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Assessment of Cluster Front Line Demonstrations (CFLDs) on Groundnut in West Godavari District of Andhra Pradesh, 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

This study investigates the performance of Cluster Frontline Demonstrations (CFLDs) on groundnut yield in West Godavari district, Andhra Pradesh, during the rabi season from 2016-17 to 2019-20. The demonstrations conducted on 350 farmers' fields revealed a significant improvement, with CFLDs achieving an average yield of 3663 kg/ha, 14.92% higher than the prevailing farmers' practice of 3196 kg/ha. Analysis of yield gaps revealed an average yield gap of 4.66 q/ha, indicating

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potential yield increase through improved practices. The technology gap of 10.51 q/ha and technology index of 21.52% further revealed the effectiveness of CFLDs in bridging the yield gap. The average gross return from the CFLDs was recorded as Rs. 2,01,220 per hectare, which is higher than the gross return from farmers' usual practices (Rs. 1,74,285 per hectare). Similarly, the net return from the CFLDs was recorded at Rs. 1,57,077 per hectare, higher than the net return from farmers' practices (Rs. 1,27,035 per hectare). The average benefit-cost (B: C) ratio in the cluster frontline demonstrations was calculated at 4.64, while in farmers' practices, it was 3.71. Groundnut productivity has notably enhanced by conducting cluster frontline demonstrations and incorporating proven technologies with improved varieties on farmers' fields. This increase has, in turn, improved the income levels of farmers and positively impacted the status of living of the farming community in west Godavari district.

Keywords: Groundnut; assessment; impact; demonstrations; extension gap; technology index; yield; net return.

1. INTRODUCTION

Groundnut (*Arachis hypogaea*), considered to be the 'King' of oilseeds, is our country's significant food and cash crop. Notably, this marvel of nature is a valuable source of essential nutrients and an affordable commodity. In fact, groundnuts are often referred to as the wonder nut in place of the cashew nut for the common man. Groundnut covers a vast expanse of 315 lakh hectares worldwide, producing an impressive 536 lakh tonnes with a productivity of 1701 kg per hectare [1]. In the global rankings, India stands proud as the top cultivator of groundnut and the second-largest producer, producing 101 lakh tonnes with a productivity of 1863 kg per hectare in 2021-22.China is the largest groundnut producer, accounting for over 40% of the world's production, closely followed by India with a 15% share. Groundnut oil from India was the world's most sought-after commodity in the financial year 2022, with major importing countries being the European Union, Vietnam, Indonesia, Mexico, and Russia.

The cultivation of groundnut in India is primarily concentrated states, namely Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan, and Maharashtra, which collectively account for nearly 90% of the country's total production [2]. Gujarat outshines all others in producing high-quality groundnut, contributing over 40% of the country's total output. In the state of Andhra Pradesh alone, groundnuts thrive across an impressive 8.7 lakh hectares, yielding a remarkable production of 7.74 lakh tonnes, contributing 7.63% to the nation's groundnut production [3]. According to the 2nd advance estimates for 2021-22, groundnuts were cultivated across 8.09 lakh hectares in Andhra Pradesh, with total production of 5.35 lakh tonnes and productivity of 661 kg/ha. Standing out as one of the significant groundnut-producing districts in Andhra Pradesh, West Godavari boasts an average sown area of 5,883 hectares, producing a yield of 11,953 tonnes and an impressive yield of 2,032 kg/ha.

Despite its prominence, groundnut cultivation faces challenges, including the non-availability of improved seed varieties, prevalent diseases and pest infestations, imbalanced use of fertilizers, and outdated cultivation techniques. Resolving these constraints and tapping into the tremendous potential of the West Godavari district could significantly enhance groundnut production. To boost productivity and profitability per unit area, the Krishi Vigyan Kendra (KVK) Venkataramannagudem working under Dr. YSR Horticultural University has taken the lead in demonstrating improved crop management practices in groundnut across various cropping situations in West Godavari District under. These demonstrations fall under the National Mission on Oilseed and Oil palm (NMOOP), which is aimed at elevating oil seeds cultivation practices. A comprehensive study was undertaken to gauge the effectiveness of cluster front line demonstration (CFLDs) in groundnut cultivation in West Godavari district of Andhra Pradesh. The primary objectives of this study is, to assess the increased productivity and measure the gap between potential yield verses demonstration yield, and also the extension gapand technology index.

This study sought to evaluate the performance of groundnut crop and identify areas for improvement to achieve optimal productivity. Researchers used various yield metrics to uncover the gap between the optimum and CFLD yields and the gap between farmer practices and recommended techniques.

2. MATERIALS AND METHODS

In the present study,350 front-line demonstrations covering a 140 ha area in West Godavari District, Andhra Pradesh were conducted to demonstrate the improved agricultural practices, including the use of improved varieties, integrated crop management (ICM) techniques, weed management, and integrated pest management (IPM) methods during 2016-17 to 2019-20.

Farmers from the villages under survey were selected based on their active participation and farming experience during the preliminary survey. Pre-sowing trainings involving the selected farmers were organised in each village. During these trainings, soil samples were collected from each farmer's field.

These samples were then analyzed, enabling the recommendation of appropriate fertilizer doses based on the soil's composition. After the training sessions, critical inputs such as improved high-yielding varieties and recommended chemicals (viz:imidacloprid, tebuconazole, biofertilizers, pendimethalin, neem oil, KNO_3, acetamiprid, fungicides, pheromone traps, and sticky traps) were provided as critical inputs to the farmers. The chosen production techniques for the Frontline Demonstrations (FLDs) are outlined in Table 1. The improved technology includes enhanced varieties of seeds (K-6, K-9, K-H, and Dharani), line sowing with a seed drill, seed treatment with imidacloprid and tebuconazole, weed management practices, and integrated pest management strategies. For the Cluster Frontline Demonstrations, a seeding rate of 180 kg/ha for groundnut was maintained. The sowing of groundnuts was carried out between November 1 and December 15. The spacing between rows and individual plants was set at 22.5x10 cm.

Throughout the crop growth stages, scientists from Krishi Vigyan Kendra, Venkataramannagudem supported the farmers by providing guidance on recommended fertilizer doses, methods of irrigationand pest and disease management measures. To assess the effectiveness of the demonstrations, yield parameters were collected from the CFLD fields and the control plots. Crop cutting experiments were conducted to gather this data accurately. Meaningful insights were gained by comparing the average yields of the FLDs with those of the farmers' practices. To conclude the study, a field day was organized, bringing together the beneficiary farmers, others from the village, KVK and officers from the Department of Agriculture. This event allowed knowledge-sharing, collaboration, and further discussion of the study's outcomes.

To estimate the increase in yield, technology gap, extension gap and technology index, the following formulae have been used, which were given by Samui et al. [4].

Percentage increase in the yield:

(Demonstration yield– farmers yield/farmers yield) x 100

Technology gap:

Potential yield – demonstration yield

Extension gap:

Demonstration yield – yield under farmer practice

Technology index (%):

Potential yield – demonstration yield/potential yield) x 100

The economic parameters (gross return, net return and B: C ratio) were calculated depending on current market prices of inputs and minimum support price for the produce.

3. RESULTS AND DISCUSSION

Farmers practiceand the recommended technology package for groundnut cultivation is having significant gap (Table 1). The gap is most prominent in areas such as selection of suitable seed variety, treatment of seed, nutrient management and measures for plant protection. It was observed that there is a 10-20 percent gap in Seed rate, which is likely a contributing factor to the farmers not achieving their potential yield.Lack of awareness among farmers regarding the recommended technologies is a significant issue.Many farmers continue to cultivate traditional groundnut varieties, despite the existence of higher-yielding and disease-resistant alternatives. This discrepancy can be attributed to limited access to improved seeds, insufficient knowledge about their benefits, and potentially concerns about adapting new cultivation practices. However, relying on traditional varieties can lead to lower yields, increased susceptibility to pests and diseases, and ultimately, reduced income for farmers.

Table 1. Gap between farmer practices and production technologies in Groundnut Cultivation

S.No	Particular/Intervention	Recommended Technologies in Demonstration Plot	Farmers Practice	Adoption gap
1	Farming situation	Irrigated	Irrigated	Nil
2	Variety	Improved varieties viz:K-6,K-9,K-H and Dharani	TAG - 24	Full
3	Land preparation	Preparation of land till fine tilth.	Prepare the land till fine tilth is attained.	Nil
4	Seed rate ($Kgha^{-1}$)	180	250	10-20% more than recommendation
5	Spacing	22.5x10 cm	22.5x10 cm	Nil
6	Seed treatment	Seed treatment with Imidacloprid@ 2 ml / kg & Tebuconazole @ 1 g/kg seed	Not followed	Full
7	Time of sowing	1^{st} November to 15^{th} December	1^{st} November to 15^{th} December	Nil
8	Method of sowing	Seed drill Method	Seed drill Method	Nil
9	Nutrient and Manure Management	Soil Test Based Application of fertilizers FYM – 4 -5 tonnes and Urea – 18 Kg,P – 100 Kg & Potash – 35 Kg during last ploughing and Urea – 9 Kg after 30 days and Application of Gypsum @ 200 Kg/acre at early flowering stage (30 – 45days)	Indiscriminate use of fertilizers	Full
10	Weed Management	Application of Pendimethalin 30% @ 1.3 – 1.6 L/acre Imazethapyr @ 300 ml/acre	Application of Pendimethalin 30% @ 1.3 – 1.6 L/acre Imazethapyr @ 300 ml/acre	Nil
11	Pest and Disease Management Measures	Application of plant Protection chemicals as recommended by ANGRAU as per the need	Indiscriminate use of unmatched chemicals	Full

3.1 Groundnut Yield

Adoption of Cluster Front Line Demonstrations (CFLDs) leads to significantly higher groundnut yields compared to conventional farmer practices is shown in the Table 2. The average yield achieved under FLDs was 3663 Kg/ha, representing a remarkable 14.92% increase over the typical farmer yield of 3196 Kg/ha. This compelling evidence underlines the substantial potential for yield improvement in the West Godavari district through the widespread adoption of recommended production technologies. These findings align with previous research conducted by Kalyan [5], Singh et al. [6], Sharma et al. [7], and Solanki et al. [8], collectively highlighting the significant impact of adopting recommended technologies on yield enhancement. The disparities in yield observed between FLDs and farmer practices can be attributed to several factors, including the use of low-yielding local varieties, inappropriate fertilization practices, and inadequate crop management techniques employed by farmers. Conversely, the implementation of recommended technologies, such as introducing new high-yielding varieties, implementing balanced nutrient management strategies, incorporating seed treatment practices, and adopting effective plant protection measures, leads to a substantial increase in crop yields.

3.2 Extension Gap and Technology Gap

The extension gap observed in groundnut cultivation ranged from 1.73 q/ha to 12.5 q/ha. On average, the extension gap over the four years of the study was found to be 4.66 q/ha, indicating a clear need to educate farmers through various extension methods to encourage the adoption of improved agricultural production technologies. Bridging this gap is crucial to ensure the discontinuation of old techniquesand the widespread adoption of new and improved technologies.

The maximum technology gap was observed in 2017-18 (20.77 q/ha), while the lowest was recorded in 2016-17 (2.5 q/ha). The study revealed an average technology gap of 10.51 quintals per hectare. This gap, however, varied across the studied locations. Factors like soil fertility, agricultural practices, local climate, and input availability contributed to these variations. Therefore, to effectively minimize the technology gap and enhance yield across diverse farming situations, location-specific recommendations are crucial. This approach is further supported by research conducted by Badhala, [9], Solanki et al. [10], Singh et al. [6], Sharma et al. [11], Solanki et al. [8] and Kumar et al. [12].

3.3 Technology Index

The technology index, which mea sures the feasibility of implementing advanced technologies on farms, is directly linked to its value: a lower value indicates greater feasibility. Our study, summarized in Table 2, found significant variations in this index over the four years. The highest feasibility (lowest index) of 5.55% was observed in 2016-17, while 2017-18 saw the lowest feasibility (highest index) at 37.76%. Notably, the overall average index across the study period was 21.52%, suggesting a gradual increase in farmer awareness and adoption of improved varieties and scientific practices. This trend aligns with previous research by Levish et al. [13], Patil et al. [14], Solanki et al. [10], Sharma et al. [7], Solanki et al. [8], and Lakhani et al. [15].

3.4 Economic Analysis

Table 3 showcases a compelling economic comparison between groundnut production under Cluster Frontline Demonstrations (CFLDs) and traditional farmer practices. Notably, CFLDs generated significantly higher average gross and net returns. Farmers participating in CFLDs enjoyed an average gross return of ₹2,01,220/ha and a net return of ₹1,57,077/ha, outperforming traditional practices with an average gross return of ₹1,74,285/ha and a net return of ₹1,27,035/ha. This translates to a remarkable 37.19% increase in net returns for CFLD participants.

Furthermore, the Benefit-Cost Ratio (B:C) paints a similar picture. CFLDs boast an average B:C ratio of 4.64, significantly higher than the 3.71 observed in traditional practices. These impressive results clearly demonstrate the economic advantages of adopting the demonstration technologies, ultimately leading to higher profitability for farmers.These findings resonate with previous research conducted by Jat and Katiyar [16], Pawar et al. [17], Singh et al. [18], Undhad et al. [19], and Vishal et al. [20], Yashaswini [21] collectively underlining the significant economic benefits associated with embracing improved technologies in groundnut cultivation.

Table 2. Yield performance, technology gap, extension gap and technology Index of Groundnut under Farmers' Practice and Cluster Front Line Demonstration

Year	Crop	Variety	Area (ha)	No.of Demonstrations	Yield (q/ha)			% increase over farmers practice	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
					Potential	Demo	Farmers Practice				
2016-17	Groundnut	K-6	50	125	45	42.5	30	41.66	2.5	12.5	5.55
2017-18	Groundnut	Dharani	20	50	45	36	33.75	6.66	9	2.25	20
		K-9	10	25	40	32.45	30	8.16	7.55	2.45	18.87
		K-H	20	50	55	34.23	32.5	5.32	20.77	1.73	37.76
2018-19	Groundnut	Dharani	20	50	45	37.5	31.25	20	7.5	6.25	16.66
2019-20	Groundnut	Dharani	10	25	45	34.96	31.25	11.9	10.04	3.71	22.31
		Kadiri Harithandra	10	25	55	38.78	35	10.8	16.22	3.78	29.49
Average						36.63	31.96	14.92	10.51	4.66	21.52

Table 3. Economic performance of cluster frontline demonstration on Groundnut

Year	Variety	Yield (q/ha)		Economics of Demonstration Plot (Rs./ha)				Economics of Farmers Plot (Rs./ha)			
		Demo	Farmers Practice	Gross Cost	Gross Return	Net Return	BCR	Gross Cost	Gross Return	Net Return	BCR
2016-17	K-6	42.5	30	39,500	2,72,000	2,32,500	6.88	41,000	1,92,000	1,51,000	4.68
2017-18	Dharani	36	33.75	52,500	1,80,000	1,27,500	3.43	55,000	1,68,750	1,13,750	3.06
	K-9	32.45	30	42,500	1,62,250	1,19,750	3.81	46,250	1,50,000	1,03,750	3.24
	K-H	34.23	32.5	47,500	1,71,350	1,23,850	3.61	50,000	1,56,250	1,06,250	3.12
2018-19	Dharani	37.5	31.25	40,000	2,10,000	1,70,000	5.25	45000	1,82,000	1,37,000	4.04
2019-20	Dharani	34.96	31.25	40,000	1,95,776	1,55,776	4.89	45,000	1,75,000	1,30,000	3.8
	Kadiri Harithandra	38.78	35	47,000	2,17,168	1,70,168	4.62	48,500	1,96,000	1,47,500	4.04
Average		**36.63**	**31.96**	**44,142**	**2,01,220**	**157,077**	**4.64**	**47250**	**1,74,285**	**127,035**	**3.71**

4. CONCLUSION

The results of the extensive field demonstrations conducted on groundnut have revealed a remarkable increase in yield and net returns for farmers adopting improved technologies. It is evident that disseminating these improved technologies through effective extension methods, such as training and demonstrations, is crucial. The frontline demonstrations not only raised awareness among farmers but also served as a source of motivation for others to embrace the improved practices for groundnut cultivation. The farmers who benefited from these demonstrations also played a vital role in sharing valuable information and providing quality seeds to neighbouring farmers, thus facilitating the broader adoption of high-yielding groundnut varieties.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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