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Economic Analysis of Rice Establishment Techniques in Delta Region of Krishna District

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ABSTRACT

An on-farm trial was conducted in Krishna district during *kharif* seasons of 2010-11 and 2012-13 to analyse the performance of different rice establishment techniques against traditional method of transplanting in rice in various farming situations. They include manual transplanting, direct seeding through broadcasting, direct sowing using seed drill, sowing of sprouted seed using drum seeder and system of rice intensification under mechanization (MSRI). The cost of establishment was highest in manual transplanting method (Rs. 13,838/- ha^{-1}) followed by MSRI method (Rs. 12,925/- ha^{-1}). Though broadcasting required significantly less cost for establishment (Rs. 5,233/- ha^{-1}), it required significantly higher (Rs. 5,850/- ha^{-1}) expenditure towards weed management compared with other methods of establishment. The highest grain yield (7398 kg/ ha^{-1}) with highest gross return (Rs. 1,02,013/ - ha^{-1}), net return (Rs. 65,754/- ha^{-1}) and benefit cost ratio (1.81) were realized in direct sowing using seed drill. Direct sowing using seed drill was found remunerative in heavy soils.

Key words : Economic Analysis, Rice establishment techniques.

Paddy (*Oryza sativa*) is the staple food for most of the Indians and it occupies a significant position in the agricultural economy of the country. It is grown by adopting various crop establishing techniques. The traditional method followed from many years in Krishna delta region is transplanting of seedlings raised in nursery which involves seedbed preparation, nursery growing with proper nutrition and protection, uprooting of seedlings, transportation and transplanting operations. This is a time consuming, labour intensive method and requires more water for land preparation as well as for the establishment of crop. Availability of farm labour is drastically reduced, especially for drudgery like transplanting and weeding in rice and maintaining optimum plant population is very difficult. Delayed transplanting of rice affects growth and yields not only of rice but also succeeding crops, thereby reducing system productivity and profitability. In order to overcome these problems, alternate methods of economic and environmentally appropriate production systems for rice are inevitable. Resource conserving technologies like dry direct seeded rice is a potential alternative, which, is a successful method in various rice growing countries of the world (Adair *et al*., 1992). The transplanting of rice seedlings can be replaced by direct seeding that can reduce labour needs by more than 20 per cent in terms of working hours required (Santhi *et al*., 1998.). The system of Rice intensification has been successfully used in a number of countries. Owing to the problems like delay in release of water through canals, shortage of labour during peak time, hike in labour charges *etc*., the rice farmers practicing transplanting have been switched over to various methods of rice crop establishment, taking the advantage of rains during early period of monsoons *i.e*., May and June.

MATERIAL AND METHODS

On-farm trials were conducted in Krishna district during *kharif* seasons of 2010-11 and 2012-13 to analyse the performance of different rice establishment techniques against traditional method of transplanting in various farming situations. The experiments comprised of following treatments. They include *viz,* manual transplanting, direct seeding through broadcasting, direct sowing using seed drill, sowing of sprouted seed using drum seeder and system of rice intensification under mechanization (MSRI). Five locations were selected for testing each treatment and rice variety; BPT 5204 was used in all the treatments. Thus, a

total of 25 trials were conducted. In direct sowing; seeds were sown straight to the main field either by broadcasting or tractor drawn seed drill. This method was practiced where water was not sufficient. The wet drum seeding of rice was followed in irrigated areas as it required perfect leveling and puddling of the fields. For this paddy seeds were soaked in water for 24 hours and incubated for 24 to 48 hours. These sprouted seeds were sown in puddled field 1-2 days after puddling using perforated drum seeder. "System of Rice intensification" involved different practices for plant, soil, water and nutrient management and to overcome high operational costs, it was slightly modified by introducing mechanization.

RESULTS AND DISCUSSION

An analysis was made on different crop establishment techniques followed by rice farmers compared to conventional transplanting in different farming situations of Krishna district. During *kharif* 2011, the cost of rice establishment was highest in MSRI method (Rs. 12,050/- ha^{-1}) and was on par with manual transplanting (Rs. 11,925/- ha^{-1}); while direct sowing techniques *viz*; broadcasting (Rs. 4,515/- ha^{-1}), sowing using drum seeder (Rs. 5,350/ - ha^{-1}) and sowing using seed drill (Rs. 5,900/- ha^{-1}) required significantly less cost for establishment (Table 1) as they did not require any nursery rising. The cost of weed management was significantly higher (Rs. 5,850/- ha^{-1}) in direct sowing with broadcasting method compared with other methods of establishment. The cost of inputs excluding herbicides was highest in manual transplanting method (Rs. 9,503/- ha^{-1}), while it was significantly less (Rs. 5,450/- ha^{-1}) in mechanized SRI. The cost incurred for harvesting and threshing was significantly less (Rs. 8,150/- ha^{-1}) in MSRI compared to other methods followed by broadcasting method (Rs. 15,750/- ha^{-1}). While the cost for harvesting and threshing was same for remaining three methods. The total cost of cultivation was lowest (Rs. 29,625/- ha^{-1}) for MSRI and highest (Rs. 42,478/- ha^{-1}) for manual method of planting where as it was at par for other techniques. The grain yield was significantly higher (7,800 kg/ ha^{-1}) in direct sowing using seed drill method while it was significantly less (5,738 kg/ ha^{-1}) in broadcasting method of sowing. The gross returns (Rs. 94,850/- ha^{-1}), net returns (Rs. 60,625/ - ha^{-1}) and benefit cost ratio (1.77) were significantly highest for direct sowing using seed drill method compared to all other methods.

During *kharif* 2012, the cost of establishment was highest in manual transplanting method (Rs. 15,750/- ha^{-1}) and was at par with MSRI method (Rs. 13,800/- ha^{-1}) (Table 2). Similar to the previous year, the cost of weed management was significantly higher (Rs. 5,850/- ha^{-1}) in direct sowing with broadcasting method compared with other methods of establishment. The cost of inputs excluding herbicides was highest in manual transplanting method (Rs. 16,445/- ha^{-1}), followed by broadcasting method (Rs. 13,300/- ha^{-1}). The cost incurred for harvesting and threshing was significantly less (Rs. 9,250/- ha^{-1}) in MSRI compared to other methods followed by broadcasting method (Rs. 17,700/- ha^{-1}). The total cost of cultivation was lowest (Rs. 36,485/- ha^{-1}) for MSRI and highest (Rs. 54,345/- ha^{-1}) for manual method of planting. The grain yield was significantly higher (6,995 kg/ ha^{-1}) in direct sowing using seed drill method while it was significantly less (5,513 kg/ ha^{-1}) in broadcasting method of sowing. The gross returns (Rs. 1,09,175/- ha^{-1}), net returns (Rs. 70,883/- ha^{-1}) and benefit cost ratio (1.85) were significantly highest for direct sowing using seed drill method compared to all other methods.

During kharif 2011, the total rainfall received was 744 mm from 38 rainy days. During early period of *kharif* 2012, though there was delay in release of water through canals due to delay in onset of monsoons, 1417 mm rainfall was received from 57 rainy days during the later part of the season. In addition, the rains coincided with flowering stage and resulted in low yields compared to kharif 2011. However, the sale price of paddy for the year 2011 was Rs. 1,150/- per quintal against Rs. 1,500/- for the year 2012. When both the seasons were taken into account, the cost of establishment was highest in manual transplanting method (Rs. 13,838/- ha^{-1}) followed by MSRI method (Rs. 12,925/- ha^{-1}); while for direct sowing using drum seeder (Rs. 6,050/- ha^{-1}) and seed drill (Rs. 6,175/- ha^{-1}), it was at par. Broadcasting required significantly less cost for establishment (Rs. 5,233/- ha^{-1}) (Table 3). Direct sowing through broadcasting method required significantly higher

Table 1. Cost of cultivation and returns of different rice production technologies during *kharif* 2011.

Particulars	Cost of establishment (Rs./ha)	Cost of weed management (Rs./ha)	Cost of Inputs (Rs./ha)	Cost of harvesting & threshing (Rs./ha)	Cost of cultivation (Rs./ha)	Yield (kg/ha)	Straw value (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B: C
Manual planting	11925	3550	9503	17500	42478	6823	5200	83659	41181	0.97
Broadcasting	4515	5850	8075	15750	34190	5738	5350	71331	37141	1.09
Seed drill	5900	3200	7625	17500	34225	7800	5150	94850	60625	1.77
Drum seeder	5350	3575	6800	17500	33225	6350	4550	77576	44350	1.34
MSRI	12050	3975	5450	8150	29625	6565		75498	45873	1.55
SE m±	221	185	293	187	448	125		1443	1433	0.05
C D at 0.05	663	556	879	559	1342	374		4327	4297	0.14

* Sale price of paddy = Rs. 1,150/- per quintal.

Table 2. Cost of cultivation and returns of different rice production technologies during *kharif* 2012.

Particulars	Cost of establishment (Rs./ha)	Cost of weed management (Rs./ha)	Cost of Inputs (Rs./ha)	Cost of harvesting & threshing (Rs./ha)	Cost of cultivation (Rs./ha)	Yield (kg/ha)	Straw value (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B: C
Manual planting	15750	3250	16445	18900	54345	5513	3850	86538	32193	0.59
Broadcasting	5950	5850	13300	17700	42800	6225	3700	97075	54275	1.32
Seed drill	6450	2800	10243	18800	38293	6995	4250	109175	70883	1.85
Drum seeder	6750	4325	8825	18750	38650	5850	4000	91750	53100	1.38
MSRI	13800	4225	9210	9250	36485	6253		93788	57303	1.27
SE m±	103	364	500	192	682	137		2061	1879	0.04
C D at 0.05	308	1092	1498	577	2044	411		6178	5631	0.12

* Sale price of paddy = Rs. 1,150/- per quintal.

Table 3. Cost of cultivation and returns of different rice production technologies during *kharif* 2011and 2012.

Particulars	Cost of establishment (Rs./ha)	Cost of weed management (Rs./ha)	Cost of Inputs (Rs./ha)	Cost of harvesting & threshing (Rs./ha)	Cost of cultivation (Rs./ha)	Yield (kg/ha)	Straw value (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B: C
Manual planting	13838	3400	12974	18200	48411	6168	4525	85098	36687	0.78
Broadcasting	5233	5850	10688	16725	38495	5981	4525	84203	45708	1.20
Seed drill	6175	3000	8934	18150	36259	7398	4700	102013	65754	1.81
Drum seeder	6050	3950	7813	18125	35938	6100	4275	84663	48725	1.36
MSRI	12925	4100	7330	8700	33055	6409		84643	51588	1.41
SE m$\pm$	137	203	234	149	345	112		1511	1461	0.04
C D at 0.05	410	608	701	448	1034	337		4530	4380	0.12

* Sale price of paddy = Rs. 1,150/- per quintal.

(Rs. 5,850/- ha^{-1}) expenditure towards weed management compared with other methods of establishment. Weeds were of major concern, as they compete for moisture, nutrients, light and space and a consequence, weeds infestation in direct sown rice result in yield losses and enhance the cost of production. Expenditure towards inputs (fertilizers and pesticides) was higher in case of manual transplanting (Rs. 12,974/- ha^{-1}), followed by broadcasting method (Rs. 10,688/- ha^{-1}), probably due to higher fertilizer usage and more pest incidence. In broadcasting method, farmers are adapting high seed rate (more than 20 kg/acre), which causes nitrogen deficiency, reduced tillering and lead to attack of brown plant hopers and crop lodging. Higher pest and disease incidence because of dense canopy and less ventilation around plants was reported in broadcast-sown rice with high seed rate (Sittisuang, 1995). In direct sowing, crop establishment of rice was affected in unleveled or traditional leveled fields, due to unequal distribution of water in soil profile and inundation of newly germinating seedlings at initial stages. Lantican *et al,* (1999) reported that yield for direct sown rice was significantly improved with precise land leveling.

The expenditure incurred towards harvesting and threshing was significantly less (Rs. 8,700/- ha^{-1}) in MSRI compared to other methods followed by broadcasting method (Rs. 16,725/- ha^{-1}). The cost of harvesting and threshing was more or less similar for remaining three methods. The total cost of cultivation was lowest (Rs. 33,055/- ha^{-1}) for MSRI and highest (Rs. 48,411/- ha^{-1}) for manual method of planting where as it was at par for drum seeder (Rs. 35,938/- ha^{-1}) and seed drill (Rs. 36,259/- ha^{-1}) techniques. The highest grain yield (7398 kg/ ha^{-1}) with highest gross return (Rs. 1,02,013/- ha^{-1}), net return (Rs. 65,754/- ha^{-1}) and benefit cost ratio (1.81) were realized in direct sowing using seed drill. Though gross returns were at par in other techniques, net return (Rs. 36,687/- ha^{-1}) and benefit cost ratio (0.78) were lowest in manual method of planting owing to the labour costs involved for transplanting and weed management. In broadcasting technique, the cost benefit ratio was less may be due to low yield, additional cost for weed management as reported by Aslam *et al*., (2008). Venkateswarlu *et al*., (2011) recorded a 50

per cent reduction in labour required for rising of nursery and transplanting; and 13 per cent increase in grain yield in machine planting against manual planting. Though there was no significant difference in grain yield between transplanted rice and drum seeded rice; highest net return and benefit:cost ratio were obtained with drum seeded rice compared to transplanted rice (Manoranjan *et al.*, 2011; Sucheta and Hensel., 2012). In drum seeding practice, maintenance of water in initial stages of crop establishment, birds menace, more expenditure towards weed management were the major constraints observed by Shivaramu *et al*., (2011).

The experiences of farmers of Krishna district suggest that seeding of rice after onset of monsoon become difficult due to problem in movement of machinery in the wet fields. Moreover, under wet field conditions, there are problems in depth control of drill, clogging of seed tubes etc makes seeding difficult resulting in poor crop establishment. More over, a dry spell for 2-3 days after sowing in wet soil may cause surface crust formation resulting poor emergence. Hence, for the kharif season, planting of direct sown rice 10-12 days before historical date of onset of monsoon would be better than planting early or late as suggested by Ravigopal *et al*., (2010). Direct sowing using seed drill was found remunerative in heavy soils. When paddy seed was dibbled using the seed drill at desired depth crop establishment was very good. In light textured soils, though sowing with seed drill performed well, it is little costlier and time consuming compared to direct broadcasting. During the initial period of crop establishment though weeds become problematic, farmers were able to manage them successfully with the available new herbicides and cultural methods. Based on findings of these experiments as well as experiences of farmers of Krishna district, it can be concluded that direct seeded rice with seed drill improved the crop yields and system productivity while conserving natural resources.

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