state has increased from 50 per cent in 1975 to 84 per cent in 2010 (Leena, 2010). Increasing cost of cultivation, coupled with labour scarcity, is weaning away rice farmers from cultivation. The average cost of rice production is highest in Kerala when compared to other states. The cost of production per ha in the state is Indian Rupees (INR) 20,224, while the productivity per hectare (ha) is only 38.78 quintals (CACP, 2010). To meet the demands of a population of 32 million, the state has to produce approximately 3.8–4.0 billion tonnes of food grains every year at the minimum per capita food availability of 320 g. However, the actual production is only around 0.6 billion tonnes, which is less than one-sixth of the requirement (Leena, 2010). Thus, adoption of SRI has emerged as a prominent strategy in the state in achieving increased rice production and, thus, productivity.

Considering the success of SRI in terms of low quantum of water usage, improvement of soil health (because of the application of organic manures in combination with inorganic fertilizers) and reduction in cost of production (owing to low level of seed requirement), the state of Kerala has taken efforts to disseminate this technology package to the farmers. Furthermore, there has been considerable progress in the adoption of this technology in the state for more than a decade. However, the factors influencing the adoption of SRI have not yet been studied adequately. This being the case, we undertook a study to examine the factors determining the adoption or disadoption of SRI technology of rice cultivation in Kerala. More specifically, the present article aims to: (i) examine the factors influencing the adoption of SRI by farmers, (ii) analyze the determinants of farmers' decision to discontinue SRI and (iii) suggest policy measures that will help achieve scaling-up and mainstreaming of SRI cultivation in the state.

Data and Methodology

Data

The study was conducted in Palakkad District of Kerala in the months of January and February, 2012. Palakkad, being a major rice-growing district in the state, was purposefully selected for the study. We selected three major paddy-growing blocks in Palakkad that follow both SRI and conventional methods of rice cultivation. From each block, two major paddy-growing villages that follow SRI and conventional methods of rice cultivation were selected. Finally, 21 farmers were randomly selected from each village comprising seven farmers from each of the three categories: (i) farmers using SRI method, (ii) farmers who have discontinued SRI and (iii) farmers who follow conventional method of rice cultivation. Thus, 42 farmers each from the adopters, dis-adopters and the non-adopters were selected for the study. The total sample size was 126.

For the purpose of the present study, SRI adopters (or SRI farmers) are defined as those who adopted SRI either in part or whole of their land area during the last six years (2005–2010). SRI is governed by six principles, and the greatest potential of SRI in terms of crop response is seen when all these principles are adopted together (Thiyagarajan, Pandian, & Ranghaswami, 2009). Farmers who follow at least four of the six core principles that are non-negotiable—namely, seed rate of 5 kg per ha, wider spacing (25 × 25 cm^2 or 30 × 30 cm^2), use of cono weeder, water management/alternate wetting and drying—are considered as adopters. Dis-adopters are those who have discontinued practising SRI cultivation. Non-adopters (or non-SRI farmers) are those who have not practised SRI during the reference period.

In order to fulfil the objectives of the study, necessary primary data was obtained from the sample respondents by means of personal interviews, using a pre-tested and structured schedule. The data included general information of the respondents, such as age, educational level, family size, landholding pattern, source of irrigation, cropping pattern and animal husbandry. Detailed information were collected on production aspects such as area under rice cultivation, aspects of cultivation, cost and returns as well as factors associated with adoption, dis-adoption and level of adoption of SRI technologies.

Study Area

There are no lakes, estuaries or coastal lines in Palakkad District. Based on physical features, the district is divided into two natural divisions: (i) a mid-land region consisting of valleys and plains and (ii) a high-land region formed by high mountain peaks, long spurs, extensive ravines, dense forests and tangled jungles lying at altitudes ranging from 20 to 2,386 m above the mean sea level. The terrain of Palakkad is divided into four units: (i) low rolling terrain including food plains and terraces, (ii) moderately undulating terrain with flood plain terraces, (iii) highly undulating terrain (the western part of the district), and (iv) hilly terrain including steep slopes (the north-west and the southern portion of the district). Palakkad 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. Most of the rainfall occurs during the southwest monsoon, which sets in the second week of June and extends up to September. About 75 per cent of annual rain is received during the southwest monsoon period. The temperature of the district ranges from 20^{o}C to 45^{o}C.

There are mainly four types of soil, namely peaty (*kari*), laterite, forest and black soils. Palakkad is the only district in Kerala having black cotton soil. The district also has an extensive area under brown hydromorphic soils. Crop production, cropping pattern and cultivation practices are often influenced by problem soils. These soils are generally acidic in nature (pH value below 7).

Among the main workers in the district, agricultural labourers are the dominant class followed by cultivators. While both these categories account for 42.56 per cent of the main workers in the district, at the state level they constitute only 4.47 per cent.

Paddy is the most important crop of Palakkad and it has helped the district earn the name 'Granary of Kerala'. The data from 2012–13 shows that paddy was the most important crop covering an area of 197,277 ha and 7.61 per cent of the gross cropped area in Kerala. Palakkad District alone accounted for 40 per cent of the total area under paddy cultivation and contributed to more than one-third of the state's total rice production (State Planning Board, 2013). Most of the farmers in the district cultivate paddy for their household consumption. Cropping seasons in the district are mainly paddy-based; the three seasons are defined by the 'paddy–paddy–fallow' system. In this area, drought is a major factor limiting rice production in the Kharif season. Drought is also experienced during the end of the Rabi season in eastern Palakkad. Here majority of the area is under irrigation and water shortage is experienced during summer months. It is with this background of the study area, Palakkad District was selected for this study.

Factors Affecting Adoption of SRI

Based on a review of available literature and discussions with farmers, we have identified a variety of factors that influence the adoption of SRI technologies. We used a regression method to analyze the causal linkage between an 'adoption decision' and various confounding factors. These factors include: (i) educational level of the head of the household, (ii) experience in farming, (iii) income from off-farm and non-farm income activities, (iv) size of the farm, (v) social participation and (vi) contact with extension personnel. The variables taken up for the adoption of SRI are hypothesized in the following paragraphs.

Adoption of SRI is dichotomous, represented by a value of 1 if a farmer practices SRI and 0 otherwise. Formation of the model was influenced by a number of working hypotheses. It is hypothesized that farmers' decision to adopt or reject new technologies at any time is influenced by the combined effect of a number of factors related to farmers' objectives and constraints.

Education is an easy variable to measure and is thus popular in adoption studies. This variable is used for measuring the formal education of the head of the household. It is a categorical variable, which takes a value depending on the education level of the head of the household: 0 if he is illiterate, 1 if he has primary education, 2 if he has secondary education, 3 if he has higher secondary education and 4 if he is a collegiate. Education enhances farmers' capacity to create or innovate. Several studies have looked at the role of education in adoption and have concluded that higher education levels lead to earlier and more effective adoption. Farmers having good education levels are more open to new technology. For the purpose of the study, it is hypothesized that educational levels would be positively related to adoption of technology (Habtemariam, 2004; Million & Belaya, 2004).

Education is thought to improve farmers' ability to better process the information provided about new technologies and to increase their allocative and technical efficiency. Namara, Weligamage, and Barker (2003) concluded that education significantly increases the probability of a farmer being an SRI adopter. Bakele, Machiel, Gezahegn, and Syed (2009) and Tesfaye and Alemu (2001) indicated a positive relationship between education and adoption. Teferi (2003) also indicated that education positively enhances the adoption of fertilizer use. In contrast, a study conducted by Asnake et al. (2005) in Ethiopia showed that education had no significant effect on the adoption of improved chickpea varieties. However, for the present study, it is hypothesized that education affects the adoption of SRI positively.

Farming experience is measured in terms of years of experience in farming since a respondent started farming on his own. Farmers with more experience often appear to have complete information and better knowledge, who could thus better evaluate the advantages of technology (Sita Devi & Ponnarasi, 2009). Hence, farming experience is hypothesized to affect adoption of SRI positively. This variable can be measured by recording the respondent's previous experience with the technology, years of farming experience or familiarity with the technology. The basic assumption is that familiarity decreases the uncertainty factor of adoption of new technology.

Participation in non-farm and off-farm income activities indicates whether the respondent is participating in any non-farm and off-farm income-generating activities. It is measured by the amount of income generated from these activities. Additional income earned from these activities increases the farmers' financial capacity and the probability of investment on new technologies (Habtemariam, 2004). It is, therefore, expected to affect adoption positively.

Farmers with larger landholdings can afford to bear the expenses on new agricultural technologies and can also bear the risk of crop failure. This means that farmers who have relatively larger landholdings are more likely to adopt a new technology, whereas farmers with smaller landholdings are not. It is hypothesized that farm size will affect adoption of SRI positively or negatively.

A person's involvement in social activities or his affiliation and association with any formal or informal organization is likely to expose the individual to a wide variety of knowledge. Individuals who are actively involved in social activities are likely to have better awareness than those who do not engage in social activities (Habtemariam, 2004). The variable was measured by allocating a score of 1 if a farmer is a member of any social organization, and 0 otherwise. The variable social participation is expected to affect adoption positively.

Contact with local agricultural extension officers is typically thought to reduce the risk of adoption. Sita Devi and Ponnarasi (2009) highlighted that contact with extension agent's did positively influence the adoption of land SRI in Tamil Nadu. This is a result of access to improved information provided through extension (Birkhaeuser et al., 1991).

In parts of Niger and Burkina Faso, land rehabilitation techniques were rapidly adopted, in part due to the effective extension education[1] in the area (Critchley et al., 1992). Feather and Amacher (1994) highlighted the significant role that information played in influencing improved farm management in the United States. They found that providing information to producers regarding the economic profitability and environmental benefits of the innovation leads to higher adoption rates

However, the 'extension' variable is not always a significant determinant of adoption. In a study by Adesina and Baidu-Forson (1995) on the adoption of improved mangrove rice varieties in Guinea, this particular variable was not found to be significant. This finding supported other research in the area that had found weak researcher–extension–farmer linkages. Most of the rice varieties grown there were obtained through contacts with farmers (Zinnah et al., 1993), suggesting that farmers are also important sources of technology information. When the characteristics of a technology satisfy the preferences of the farmer, he often passes the technology to other farmers for testing, thus facilitating the diffusion of the technology.

Factors Affecting Dis-adoption of SRI

An important question that still remains unanswered among the policy makers and development personnel is why farmers discontinue the use of SRI technologies. In order to understand the factors that are responsible for dis-adoption of SRI technology, the present study has relied on several researches in order to come up with the right model.

Following Rasouliazar and Fe'li (2011), a logistic regression model was employed to study the factors responsible for dis-adoption of SRI technologies[2]. In a study by Namara, Weligamage, and Barker (2003), age was shown to have a negative influence on adoption of technologies; growing age thus reduces the likelihood of a farmer being an SRI adopter. It is hypothesized that age may affect SRI dis-adoption positively or negatively.

More experienced farmers may have a lower level of uncertainty about SRI, but they are often unwilling or are unable to invest all of their land in SRI (Moser & Barret, 2002). Hence it is hypothesized that experience affects dis-adoption positively.

Education measures formal education of household head in the family. This variable is easy to measure and is thus popular among adoption studies. It is a dummy variable, which takes a value 1 if the farm household is literate (can only read and write), and 0 illiterate. This variable affects dis-adoption negatively.

It has been observed in the study that the undulating topography is positively correlated with the adoption of SRI. The undulated rice fields without proper drainage facilities limit the adoption of SRI (Kabir, 2006). Topographical landscape of the rice fields, where it is difficult to control water, affects the dis-adoption of SRI (CEDAC, 2008).

Non-availability of subsidy is measured in terms of whether respondents have access to availability of subsidy sources and possibility of getting subsidy. It is a dummy variable, which takes the value of 1 if the farm households have used subsidy, or 0 otherwise. Farmers who avail subsidy may overcome their financial constraints and so are able to buy inputs (Mekonnen, 2007; Minyahel, 2007; Taha, 2007).

An index of negative perception of farmers towards SRI was constructed based on the reported disadvantages of SRI. The value of this variable ranges from 0 to 7, where 0 indicates the lowest negative attitude of the SRI practitioners towards SRI and 7 shows the strongest. This variable is expected to have a positive relationship with dis-adoption, since the farmers who had a negative attitude towards SRI are expected to discontinue with SRI (Regassa, 2002).

Labour was measured in terms of man-days equivalent. Availability of labour is likely to influence the gross margin of the innovation. A farm with larger number of workers per ha is more likely to be in a position to try and continue using a potentially profitable innovation, and it is expected to influence adoption positively. Thus, non-availability of labour positively influences the dis-adoption of SRI.

In this study, weighted averages of individual positives (advantages) and negatives (disadvantages) of line planting were calculated along with the total advantages and disadvantages. The variable of difficulty in line planting is hypothesized to influence dis-adoption negatively.

Difficulty in using the cono weeder is taken to be continuous and is measured in a scale from 1 to 4, where 1 = less difficult, 2 = difficult, 3 = more difficult and 4 = highly difficult. In this study, weighted average of individual positive (advantages) and negative (disadvantages) of using the conoweeder was calculated and total advantage and disadvantage was calculated. Then the total perceived attribute of the technology was taken as the difference between the two. This variable is expected to have a positive relationship with dis-adoption, since the farmers who had a negative attitude towards SRI are expected to discontinue with the practice of SRI (Regassa, 2002).

Difficulty in water management is taken as a dummy variable as follows: 1 = yes, 0 = otherwise. This variable is expected to have a positive relationship with dis-adoption of SRI technology.

Results and Discussion

General Characteristics of Sample Respondents

An analysis of age-wise composition of respondents reflects that younger farmers show greater inclination towards adopting SRI technology. The reason for poor response from the older farmers may be attributed to their strict adherence to traditional practices. The average area under paddy was 1.35 and 1.30 ha in adopter and non-adopter farms, respectively. As most of the sample respondents were small farmers, it could be easily concluded that adopters who practice SRI were also small farmers. It was observed in the survey that 45.12 per cent of the SRI farmers had two years of experience in SRI technology. In the case of dis-adopters, about 54 per cent of the farmers practised SRI for one year and then discontinued. This might be due to the scarcity of skilled labour and also because more personal attention was required for SRI technology.

We analyzed the extent of adoption of different SRI technologies by the farmers. It could be seen that 83 per cent of the sample farmers adhered to the suggested nursery area of 2.5 cents for 1 ha (1 ha = 247.10 cents). Seed rate (5 kg/ha), another core component of SRI, was followed by 76 per cent of the famers. Wider spacing of 25×25 cm^2 was followed by all the adopters. Organic manures are recommended in SRI cultivation since they give better results. But due to their non-availability, only 52 per cent of farmers used them.

Controlled irrigation is an essential element in SRI. Irrigation is provided first to only wet the soil, just enough to saturate the soil with moisture. Subsequent irrigation is suggested when the soil develops fine cracks. Irrigation interval depends on the soil type and weather conditions. This method helps in better growth and spread of roots. Regular wetting and drying of soil results in increased microbial activity in the soil, which facilitates easy availability of nutrients to plants. For a smooth weeding operation, the field should be irrigated in a manner that a thin film of water is always maintained. After the completion of the weeding, water should not be let out of the field. Once the tillering process is complete, standing water of 2.5 cm height may be maintained. Paddy fields are irrigated intermittently rather than continuously flooded, so that the soil remains moist with mostly aerobic conditions, rather than always saturated. This method of alternate wetting and drying was followed by only 69 per cent of the farmers. Evidence shows that SRI technology increased water preservation by 65 per cent in China (Satyanarayana, Thiyagarajan, & Uphoff, 2007). Water is applied only when it is necessary to keep the soil moist, and the soil is even allowed to dry out for three to six days. However, relative water saving tend to be larger than relative decrease in yield, often resulting in increased water productivity. This is done to keep the soil well aerated, so that root growth is better.

Adoption of SRI

The descriptive statistics of the variables used in the study show that, on an average, a farmer had experience of 23 years in farming. The size of the farm on an average was 1.58 ha. It could also be seen that, on an average, sample farmers had only primary education.

The socio-economic variables included in the factors influencing adoption of SRI were education level, farm size, experience, income from off-farm and non-farm activities, participation of the farmer in social activities and the farmer's contact with the extension agents.

It was observed that variables such as farm size, experience, income from off-farm and non-farm activities and contact with extension agents are significant determinants of adoption of SRI technology. Experience improves the farmer's skills on SRI cultivation. A more experienced farmer may have a lower level of uncertainty about the performance of SRI cultivation. Farmers with higher experience appear to have complete information and better knowledge and are able to evaluate the advantages of SRI technology. We found that the experience level of the farmer is positively and significantly influencing the adoption of SRI.

Income from off-farm and non-farm activities increases the financial capacity of farmers and thus increases the probability of investing in new technologies. Additional income earned from activities other than agriculture increases the probability of adoption of SRI. Findings indicate that participation in off-farm and non-farm income activities positively and significantly influences adoption of SRI.

One can argue that farmers with smaller farm size cannot afford the expenses required for new agricultural technologies. However, during the survey we found that SRI is being practised mostly by small farmers, and it can be inferred that farm size affects adoption of SRI significantly, but negatively.

Contact with extension agents is supposed to have a direct influence on the adoption behaviour of farmers. When there is contact with extension agent, there is greater possibility of farmers being influenced to adopt agricultural innovations. We find that access to extension service positively and significantly influences SRI adoption.

Dis-adoption of SRI

Following Rasouliazar and Fe'li (2011), a forward stepwise logistic regression analysis technique was applied to identify the major components of independent variables for distinguishing adopters from dis-adopters. The findings of this study indicate that logistic regression stopped at the fourth step, and variables such as difficulty in water management, difficulty in early transplantation, non-availability of skilled labour and difficulty in using cono weeder are the most important components for disadoption of SRI.

Water management is one of the important practices to be followed in SRI cultivation. We find that difficulty in water management, as expected, does influence the dis-adoption in a significant and positive manner. The farmers had no direct say on the timing of closure of canal water for irrigation and, therefore, they used as much water as possible when they had access to it. Moreover, the paddy fields near the opening of irrigation channels received more water compared to faraway fields. This was due to the fact that paddy fields were undulating or sloppy, resulting in poor management of water. This led to the dis-adoption of SRI. Water management is an important activity in SRI. On the contrary, it could be observed from the fields of adopters that their fields were flooded in the morning and drained in the evening and, in some plots, vice versa. Water was allowed to remain in the fields for a few hours only.

In SRI, extra care is needed to handle young seedlings. The time required for planting is also more, as regular spacing of plants is necessary to allow mechanical weeding. Women agricultural labourers complained that handling young seedlings and maintaining proper spacing in between rows and planting rows simultaneously was difficult. Such difficulty in early transplanting led to the dis-adoption of SRI.

Practising the modified method of planting led to increased scarcity of labour. Since square planting was advised to be undertaken using ropes and marker sticks, labourers who were less experienced with this modified planting method took more time to plant the same area than in the conventional planting method. SRI required 50 per cent more women labourers than conventional planting and women labourers expressed unwillingness for modified planting.

A considerable number of farmers expressed dissatisfaction with the use of the cono weeder, which they found difficult to handle because of its weight. As women agricultural labourers could not operate the cono weeder, male agricultural labourers were employed for weeding at a relatively higher cost. Thus, difficulty in using the cono weeder led to the dis-adoption of SRI.

Concluding Remarks

A number of studies, focussing on varying depth and interval of irrigation water, report that continuous submergence of rice during production is not essential for obtaining high yields. Our study substantiates that more rice yield could be obtained with less water by using SRI technology. We find that younger farmers are more inclined towards accepting SRI technology compared to aging farmers. The reason for the poor response from aging farmers could be attributed to their strict adherence to traditional practices. We find that SRI technology is practised mostly in marginal and small farms, because it needs careful and intensive management. Therefore, the study indicates that without bringing any complex and potentially costly changes in other management practices, a simple adoption of water-saving irrigation can maintain yields at the present level and also produce more rice with less water on the same fields. The adoption of SRI is significantly influenced by experience in farming, income from off-farm and non-farm activities and contact with extension agents. Efforts in water management, difficulty in early transplantation, non-availability of skilled labour and difficulty in using the cono weeder are significant determinants for dis-adoption of SRI.

The main problem associated with dis-adoption of SRI is the shortage of skilled labour. Training and education of farmers on SRI techniques should be enhanced so that skilled labour is available for various operations. This can result in an increase of its adoption. A considerable number of farmers expressed dissatisfaction with the use of the cono weeder, which they found difficult to handle. In other words, more farmers could be attracted to SRI technology if farmer-friendly cono weeders, which suit local conditions and can be operated easily by labourers, are introduced. Furthermore, there is a significant difference in the adoption of SRI between farmers located at the head of an irrigation canal and those located at the middle and the tail end. Hence, SRI could produce more yield as comapred to conventional method of rice cultivation by using less amount of water. Alternate drying and wetting of the fields, as usually followed in SRI, allows for good aeration of the soil and better root growth, thereby increasing rice yield and efficient water usage. It is imperative to develop proper irrigation facilities and promote participatory irrigation management so that water could be supplied in small amounts regularly and reliably, to sustain water management. Many farmers reported the lack of institutional support to provide them with the required technical guidance as a reason for dis-adoption of SRI. We suggest that there is a need to provide farmers with essential institutional support by means of technology and capacity-building to ensure increase in the adoption of SRI.

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Notes

1. Extension Education deals with practical items of information which is useful for rural people which solve their daily problems, especially those relations to agricultural production.
2. Authors have applied the regression model developed by Rasouliazar and Fe'li (2011).

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