Resource use efficiency in rice production under SRI and conventional method in Assam, India

Ishani Parasar, J.P. Hazarika and Nivedita Deka*

Department of Agricultural Economics, Faculty of Agriculture, Assam Agricultural University, Jorhat-785 013, Assam, India.

Received: 30-06-2015 Accepted: 13-03-2016 DOI: 10.18805/asad.v36i2.10638

ABSTRACT
To meet the rising demand for rice, the staple food in Assam, the production of rice has to be increased by many folds. Considering the shrinkage of agricultural lands, productivity increase is the only way out to increase the production. System of Rice Intensification (SRI) is reported to enhance rice yield to considerable extent. However, the acceptability of the method by the tradition rice growers of the state is a matter of concern. Further, the resource use status of SRI is yet to be studied systematically in Assam. The present study on resource use in SRI has shown that the resources used in SRI need to be increased for enhanced rice production the state. Awarai the farmers about SRI and imparting proper training on SRI would certainly help the farmers to increase their rice production to make them rice secured.

Key words : Food security, Rice, Resource use, SRI.

INTRODUCTION
Rice is the staple food in Assam and its consumption is growing due to high income elasticity of demand. However, the growth scenario of rice in the state has yet to gain the required momentum. Considering the unparallel population growth in the state, the matter requires greater attention. The population of Assam has increased at an alarming rate in the last three decades. With this trend, rice requirements for the state would be 120.0 lakh tonnes by 2020. Drought, submergence and flash flooding, low resource base of farmers, and lack of proper infrastructural facilities are varied obstacles to obtain higher rice productivity in rained areas. There is no other way but to increase the per capita productivity of land, as there is limited scope of increasing crop area due to rapid urbanization in the state. (Deka and Devi 2014). System of Rice Intensification (SRI) may be an appropriate practice to produce more rice with fewer inputs in the state. SRI has been practised in Assam in an organized way under National Food Security Mission (NFMS) since 2007-08 and enhanced rice yield was reported. However, so far no systematic study was done on the resource use efficiency in SRI in Assam. Therefore, the present study was conducted to examine the resource use efficiency in SRI in Assam during 2013.

MATERIALS AND METHODS
A multi stage random sampling design was used for the present study. In the first stage Nagaon district was purposively selected as the district has the highest area under SRI in Assam. In the second stage, two blocks were selected from the district at random based on the number of farmers adopting SRI method. In the final stage, sixty farmers adopting both SRI and conventional method were selected from the two blocks resulting in 120 sample respondents. Primary data have been collected from the sample rice growers by interviewing them personally at their door step with the help of the schedule that included information on, area under rice and other crops, various inputs used, output produced, cost of inputs, price of outputs, etc. The study pertains to the year 2013-14. Cobb-Douglas production function was used to analyze the impact of production variables on the production of rice both under SRI and conventional method.

Production function in general form can be written as:
\[
Y = f (X_1, X_2, \ldots, X_n)
\]

Eq. (1) of production function in log form is:
\[
\ln Y = \ln Y + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_n \ln X_n + \varepsilon
\]

Where, Y is the gross return obtained from rice cultivation calculated by multiplying the rice output by the price of the output, SD is the value of seed used per hectare in rupee terms, CF is the value of chemical fertilizers used in rupee terms, PPC is the value of plant protection chemicals used in rupee terms and HL is the wage of human labour used in
rupee terms. The coefficients $\beta_i$ (i = 1, 2, 3, 4) are the elasticities of the respective variables with respect to the gross return obtained from rice production, with the assumption that $\beta_i > 0$. The estimated coefficients of significant independent variables were used to compute the marginal value products (MVP) and the resource-use efficiency (r) was worked out using the following equation:

$$r = \frac{\text{MVP}}{\text{MFC}},$$

where,

- $r = \text{Efficiency ratio}$
- $\text{MVP} = \text{Marginal value product of variable inputs}$
- $\text{MFC} = \text{Marginal factor cost (price per unit inputs)}$. If the MFCs of all the inputs expressed in terms of an additional rupee, in calculating the ratio of MVP to MFC, the denominator will always be one, and therefore, the ratio will be equal to their respective MVP.

$$\text{MVP}_i = \beta_i \frac{\bar{y}}{\bar{x}_i} \times P_y$$

Where,

- $\text{MVP}_i = \text{Marginal value product of the } i^{th} \text{ input}$
- $\bar{y} = \text{Geometric mean of the value of output}$
- $\bar{x}_i = \text{Geometric mean of the } i^{th} \text{ input}$
- $\beta_i = \text{Estimated co-efficient (or) elasticity of the } i^{th} \text{ input}$
- $P_y = \text{Price of output}$.

Based on economic theory, a firm maximizes profits with regard to resource use when the ratio of the marginal return to the opportunity cost is one. The value are interpreted thus,

- If $r < 1$; resource is excessively used or over utilized hence decreasing the quantity use of that resource increases profits.
- If $r > 1$; resource is under used or being under utilized hence increasing its rate of use will increase profit level.
- If $r = 1$; it shows the resource is efficiently used, that is optimum utilization of resource hence the point of profit maximization.

**RESULTS AND DISCUSSION**

The estimates of factors affecting rice production under SRI and conventional method is presented in Table 1.

**Estimation of production variables of rice production under SRI method:** From the Table it is observed that there is a positive relation of all the factors considered with rice production. This positive relation may be inferred that there is scope for increasing the use of these inputs for improving the rice production. The regression coefficient for seeds was 0.414 which indicated that considering all other factors constant, one per cent increase in seed cost would increase gross returns by 0.414 per cent. The regression coefficient for fertilizers was 0.222 which indicated that keeping the other factors constant, one per cent increase in fertilizers would increase yield by 0.222 per cent. Similarly for plant protection chemicals and human labour, one per cent increase in both the inputs singly keeping other inputs constant would lead to an increase in production by 0.411 per cent and 0.656 per cent, respectively. The coefficient of multiple determination ($R^2$) was found to be 0.85 which shows that 85 per cent variation in the rice production was explained by the variables considered in the study. However, the intercept (-1.491) was found to have a negatively significant relation with the production of rice. From the above results it can be concluded that the farmers from the study area had still scope for improvement of rice production by increasing the various factors considered. Similar results were reported by Rama Rao (2011) that the $R^2$ value in SRI was 0.84, which suggested that the various factors considered had jointly explained as high as 84 per cent variation in yield in SRI method. Basorun and Fasakin (2012) reported that status of farmers, area used for cultivation, labour, market and agrochemicals had a significant impact upon the quantity of rice harvested.

**Estimation of production variables of rice production under conventional method:** It could be inferred from the Table that seeds (0.100), chemical fertilizers (0.141), plant protection chemicals (0.018) and human labour (0.078) were found to have positive and significant effect on the production. This positive relation between the factors and the production revealed that there was still scope for increasing these inputs and improving the production of rice. The coefficient of multiple determination ($R^2$) was found to be 0.76 which shows that 76 per cent variation in the rice production was explained by the variables considered in the study for conventional method. The intercept (7.967) had a positive relation with the production of rice. From the above results it could be concluded that even in conventional method of rice cultivation, there is scope for improving rice production by farmers but the per cent increase in the

<table>
<thead>
<tr>
<th>Table 1: Cobb-Douglas production function estimate for SRI and conventional methods of rice cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulars</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Seed ($X_1$)</td>
</tr>
<tr>
<td>(0.040)</td>
</tr>
<tr>
<td>Fertilizers ($X_2$)</td>
</tr>
<tr>
<td>(0.047)</td>
</tr>
<tr>
<td>Plant protection chemicals ($X_3$)</td>
</tr>
<tr>
<td>(0.043)</td>
</tr>
<tr>
<td>Human labours ($X_4$)</td>
</tr>
<tr>
<td>(0.067)</td>
</tr>
<tr>
<td>Intercept</td>
</tr>
<tr>
<td>(1.087)</td>
</tr>
<tr>
<td>$R^2$</td>
</tr>
<tr>
<td>F value</td>
</tr>
</tbody>
</table>

Figures within parenthesis indicate standard errors
* Significant at 10 per cent probability level
** Significant at 5 per cent probability level
*** Significant at 1 per cent probability level
production in SRI method were found to be higher in comparison to the conventional method. Thus, it would be beneficial if the farmers increase the use of inputs in SRI method of rice cultivation.

Resource-use efficiency in rice cultivation under SRI:
Based on the estimated parameter from rice production function, marginal value product for seed, chemical fertilizers plant protection chemicals and human labour were computed. The results are presented in Table 2. From the Table it was found that the MVP for seed was 37.57, for chemical fertilizers it was 7.47, for plant protection chemicals it was 10.55 and for human labour, it was 145.57. The MVP values for all the variables were greater than one which indicated that farmers had opportunities to increase per hectare output by using more seedling, chemical fertilizers, plant protection chemicals and human labour. Mazumder et al. (2009) presented similar studies reporting that for owners and tenant operators, the MVP of seedlings and insecticides were higher than one which indicates that more of these resources can be used while for cash tenants, MVP of seedlings, insecticides and fertilizers were greater than one which indicates scope for increasing output by spending more on these inputs. The analysis of ratio of MVP to factor cost showed that the MVP of all the factors were found to be higher than their respective prices which showed the scope of increasing the use of these inputs for maximizing outputs were of rice production. The MVP to MFC ratios for fertilizer, labour and land were reported to be greater than one (Sani et al, 2010).

CONCLUSION
The above study concludes that SRI is a profitable method of producing rice in Assam. There is still scope for increasing the use of the strategic resources under SRI and thereby there is still potentiality of increasing rice yield in the state. Some problems such as unavailability of skilled labours, difficulty in transplanting young seedlings, lack of standard package of practices and lack of trainings and awareness may come up on the way of adopting SRI. However with proper trainings, awareness drive and development of an appropriate package of practice might overcome these problems and encourage the rice growers to adopt SRI and hence contribute to achieve the goal of rice security in Assam.

REFERENCES