

Resource use efficiency and constraints in the production of direct seeded rice in Haryana

ABSTRACT

The present study was conducted during 2022-23 in three districts namely, Kurukshetra, Karnal and Yamunanagar in Haryana with the objective to analyse the resource use efficiency and constraints in the production of direct seeded rice (DSR). To achieve the objective of the study Cobb-Douglas production function technique was used. The result of the study revealed that inputs like machine labour and irrigation in direct seeded basmati paddy and seed, human labour and irrigation in direct seeded non-basmati paddy were greater than one indicating underuse of these resources. The seed, chemical fertilizers and human labour in direct seeded basmati paddy while chemical fertilizers and machine labour in direct seeded non-basmati paddy were less than one which indicated the overuse of these inputs. As DSR technology is a water, labour and energy saving practice, it needs to be popularized among the farmers by offering viable solutions to the problems faced by the rice growers. Weed infestation and management, iron deficiency, non-availability of DSR drill and difficulty in land preparation were the major problems faced by farmers in adoption of DSRs which warrant appropriate remedial solutions.

Keywords: Resource use efficiency, constraints, direct seeded rice (DSR), basmati, management

INTRODUCTION

In recent years, there has been a shift from TPR to DSR cultivation in several countries of Southeast Asia. This shift was principally driven by water scarcity issues and expensive labour component for transplanting under acute farm labour shortage. Direct-seeding of rice has the potential to provide several benefits to farmers and the environment over conventional practices of puddling and transplanting. Direct seeding helps reduce water consumption by about 30.00 per cent as it eliminates raising of seedlings in a nursery, puddling, transplanting under puddled soil and maintaining 4-5 inches of water at the base of the transplanted seedlings. Direct seeding (both wet and dry), on the other hand, avoids nursery raising, seedling uprooting, puddling and transplanting and thus reduces the labour requirement [9]. In addition to labour savings, the demand for labour is spread out over a longer period in DSR than in transplanted rice [10]. Conventional tillage (CT-TPR) requires intensive labour in the critical operation of transplanting, which often results in a shortage of labour requirement. Hence, DSR helps in making full use of family labour and having less dependence on hired labour. Due to avoidance of transplant injury, DSR is established earlier than TPR without growth delays and hastens physiological maturity and reduces vulnerability to late-season drought.

In India rice is being cultivated in wide range of ecosystems from irrigated, shallow lowlands to mid-deep lowlands and deep water to uplands and transplanting is the chief method of rice cultivation. In India rice is commonly grown by transplanting seedlings in the puddled soils, the

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puddling and transplanting require great amount of water and labour, both of which are becoming progressively scarce and expensive, resulting in reduction of profit in rice production. The most important challenges are to guarantee a sufficient rice supply in response to the growing and urbanizing population as well as to alleviate poverty. For every one billion people added to the world's population, 100 mt of more rice need to be produced annually with less land, less water and less labour, in more efficient environmentally friendly production systems. However, farmers who are practicing transplanting method are facing difficulty due to scarcity of water and increasing labour wages, which established the situation of scarce resources and reduced profits. Thus, Direct Seeded Rice is gaining popularity among farmers of India as in other Asian countries. The most promising option for the future is to adopt direct sowing of rice in place of transplanting; DSR overcomes the problem of seasonality in labour requirement for rice nursery raising and transplanting operations. Non-development of ground water in *kharif*, late onset of monsoon and drudgery of operations often delays rice transplanting which leads to late vacation of fields, risk of cracking of soil under limited water supply, forcing farmers to plant wheat after the optimum sowing time. DSR is a plough towards a new set of principles based on minimal soil disturbance, management of crop residues and innovative cropping systems is the good option of farming under rice-wheat cropping system.

It is evident from the past experiences that, DSR method is associated with high weed infestation incidences. Direct seeding of rice is possible provided there is a good crop establishment as well as adequate weed control methods are available to keep the crop free from weeds. Therefore, an effort has been made in this investigation to address various issues and the benefits of DSR over TPR and how best the labour, land, capital, water and time can be utilized with DSR method of rice cultivation.

METHODOLOGY

Haryana state was selected for this study as farmers are rapidly adopting modern methods of crop cultivation. Karnal, Kurukshetra and Yamunanagar districts were selected purposively due to widespread adoption of modern methods of crop production. A list of farmers who had adopted DSR technology was obtained from KVK's and state Department of Agriculture and Farmers' Welfare, Haryana. From these lists, using simple random technique, 30 farmers were selected who were growing direct seeded rice (DSR). Among 30 DSR farmers 11 farmers were growing basmati DSR and 19 farmers were growing non-basmati DSR were finally chosen for the ultimate analysis. Primary data were collected during the years 2022-23 with the help of interview schedule using survey method. The information collected from the respondents for the purpose of the study was quantified, categorized and tabulated. In order to achieve the objectives of the study, the data collected from farmers were subjected to the statistical analysis. For this purpose the following statistical tools were used to explore the relevant inferences, tabular analysis, production function and MVP to MFC ratio.

Analysis of resource use efficiency

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The resource use efficiency was studied by fitting the Cobb-Douglas production function for the farm level data. The analysis was carried out based on the average values of all the farms. In the present study, the Cobb-Douglas production function of the following type was used for analysis.

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} e^u$$

The logarithm form of the above equation is:

$$\log Y = \log a + b_1 \log x_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + u \log e$$

Where,

Y = Gross returns per farm (Rs. /ha.)

X₁ = Seed (Rs./ha.)

X₂ = Chemical fertilizers (Rs. /ha.)

X₃ = Human labour (Rs. /ha.)

X₄ = Machine labour (Rs. /ha.)

X₅ = Irrigation (Rs. /ha.)

a = Constant / intercept term

u = Random variable

e = 2.718

In the above equation, output is taken as Y. while, b₁ to b₅ are the elasticity coefficients of the respective inputs. The coefficient of multiple determinations (R²) was worked out to test the goodness of fit of the model. Production function analysis was carried out for DSR method of paddy cultivation.

Allocative Efficiency

The ratios of the MVP to MFC among individual resources were used to judge the allocative efficiencies. The computed Marginal Value Product (MVP) was compared with the Marginal Factor Cost (MFC) or opportunity cost of the resource to draw inferences. A resource is said to be optimally allocated when it's MVP = MFC.

The marginal value products (MVP's) were calculated using the geometric mean levels of the variables using the formula.

$$\text{MVP of } x_i \text{ th resource} = b_i Y X_i$$

Where,

Y = Geometric mean of gross returns in different farming systems.

X_i = Geometric mean of ith independent variable

b_i = Regression coefficient or elasticity of production ith independent variable This analysis was carried out in order to identify the possibilities of increasing gross returns under a given farm situation.

RESULT AND DISCUSSION

Resource use efficiency in basmati DSR and non-basmati DSR

The value of the coefficient of multiple determination, R square (R² estimated 0.4682 and 0.4624) indicated that 46.82 and 46.24 percent of variation in the total gross income of basmati DSR and non-basmati DSR, respectively was explained by explanatory variables included in the model. Out of five independent variables included in the model, three variables in basmati and one variable in non-basmati under DSR had statistically significant effect on the income attained from rice

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cultivation. The variables like seed and machine labour (10% level of significance) and chemical fertilizers (5% level of significance) in basmati DSR and chemical fertilizers (10% level of significance) in non-basmati DSR were reported.

The estimated marginal value product (MVP) and efficiency ratios of different inputs used in rice production were presented in table 1. The efficiency ratio of the inputs: machine labour (1.32) and irrigation (1.02) in basmati DSR and seed (1.34), human labour (1.24) and irrigation (1.11) in non-basmati DSR were greater than one indicating that the uses of these inputs were underuse. While, seed (0.44), chemical fertilizers (0.74) and human labour (0.61) in basmati DSR and chemical fertilizers (0.66) and machine labour (0.39) in non-basmati DSR were less than one indicated over utilization of these resources and the findings are supported by the study conducted by Deshetty *et al.*, (2020).

Table 1: Estimation of resource use efficiency of inputs used in direct seeded paddy cultivation

Particulars	Basmati-DSR					
	GM	Coefficients	MVP	MFC	R= efficiency ratio	Efficiency
Seed	1789	0.23*	0.44	1	0.44	Over utilized
Chemical fertilizers	22504	0.52**	0.74	1	0.74	Over utilized
Human labour	17614	0.42	0.61	1	0.61	Over utilized
Machine labour	7413	0.82*	1.32	1	1.32	Under utilized
irrigation	5984	0.62	1.02	1	1.02	Under utilized
R²	0.4682					
Particulars	Non-basmati-DSR					
	GM	Coefficients	MVP	MFC	R= efficiency ratio	Efficiency
Seed	1110	0.64	1.34	1	1.34	Under utilized
Chemical fertilizers	21592	0.45*	0.66	1	0.66	Over utilized
Human labour	3741	0.70	1.24	1	1.24	Under utilized
Machine labour	12285	0.25	0.39	1	0.39	Over utilized
irrigation	6049	0.66	1.11	1	1.11	Under utilized
R²	0.4624					

** Significant at 5% level; * Significant at 10% level

Constraints impeding in the cultivation of DSR

Constraints impended by DSR farmers are presented in table 2. Weeds are the major problem in DSR. Weeds compete with crop for food shelter and nutrients and affect the growth and yield of crop plants (Rao *et al.*, 2007; Kumar and Ladha, 2011). The DSR farmers reported that high weed infestation (93.33%) was one of the most serious constraints in DSR as they emerge simultaneously with paddy crop due to absence of puddling operation (Bhurer *et al.*, 2013). DSR field requires laser land leveling each year before sowing, otherwise, water standing problem occurs in the field. Laser land leveling provides good and uniform crop stand that leads to improved weed control efficiency and nutrient use efficiency (Jatet *et al.*, 2009). Requirement of laser land levelling each year (90.00%) was the second major constraint in DSR followed by off-type plants or variety mixture problem also arose in the field of direct seeded rice. Out of total respondents, 86.67 per cent of respondents reported the problem related to variety mixture. DSR farmers also reported the problem of high cost of weed control (83.33%). Direct seeding of rice is practised with specific machinery known as DSR drill. But this drill was available only in the cooperative societies (one or two drills/society) in villages. Some rich respondents also had their own DSR drill. Respondents had to

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wait for their turn for sowing with DSR drill. So this was a major problem arising in DSR adoption. The study reported that 73.33 per cent of the respondents faced the problem of non-availability of seed drill. Yield is the main criteria for the success of any crop. Some respondents believed that direct seeding of rice gave less yield due to more weed competition than the transplanting method. 66.66 per cent farmer reported problem of low productivity. Iron deficiency is the major deficiency that appears in the direct seeded rice field. Due to this deficiency, chlorosis among the young seedlings appears after three weeks of sowing and after some time whole plant will die (Joshi *et al.*, 2013). Insects are the major problem of any crop. Sometimes, whole crop is affected by insects and yield is reduced drastically. More than 50.00 per cent of rice growers are reported to face insect pest problem in puddle that as well as non-puddle rice (Diagne *et al.*, 2013). In the present study, 40.00 per cent of respondents reported that high infestation of insect-pest and diseases was the major problem of DSR. Study revealed that deficiency of micro-nutrients (iron) (36.37%) of the respondents faced the problem of iron deficiency in direct seeded rice. The problem of non-availability of short duration varieties (30.00%) was reported by DSR farmers.

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Table 2: Constraints impeding the cultivation of DSR in Haryana N=30

S. No.	Particulars	No. of farmers	%
1	High weed infestation	28	93.33
2	Requirement of laser land leveling each year before sowing to avoid water standing problem	27	90.00
3	Off-type plants or Variety mixture	26	86.67
4	High cost for weed control (manual weeding and herbicide spray)	25	83.33
5	Less availability of DSR drills machine for marginal and small farmers	22	73.33
6	Low yield in DSR or reduction in yield	20	66.66
7	High infestation of insect-pest and diseases	12	40.00
8	Deficiency of micro nutrients (Iron), which leads to chlorosis in young seedlings	11	36.67
9	Non-availability of short duration varieties (deleted)	09	30.00

CONCLUSION

The study concluded that the efficiency ratio of the inputs like machine labour and irrigation in direct seeded basmati paddy and seed, human labour and irrigation in direct seeded non-basmati paddy were greater than one indicating underuse of these resources. The seed, chemical fertilizers and human labour in direct seeded basmati paddy while chemical fertilizers and machine labour in direct seeded non-basmati paddy were less than one which indicated the overuse of these inputs. As DSR technology is a water, labour and energy saving practice, it needs to be popularized among the farmers by offering viable solutions to the problems faced by the rice growers. Weed infestation and management, iron deficiency, non-availability of DSR drill and difficulty in land preparation were the major problems faced by farmers in adoption of DSRs which warrant appropriate remedial

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solutions. Farmers should be awarded to adopt better weed management practices for achieving potential yield of basmati and non-basmati paddy under direct seeded conditions.

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