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Impact of front-line demonstrations on extent of adoption and horizontal spread of Direct seeding in rice with drum seeder in Nalgonda district of Telangana

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Abstract
The present investigation was carried out in Nalgonda district to study the impact of FLDs conducted during 2016-17 to 2018-19 in rice with drum seeder in puddled conditions. DAATTC promoted this technology in different villages through On-farm trials, Frontline demonstrations, Training programmes, Field days and Exposure visits since its introduction in 2016-17. Conventional method of cultivating rice i.e., transplanting under tanks and canals is common. Nurseries are laid from June last week in anticipation of rain water and as rains are delayed over-aged seedlings are transplanted. It would be advantageous, if transplanting could be substituted by a low-cost method of crop establishment which can give on par results. Drum seeding is one of the viable options, a process of establishing rice crop from seeds sown in the field. It offers advantages like labour saving, less water, energy, time, less drudgery, early crop maturity, low production cost etc. The study indicated that Average highest yield recorded was 6870 kg/ha in demonstration plot over control (6260.2 kg/ha) and an average additional yield of 609.8 kg/ha was observed, 9.74% of average yield increase over control plot. The extension gap ranged from 574.6 kg/ha to 675 kg/ha where as technology gap was 150 to 625 kg/ha respectively, with technology index of 5.24% during the demonstration years. The demonstrated plots gave higher gross returns with higher benefit cost ratio compared to farmer's practice. A gap existed in potential yield and demonstration yield due to soil fertility and weather aberrations. The horizontal spread has increased by 136%.

Keywords: frontline demonstrations, direct seeding, drum seeder and technology index

1. Introduction
Agriculture plays a vital role in India's economy and accounts for 16.00% of the country's Gross value Added (GVA) for the year 2018-19 (Source: Anonymous 2018-19, Department of Agriculture, 2018). Rice (*Oryza sativa* L.) is considered as the "global grain" (Balai *et al.* 2013) [2]. It is the major staple food for more than half of the global population. Rice is the dominant crop of the country as it is grown in almost all the states of the country. The term 'rice is life' is most appropriate in Indian context as this crop plays vital role in country's food security and is the backbone of livelihood for millions of rural households (Jaya Prakash *et al.* 2015) [12]. It is one of the major cereal crops cultivated in more than 110 countries (Degenkolbe *et al.* 2013) [8] in the world with a total production of 527 million tones, of which 78.00% is contributed by the major rice growing countries of Asia [Chandima *et al.* 2013] [4]. India is the largest producer of rice in the world and it occupies the largest cropped area of 44.2 M ha with a total production of 112.91 Million tones with an average productivity of 2578 kg ha^{-1} (Source: Anonymous 2018-19, Department of Agriculture, 2018). However, it ranks second to China in terms of production. In Telangana rice is the major food crop grown in an area of 28.03 lakh ha in kharif and 15.84 lakh ha in rabi with an average productivity of 2404 kg ha^{-1} (Source: Anonymous 2018-19, Department of Agriculture, 2018). Rice is the principle food crop cultivated throughout the Telangana state, providing food for the growing population, fodder to the cattle and employment to the rural masses [Jaya prakash *et al.* 2015] [12].
India faces the most challenging task of transferring the fast emerging agricultural technologies to sustain the increase in farm productivity and economic viability of farming. The Frontline demonstrations are an important method of transfer of latest technologies and package of practices in totality to farmers (Hiremath *et al.* 2012) [9] and main objective of this programme is demonstration of proven crop production technologies and to introduce suitable agriculture practices like seed treatment, spacing, timely sowing, nutrient management, growth hormones, pest and disease management practices, high yielding varieties in the farmer's field

on large scale under real farming situations in different agro-climatic regions accompanied with organizing extension programmes (group discussions, awareness campaigns, field days etc) for horizontal dissemination of the technologies (Venkatarajkumar *et al.* 2020). FLD's play a very important role in transfer of technologies and in changing the scientific treatment of the farmers by seeing and believing principle in order to have better impact of the demonstrated technologies for farmers and field level extension functionaries (Sagar *et al.* 2004) [21]. Front Line Demonstrations were conducted at farmer's field, in a systemic manner, to show case the improved production technology, to convince them about the potential of improved production technologies to enhance the yield.

Generally, the agricultural technology is not accepted by farmers as such in all aspects. There is always gap between recommended technology by the scientist and its modified form at farmer's level. It is need of the hour to reduce this technological gap between the agricultural technology recommended by the scientists or researchers and its acceptance by the farmers on their field. In view of the above facts, present study has been undertaken to assess the impact of frontline demonstrations on extent of adoption and horizontal spread of direct seeding in rice with drum seeder in Nalgonda district.

2. Materials and Methods

The present study was carried out by DAATTC in Nalgonda district based on the FLD's conducted from 2016-17 to 2018-19 in the farmer's field in different locations of the district. Total 30 demonstrations were conducted on direct seeding in rice with drum seeder in different villages for three continuous years. Each frontline demonstration was laid out on 0.4 ha area and the critical inputs were applied as per the package of practices while adjacent 0.4 ha was taken as control for comparison of farmer's practice. The selection of farmers was done, on basis of survey by DAATTC and imparted trainings to the selected farmers on agronomic and package of practices in Rice cultivation with drum seeder. Direct seeding with drum seeder is done by pulling drum seeder in puddled soil. On pulling the seeder, seeds are placed on the soil surface at a distance of 20 cm between rows and at about 12.5 cm between plants. The field was ploughed twice, puddled and then levelled. For drum seeding, seeds with radicle just emerged was used i.e; sowing of pre-germinated seed into a puddled soil (wet seeding). Seeds are soaked in water for 24 hours, incubated for another 24 hours. The Conventional puddled transplanted rice was taken as a control. Field days were also conducted in each cluster to show the results of front line demonstrations to the farmers of the same and neighboring villages.

The yield and economic performance of front line demonstrations, the output were collected from FLDs as well as local control plots from all selected farmers of Rice for analysis and interpretation of the data. The data is interpreted and presented in terms of percentage and the qualitative data were converted into quantitative form and expressed in terms of per cent increased yield. Finally, the grain yield, cost of cultivation, net returns with benefit cost ratio was worked out. An average of cost of cultivation, yield and net returns of different farmers was analyzed by the formula.

Average = [F1+ F2+F3. . . . . Fn] / N; F1 = Farmer; N = No. of Farmers.

In the present study, technology index was operationally defined as technical feasibility obtained due to implementation of front line demonstrations on direct seeding with drum seeder in Rice. To estimate the technology gap, extension gap and technology index the following formula as mentioned below were used as suggested by Samui *et al.* (2000) [22], Sagar and Chandra (2004) [21] and Dayanand and Mehta (2012) [5].

Per cent increase in yield = Demonstration yield - farmers yield X 100 /Farmers yield

Technology Gap = Pi (Potential Yield) – Di (Demonstration Yield)

Extension Gap = Di (Demonstration Yield) – Fi (Farmers yield)

Technology index = [(Potential Yield – Demonstration yield/potential yield) X 100].

The data on adoption and horizontal spread of technologies were collected from the selected farmers with the help of schedule. Data were subjected to suitable statistical methods. The following formulae were used to assess the impact of different parameters of Rice crop.

Impact of yield = Yield of demonstration plot- yield of control plot/Yield of control plot X 100

Impact on adoption (% change) = No. of adopters after demonstration - No. of adopters before demonstration /No. of adopters before demonstration X 100

Impact on horizontal Spread (% change) = After area (ha) - Before area (ha)/ Before area ×100

3. Results and Discussion

The data was pooled on different parameters and the results obtained are discussed accordingly. Adoption of Improved Practices in Rice crop from Table 1 shows that all the FLD farmers fully adopted the recommended package of practices with slight modifications where as non-FLD farmers were unable to adopt the practices may be due to the fact that they had poor access to knowledge and poor extension linkages with DAATTC and other line departments

Table 1: Difference between demonstration package (drum seeder) and farmer's practice (transplanting) in the study area

S.no	Particulars	Demonstration package (Drum seeder)	Farmer's practice (transplanting)
1	Seed Rate	8-12 kg/acre	25-30kg/acre
2	Days to transplant	0	25-30 days
3	Seed Placement	Seed on the surface	Seedling in the soil
4	Seed priming	Seed priming was performed for better germination. Seed are soaked in water for 24h & incubation in gunny bags for 24-48hr.	Seed priming is generally not practiced.
5	Cost of nursery raising	Nil	1250/- per acre
6	Seed sowing	Pre-germinated Rice seed are sown with drum seeder after draining standing water	Nursery is raised, 25-30 days old seedlings are transplanted in the field
7	Spacing	20 X 12.5cm	Zig-zag
8	Water management	No standing water after seeding, the field is kept at saturation up to maximum tillering and there after 2- 3 cm standing water till 10 days before harvesting	3-5 cm or more standing water from the day of transplantation to 10 days before harvesting
9	Weed management	Use of pre & post emergent weedicide is a must in drum seeding. Oxadiargyl @ 75g/ha or pyrazosulfan @ 200 g/ha 3 days after seeding, and if necessary 2.4-D. Sodium salt application at 30-35 days after seeding. Conoweeder is run in one direction only, either E-W or N-S, i.e., in the direction in which the drum-seeder was pulled	Manual weeding twice (or) application of herbicide 1st time and manual weeding 2nd time.
10	Labour requirement for sowing	Two labour for pulling the drum seeder	Six to eight for completion of transplanting.
11	Crop duration	Matures 7-10 days earlier than transplanting method	Normal crop period

3a. Yield parameters

The perusal of data (Table 2) indicate that due to front line demonstrations Rice yield ranged from 7100 q/ ha to 6625 q/ha in demonstration plots and from 6525.4 q/ ha to 6045.2 q / ha in farmer's practice in three years of frontline demonstrations conducted. An average yield of 6870 q/ ha was obtained under demonstration plots as compared to farmer's practice plots yield 6260.2 q/ha consecutively. These results clearly indicate that the higher average yield was obtained in demonstration plots over the years compared to farmer's practice due to high knowledge and adoption of full package of practices in direct seeding with drum seeder, along with use of recommended dose of fertilizers and timely application of plant protection chemicals. The average yield of Rice increased by 9.74 per cent compared to farmer's practice that is by transplanting in Rice. The above findings are in similarity with the findings of Singh *et al.* (2011) [26] and Balai *et al.* (2013) [2]. Similarly yield enhancement in different crops by initiation of frontline demonstrations were documented by Hiremath *et al.* (2007) [11], Mishra *et al.* (2009) [16], Kumar *et al.* (2010) [14], Surywanshi and Prakash (1993) [27], Dhaka *et al.* (2010) [6] and Misra *et al.* (2014) [18].

Table 2: Productivity, technology gap, technology index and extension gap in direct seeding in rice with drum seeder under FLD

Year	Area (ha)	No. of farmers	Yield (kg/ha)			% increase in yield	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
			Potential yield	Demonstration yield	Farmer's Yield				
2016-17	4	10	7250	7100	6525.4	8.81	574.6	150	2.07
2017-18	4	10	7250	6625	6045.2	9.59	579.8	625	8.62
2018-19	4	10	7250	6885	6210.0	10.87	675.0	365	5.03
Pooled data	-	-	7250	6870	6260.2	9.74	609.8	380	5.24

The increment in yield ranged between 8.81 to 10.87 per cent. The per cent increase in yield over farmer's practice was highest (10.87) during 2018-19 because water was received early in the canals compared to previous years. However, variations in the yield of Rice in different years might be due to the variations in soil moisture availability, rainfall pattern and change in the location of demonstrations every year.

3b. Extension gap: Extension gap of 574.6, 579.8 and 675 q/ha was observed during 2016-17, 2017-18 and 2018-19 respectively. On an average extension gap under three year FLD programme was 609.8 q/ha. This emphasizes the need to educate the farmers through various techniques for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. Frequent and continuous use of improved production technologies like drum seeding in Rice coupled with high yielding variety/hybrid will subsequently change this alarming trend of galloping extension gap.

3c. Technology gap: The technology gap is the difference between potential yield and yield of demonstration plots which was recorded as 150, 625 and 365 q /ha during 2016-17, 2017-18 and 2018-19 respectively. On an average technology gap under three year FLD programme was 380 q/ha. This may be due to soil fertility, managerial skills of individual farmer's and climatic conditions of the selected area. Hence, location specific recommendations are necessary to bridge these gaps. These findings are similar to Singh *et al.* (2011) [26], Sharma *et al.* (2004) [23] and Misra *et al.* (2019) [17].

3d. Technology Index: The technology index shows the feasibility of the demonstrated technology at the farmer's field. The technology index varied from 2.07 to 8.62 (Table 2). On an average technology index was 5.24 per cent, observed during the three years of FLD programme, which shows the effectiveness of technical interventions. This accelerates the adoption of demonstrated technical interventions to increase the yield performance of Rice.

3e. Economic returns: In order to find the economic feasibility of the demonstrated technologies over the control, some economic indicators like cost of cultivation, net returns and B:C ratio was worked out. The economic viability of improved demonstrated technology over farmer's practice was calculated depending on prevailing price of inputs. Output costs are represented in the form of B:C ratio (Table 3). It was found that the cost of production of Rice under demonstration varied from Rs. 44,575 to 50,550 per ha with an average of Rs. 47,850 as against Rs 48,650 to 60,837 with an average of Rs. 55,662.34 under control or farmer's practice. The additional cost increased in control or farmer's practice was mainly due to cost involved in transplanting, seed cost and raising of nurseries under traditional transplanting method.

Table 3: Comparative B:C analysis of Rice under FLD and farmer's practice

Year	Cost of Cultivation		Gross return (Rs./ha)		Net Returns (Rs./ha)		B:C Ratio	
	Demo	Control	Demo	Control	Demo	Control	Demo	Control
2016-17	44575.00	48,650.00	107210.00	98533.54	62635.00	49883.54	2.40	2.02
2017-18	50550.00	57500.00	102687.50	93700.60	52137.50	36200.60	2.03	1.63
2018-19	48425.00	60837.00	120487.50	108675.00	72062.50	47838.00	2.49	1.78
Average	47850.00	55662.34	110128.33	100303.05	62278.30	44640.71	2.30	1.80

The cultivation of Rice with drum seeder gave higher net return of Rs. 62,635.00 per ha, Rs. 52137.50 per ha and Rs. 72,062.50 per ha during the years 2016-17, 2017-18 and 2018-19 respectively with an average net return of Rs. 62,278.30 per ha which was Rs 44,640.71 per ha in farmer's practice. The benefit cost ratio ranged from 2.03 to 2.49 in demonstration plots and from 1.63 to 2.02 in farmer's practice during three years of demonstration with an average of 2.30 in demonstration and 1.80 under farmer's practice. This may be due to higher yield obtained and lower cost of cultivation under improved technologies compared to farmer's practice. This finding is similar with the findings of Singh *et al.* (2011) [26] and Misra *et al.* (2014) [18]. Similar findings were also reported by Dhaka *et al.* (2015) [7], Hiremath *et al.* (2009) [9] and Morwal *et al.* (2018) [19] in case of coriander and cumin.

The B:C ratio was recorded to be higher under demonstration against control during all the years of study. Direct seeding with drum seeder in Rice can reduce the technology gap to a considerable extent, thus leading to increased productivity of Rice in the district during late release of water conditions in ayacut areas and saving the crop period which in turn will improve the economic condition of the growers. Moreover, extension agencies in the district need to provide proper technical guidance to the farmers by organizing exposure visits, field days etc through different farmer awareness programmes to reduce the extension gap for enhancing the productivity in the district.

Table 4: Impact of Front Line Demonstrations (FLDs) on adoption of drum seeder in Rice

Technology interventions	Number of adopters		Change in no. of adopters	Impact (% change)
	Before demonstration	After demonstration		
Seed Rate is reduced in drum seeder	18	37	19	105.55
Seed priming for better germination	21	43	22	104.76
Cost of nursery raising is nil	10	35	25	250.00
Pre-germinated Rice seed are sown with drum seeder	9	23	14	155.55
Weed management	15	32	17	113.33
Water management	08	23	15	187.50
Labour requirement for sowing	08	19	11	137.50
Matures 7-10 days earlier than transplanting method	13	29	17	123.07
Overall impact	117	277	160	136.75

The result of improved technology intervention brought out that adoption of recommended technology, before demonstration was negligible, which increased by 136.75% after demonstration. The overall adoption level with use of drum seeder for direct seeding in Rice increased by 136.75% due to FLD's conducted by DAATTC, Nalgonda (Table 4). The findings are in uniformity with the findings of Chapke (2012) [3] and Mandavkar *et al.*, (2012) [15].

Table 5: Impact of Front Line Demonstrations (FLDs) on horizontal spread of the technology in Rice in Nalgonda district

Name of the technology	Area (ha)		Change in area	Impact (% change)
	Before demonstration	After demonstration		
Direct seeding in rice with drum seeder in Rice	14	48	34	242.85

In present study efforts were made to study the impact of FLD's on horizontal spread of direct seeding in rice with drum seeder. It is inferred from Table 5 that FLD's organized in Rice in the target area helped to increase the area under direct seeding in rice with drum seeder as the technology was feasible, profitable, easy to adopt. There was significant increase in area and horizontally spread was from 14 to 48ha with drum seeder in Rice.

4. Conclusion

The FLDs helped to demonstrate productivity potential and profitability through drum seeder under real farming situations and they made significant impact on horizontal spread. Training programmes laced with multiple on-farm demonstrations will enhance the knowledge and skills of farmers in adopting the technology. This could circumvent some of the constraints in the existing transfer of technology system. The productivity gain through FLD's in Rice has motivated other farmers to adopt the technology thus enhancing the productivity, and nutritional security of the farmers.

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