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RESEARCH

EFFECT OF INTEGRATED CROP MANAGEMENT PRACTICES ON YIELD AND ECONOMICS OF OKRA (*ABELMOSCHUS ESCULENTUS* (L). MOENCH) IN DAKSHINA KANNADA DISTRICT OF COASTAL KARNATAKA, INDIA

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Abstract: The present investigation was conducted in the different villages of Dakshina Kannada district in the Coastal Karnataka during 2021-22, 2022-23 and 2023-24. Total 30 front line demonstrations (FLD) were laid out on farmers' fields in the district. Front line demonstrations were conducted on Integrated Crop Management practices of okra with farmers' active participation to disseminate improved technologies to achieve production potential. The improved technology consisted of the foliar spray of Arka Vegetable special @ 2 g/lit., five Kg of AMC mixed with 500 Kg of FYM and applied near the root zone of standing crop, balanced use of fertilizer application, integrated pests, and disease management. Okra is a major vegetable crop of coastal Karnataka, but the productivity is very low in the district due to lack of knowledge and partial adoption of recommended package of practice by farmers. Results showed that average yield obtained were 14.98, 14.38 and 13.65 t/ha under demonstrated practice, whereas, in farmers practice 8.28, 8.54 and 7.98 t/ha during Rabi season 2021-22, 2022-23 and 2023-24, respectively. On an average technology gap of three years front line demonstration programme was 5.66 t/ha. The per cent increase in yield over check was 73.45 per cent. The extension gap recorded was 6.70, 5.84 and 5.67 t/ha 2021-22, 2022-23 and 2023-24, respectively. During the three years of front-line demonstration programme, an average of 28.30 per cent technology index was observed which showed the efficacy of good performance of technical interventions. The improved technology gave higher gross and net returns with a higher benefit-cost ratio compared to farmer's practices.

Keywords: B: C ratio, Okra, Front Line demonstration, Growth, Yield

INTRODUCTION

Okra *(Abelmoschus esculentus* (L). Moench) belongs to the family Malvaceae. It is a grown in tropical and sub-tropical parts of the world as economically important vegetable crop. It is known as 'Gumbo' in USA, 'Lady's Finger' in England, whereas 'Bhindi' in India (Choudhary *et al*., 2022). It is well distributed throughout the Indian sub-continent and East Asia (Talukder *et al*., 2016). Okra originated from tropical Africa and is extensively cultivated in India. Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka are important okra growing states. This crop has a prominent position among vegetable fruits due to its higher nutritive and medicinal value, ease of It is widely grown for its immature tender fruits which are used as vegetable. It is used in curries, cooked into soups, canned green or dried for off season uses. The root and stem of okra plants are used for cleaning the cane juice in the manufacture of Jaggery and Sugar. Its fruits also have good nutritional and medicinal values as the fruit contain 6.4g carbohydrates, 2.2g protein 0.2g fat, 66mg calcium, 500mg phosphorus, 15mg iron and 13mg vitamin-C per 100g edible portion. Similarly, okra fruit is excellent source of iodine which is necessary for the resistance against throat disease like goitre. Okra is highly beneficial for the people suffering from heart weakness. Roasted and ground ripen seeds of okra are used as substitute for coffee in turkey. Crude fibrewhich is present in matured fruits and stems of okra is used in paper industry. Okra thrives in all kinds of soils, but it grows best in a friable well manure soil cultivation and wider adaptability to varying climatic conditions (Reddy *et al*., 2012). Okra variety white velvet was introduced to the public in 1890 by Peter Henderson & Company of New York. White Velvet variety okra is long, white, and velvety, widely used due to its tender fruit lacking spines and very popular variety in coastal Karnataka like Dakshina Kannada and Udupi districts.

Krishi Vigyan Kendra is an farm science and innovative science–based institution, plays an vital role in bringing the researchers face to face with

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farmers. The Krishi Vigyan Kendra aim is to transfer of technology to farmers for increasing productivity to achieve sustainability. The mandate of KVK is technology assessment, refinement, and demonstration for its application and capacity development. Front line demonstration is a long-term educational activity conducted in a systematic manner to introduce a new practice/technology in farmer's fields. Farmers in India are still producing crops based on the knowledge transmitted to them by their fore fathers leading to a grossly unscientific agronomic, nutrient management and pest management practices (Papnai *et al.*, 2017).Due to these reasons, farmers often fail to achieve the desired potential yield of various horticultural crops.

To improve yield levels and make awareness to the okra growers, front line demonstrations were carried out in a systematic manner on farmer field to show the worth of a new technology and convincing farmer to adopt integrated crop management practices for enhancing productivity of Okrain Dakshina Kannada district of Karnataka, India.

MATERIALS AND METHODS

KrishiVigyan Kendra, Dakshina Kannada carried out front line demonstrations (10 per year) from 2021-22, 2022-23 and 2023-24 with 30 farmers to spread the technology to farmers. Each frontline demonstration was laid out in a hectare area which was taken as demo while adjacent one hectare was taken as control for comparison of farmer. The farmers were selected randomly based on surveys, diagnostic visits and farmer meetings conducted by KVK.

Application of Arka vegetable special (developed from Indian Institute of horticultural research, Bengaluru) as foliar application in critical phases of plant growth along with the recommended dose of NPK application was the main aim of the Front line demonstration. The foliar spray of Vegetable special at 2 g/lit. The first spray was carried out 45 days after planting. The second and third spray was carried out at 15 days interval after each spray and Five Kg of AMC mixed with 500 Kg of FYM and applied near the root zone of standing crop. The materials and inputs required under the study with respect to FLD and farmers practice are given in Table 1.

Critical inputs like Arka Vegetable Special (Micronutrient Mixture), Arka Microbial Consortium, Yellow and blue sticky traps for sucking pests' management and Neem oil for plant protection measures were provided for Front line demonstrationsfarmers and non-monetary inputs like Correct date of sowing in lines, timely intercultural operations like weeding and irrigation were monitored. The FLD farmers were facilitated by the KVK Scientists in performing field operations during trainings and visits. Two Off-campus trainings have been organized for the group of beneficiaries Farmers. The farmer's practice was taken as a control. Field days were also conducted in each cluster to show the results of front-line demonstration to the farmers of the same village and neighbouring villages, print and visual media were also used to disseminate the technology.

In general, soils of the area under study were acidic with average soil pH of 5.43 was recordeddue to the high rainfall condition. These soils are non- saline in nature (free of soluble salts) with average electrical conductivity ranges between 0.14 dSm^{-1}. The average organic carbon content of the soils 8.1 $g\ kg^{-1}$ and was found to be high in all plots. This is attributed to the addition of plant residues and farmyard manure to surface horizons (Harish Shenoy, 2019) and receives an annual rainfall of about 3000 mm and above with hot humid climatic condition.

Data on yield and yield attributing characters, expenditure incurred by the farmer (Farmers practice) and expenditure of demonstration plots were collected and analysed. Gross income was calculated based on local market prices of okra var. white velvetand net income by subtracting the total cost of cultivation from gross income. Benefit cost ratio was computed by dividing gross returns with cost incurred for cultivation.

To estimate the technology gap, extension gap and technology index the following formula as mentioned below were used as suggested by Sagar and Chandra, 2004; Dayanand *et al.* 2012), Kumar, 2013; Kumar, 2014a; Kumar 2014b and Samui *et al.*, 2000.

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]

Table 1. Technological Interventions under FLD and farmers' practice

Sl. No.	Particulars	Demonstration	Farmers practice
1	Sowing time	Jan-Feb	Dec-Jan
2	Seed rate	3 Kg/ha	5 Kg/ha
3	FYM	Application of FYM @ 25 tonnes per ha before sowing	Application of FYM @ 12.5 tonnes per ha before sowing
4	Spacing	45 X 45 cm	30 X 30 cm
5	Fertilizer	Application of 50: 30:25 kg NPK per ha	Application of 15:15:15 @ 150 kg per ha at the time of planting

6	Micronutrients	Arka Vegetable Special 2g/lit of water @ 15 days interval for 4 times	No micronutrient application
7	Microbial Consortia	Arka Microbial Consortia @ 5Kg/500 kg of FYM	Not practiced
8	Plant protection	Yellow and Blue sticky traps to manage aphids	Not practiced
		Application of Dimethoate 30 EC @ 1.7 ml per litre against sucking pests (2 times)	Application of Dimethoate 30 EC @ 1.7 ml per litre against sucking pests (3times)

Table 2. Influence of Front-Line demonstration on yield and yield parameters in okra

Year	Plant height (cm) @120 DAP		Fruit length (cm)		Fruit girth (cm)		Average fruit weight (g)		Number of fruits/plant		Fruit yield/plant (kg)		% increase over check
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check	
2021-22	122.78	82.53	26.23	21.48	8.34	7.21	68.16	51.68	26.57	18.50	1.82	0.92	80.91
2022-23	115.98	75.45	24.73	19.56	7.92	7.02	67.45	49.98	24.32	17.20	1.66	0.84	68.38
2023-24	117.96	77.63	27.45	23.23	8.87	7.34	67.95	52.64	27.20	18.00	1.75	0.97	71.05
Average	**118.91**	**78.54**	**26.14**	**21.42**	**8.38**	**7.19**	**67.85**	**51.43**	**26.03**	**17.60**	**1.74**	**0.91**	**73.45**

Table 3. Cost economics of FLD on ICM in Okra variety var. white velvet

Year	Yield t/ha		Gross cost of cultivation (Rs. /ha)		Gross returns (Rs. /ha)		Net returns (Rs. /ha)		Benefit Cost Ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2021-22	14.98	8.28	1,43,064.00	1,00,476.00	4,49,400.00	2,48,400.00	3,06,336.00	1,47924.00	3.14	2.47
2022-23	14.38	8.54	1,64,523.00	1,15,547.00	5,03,300.00	2,98,900.00	3,38,777.00	1,83,353.00	3.06	2.58
2023-24	13.65	7.98	1,80,975.00	1,27,101.00	5,46,000.00	3,19,200.00	3,65,025.00	2,37,924.00	3.02	2.51
Average	**14.34**	**8.27**	**162854.00**	**114374.67**	**499566.67**	**288833.33**	**336712.67**	**189733.67**	**3.07**	**2.52**

Table 4. Yield, extension gap, technology gap and technology index of FLD on ICM in Okra variety Var. White velvet

Year	Yield t/ha		Potential Yield t/ha		Extension gap (t/ha)	Technology gap (t/ha)	Technology index (%)
	Demo	Check	Demo	Check			
2021-22	14.98	8.28	20	10	6.70	5.02	25.10
2022-23	14.38	8.54			5.84	5.62	28.10
2023-24	13.65	7.98			5.67	6.35	31.75
Average	**14.34**	**8.27**			**6.07**	**5.66**	**28.30**

RESULTS AND DISCUSSION

The data on Yield and yield attributing characters, economic parameters, technology gap, extension gap and technology index were pooled on different parameters and the results obtained were discussed accordingly. The Technological Interventions under FLD and farmers' practice details were given in Table1 and show that all the FLD farmers fully adopted the recommended package of practices where as non-FLD farmers were not adoptedrecommended package.

Yield and yield attributing characters

The Yield and yield attributing characters are presented in Table 2. The cumulative effect of demonstrated package over three years revealed an average plant height of 118.91 cm compared to farmers practice 78.54. The difference in fruit length of demonstrated package and check was observed and maximum length was recorded in demonstrated package (26.14) followed by check (21.41 cm). The average number of fruits per plant was also recorded 26.57, 24.32 and 27.20 in demo compared to 18.50, 17.20 and 18.00 in control plots during 2021-22, 2022-23 and 2023-24 respectively. The cumulative effects of technological intervention over three years revealed an average number of fruits per plant in demonstration is26.033compared to 17.60 number of fruits per plant in check. The total fruit yield per ha under demonstrated package recorded were 14.98, 14.38 and 13.65 t/ha in demo compared to 8.28, 8.54 and 7.98 t/ha in control plots during 2021-22, 2022-23 and 2023-24 respectively. The cumulative effects of demonstration over three years revealed an average total fruit yield per ha as **14.34 t/ha** compared to **8.27 t/ha** in farmers practice**(Fig 1.).** The average total yield per ha of Okra is increased by 73.45 percent over the yield obtained under farmer's practice. The year-to-year fluctuations in yield and cost of cultivation can be explained based onvariations in prevailing social, economic, and microclimatic condition ofthat location. The above findings are in similarity with the findings of Choudhary*et al.* (2022) and Mahanthesh *et al.* (2021).

Economic parameters

Economic indicators i.e. Gross cost of cultivation, gross returns, net returns, and BC ratio of Front-Line Demonstration are presented in Table 3. The net returns from the demonstration plot higher than control plot, i.e. farmers practice during all the three years of demonstration. Average net returns from demonstration plot were Rs. 3,36,713/ha compared to Rs 1,89,733/ha in control. The average gross expenditure from the demonstration plot was recorded as Rs.1,62,854.00per ha compared to Rs. 1,14,374.67per ha in control. Gross returns from the demonstration plot were Rs. 4,99,566.67/ha compared to Rs. 2,88,833.33/ha in control plots.

Economic analysis of the yield performance revealed that significantly higher benefit cost ratio was observed in demonstration plots compared tocheck. The benefit cost ratio of demonstrated were recorded as 3.14, 3.06 and 3.02 and control plots 2.47, 2.58 and 2.51 during 2021-22, 2022-23 and 2023-24, respectively. The cumulative effect of technological interventions over three years, revealed an average benefit cost ratio of 3.07 in demonstration plots compared to 2.52 in control plots.The maximum benefit cost ratio of okra cultivation was observed under improved practices than farmers' practices, this may be due to maximum yield obtained under demonstration compared to check. This finding is similar with the findings of Aklade*et al.*, (2018), Sivakumar *et al.*, (2020), Ray *et al.*, (2020) and Bhati *et al.*, (2021) in okra

Extension gap

Extension gap of 6.70, 5.84 &5.67 t/ha was observed during 2021-22, 2022-23 and 2023-24, respectively. On an average extension gap under three-year FLD programme was 6.07 t/ha. This emphasized the need to educate and motivate the farmers for the adoption of improved production, management and plant protection technologies to reverse this trend of wide extension gap. More and more use of latest production technologies along with high yielding variety will subsequently change this alarming trend of galloping extension gap.These findings are like Aklade *et al.*, *(*2018), Sivakumar*et al.*, (2020), Kachari and Barooah (2020), Ray *et al.*, (2020) and Bhati *et al.*, (2021).

Technology gap

The technology gap, the difference between potential yield and yield of demonstration plots was 5.02, 5.62 and 6.35t/ha during 2021-22, 2022-23 and 2023-24, respectively (Table 4). On an average technology gap under three-year FLD programme was 5.66 t/ha. This may be due to the soil fertility, managerial skills of individual farmer's and climatic conditions of the selected area. Therefore location specific technologies are necessary to bridge these gaps. These findings are like Aklade *et al.*, *(*2018), Sivakumar *et al.*, (2020), Kachari and Barooah (2020), Ray *et al.*, (2020) and Bhati *et al.*, (2021).

Technology Index

Technology index shows the feasibility of the demonstration at farmers field has depicted good performance of the intervention. The technology index varied from 25.10 to31.75 (Table 4). On an average technology index of 28.30 per cent was 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 Okra variety Var. White velvet. The technology index showed the economic feasibility of the demonstrated technology at farmer's field these findings are like Bhati, *et al.*, (2021).

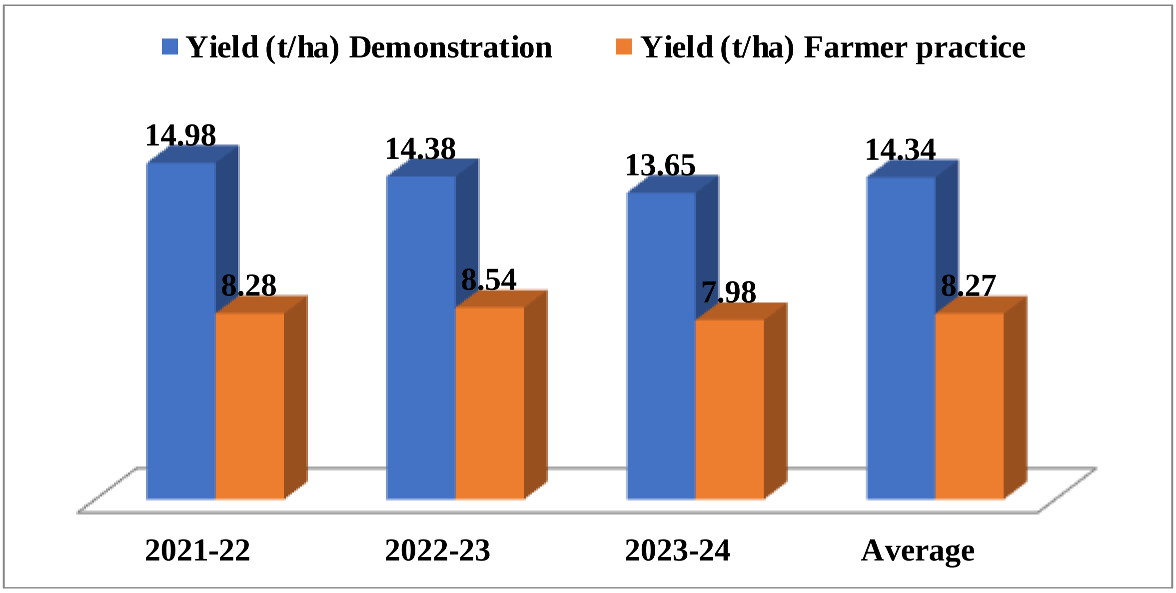

Fig 1. Yield (t/ha.) under FLD on ICM in Okra and farmers' practice

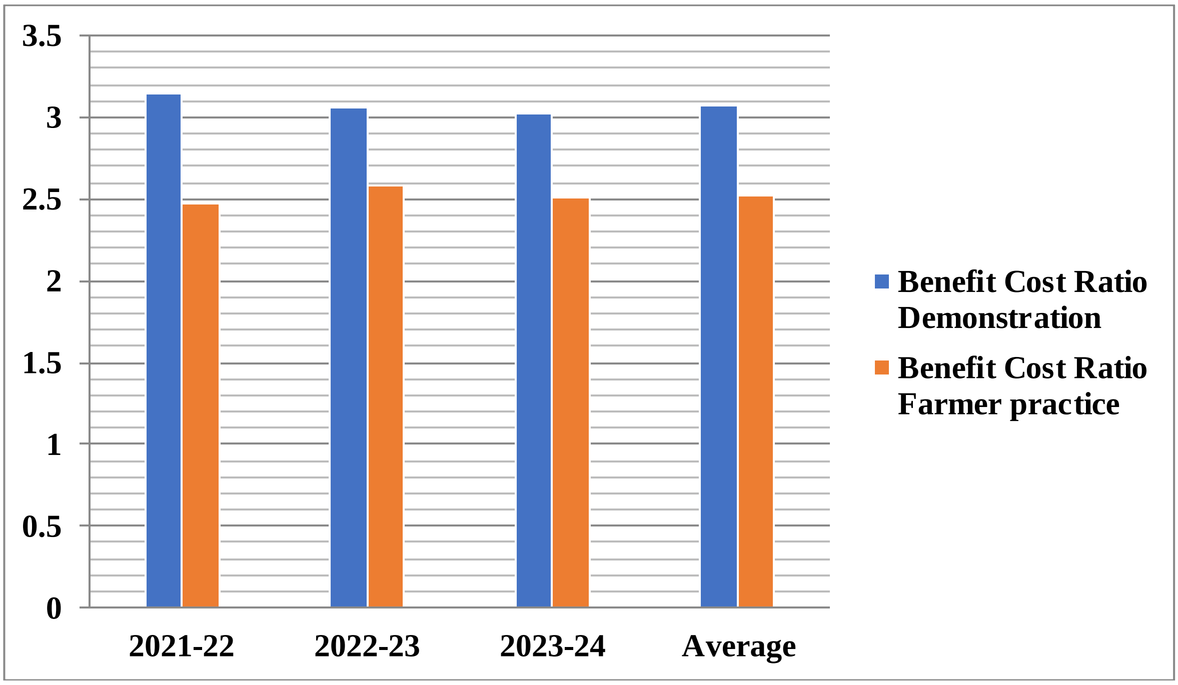

Fig 2. Benefit Cost Ratio of FLD on ICM in Okra variety

CONCLUSION

The FLD produced a significant positive result and provided an opportunity to demonstrate the productivity potential and profitability of the latest technology (intervention) under the real farming situation. By conducting demonstrations of improved production technologies, okra yield potential can be increased. This will substantially increase the income and helps to achieve sustainability of farming community. There is a need to adopt multi-pronged strategy that involves enhancing okra production through improved technologies in coastal Karnataka.

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