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Evaluation of yield gap analysis and impact of integrated crop management in cotton through FLDs in Kurnool district of Andhra Pradesh

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Abstract

During the three consecutive years, from 2019 to 2021, the RARS (Regional Agricultural Research Station), Nandyal, conducted 25 front line demonstrations on integrated crop management across different locations in Kurnool district of Andhra Pradesh with the objective of improving cotton productivity. The technologies included were summer ploughing, tank mixture of quizalofop ethyl and pyriproxyfen sodium for early weed control, usage of neem oil, sticky traps and raising of maize crop as a barrier to prevent pest spread, foliar spray of micro-nutrient (19:19:19), application of thiodicarb, profenophos, lambda cyhalothrin, and the deployment of pheromone traps for pink bollworm control, along with the utilization of planofix to minimize boll drop. The average seed cotton yield of the demonstration fields utilizing improved technologies was recorded at 12.71 q ha⁻¹ compared to the existing farming practices (11.43 q ha⁻¹).

Keywords: Cotton, economics, front line demonstrations (FLDs) and yield gap analysis

Introduction

Cotton, renowned as the "white gold," has served as the fundamental pillar of the global textile industry for centuries. As cotton cultivation continues to face numerous challenges, ranging from unpredictable weather patterns to pest infestations and market fluctuations, it becomes imperative to explore innovative agricultural techniques that can optimize yield, enhance quality, and improve farmers' livelihoods. India is the largest country in world in the matter of area under cotton is 13.01 million hectares whereas, with regard to production and productivity were 35.38 million bales (1 bale=170 kg) and 462 kg ha⁻¹ (Directorate of economics and statistics, 2020- 21) ^[1]. However, when compared to several prominent cotton-growing nations, India exhibits considerably lower productivity levels. In this article, we shine a spotlight on FLDs as a powerful tool in the quest for sustainable cotton cultivation and higher productivity. FLDs involve on-field trials and demonstrations conducted directly with farmers to showcase the latest agricultural technologies, best practices and interventions. These demonstrations provide a platform for farmers to witness firsthand the potential benefits of adopting new techniques and make informed decisions based on their experiences.

In this article, we explore the importance of demonstrations (FLDs) in cotton cultivation, highlighting their significance,

objectives, and outcomes. FLDs act as a vital link between scientific research and practical application, equipping farmers with knowledge and enabling them to fully harness the potential of cotton farming. Additionally, FLDs contribute to maximizing economic returns for small and marginal farmers. The RARS in Nandyal is a prominent research institution in the scarce rainfall zone of Andhra Pradesh, successfully implemented FLDs as a component of the AICRP (All India Coordinated Research Project) on cotton.

Materials and Methods

Systematic implementations of front line demonstrations were executed across nine villages in various mandals of Kurnool district, aiming to showcase the significance of proven crop management technologies in cotton cultivation. The demonstrations encompassed a range of technology interventions, including summer ploughing, application of quizalofop ethyl (50 g a.i ha⁻¹) and pyriproxyfen sodium (62.5 g a.i ha⁻¹) as a tank mix at the 2-4 weed leaf stage, spraying of neem oil, deployment of sticky traps (yellow and blue) for sucking pest control, sowing of maize as a barrier crop along the borders effectively hinders the spread of sucking pests, foliar spray of 19:19:19 for micronutrient correction, implementation of pheromone traps for monitoring of pink boll worm, spraying of thiodicarb, profenophos and lambda

cyhalothrin for pink bollworm control and the use of planofix for reduction of boll drop. The fields underwent regular monitoring and periodic observation by the scientists from the RARS, Nandyal. Yield data was collected from the farmers' fields and the demonstration plots during the harvest period. The expenses associated with cultivation and the profits generated from both systems were obtained from the farmers in order to calculate the benefit-cost ratio. The excessive rainfall experienced during the 2020-21 and 2021-22 seasons resulted in reduced yields.

The selection of site and farmers were made in accordance with the guidelines outlined by Choudhary (1999) [2] in order to collect the required data. Subsequently, the collected data was analyzed and interpreted for further insights. To assess the level of adoption of enhanced techniques in cotton farming, extension gap technology gap and technology index (In accordance with the methodology described by Samui *et al.*, 2000) [3] were calculated.

$$\text{Extension gap (q ha}^{-1}\text{)} = \text{DY} - \text{FY}$$

$$\text{Technology gap (q ha}^{-1}\text{)} = \text{PY} - \text{DY}$$

$$\text{Technology index (\%)} = \frac{\text{PY} - \text{DY}}{\text{PY}} \times 100$$

Here,

DY=Demonstration yield; FY=farmers yield; PY=potential yield

Results and Discussion

Seed cotton yield

The FLDs exhibited a notable increase in seed cotton yield, ranging from 7.00 to 17.6% (8.07 to 21.74 q ha⁻¹), compared to farmers' practices. Over the course of three years, the demonstrations, which employed improved cultivation practices, achieved an average yield advantage of 11.2% over traditional cotton farming methods. The results presented in table 1 clearly demonstrate the positive impact of front line demonstrations on the cotton farming community in Kurnool district. This can be attributed to the farmers' enthusiasm in adopting new agricultural technologies in the FLD plots. However, it is important to note that the seed cotton yield obtained in the FLDs fell short of the potential yield of the cultivar. This can be mainly attributed to variations in soil fertility levels and unpredictable weather conditions during the square and boll

formation stage of the crop. The crop exhibited positive effects from improved cultivars and the implementation of scientific agronomic practices such as weed and nutrient management, which resulted in a more substantial and sustained nutrient supply aligned with the crop's requirements. Similar findings emphasizing the significance of technology adoption in enhancing crop productivity have been reported by Katare *et al.* (2011) [4] and Ahmad *et al.* (2013) [5].

Gap analysis

Over a period of three years, a considerable difference noticed in the extension gap, ranging from 1.21 to 1.43 q ha⁻¹ was observed between the technology demonstrated and the practices employed by farmers. On average, the extension gap amounted to 1.28 q ha⁻¹ (Table 1). Additionally, a substantial technology gap was identified, ranging from 1.26 to 14.93 q ha⁻¹ across the different years. The average technology gap throughout the three-year period was calculated to be 10.28 q ha⁻¹ (Table 1). The observed gaps can be attributed to several factors, including disparities in soil fertility status, adherence to timely crop management practices, adoption of new technologies and prevailing weather conditions. Similar findings were reported by Singh *et al.* (2017) [6], Mitra and Samajdar (2010) [7] and Raj *et al.* (2013) [8], who conducted their own examinations on extension and technology gaps, respectively.

Technology index

The technology index for each demonstration conducted in different years corresponded to the observed technology gap, with the highest technology index being recorded in the year 2020-21 (64.91%) and lowest observed technology index at 5.48% in the year 2019-20. The average technology index over the course of three years was 44.74% (refer to Table 1). The technology index provides a measure of the effectiveness and feasibility of the developed technology when implemented on farmers' fields. A lower value of the technology index indicates a higher feasibility of the technology. These research findings are consistent with the conclusions drawn by Hiremath and Nagaraju (2009) [9] as well as Dhaka *et al.* (2010) [10]. One probable reason for the high feasibility of cotton production technology could be attributed to the active involvement of participant farmers, who had the opportunity to interact with scientists and were encouraged to adopt recommended practices and acquire new skills during the FLD process.

Tale 1: Yield, gap analysis and technology index of FLDs on cotton crop from 2019-2020 to 2021-2022

Year	No. of Demos	Extension gap (q ha ⁻¹)	Technology gap (q ha ⁻¹)	Technology index %	% increase	Seed cotton Yield (q ha ⁻¹)	
						Demo	FP
2019-20	25	1.43	1.26	5.48	7.0	21.74	20.31
2020-21	25	1.21	14.93	64.91	17.6	8.07	6.86
2021-22	25	1.23	14.66	63.74	17.3	8.34	7.11
Average	25	1.28	10.28	44.74	11.2	12.71	11.43

Economics

Various factors, such as seed rate, fertilizer dosage, labor requirements, and pesticide usage were considered essential inputs for conducting both the front line demonstrations and farmers' practices at the local level. The prevailing prices of

these inputs and the resulting outputs were used to calculate the costs of cultivation, returns, and the benefit-to-cost ratio (B:C ratio) as shown in table 2. Over the three-year period, the average cultivation cost in the front line demonstration (FLD) plots was Rs. 39,506 ha⁻¹, which was lower

compared to the farmers' practices costing Rs. 41,512 ha⁻¹. This difference was primarily attributed to the implementation of best management practices with optimal agro-inputs. Throughout all the years, the net returns from the FLD plots consistently exceeded those from the farmers' practices. On average, the FLD plots generated a higher net return of Rs. 35,476 ha⁻¹ compared to Rs. 25,634 ha⁻¹ in the farmers' practices. Consequently, the technological interventions provided in the FLD plots resulted in an additional income of Rs. 9,842 ha⁻¹ on average, representing a 38.39% increase. The economic analysis consistently revealed a higher B:C ratio in the FLD plots compared to the farmers' practices. The highest B:C ratio of 2.4 was

observed in the year 2019-20, followed by 1.9 in 2021-22, while the lowest ratio of 1.2 was recorded in 2020-21. The variations in the B:C ratio can be attributed to price fluctuations and variations in seed cotton yields during the study years. On average, the B:C ratio in the FLD plots was 1.9, whereas it was 1.5 in the farmers' practices throughout the study period. Therefore, the favorable B:C ratio confirms the economic viability of the interventions implemented under the demonstrations and successfully convinces farmers of their usefulness. These findings are further supported by consistent results reported by previous studies conducted by Sreelakshmi *et al.* (2012)^[11], Singh (2017)^[12] and Singh *et al.* (2022)^[13].

Table 2: Economics as influenced by FLD on cotton crop from 2019-2020 to 2021-2022

Year	No. of Demos	Cost of cultivation (Rs. ha ⁻¹)		Gross returns (Rs. ha ⁻¹)		Net returns (Rs. ha ⁻¹)		B:C ratio	
		Demo	FP	Demo	FP	Demo	FP	Demo	FP
2019-20	25	49942	57470	119570	111705	69628	54235	2.4	1.9
2020-21	25	34109	33153	41157	34986	7048	1833	1.2	1.1
2021-22	25	34467	33913	64218	54747	29751	20834	1.9	1.6
Average	25	39506	41512	74982	67146	35476	25634	1.8	1.5

Demo-Demonstration plot; FP-Farmers Practice

Conclusion

The study reveals that average seed cotton yield of the demonstration fields utilizing improved technologies was recorded higher yield (12.71 q ha⁻¹) compared to the existing farming practices (11.43 q ha⁻¹). This suggests the potential for wider dissemination of additional technological interventions among farmers.

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