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Impact of Cluster front-line Demonstrations on Productivity and Economics of Groundnut in Southern Transition Agro Climatic Zone (Zone-7) of Hassan District, Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Groundnut is a important commercial legume cum oilseed crop growing in Hassan district of Karnataka and there is a notable yield gaps found between the farmers and demonstration plots due to non adoption of improved agronomic technological practices and use of local varieties. Integrated crop management (ICM) practices in groundnut under cluster front-line demonstration were conducted by ICAR-Krishi Vigyan Kendra, Hassan during Summer seasons of 2018-19 to 2022with active participation of 250 groundnut growers with a objective of practicing improved

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agronomic practices over a 100 ha area in 5 consecutive years.The highest groundnut pod yield was achieved in demonstration plots with an mean of 1842.8kg/ha as compared to farmers practices with an mean of 1254.80kg/ha; which was 22.24 per cent higher yield as compared to farmers practices. The demonstration plots average mean of extension gap, technology gap and technology index were calculated as 281.20 kg/ha, 564 kg/ha, 26.75 per cent, respectively. The higher mean net returns of 62592.60/ha with B:C ratio of 2.35 was exhibited in improved agronomic practices demonstrated plot as compared to local practices (Rs.43897.60/ha). So it's concluded that improved agronomic technological practices have high potential to increase the groundnut productivity through cluster front-line demonstration.

Keywords: Groundnut; CFLD; potential yield; extension gap; technology gap; agronomic practices; economics; B:C ratio.

1. INTRODUCTION

Groundnut (*Arachis hypogea* L.) is a key legume cum oilseed crop in India, grown both rain-fed and irrigated condition throughout the year. The groundnut crop accounts for around 37 per cent of total oilseed output in India. The country's acreage has fluctuated throughout the years, with the amount decreasing from 87 lakh ha to 47 lakh ha during the previous two decades. Due to low minimum support prices and market price swings, farmers are moved away from groundnut cultivation to more profitable crops. Worldwide, India stands first in Groundnut area (54.20 lakh ha.) and second biggest producer in the world with 101 lakh tones of production and 1863 kg ha^{-1} productivity in 2021-22 (agricoop.nic.in). Groundnut covers 6.70 lakh hectares in Karnatak, with a yield of 6.40 lakh tonnes and an average productivity of 966 kg ha^{-1} [1].

The groundnut area in Hassan district significantly declined nearly by half in last two decades along with low productivity of 709. 14 kg ha^{-1}as compared to the Karnataka state average about 1024 kg ha^{-1} [2]. in this stagnated productivity is cause serious concern in the state warranting immediate interventions to enhance the productivity of groundnut crop to arrest further decline in yield and crop area. In Hassan district large gap between potential yield and actual yield was observed in groundnut production system is due to major production constraints *viz.*lower yield, destructive pest and diseases, un assured rainfall and moisture, labour intensive,more variationsin market price and more importantly old varieties in cultivation and non availability of improved quality seeds [3].

In Hassan district due to a lack of awareness about the most recent enhanced technologies among groundnut farmers, the technology gap is a key limitation in enhancing production and sustainability. Hence there is a immediate need to replace old cultivation practices with new scientific cultivation practices through Cluster Frontline Demonstrations (CFLDs). Cluster Frontline Demonstrations are a novel strategy with the goal of performing demonstrations in wider areas on farmers' fields and raising farmer knowledge about the newest crop production technology and productivity with low coast of cultivation [4].

In light of this, Krishi Vigyan Kendra, Hassan planned and executed Cluster Frontline Demonstrations with improved technologies in groundnut under various farming situations under the supervision and monitoring of KVK Scientists, which aids in increasing productivity, economic returns, and sustainability, as well as analyzing yield gap, technology gap, economicsand impact.

2. MATERIALS AND METHODS

Cluster frontline demonstrations on integrated crop management of groundnut were carried out by ICAR-Krishi Vigyan Kendra, Kandali, Hassan during summer season from 2018-19 to 2022. Over a 100 ha and in 250 farmer's field demonstration were carried out to study the effect of improved technologies to increase the production potentialities of groundnut varieties GPBD-4, GPBD-5, GKVK -5 and G2-52 with package of practices given by University of Agricultural Sciences, Bengaluru. The soil of CFLDs was red sandy loam to sandy clay loam with the pH of soil is about 6.21 to 7.46. The technologies to be demonstrated for groundnut were identified based on participatory rural approach and group discussions technique. Partner farmers for conducting CFLDs on groundnut were selected and trained them to follow the improved technologies of groundnut cultivation. In each farmer field 0.4 ha area

allotted to demonstrate the improved technologies and adjoining 0.4 ha area was followed to farmers practice (Control).

Critical inputs and technologies provided: The significant technological inputs like improved varieties seed (GPBD-4, GPBD-5, GKVK -5 and G2-52) and bio-fertilizers (*Rhizobium* and PSB) were given to farmers by KVK. Selected farmer for CFLDs on groundnut were recommended to use 112.5 kg seed/ha, line sowing with spacing of 30 * 10 cm, recommended fertilizer dose of 24 kg N, 50 kg P2O5, 25 kg K2O, 10 kg Zinc Sulphate, 10 kg Boran per ha., seed treatment with Thiram @ 2.5 g/kg seeds, use of Quinalphos 25 EC @ 1 liter water against pod borer and weed management against the control (Farmers practice). Scientist of KVK regularly monitored and given guidance to farmers regarding adoption of improved technologies in their fields. At the time of reproductive stage and harvesting stage group meetings and field days were organized with state line department officials to exhibit the demonstration to the other farmers to indication the impact of improved technologies on groundnut production. The data and opinion were also collected from the farmers on demonstrated improved technologies. The collected data from demonstration and control fields were used to calculate the extension gap, technology gap and technology index as stated by Raj et al. [5] and Samui et al. [6] with following formula given as follows

Technology gap=Potential yield (kg/ha)-Yield of demonstration (kg/ha)

Extension gap = Yield of demonstration (kg/ha) – Yield of farmers practice (kg/ha)

Technology index = Potential yield of variety (kg/ha)-Demonstration yield of variety (kg/ha) / Potential yield of variety (kg/ha) X 100

Increase in Yield (%)=Demonstration yield of variety (kg/ha)-Yield of farmers practice (kg/ha) / Yield of farmers practice (kg/ha) X 100

Additional cost (Rs./ha) = Cost of cultivation of demonstration (Rs./ha)–Cost of cultivation of farmers practice (Rs./ha)

Additional return (Rs./ha) = Gross return of demonstration (Rs./ha) – Gross return of Farmers practice (Rs./ha)

Effective gain (Rs./ha) = Additional return (Rs./ha) – Additional cost (Rs./ha)

$$\mathrm{B:C} = \frac{\text{Grossreturn}}{\text{Cost of Cultivation}}$$

3. RESULTS AND DISCUSSION

The technologies to be demonstrated for groundnut were identified based on participatory rural approach (PRA) technique and paramount gap was found between improved technology and farmer's practice (control) of groundnut crop cultivation in Hassan district of Karnataka (Table 1). Among different cultivation components, cent percent gap was observed in the use of improved high yielding varieties and seed treatment by bio-fertilizer and partial gap was found in seed rate, seed treatment by chemical fungicide, use of fertilizers and plant protection chemicals. These gaps observed at the farmer's field are cause due to non accessibility of improved agronomic technological practices associated with unreached extension activities among small and margin land holding farmers [7] and Meena et al. 2022). Under farmers practice old and traditional groundnut variety with less yield potential were used and not following the improved agronomic practices. On the basis of PRA information the technological gaps obtained demonstration module developed and technological inputs like variety (GPBD-4, GPBD-5, GKVK -5 and G2-52), plant protection chemicals and bio-fertilizers (*Rhizobium* and PSB) were distributed to the CFLD farmers and other technologies like chemical fertilizers and other intercultural operations were timely practiced by the farmers under the guidance and training of KVK scientist. Similar findings have also been observed by Thentu et al. [8] Meena et al. [9] Saikia et al. [10] Bhargav et al. [11] and Kothyari et al. [12].

3.1 Groundnut Yield

The finding obtained from 250 cluster frontline demonstrations of high yielding groundnut varieties with improved agronomic technological practices in an 100 farmers field during 2018-19 to 2022-23 (5 consecutive years) were given in Table 2 revealed that highest groundnut yield in demonstration plot was ascribed due to adoption of improved high yielding varieties, seed treatment and recommended dose of fertilizers management and other agronomic practices as compared to control (farmers practice). The

mean pod yield of groundnut in 250 demonstrated plots was 15.36 qha^{-1} which was higher as compared to control 12.54 q ha^{-1}(farmers practices). Groundnut pod yield in demonstrated fields from last 5 years ranged from 13.18 to 18.30 q ha^{-1} as compared to 10.90 to 14 q ha^{-1} under control (farmers practice) with increased yield per cent of 18.98 to 24.65 over control. The average 22.65 per cent increased yield in CFLD plots compared control. However, Variety GKVK-5 gave the highest pod yield of 18.30 q ha^{-1}in demonstrated field as compared to other varieties during the year 2022-23. The results obtained through adoption of improved technologies have also been corroborate the facts of [9] in chickpea and [12] in black gram. The yield of groundnut pod obtained under demonstration fields were higher than the district (4.60 q ha^{-1}) and state (2.80 q ha^{-1}) average yield due to adoption of high yielding groundnut varieties and good intercultural practices. These data were found same with Thentu et al. (2023), Meena et al. [9] Arunkumar et al. [13] and Vishal et al. [14].

Table 1. Technological gap between CFLDs and farmers practices on groundnut

Component	Technological intervention	Farmers practices	Technological Gap (%)
Variety	GPBD-4, GPBD-5, GKVK-5, G2-52	Unidentified/ local variety	100 (Full gap)
Seed rate	112.5 kg/ha	15-20 % higher	75 (Partial gap)
Time of sowing	*Kharif*/Summer	*Kharif*/Summer	-
Seed treatment by chemical fungicide	Thiram @ 2.5 g/kg seeds	15 % farmers used capton/Thiram	65 (Partial gap)
Seed treatment by bio-fertilizers	Rhizobium/PSB @ 150 gm/ acre seeds	No seed treatment	100 (Full gap)
Method of sowing	Line sowing	Line sowing	-
Fertilizer dose	Recommended dose of fertilizer (RDF)	Imbalance use of fertilizer	80 (Partial gap)
Weed management	Manual weeding	Manual weeding	-
Plant protection measures	Quinalphos 25 EC @ 1 litre/ha	Indiscriminate use of insecticide	85 (Partial gap)
Irrigation	Irrigated and rainfed	Irrigated and rainfed	-

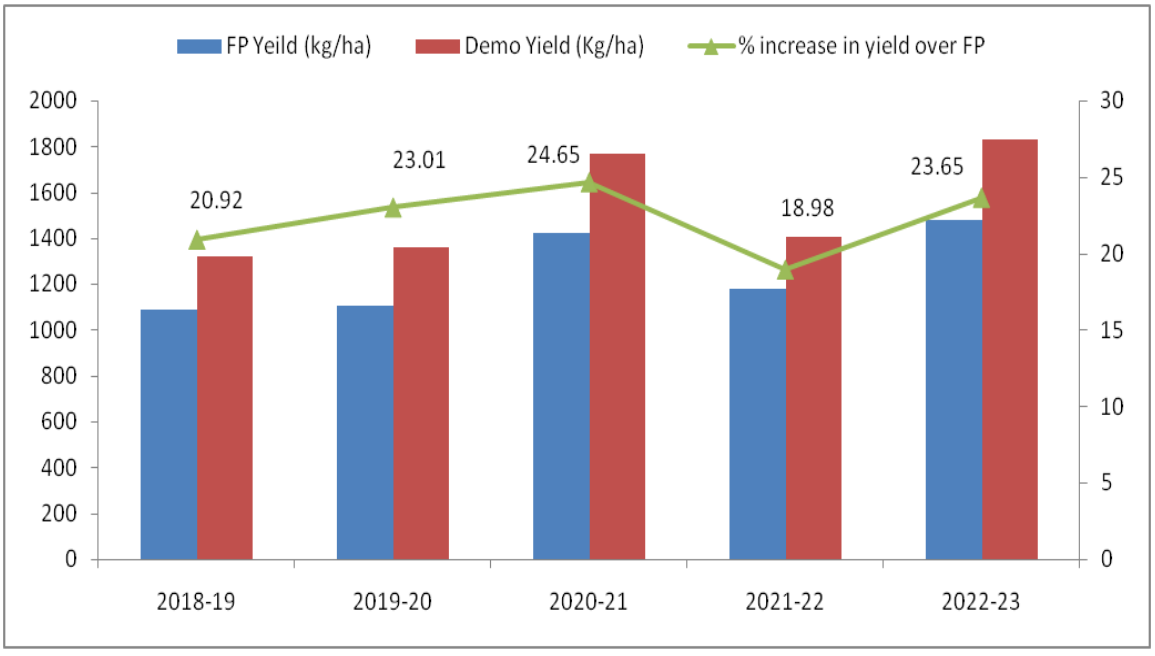

Fig. 1. Per cent increase in yield in demo plots over farmers practice (FP)

Table 2. Comparative assessment of yield and other parameters of cluster front line demonstrations on groundnut in Hassan district of Karnataka (Potential yield of GPBD-4 / GPBD-5 = 1800 kg, G2-52/GKVK – 5 = 2300 kg per hectare)

Year	Village	Cluster	Variety	No. of Demo.	Area (ha)	Yield of Demo. (kg/ha)			Average yield under FP (kg/ha)	% increase over FP	EG (kg/ha)	TG (kg/ha)	TI (%)
						H	L	Av.					
2018-19	Ganguru J. Hosahalli	Arakalagudu	GPBD - 4	50	20	1560	1130	1318	1090	20.92	228	482	26.78
2019-20	J. Hosahalli	Arakalagudu	GPBD - 5	50	20	1610	1080	1358	1104	23.01	254	442	24.56
2020-21	J. Hosahalli Kattrighatta	Arakalagudu Channarayapattana	GKVK - 5	50	20	2018	1321	1770	1420	24.65	350	530	23.04
2021-22	Ganguru Ruddrapattana J.Hosahalli	Arakalagudu	G2-52	50	20	1912	1130	1404	1180	18.98	224	896	38.96
2022-23	Ruddrapattana J.Hosahalli Ramanathapura	Arakalagudu	GKVK - 5	50	20	2114	1280	1830	1480	23.65	350	470	20.43
Average	-	-	-	-	-	1842.80	1188.20	1536	1254.80	22.24	281.20	564	26.75
Total	-	-	-	250	100	-	-	-	-	-	-	-	-

Demo. = Demonstration, H = Highest, L = Lowest, Av. = Average, FP = Farmer's practice (Control), EG = Extension gap, TG = Technology gap, TI = Technology index

Table 3. Economics of the front line demonstrations on groundnut in hassan district of Karnataka

Year	Variety	No. of Demo.	Area (ha)	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		% increase in gross return	Net return (Rs./ha)		% increase in net return	Additional cost (Rs./ha)	Additional return (Rs./ha)	Effective gain (Rs./ha)	Benefit-Cost ratio	
				Demo.	FP	Demo.	FP		Demo.	FP					Demo.	FP
2018-19	GPBD - 4	50	20	31730	28260	97002	80256	20.87	65272	51996	25.53	3470	13276	9806	3.06	2.84
2019-20	GPBD - 5	50	20	51250	46250	108080	89680	20.52	56830	43430	30.85	5000	13400	8400	2.11	1.94
2020-21	GKVK - 5	50	20	52310	47830	110660	88810	24.60	58350	40980	42.39	4480	17370	12890	2.12	1.86
2021-22	G2-52	50	20	54613	47940	120870	90610	33.40	66257	42670	55.28	6673	23587	16914	2.21	1.89
2022-23	GKVK - 5	50	20	53416	49318	119670	89730	33.37	66254	40412	63.95	4098	25842	21744	2.24	1.82
Average	-	-	-	48663.8	43919.6	111256.4	87817.2	26.55	62592.6	43897.6	43.60	4744.2	18695	13950.8	2.35	2.07

Demo. = Demonstration, FP = Farmer's practice (Control)

3.2 Extension Gap

Extension gap found between demonstrated practices and farmers practices average results were stated in Table 2. The extension gap in demonstrated and control plots were ranged from 2.24 to 3.56 q ha^{-1}. Mean extension gap during the last 5 study years was 2.81 q ha^{-1}. Higher extension gap in existing study suggested that there is a need to motivate and trained the farmers for adoption of improved agronomic technological practices and high yielding ground varieties through extension activities and to reduce the wider extension gap. These results corroborate the results of Meena et al. [9] Vishal et al. [14] Reager et al. [15] and Patil et al. [16].

3.3 Technology Gap

The results of technological gap in demonstrated yield against potential yield data presented in Table 2 showed that the technological gap ranged from 4.42 to 8.96 q ha^{-1} during the last 5 study years of demonstration. Technological gap was higher (8.96 q ha^{-1}) during 2021-22 while during 2019-20 the low (4.42 q ha^{-1}) observed may be resulted in the soil fertility variations, weather parameters, pest and disease incidence during study years. The average technology gap during 5 years of demonstrations plots were 5.64 q $ha^{-1}$for groundnut cultivation. These results attributed lesser adoption of improved agronomic technological practices by farmers due to lack of extension activities. However, proper site specific adoption of recommended technologies and extension services are essential to minimize the technology gap in farmer's field. These findings were in agreement with the results of Thentuet al. (2023), Meena et al. [17] and Devigangaet al. (2018).

3.4 Technology Index

The technology indexgenerally shows the viability of the technologies to adopt in the farmers fields. The results of Table 2 revealed that the technology index ranged from 20.43 to 38.96 per cent during the study years. Whereas the average mean of technology index 26.75 per cent was observed during last 5 demonstrated years. During the study years highest technology index 38.96 per cent and lowest 20.43 per cent was found during 2021-22 and 2022-23, respectively. Lower the range of technology index shows the efficacy of right conduct of technological interventions with more feasibility and applicability. This showed that a gap prevailed between technology involved and technology adapted at farmer's plots. The similar findings were also recorded by Reager et al. [15] Pawar et al. [18] Bhargav et al. [11] and Devigangaet al.(2018).

3.5 Economics

Economics of groundnut under Cluster front-line demonstration tabulated in Table 3. Average cost of cultivation in demonstrated plots (Rs. 48663.80 ha^{-1}) is more as compared to control (Rs. 43919.60ha^{-1}) over the five years of groundnut cultivation. The current CFLD programme showed improved agronomic practices increased the net returns to the range of Rs. 66257$ha^{-1}$to Rs. 56830$ha^{-1}$with the 5 years of average (Rs. 62592.6ha^{-1}) compared to farmers practices. The higher per cent 63.95 net returns recorded during 2022-23 in GKVK-5 variety with average of 43.60 per cent net return in last five years of demonstration compared to farmers practices. Pod yield, cost of cultivation and prevailing market price decides the net returns and these values varies from year to year. Further, on average of all five years of study revealed that improved agronomic practices gave higher mean gross return (Rs.111256.4ha^{-1}), mean net return(Rs. 62592.6ha^{-1}), mean additional returns (Rs. 18695ha^{-1}), mean effective gain (Rs.13950.8ha^{-1}) and mean benefit cost ratio (2.35) compared to control (farmers practices). Increased monetary returns as well as B:C through improved farm practices and technologies were also opined by Thentuet al. (2023), Bhowmik et al. [19] Meena et al. [9] Vishal et al. [14] and Meena et al. [20,21,22].

4. CONCLUSION

This cluster front-line demonstrations study on groundnut at farmer's field indicated that incorporation and adoption of scientific and improved agronomic technological practices associated with active participation of farmers significantly increased the yield and monetary return of groundnut to the Hassan district farmers. The economic profitability of suitable technology for increasing the productivity of groundnut motivated the farmers through extension outreach activities like group discussion, training, campaigns, demonstrations and field days to adopt the recommended package of practices. Farmers participated in cluster front-line demonstrations play an

prominent role in dissemination of technology and quality seeds of groundnut for other farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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