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RESEARCH ARTICLE :

Economic comparison of direct seeded rice (DSR) and transplanted rice cultivation in TBP command area of Karnataka

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SUMMARY : The present study was conducted in Koppal, Bellary and Raichur districts in TBP command area of Karnataka with the objectives to estimate and compare the costs and returns for direct seeded rice and transplanted methods of paddy cultivation. A total of 90 sample paddy growing farmers were selected by adopting purposive random sampling technique. The total cost of cultivation of paddy under DSR was found to be lower by 15.39 per cent (Rs.73661.1/ha) when compared to TR (Rs.87061.5/ha) method of cultivation. The cost concepts revealed that according to cost A_1, maximum costs were incurred for the transplanted rice (Rs.62548.6/ha) than that of direct seeded rice (Rs.50045.6/ha). The cost B_1 for transplanted rice (Rs.62863.6/ha) was slightly higher than direct seeded rice (50330.1/ha). The average yield was considerably high in DSR (64.18 qtl/ha) compared to TR (56.79 qtl/ha) method of cultivation. The gross returns obtained were Rs.1,36,127 and Rs.1,19,755 per ha for DSR and TR of rice cultivation respectively. The net returns were higher in DSR (Rs.62465/ha) than that of TR (Rs.32693/ha), this was due to high cost of cultivation in transplanted rice. Returns per rupee spent was higher in DSR (1.85), when compared with TR (1.38).

KEY WORDS:
Direct seeded rice, Transplanted rice, TBP

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BACKGROUND AND OBJECTIVES

Rice is the staple food crop in India and occupies highest area among the cereal crops. Rice provides about 20 per cent of the global average calorie intake and its cultivation occupies 11 per cent of world agricultural land (Singh *et al*., 2016). The major challenge in rice production is to achieve the maximum yield with less water, labour and chemicals, thereby ensuring long-term sustainability.The growing world population requires increased food production, while less water resources are available for agriculture. This alarming situation can only be resolved if water is managed more efficiently, so that crop yield per unit of water consumption increases.

Asia dominates the world in rice production as it accounts for about 90 per cent of world's rice area and 92 per cent of production (FAO, 2013). Direct seeded rice

in Asia occupies about 28.3 Mha which is approximately 21 per cent of the total rice area in the region (Toriyama, 2005).

India has the largest area under rice crop (about 45 million ha.) and it occupies 23.3 per cent of gross cropped area of the country (Singh *et al*., 2016). Rice production in India has increased from 20.60 mt (1950-51) to 105.5 mt (2014-15). The productivity and sustainability of rice-based systems are threatened because of inefficient use of inputs, increasing scarcity of resources, especially water and labour, changing climate, emerging energy crisis and rising fuel prices, the rising cost of cultivation and emerging socio-economic changes such as urbanization, migration of labour, preference for non-agricultural activities etc. (Ladha *et al.,* 2009). Efficient agronomic management and technological innovations are needed to address these issues.

In India, transplanting is the mostly adopted method of rice establishment. However, depletion of water resources is forcing farmers to shift to Direct Seeded Rice (DSR). The direct seeding of rice refers to the spreading of seeds in fields before or immediately after pre-monsoon showers. The need to increase productivity against rising labour costs for transplanting has led to a considerable increase in directseeding in recent decades, particularly in South and Southeast Asia (Johnson *et al.* 2003). The main motivating factor for shift in rice establishment method from transplanting to direct seeding in India is response to labour scarcity (Balasubramanian, 2002) and lack of technically feasible transplanters.The dry seeded rice is not continuously flooded, but is irrigated frequently to avoid yield loss.

Karnataka is one of the major rice growing states in India. In Karnataka, DSR is becoming a popular rice cultivation practice among the farmers of command area of Tungabhadra (TBP) in Raichur, Koppal and Bellary districts of Karnataka. Under late onset of monsoon conditions and insufficient water in reservoir, canal water may become erratic and untimely leading to delayed transplanting (beyond August). To overcome these problems, Direct Seeded Rice method is widely adopted by the farmers of the region.

RESOURCES AND METHODS

The present study was conducted in Koppal, Bellary and Raichur districts in TBP command area of Karnataka.The data required for the study was obtained from primary sources. The primary data required was obtained from the sampled farmers by interview method through a pre-tested questionnaire. A total of 90 sample paddy growing farmers were selected by adopting purposive random sampling technique. Tabular and functional analysis were employed to arrive at valid results and conclusions.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Socio-economic profile of sample farmers :

Data was collected using structured schedule to understand the socio-economic status of sample farmers in the study area. The average age of the farmers in the study area was 44.43 years and the average age of farmers practicing DSR and TR was 46.42 and 42.44 years, respectively.

Majority of the sample farmers (54.45%) in the study area on an average completed college level education and it was 51.11% and 57.78% for farmers practicing DSR and TR, respectively. None of the sample farmers were illiterate. Majority of the farm families fall under joint type (67.78 %) and it was 75.56% and 60% for farmers practicing DSR and TR, respectively. The average size of the family in the study area was six, and it was six and five for farmers practicing DSR and TR, respectively. The average operational size of land holding in the study area was 2.71 ha. Highest operational size of land holding was found among the farmers practicing DSR (3.21 ha) followed by farmers practicing TR (2.21 ha) which depicts that the farmers with more landholding are likely to adopt a technology earlier. On an average, 65.55% of the sample farmers in the study area had extension contacts (Table 1).

Cost and returns structure in DSR and TR :

The total cost of cultivation of paddy under DSR and TR is presented in Table 2. In DSR, the total cost of cultivation was found to be lower by 15.39 per cent (Rs.73661.1/ha) when compared to TR (Rs.87061.5/ha) method of cultivation. This was inconformity with the findings of Nirmala *et al*. (2016) and Vinay *et al*. (2016) who revealed that the total cost of cultivation was highest for transplanted rice when compared to that of direct

seeded rice.

Cost of cultivation of sample DSR paddy farms :

The total cost of cultivation of sample paddy farms adopting DSR was estimated to be Rs.73661.1 per hectare. The share of variable and fixed costs in the total cost of cultivation accounted to 65.32 (Rs.48114.48/ ha) and 34.68 (Rs.25546.65/ha) per cent, respectively.

The breakup of various variable cost components indicated that, human labour occupied maximum share of Rs.13140.55/ha (27.31%), followed by machine labour accounting Rs.11483.33/ha (23.87%), plant protection chemicals (20.04%), fertilizers (18.68%), interest on working capital (3.36%), irrigation charges (2.58%), manures (1.9%) and seed (1.88%).This was inconformity with the findings of Ramesh (1990) who revealed that the labour cost accounted for lion share in total operational cost of paddy cultivation.

Among the various fixed cost components, rental value of owned land occupied maximum share of Rs.21674.98/ha (84.85%) which was followed by depreciation accounting Rs.1636.67/ha (6.41%), interest on fixed capital (6.2%) and land revenue (2.54%).

Cost of cultivation of sample TR paddy farms :

The total cost of cultivation of sample paddy farms adopting TR was estimated to be Rs.87061.47 per hectare. The share of variable and fixed costs in the total cost of cultivation accounted to 69.37 (Rs.60391.91/ ha) and 30.63 (Rs.26669.56/ha) per cent, respectively.

The breakup of various variable cost components indicated that, human labour occupied maximum share of Rs.17233.89/ha (28.54%) followed by machine labour accounting Rs.13350/ha (22.11%), fertilizers (20.04%), plant protection chemicals (19.84%), seed (3.43%), interest on working capital (3.4%), irrigation charges (2.61%) and manures (0.06%). The same was in conformity with the findings of Adinarayana (1990)who revealed that the labour cost and fertilizers constituted the major items of total operational costs in paddy cultivation.

Among the various fixed cost components, rental value of owned land occupied maximum share of Rs.22513.74/ha (84.45%) which was followed by depreciation accounting Rs.1840/ha (6.9%), interest on fixed capital (6.3%) and land revenue (2.44%).

Cost structure in terms of cost concepts of DSR and TR :

The particulars in Table 3 revealed that, maximum costs were incurred for the transplanted rice (Rs.62548.6/ ha) than that of direct seeded rice (Rs.50045.6/ha). This

Table 1: Socio-economic profile of sample farmers **(n=90)**

Sr. No.	Particulars	DSR (n=45)	TR (n=45)	Average
1.	Average age of farmers (in years)	46.42	42.44	44.43
2.	Education (average in %)			
	Illiterate	-	-	-
	Primary	-	-	-
	Mid-School	2 (4.44)	-	4.44
	High-School	20 (44.44)	19 (42.22)	43.33
	College	23 (51.11)	26 (57.78)	54.45
3.	Family type (average in %)			
	Joint	34 (75.56)	27 (60)	67.78
	Nuclear	11 (24.44)	18 (40)	32.22
4.	Average family size (No.)	6.356	5.44	5.9
5.	Average size of operational land (in ha)			
	Owned	3.008	1.94	2.474
	Leased-in	0.202	0.27	0.236
	Total	3.21	2.21	2.71
6.	Experience in cultivating rice (in years)	18.4	15.33	16.87
7.	Experience in Practising DSR (in years)	2.356	-	-
8.	Extension contacts (average in %)	31 (68.89)	28 (62.22)	65.55

Note: Figures in parentheses indicates percentage (%) of total

Table 2 : Comparative cost of cultivation of paddy under TPR and DSR methods in TBP command area (Rs./ha)

Particulars	DSR	TR
Operational costs	48114.48 (65.32)	60391.91 (69.37)
Human labour	13140.55 (27.31)	17233.89 (28.54)
Animal labour	45 (0.09)	0
Machine labour	11483.33 (23.87)	13350 (22.11)
Seed	903.33 (1.88)	2073.94 (3.43)
Manures	961.11 (1.9)	33.33 (0.06)
Fertilizers	8987.31 (18.68)	12102.78 (20.04)
Plant protection chemicals	9639.72 (20.04)	11978.81 (19.84)
Irrigation charges	1241.67 (2.58)	1577.78 (2.61)
Miscellaneous	94.44 (0.2)	0
Interest on working capital	1618.01 (3.36)	2041.39 (3.4)
Fixed costs	25546.65 (34.68)	26669.56 (30.63)
Rental value of Owned land	21674.98 (84.85)	22513.74 (84.45)
Rent paid for leased-in-land	0	0
Land revenue, cesses and taxes	650 (2.54)	650 (2.44)
Depreciation on implements and farm building	1636.67 (6.41)	1840 (6.9)
Interest on fixed capital	1584.99 (6.2)	1665.82 (6.3)
Total cost	73661.13	87061.47

Note: Figures in parentheses indicates percentage (%) of total cost

Table 3 : Comparison of cost of cultivation and cost of production in DSR and TR

Particulars	Cost of cultivation (Rs./ha)		Cost of production (Rs./quintal)	
	DSR	TR	DSR	TR
Cost A1	50045.6	62548.6	779.77	1101.36
Cost A2	50045.6	62548.6	779.77	1101.36
Cost B1	50330.1	62863.6	784.2	1106.91
Cost B2	72005.1	85377.3	1121.92	1503.33
Cost C1	50685.6	63196.9	789.74	1112.78
Cost C2	72360.6	85710.7	1127.46	1509.20
Cost C3	79596.7	94281.7	1240.21	1660.12

Table 4 : Cost and return structure of paddy under DSR and TR in TBP command area (Rs./ha)

Sr. No.	Particulars	DSR	TR
1.	Total variable cost	48114.48	60391.91
2.	Total fixed cost	25546.65	26669.56
3.	Total cost	73661.13	87061.47
4.	Yield (in quintals)	64.18	56.79
5.	Straw value	1253.33	1253.33
6.	Gross returns	136126.56	119754.75
7.	Net returns	62465.43	32693.28
8.	Returns per rupee spent	1.85	1.38

high amount of cost A_1 in transplanted rice was mainly due to high cost of human labour, machine power, fertilizers etc. There were no tenants and hence there was no difference of cost A_1 and cost A_2 in sample paddy farms.This was in agreement with the findings of Patel *et al.* (1987).

The cost B_1 for transplanted rice (Rs.62863.6/ha) was slightly higher than direct seeded rice (50330.1/ha). The cost B_2 was also higher for transplanted rice (Rs.85377.3/ha) than the direct seeded rice (Rs.72005.1/ha) due to slight variation in average rental value of owned land.

There was only slight difference of cost B_1 and B_2 to cost C_1 and C_2 because family labour utilization was less in cultivation process and was only restricted for ploughing and applying fertilizers. Cost C_3 was calculated by summing up cost C_2 and value of management output (at 10% of total cost of cultivation) and was accounted Rs.79596.7/ha and Rs.94281.7/ha for direct seeded and transplanted rice, respectively (Table 3).

Cost and return structure of paddy under DSR and TR in TBP command area :

The average yield was considerably high in DSR (64.18 qtl/ha) compared to TR (56.79 qtl/ha) method of cultivation. There was 11.51 per cent yield advantage in DSR when compared to TR. This was compliant with the findings of Yadav (2012). The gross returns obtained were Rs.1,36,127 and Rs.1,19,755 per ha for DSR and TR of rice cultivation, respectively.

The net returns were higher in DSR (Rs.62465/ha) than that of TR (Rs.32693/ha), and this was due to high cost of cultivation in transplanted rice. The results were on par with the findings of Vinay *et al.* (2016) whose results showed that net returns were higher in direct seeded rice when compared to transplanted method of paddy cultivation. Returns per rupee of investment was higher in DSR (1.85), when compared with TR (1.38). This was in compliance with the study conducted by Singh (2015) who revealed that the benefit cost ratio was higher in DSR (6.17) when compared to TR (5.64) method of basmati rice cultivation (Table 4).

Conclusion:

Due to the continuous depletion of the water resources, increasing fuel charges and labour scarcity, there is an urgent need to popularize the DSR technology to conserve resources like water, fuel and labour and to enhance the profitability of rice farmers.Weeds are the major problem in DSR. Hence, there is a need for Research and Development efforts in developing suitable agronomic practices, varieties and mechanized devices to overcome the problem of weeds. More research is needed to develop high yielding rice varieties suitable for DSR under different agro-climatic conditions. Varieties must possess the desirabletraits, *viz*., vigorous growth, weeds uppres singability, germinating ability under moistures tress, tolerant to micronutrient deficiency.

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