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Impact of Front-line Demonstration in Transfer of Groundnut Production Technologies for the Livelihood Improvement of Oilseed Farmers

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ABSTRACT

The present investigation was conducted in different villages under DAATTC in Nalgonda & Yadadri Bhuvanagiri districts, Telangana state, India *rabi* season (October–January) during 2018–19 to 2020–21. Total 30 demonstrations were laid out on farmers' fields in the district. The main objective of front-line demonstrations (FLDs) was to demonstrate the integrated nutrient management practices in groundnut for getting higher yields over farmer's practice. The study was undertaken to evaluate the impact of frontline demonstrations on integrated nutrient management in Groundnut and in enhancing the income of oilseed farmers. The results of the study revealed that 80.00% of the respondents had less than 5a of land holding for cultivation of various crops, the average highest yield recorded was 2659 kg ha^{-1} in demonstration plot, a 12.53% increase over farmer's practice (2362 kg ha^{-1}). The extension gap ranged from 216–371 kg ha^{-1} and technology gap ranged between 998–1169 kg ha^{-1} respectively with average technology index of 29.09% during the demonstration years. Besides this, the demonstrated plots gave higher gross returns, net return with higher benefit cost ratio when compared to farmer's practice. In present study efforts were also made to study the impact of FLD on horizontal spread which has increased by 242.85%, adoption levels by 136.75%. The study also revealed that there was significant increase in knowledge level of the farmers due to frontline demonstrations, a significant and positive relationship existed between farm size, extension contacts and yield.

KEYWORDS: Frontline demonstrations, demonstrated practice, farmer's practice, groundnut

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1. INTRODUCTION

Groundnut (*Arachis hypogaea*) is a leguminous, self–pollinated, edible, essential oilseed crop found throughout the world for its economic and nutritional importance (Ramanathan, 2001). It is the fourth most important source of edible oil and third largest source of vegetable protein grown widely in the tropics and subtropics between 40°N and 40°S latitudes. (Rajib et al., 2022). Groundnut gives 570 cal 100 g^{-1} serving and are an excellent source of B vitamins; vitamin E; dietary minerals such as manganese (95% DV), magnesium (52% DV), phosphorous (48% DV) and dietary fibre (Kaushik 1993, Rai et al., 2020). They also contain about 25% protein 100 g^{-1} serving, a higher proportion than in many tree nuts (Anonymous, 2017).

Globally, groundnut covers an Area of 298 lha with a production of 495 lt with a productivity of 1662 kg ha^{-1} (Anonymous, 2020a). India occupies 2nd rank in terms of area (66.95 lha) and is second largest producer of groundnut in the world (101 lt) contributing 15% of world groundnut production (Anonymous, 2020–21) with a productivity of 1816 kg ha^{-1} in 2020–21 (Anonymous, 2020–21). India is one of the world's largest exporters and trades closely with Brazil, the US and China with 20–25% stake in global markets (Reddy and Immanuel., 2017). During 2020–21, India exported 6.38 lt worth 5381 crores (Anonymous, 2020–21), 3877 mt of groundnut oil meal and 8627.16 t of vegetable oil during 2020–21 (Anonymous, 2020c). Groundnut is primarily cultivated in the South and Northwest states of India. Telangana stands first in area with 1.14 lha followed by Karnataka (1.01 lha), Andhra Pradesh (0.23 lha), Odisha (0.16 lha), Tamil Nadu (0.15 lha) along with Gujarat, Maharashtra and Madhya Pradesh which together occupy 84% of the acreage in India (Anonymous, 2020b). However, the low groundnut productivity is a major concern to the scientific community and policy makers. Integrated nutrient management (INM) is one of the possible ways to improve the yield. The key to sustained crop production is INM (Cisse and Amar, 2000, Patra et al., 2012). INM strategy will play significant role in plant nutrition for better crop production (Kamble et al., 2018, Annadurai et al., 2009), better soil physical properties (Mondal et al., 2019), flexible and minimizes the use of chemicals, improves soil health (Jana et al., 2020) and increases yields (Ghosh et al., 2021).

Adoption of the technologies by farmers is very low (Kalita et al., 2019, Kumar and Yadav, 2007). In order to show productivity potential and profitability, FLD's were conducted in Nalgonda and Bhuvanagiri districts. The demonstrations on INM whole package conducted during 2018–19, 2019–20 & 2020–21 were compiled and partial budgeting technique was used to understand the economics. The FLD's are important in transfer of latest technologies. package of practices in totality to farmers (Tankodara et al., 2018, Hiremath and Hilli, 2012) and main objective is demonstration of proven crop production technologies (Choudhary and Suri, 2014, Kumar et al., 2020) and to introduce suitable agriculture practices on large-scale under real–farming situations (Deka et al., 2021, Kushawah et al., 2016, Meena and Singh, 2019) in different agro-climatic regions accompanied with organizing extension programmes for horizontal dissemination of technologies (Madhushekar et al., 2021, Singh et al., 2016, Venkatarajkumar et al., 2020, Singh et al., 2018). FLD's help in changing the scientific treatment by seeing and believing principle to have better impact (Singh et al., 2019, Singh et al., 2020). In view of above facts, present study has been undertaken to assess the impact of FLD's in groundnut.

2. MATERIALS AND METHODS

DAATTC, Nalgonda has conducted FLDs in 30 locations under real farming situations from 2018–19 to 2020–21 during *rabi* season (October–January) in different villages located in different blocks under DAATTC in Nalgonda and Yadadri Bhuvanagiri districts, Telangana state, India. FLDs were conducted along with check plot and they were taken into consideration for the study to find out the impact of integrated nutrient management in Groundnut. Each demonstration is conducted in an area of 0.4 ha along with farmer' practice or check consisting of 0.4 ha with improved technologies such as new cultivar, optimum seed rate, spacing, nutrient management, application of recommended dose of fertilizers, gypsum application and management of pests and diseases. The FLDs neighbouring plot acted as farmers practice. The detailed recommended practices demonstrated in demo plot and farmer's practices are given in Table2. The improved demonstration comprised of following practices– variety, spacing, sowing time, seed rate, FYM application, recommended fertilizer application (RDF), gypsum application and application of need-based chemicals and pesticides. The differences in the packages were in line with the findings of Singh et al. (2019), Shah et al. (2019) and Morwal et al. (2018).

Data on expenditure incurred by the farmer (Farmer's practice) and expenditure of demonstration plots were collected and analyzed. Gross income was calculated based on local market prices of groundnut and net income by subtracting the total cost of cultivation from gross income. B:C ratio was computed by dividing gross returns with cost of cultivation in groundnut. 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).

% Increase in yield=(Demonstration yield-farmers yield/ Farmers yield)×100 ....(1)

Technology Gap=Pi (Potential Yield)-Di (Demonstration Yield) ....(2)

Extension Gap=Di (Demonstration Yield)-Fi (Farmers yield) ....(3)

Technology index=(Potential yield-Demonstration yield)/ (Potential yield)×100 ....(4)

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

Impact of yield =(Yield of demonstration plot- Yield of control plot)/(Yield of control plot)×100 ....(5)

Impact on adoption (% change)= (Number of adopters after demonstration-Number of adopters before demonstration)/ (Numbers of adopters before demonstration) ×100 …(6)

Impact on horizontal Spread (% change)=(After area (ha)-Before area (ha))/(Before area)×100 ....(7)

2.1. *Correlation analysis*

Pearson's correlation coefficient when applied to a sample is commonly represented by the letter "r" and may be referred as the sample correlation coefficient or the sample Pearson correlation coefficient. It is used with two variables (independent and dependent) to determine a relationship/ association.

2.2. *Paired t-test*

A paired t-test is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample.

3. RESULTS AND DISCUSSION

3.1. *Socio– economic characteristics of respondents*

The data were pooled on different parameters and the results obtained were discussed accordingly. Table 1, shows the socio-economic characteristics of the respondents and it can be inferred that 60% of the respondents were middle aged which is the active and agile stage of production, with more than 60% having Upper primary school education or above.

Nearly 80.00% of the respondents had less than 5a of land holding for cultivation of various crops. 40.00% of the farmers had more than ten years of experience in cultivation of different crops. The family size consists of nearly 1–4 members as evident from above table with 56.67% under this category. Most of the farmers i.e., 56.67% of them had high extension contact i.e.; farmers maintained good relations with officials of agriculture department and Scientists for obtaining need-based information.

Table 1: Socio-economic characteristics of Respondents (n=30)

Sl. No.	Variables	Category	Frequency	%
1.	Age	Young (24–39)	07	23.33
		Middle (40–54)	18	60.00
		Old (55–69)	05	16.67
2.	Education	Illiterate	05	16.67
		Primary school	07	23.33
		Upper school	09	30.00
		High school	03	10.00
		Above matriculation	06	20.00
3.	Farm Size (in a)	Marginal (0–2.5)	11	36.67
		Small (2.5–5)	13	43.33
		Large (5 & above)	06	20.00
4.	Farming Experience (in years)	<5 year (less than 5year)	08	26.67
		5–10year	10	33.33
		>10year (more than 10year)	12	40.00
5.	Family Size	1–4 members	17	56.67
		5–8 members	09	30.00
		More than 8 members	04	13.33
6.	Extension contacts	Low (10–16)	07	23.33
		Medium (17–23)	06	20.00
		High (24–30)	17	56.67

3.2. *Recommended package of practices*

The Gap between the Recommended practice and farmer's practice details were given in Table 2. It shows that all the FLD farmers fully adopted the recommended package of practices with slight modifications as per their situation where as non-FLD farmers were unable to adopt the practices. No gap has been observed in the farming situation but 20% of the non-FLD farmers extended sowing time beyond Dec 15^{th} depending on preceding crop to be harvested, limited supply of inputs especially seed and other factors. Most of the farmers used K-6 but 16.67% gap was noticed as farmers also cultivated old varieties like TMV-2, TAG-24 etc. 50.00% of the farmers used higher seed rate for realization of higher yields thereby increasing the cost of cultivation as seed is the major input in groundnut cultivation, Afzal et al. (2013) also noticed use of high seed rate. 100.00% gap is observed in case of seed treatment; the

Table 2: Gap analysis between Recommended package of practices and farmers' practice in Groundnut cultivation

Sl. no.	Particulars	Recommended practice	Farmers practice	% Gap in the recommended practice
1.	Farming Situation	Rainfed	Rainfed	No gap
2.	Sowing time	Sept 15th–Nov 15th	Oct 15th – Jan 15th	20%
3.	Variety	K-6	TMV-2, TAG-24, K-6, K-9.	16.67%
4.	Seed rate	150–200 kg ha^{-1}	250 kg ha^{-1}	50%
5.	Seed treatment	Tebuconazole 2 DS @ 1 g or Mancozeb @ 3 g kg^{-1} Seed	Nil	100%
6.	Spacing	22.5×10 cm^2	Closer spacing because of high seed rate	70%
7.	Application of FYM	3–4 t of FYM to be applied a^{-1}	No FYM is applied	100%
8.	Application of recommended dose of fertilizers (RDF)	Urea-18 kg SSP-100 Kg MOP-33 kg as basal dose Urea-15 kg 30 days after sowing	Urea-10 kg SSP-150 kg MOP-10 kg as basal dose Urea-Nil 30 days after sowing	45% 83% 62%
9.	Gypsum application	200 kg a^{-1} (before 45 days after sowing)	No gypsum application	100%
10.	Spraying of Micro nutrients Zinc and Iron	Recommended spray was followed on appearance of the nutrient deficiency symptoms	No spraying of micro nutrients	75%
11.	Spraying of need based pesticides	Need based spray of insecticides and fungicides (Carbendazim 50 WP, Dimethoate, Zineb 68%)	Higher dose of insecticides and pesticides	100%
12.	Weed management	Pre plant application of weedicides, use of post emergent weedicides	1–2 times hand weeding	50%

results are in tune with the findings of Singh et al. (2014). Closer spacing is observed in farmer's practice as high seed rate is used i.e., a gap of 70.00% is noticed.

In case of FYM, Gypsum application, spraying of need based pesticides showed 100.00% gap, farmers didn't practice the above practices which are critical for plant growth and yield and these directly affect the yield. In case of fertilizers and micro nutrients also, farmers use high doses of a particular type and others are either applied or not applied fully, partial adoption is followed among non–FLD farmers, Rajib et al. (2022), Shivran et al. (2020) also observed similar differences in nutrient management. With regard to weedicide application, pre–emergence weedicides are not used fully and post emergence weedicides are applied after the stipulated time there by affecting the weed control. The above result of differences in recommended practices to farmers practice are in unity with the findings of Kumar et al. (2010) observed differences in adoption of recommended fertilizer dosage in Bajra, Madhushekar et al. (2021) observed indiscriminate use of weedicides by non–FLD farmers compared to FLD farmers, Hiremath et al. (2007) observed excessive use of fertilizers in Onion by non–FLD farmers, Balai et al. (2021) recorded gap in use of soil treatment followed by weed management, pest and disease management, seed treatment and application of nutrient Sulphur and Meena and Singh (2019) observed gap in use of recommended dose of fertilizers.

3.3. Economic parameters

Economic indicators i.e. gross expenditure; gross returns, net returns and BC ratio of Front-Line Demonstrations are presented in Table 3. The data clearly envisages that net returns from the demonstration plot were substantially higher than control plot during all the years of demonstration. Average net returns from demonstration plot were ₹ 91566.97 ha^{-1} compared to ₹ 74156.5 ha^{-1} in control. The average gross expenditure from the demonstration plot was recorded as ₹ 50,233.34 ha^{-1} compared to ₹ 51,764.64 ha^{-1} in control. The average gross returns from the demonstration plot were ₹ 1,41,800.3 ha^{-1} compared to ₹ 1,25,920.8 ha^{-1} in control plots. The results are in tune with the findings of Rana et al. (2017) observed average additional net returns of ₹ 15,303 ha^{-1} and Rajib et al. (2022), Singh et al. (2018) observed B:C ratio in groundnut and mustard as 2.89 and

2.81 respectively because of FLD's, Hiremath and Nagaraju (2009) and Kumar et al. (2020) observed additional net returns because of FLD's in Onion and Toria crops.

Economic analysis of the yield performance revealed from Table 3 showed that benefit cost ratio of demonstration plots was observed to be significantly higher than farmer practice. The benefit cost ratio of recommended and control plots was recorded as 2.69, 3.03 and 2.75 and 2.43, 2.58 and 2.31 during 2018–19, 2019–20 and 2020–21 respectively. The cumulative effect of technological interventions over three years, revealed an average benefit cost ratio of 2.82 in demonstration plots compared to 2.44 in control plots. The results are in tune with the findings of Madhushekar et al. (2021), Deka et al. (2021), Kumar et al., (2010), Rai et al. (2012) and Puniya et al. (2021) observed additional net returns and increase in B:C ratio among FLD farmers.

Table 3: Cost economics of FLD on integrated nutrient management in groundnut

Year	Yield ha^{-1} (t ha^{-1})		Gross expenditure ha^{-1} (₹)		Gross returns ha^{-1} (₹)		Net Returns (₹)		B:C ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2018–19	25.81	23.65	48750	49500	131372.9	120378.5	82622.90	70878.50	2.69	2.43
2019–20	27.52	23.81	49100	49925	148608	128574	99508.00	78649.00	3.03	2.58
2020–21	26.44	23.42	52850	55868	145420	128810	92570.00	72942.00	2.75	2.31
Average	26.59	23.63	50233.34	51764.34	141800.3	125920.8	91566.97	74156.50	2.82	2.44

1US$= 77.02INR, 2022. (monthly average value of the harvesting month)

3.4. Technology gap

The technology gap, the difference between potential yield and yield of demonstration plots was 1169, 998 and 1106 kg ha^{-1} during 2018–19, 2019–20 and 2020–21 respectively (Table 4). On an average technology gap under 3 year FLD programme was 1091 kg ha^{-1}. The technology gap is very wide and this has to be decreased through various interventions. This gap may be due to soil fertility, nutrient management, 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 findings of Tunvar et al. (2017), Kumar et al. (2010), Kumar et al. (2007), Shankar et al. (2022) and Mishra et al. (2009) observed wide technology gap under 3 year FLD programme in groundnut, Bajra, Brinjal and Potato crops among FLD farmers.

3.5. Extension gap

The FLD's conducted in groundnut on Integrated nutrient management gave an extension gap of 216, 371 and 302 kg ha^{-1} during 2018–19, 2019–20 and 2020–21 respectively. On an average extension gap under 3-year FLD programme was 296 kg ha^{-1}. This emphasized the need to educate the farmers through various techniques especially on INM, use of new ICT tools for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies along with high yielding varieties will subsequently change this trend. Shankar et al. (2022), Ray et al. (2019) observed wide extension gap in Brinjal and paddy where as Morwal et al. (2018) and Shah et al. (2019) observed extension gap in the range of 280 to 390 kg ha^{-1} under 3 year FLD programme in Cumin and pulses.

3.5. Technology index

The technology index results from Table 4 shows the feasibility of the demonstrated technology at the farmer's field. The technology index varied from 26.61% to 31.17% (Table 4). On an average technology index of 29.09% was observed during the three years of FLD programme, which shows the effectiveness, efficacy and ease of adoption of INM module for yield increase in groundnut. The results are in unity with the findings of Shankar et al. (2022), Choudhary and Suri (2014), Kalita et al. (2019), Kumar

Table 4: Fruit yield, extension gap, technology gap and technology index in integrated crop management in groundnut under FLD

Year	Fruit yield ha^{-1} (kg ha^{-1})		Farmer's practice	(%) increase in productivity	Technology gap (kg ha^{-1})	Extension gap (kg ha^{-1})	Technology index
	Potential	Demo					
2018– 19	3750	2581	23.65	9.13	1169	216	31.17
2019– 20	3750	2752	23.81	15.58	998	371	26.61
2020– 21	3750	2644	23.42	12.89	1106	302	29.49
Average	3750	2659	23.62	12.53	1091	296	29.09

et al. (2010), Kumar et al. (2020) and Singh et al. (2020) observed yield increase in Brinjal, Oil seeds, Mustard and Bajra among FLD farmers showing ease of adoption of different technologies. It was also observed from Table 4 that % increase in productivity was 9.13, 15.58 and 12.89 during 2018–19, 2019–20 and 2020–21 respectively. The results are in uniformity with the results of Madhushekar et al. (2021), Tankodara et al. (2018) observed average increase in productivity which varied from 9.10% to 13.50% among FLD farmers.

In present study, efforts were made to study the impact of FLD's on horizontal spread of Integrated Nutrient management in Groundnut. It is inferred from Table 5 that FLD's organized in the target area helped to increase the area under Integrated Nutrient Management in groundnut as the technology was feasible, profitable, easy to adopt. There was significant increase in area and horizontally spread was observed from 14–48 ha, the change in area being 34 ha and % change observed was 242.85%. The results are in conformity with that of Balai et al. (2013).

Table 5: Impact of Front Line Demonstration (FLDs) on horizontal spread of integrated nutrient management in groundnut

Name of the technology	Area (ha)		Change in area	Impact (% change)
	Before demon-stration	After demon-stration		
Integrated nutrient management in Groundnut	14	48	34	242.85

The result of improved technology interventions 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 INM in groundnut increased by 136.75% due to FLD's conducted by DAATTC (Table 6). The findings are in uniformity with the findings of Tunvar et al. (2017), Subbaiah and Jyothi (2019).

3.6. Increase in knowledge

Knowledge level of respondent farmers on various aspects of improved groundnut production technologies before conducting the frontline demonstration and after implementation was measured and compared by applying independent 't' test. It could be seen from the Table 7 that farmers mean knowledge score had increased by 41.49 after implementation of frontline demonstrations. The increase in mean knowledge score of farmers observed was significantly higher. As the computed value of 't' (5.24) was statistically significant at 5% probability level. The results are at par with Narayanaswamy and Eshwarappa (1998), Singh et al. (2007) and Shah et al. (2019). It means there was significant increase in knowledge level of the farmers due to frontline demonstrations. This shows positive impact of frontline demonstrations on knowledge of the farmers that have resulted in higher adoption of improved farm practices. The results so arrived might be due to the concentrated educational efforts in the form of trainings, method demonstrations and others made by the scientists.

Table 6: Impact of Front Line Demonstrations (FLDs) on adoption of INM in groundnut

Technology interventions	Number of adopters		Change in no. of adopters	Impact (% change)
	Before demon-stration	After demon-stration		
Variety	18	37	19	105.55
Seed rate	23	43	20	86.95
Seed treatment	13	35	22	169.23
Spacing	14	28	14	100.00
Application of FYM	15	32	17	113.33
Application of recommended dose of fertilizers (RDF)	08	34	26	325.00
Gypsum application	11	33	22	200.00
Spraying of micro nutrients zinc and Iron	15	35	20	133.33
Overall impact	117	277	160	136.75

Table 7: Comparison between knowledge levels of the respondent farmers about improved farming practices of groundnut

Sl. no.	Mean score			Calculated "t" value
	Before FLD implementa-tion	After FLD implementa-tion	Mean difference	
1	28.18	69.67	41.49	5.24*

*Significant at (p=0.05) probability level

3.7. Relationship between personal characteristics with Yield

Positive and significant correlation (Table 8) was observed between age, education with yield of groundnut. The variable education provides the respondent a broader horizon on any technology. More the education more will be the farmer's outlook towards various sources of information. Because of education, the farmers could perceive the importance of technology better, thereby impacting on the yield. This might be the reason for positive, high significant relationship between education and yield. This study also revealed that there was significant and positive relationship between farm size, extension contacts and yield whereas farming experience & family size didn't have any significant effect on the yield.

Table 8: Pearson correlation analysis on the socio-economics characteristics and yield attributes of groudnut

Sl. No.	Socio economic characteristics	Pearson correlation	Significance
1.	Age	0.206*	S
2.	Education	0.173*	S
3.	Farm size	0.248*	S
4.	Farming experience	0.106NS	NS
5.	Family size	0.124NS	NS
6.	Extension contact	0.204*	S

*Significant at (p=0.05) probability level

3. CONCLUSION

The FLDs helped to demonstrate productivity potential and profitability with INM in groundnut involving application of FYM, application of recommended dose of fertilizers, Gypsum application, weed management helped in recording higher yields. The yield of demonstrated package was 2659 kg ha^{-1} compared to farmer's practice of 2362 kg ha^{-1}. The benefit cost ratio also increased from 2.02 in farmer's practice to 2.29 in demonstrated practice. Further there was significant increase in area, adoption and knowledge levels of FLD farmers.

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