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Impact of Direct Seeded Rice in Paddy Crop under Upper Krishna Command Area

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A B S T R A C T

The farmers under Upper Krishna command areas are experiencing severe water scarcity, high labour cost and unavailability of labour for agricultural production due to adverse climate change. To overcome this problem, Direct Seeded Rice (DSR) method was introduce under UKP command areas.The average crop yield of paddy under DSR method was 5.85 and 6.20 t.ha^{-1} andin Transplanting Practices(TP) it was 5.23 and 5.45 t.ha^{-1}during *kharif* 2018 and 2019 respectively against potential yield of 7.5 t.ha^{-1}.Adoption of DSR method in paddy cultivation enhanced crop yield up to 10-13 % by using 30 % less crop inputs such as irrigation water and fertilizer and it minimizes the pest and disease incidence. Increase in crop yield under DSR stretched the B:C ratio up to Rs. 2.77 higher than traditional practices. The study suggests that, adoption of DSR method in paddy cultivation minimizes the cost of crop inputs, pest and diseases incidence and conserves the irrigation water for future generation.

Introduction

Assurance of food security through traditional agricultural practices for ever increasing population in India is the biggest challenge. The lateset monsoon, labour scarcity, time consuming field operations and increasing labour cost are major constraints for decreasing agricultural production. All the command areas of irrigation project in India, paddy is cultivated by traditional method of transplanting by puddling which consumes up to 1500 or more mm of water, besides labour, time, fuel and chemical inputs (Kuchanur *et al.,* 2018). Most of the crops yield in the country is less than the potential yield due to use of traditional practices and less knowledge on new technologies available for crop

production. Farm universities in the country have developed many new technologies which help in increasing crop yield and reduce cost of cultivation, particular on farm mechanization. To reduce the gap between potential yield and farmer's practices yield, the extension activities like front line demonstration, trainings and providing information on new technologies plays major role. Krishi Vigyan Kendras (KVK) in the country has taken up many such extension activities and reduced this yield gap which helps the small and marginal farmers to sustain their economic status.

There is a need to introduce of new technologies in command areas where 80 % of farmers practicing paddy –paddy crop pattern which consumes more water and labour under present adverse climate condition. Scarcity of labour during peak period of transplanting, uncertain supply of irrigation water, depletion of groundwater and increasing production cost necessitate the search for an alternative to the conventional puddled transplanting of rice (Pathak., 2011). The introduction of Direct Seeded Rice, Drum Seeded Rice, Alternate wetting and drying (AWD) in paddy cultivation enhance the crop productivity and minimizes the water scarcity problems. These technologies also help in management of soil health by using minimum use of fertilizer, pesticide and water for crop production. The use of DSR and AWD methods also help in minimizing soil salinity problem by maintaining groundwater table through controlling seepage and percolation losses which is major problem in paddy transplanting method.

The Direct Seeding Rice (DRS) is the method of direct sowing of paddy seeds in the main field rather than transplanting of seedlings from nursery. After good germination and seedling establishment, crop can be irrigated and water regimes maintained as for transplanted rice (Bishal Bista., 2018). This DSR technology has proved successfully on water saving and paddy yield enhancement throughout the world and presently it contributes 23% of rice productions under direct-seeding (Rao *et al*., 2007).Many researchers reported that, scanty rainfall, water scarcity and higher costs for labour are the major constraints for shifting from traditional transplanted method to DSR. The adaptation of DSR in paddy cultivation is expected to reduce the water use by 30% and 60% labour cost as it lacks raising of paddy nursery, transplanting, puddling and maintenance of standing water **(**Gupta *et al*., 2006). The DSR increase the net profit by reducing the cost of production by US$ 9-125 ha^{-1}(Kumar and Ladha, 2011). The timely field operation, low crop inputs and water use has enhanced crop productivity up to 5-10% more than farmer's traditional practices. In Karnataka under Cauvery and Tunga Badra command areas, DSR technology has been introduced and farmers are successfully adopted. However, the farmers in the Upper Krishna Project (UKP) command areas are still practicing the traditional paddy cultivation which consumes more water and causes less crop yield as compared to DSR. Therefore, the present study is undertaken to create awareness on DSR sowing method in UKP to minimize water scarcity and lobour problems through front line demonstration.

Materials and Methods

The ICAR-Krishi Vigyan Kendra, Yadgir (Karnataka) conducted demonstration of direct seeded rice sowing method through Front Line Demonstrations (FLD) in 12 participatory involvement of selected farmer's field during *kharif* season of 2018 and 2019 at KVK cluster villages. The paddy was sown with tractor operated paddy direct seed drill in demonstration field and transplanted paddy cultivation was selected as check for analysis

of yield and economic feasibility. The direct seeded seed drill was provided by KVK for sowing of paddy and seeds, farm manure, balanced fertilizers and agro- chemicals were managed by farmers himself as per recommendation of package of practices of University of Agricultural Science, Raichur. Selected farmers were trained on use of direct seeded seed drill for sowing and frequent field visits have made for collection of required data during crop growth period and on the harvest day field day had organized to create awareness of selected technology among village people. Farmers were informed to note down all quantities of inputs used in all practices and used for economic analysis. The parshall flume was installed at demonstration fields for measurement of quantity of irrigation water applied at each technology. The extension tools such as extension gap, technology gap, and technology index were calculated as suggested by (Chaudhary *et al.,* 2018 and Suthar *et al.,* 2016) to study impact of front-line demonstrations among selected farmers in paddy crop.

Technology gap = Potential yield - Demonstrated yield

Extension gap = Demonstrated yield - Yield under existing practice

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential yield}} \times 100$$

Results and Discussion

Grain yield

Any technologies which are helpful to reduce labour cost and increase the crop yield will certainly impact on Indian farmers. The use of small-scale farm mechanization in crop production could not only reduce the cost of cultivation but also helps in increase in crop yield. The result of the demonstration is presented in Table 1 and it is reported that, the average crop yield of paddy under DSR method was 5.85 and 6.20 $t.ha^{-1}$ andin Transplanting Practices(TP) it was 5.23 and 5.45 $t.ha^{-1}$during *kharif* 2018 and 2019 respectively against potential yield of 7.5 $t.ha^{-1}$.It is also observed that, 11.85 % and 13.76 % increase in crop yield in DSR method as compared to traditional practices during *kharif* 2018 and 2019 respectively.The less application of nitrogen in direct sown method minimizes the incidence of pest and diseases which help in enhanced crop yield in demonstration fields. The less use of irrigation water up to 35% helps the soil aeration and better root growth may be another reason for increase in crop yield in paddy crop. This resultis confirmed with (Bishal Bista., 2018 and Pathak *et al.,* 2011) where DSR increases productivity by 5-10%. Kuchanur *et al.,* (2018) reported that farmers in Yadgir district which comes under UKP command areas gained 10 to 15 % more paddy yield than the traditional method by saving 30 % irrigation water during growth period.

Paddy yield gap

The paddy yield gap in DSR and Transplanting practices is presented in Table 2 and it is observed that, the technology gap during *kharif* 2018 and 2019 was 1.65 and 1.30 $t.ha^{-1}$ respectively. The extension gap and technology index was 0.62 to 0.75 $t.ha^{-1}$ and 22.00 and 17.33 during *kharif* 2018 and 2019 respectively. These results clearly indicated that, DSR impact on crop yield is merely 8 to 10 %. However, DSR methods helps in minimizing crop inputs like seeds, fertilizer, labour and mainly water without declining crop yield. DSR method would be more useful for command area farmers to solve water scarcity problem and sustain the soil health management without effect on crop yield. This indicated that, farmers need to be educating on use of DSR for resource conservation and judicious use crop inputs for minimizing cost of cultivation.

Table.1 Details of paddy yield under direct seeded and drum seeded paddy sowing method during *kharif*-2018 and 2019

Year	Name of the technology demonstrated	Area (ha)	No. of Demo	Potential yield ($t.ha^{-1}$)	Yield of the crop ($t.ha^{-1}$) under Demonstration			Yield of TP ($t.ha^{-1}$)	% Increase
					Highest	Lowest	Average		
Kharif-2018	DSR	08	12	7.5	6.1	5.6	5.85	5.23	11.85
Kharif-2019	DSR	08	12	7.5	6.6	5.8	6.20	5.45	13.76

Table.2 Details of paddy yield gap under DSR and Transplanting Practices

Year	Technology Demonstration	Technology gap ($t.ha^{-1}$)	Extension gap ($t.ha^{-1}$)	Technology index (%)
***Kharif*-2018**	DSR	1.65	0.62	22.00
***Kharif*-2019**	DSR	1.30	0.75	17.33

Table.3 Cost of cultivation and economic feasibility of transplanted and direct seeded rice during kharif 2018 and 2019

S.L No	Details	Farmers practices		Direct Seeded Rice	
		2018 ($Rs.ha^{-1}$)	**2019** ($Rs.ha^{-1}$)	**2018** ($Rs.ha^{-1}$)	**2019** ($Rs.ha^{-1}$)
01	Seed (25 Kg)	1500	1650	700	730
02	Fertilizer cost	15875	17462	8937	9334.
03	Herbicide and Pesticide	7800	8580	6500	6933
04	Land Preparation	2500	2750	1250	1912
05	Puddling	5000	5500	-	-
06	Nursery rising and transplanting	6750	7425	750	787
07	Fertiliser, Pesticide and Weedcide application	3750	4125	3250	3912
08	Irrigation	2500	2750	750	887
09	Harvest and transportation	5250	5775	5250	5512
10	Total Expenditure	50,925	56017.5	27,388	30,011
11	Crop Yield	5.23	5.45	5.85	6.2
12	Grass returns	67990	70850	76050	80600
13	Net Returns	17,065	14,833	48,663	50,589
14	**B:C Ratio**	**1.33**	**1.26**	**2.77**	**2.68**

Economic feasibility of DSR method in rice cultivation

Any new technology in agriculture production wills success only when it is economically viable. Economic analysis would indicate the success or failure of the new technology and in agriculture it is mainly depends on the crop inputs used for crop production. The total expenditure per hectare of traditional practices was Rs.50,925.00 and Rs.56017.500 during *kharif*-2018 and 2019 respectively. However, total expenditure per hectare in DSR was Rs.27,388.00 and Rs.30,011.00 during *kharif*-2018 and 2019 respectively which enhance the net profit of Rs. 48,663.00and 50,589.00 per hectare during *kharif*-2018 and 2019 respectively. The less use of crop inputs in DSR methods enhance the highest benefit cost ratio (B:C Ratio) of 2.77 and 2.68 during *kharif*-2018 and 2019 respectively as compared mere 1.26 in traditional practices. The highest B:C ration in DSR method was due to use less crop inputs such as seed, fertilizer and labour cost during crop growth period.

Extension strategies

The aim of extension is to transfer the technology from scientists or farm university to farmers. During *kharif*-2018 when DSR method was introduced through Front Line Demonstration and only few farmers came to forward for adopting new technology. However, the success of technology created good impact in the command area and it could able to reach 50 farmers in next year and brought 200 acres of land under DSR cultivation. Organizing of training programmes and celebration of field days has given opportunity to other farmers to understand new technology. This shows that, the conducting front line demonstrations in farmers own field plays major role in building the confidence of the farmers to adopt new technologies.

In conclusion, the paddy cultivating farmers in Upper Krishna command area under paddy-paddy cropping pattern already experiencing water scarcity, high labour cost and unavailability of labour for field operations reduces considerable the crop yield. The present study suggested that, the average crop yield of paddy under DSR method was 5.85 and 6.20 $t.ha^{-1}$ and followed by 5.23 $t.ha^{-1}$ and 5.45 $t.ha^{-1}$ during *kharif* 2018 and 2019 respectively against potential yields of 7.5 $t.ha^{-1}$.Adoption of DSR method in paddy cultivation enhanced crop yield up to 10-13 % by using 30 % less crop inputs such as irrigation water and fertilizer and minimizes the pest and disease incidence. Increase in crop yield stretched the B:C ratio up to Rs. 2.77 higher than traditional practices. It also helps in maintaining soil health by controlling seepage and percolation which intern raises ground water table. Therefore, the study suggests that, DSR method in paddy cultivation will be more useful for UKP command areas farmers.

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