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Yield Gap Analysis and Impact Assessment of Rapeseed- Mustard through Cluster Front Line Demonstrations in Khowai District of Tripura, 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

The present study was carried out by KVK Khowai Tripura to know the yield gaps between improved practices under frontline demonstration and farmers practice of rapeseed- mustard crops. The productivity ranged from 8.00 to 10.50 q/ ha with average yield under demonstration recorded 9.24 q/ ha under improved technology on farmers field as against a yield ranged from 5.50 to 6.50 q/ ha with a mean of 5.88 q/ ha recorded under farmers practice. However, in the demonstration plot the yield enhancement due to technological intervention was 36.21% over the farmers practice. An average net returns of Rs 18,644/- at demonstrations plot, while the average net returns from farmers practice is Rs 7046/-. The additional cost of Rs 5565/- gave additional net return; it is Rs. 11,510/- per hectare, respectively. The increase benefit cost ratio was also estimated; it ranged

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from 1.38 to 1.87 in recommended practices and 1.22 to 1.47 in farmers practice. An extension gap of 3.36 q/ ha was found between demonstrated technology and farmers practice, technology gap was observed 3.23 q/ ha, whereas technology index 24.86%. Therefore, CFLD of rapeseed-mustard was an effective for increasing the productivity and cropping intensity (%) of rapeseed-mustard and changing the knowledge, attitude and skill of the farmers. This created greater awareness and motivated the other farmers to adopt improved practices of rapeseed- mustard.

Keywords: Rapeseed- mustard; yield; technology gap; extension gap; technology index.

1. INTRODUCTION

"Rapeseed- Mustard, because of resilience to grow under diverse agro- climate conditions and characteristics like low input requirement has emerged as a major strategic component in enhancing domestic production of edible oilseeds. Exploiting the latent potential for enhancing domestic oilseed production and productivity by tackling major biotic and abiotic production constraint forms and corner stone of the strategy to attain edible oil self sufficiency. The policy stance has to be carefully designed taking into consideration a host of factors like livelihood security of oilseed producers, level of desired import dependency, trade efficiency, changes in dietary standards and nutritional requirements, rising demand for vegetable oils in bio fuel production etc" [1]. "In Khowai district of Tripura has a sizeable area under rapeseed and mustard, it is cultivated in 1465 ha area with 1170 MT production and the 7.99 q/ ha productivity" Anonymous [2]. The major constraints to boost up the production of oilseeds in Khowai district are observed as poor productivity of oilseeds due to poor resources of the farmers, non- availability of oil extraction units, lack of technical know- how, reluctance towards oilseed production, uncertainty of weather conditions, non- availability of quality seed etc., which leads to their reluctance towards proper scientific management of the crop.

"Addressing the concern of significance, the Ministry of Agriculture and Farmers Welfare, Govt of India had initiated a nation- wide cluster frontline demonstration (CFLD) programme on oilseeds under National Mission for Oilseeds and Oil palm Production (NMOOP). The basic strategy of the mission is to popularize improved technologies, i.e. seed, micro-nutrients, soil amendments, weed management, integrated pest and disease management, farm machinery and implements, micro irrigation devices along with capacity building of farmers. The ICAR through its Krishi Vigyan Kendras (KVKs) across the country has been implementing this CFLD programme on different oilseed crops to boost the production and productivity of oilseeds which improved varieties and location specific technologies. Despite great scope and better opportunities for pulses production in Khowai district of Tripura in rice- fallow areas for increasing the production and productivity and cropping intensity . The growth rate is low due to many intricate and interrelated factors right from soil, climate related constraints to technological and extension- oriented tribulations. Besides, shrinkage in land holding, growing population pressure, increasing food demand and poor soil health are the key constraints" (Laxmi et al., 2017); [3].

Nonetheless, the government has placed a high priority on rapeseed and mustard crops because to the significant output difference between their potential and actual farming conditions. The main factors limiting the potential yield include less or unclear productivity, primarily caused by incorrect sowing techniques, inappropriate crop geometry, avoidance of bio-fertilizers, other intercultural operations, and climate unpredictability. To combat the causes of yield reduction and technology gap, dissemination of recommended technologies of rapeseed-mustard through CFLD were conducted at farmers field during 2015- 16 to 2022 23. KVK Khowai had done intensive efforts on training about scientific cultivation, demonstration of new variety and other interventions. The study aimed at assessing the impact of CFLDs in terms of grain yield, economic gains, extension and technological gap in rapeseed- mustard crop in different villages of Khowai district and also convey the scientific technical message to farmers that if they use recommended package and practices then the yield of this crop can be easily doubled than their present level.

2. MATERIALS AND METHODS

The present study was carried out by Krishi Vigyan Kendra (Divyodaya) Khowai Tripura in Rabi season at the farmers fields of nine villages

viz. RC Ghat, Batapora, Ratia, Namapara, Chebri, Ghilatali, Krishnapur, Singichera, Nayanpurin Khowai district of Tripura state during the period of 2015- 16 to 2022- 23 (8 consecutive years). The district lies between latitude 23.8974^0 N and Longitude 91.6372^0 E. The soils of the demonstration area was sandy loam and acidic in nature (P^H 5.1 to 6.2), available N 286.5 kg/ ha, P 14.3 kg/ ha, K 135 kg/ ha and 0.98% organic C. The data on Fig. 1 evident that the minimum temperature in the Khowai district is 9.72° Celsius (February) and highest temperature is 32.83° Celsius (April). The mean average maximum atmospheric temperature is 29.97^{0}C and the minimum 19.93^{0}C. The annual average rainfall of Khowai district is 1874.20 mm besides, humidity between 82 to 47% was also observed during the demonstration years.FLD on YSH- 40 (Yellow Sarson) variety during 2015-16; TRC T-1-1-5-1 variety during 2016- 17 to 2018- 19; and NRCHB-101 variety in 2022- 23 were taken and demonstrated to the farmers field. 430 front line demonstrations on field pea were laid out comprising 430 farmers covering the total area 190 ha with demonstration plots ranging from 0.20 to 1.0 ha. The required inputs like variety, seed quantity, seed treatment, sowing method, spacing, time of sowing, application of nutrient, weed and disease management etc are presented in List 1. Regular visits to the demonstration fields by the KVK Scientists ensured proper guidance to the farmers. Farmers training, field days, group discussion group meeting were also organized to provide the opportunities for other farmers to witness the benefits of demonstrated technologies. Production and protection technologies except the interventions were followed in similar manner in recommended as well in farmers practices. All other steps like farmer's selection, site selection, farmers participation etc was followed as suggested by Kirar et al. [4], Sachan et al. [5]. The yield data were collected from the farmers practice and demonstration plots and cost of cultivation, net income and benefit/ cost ratio were computed. The technology gap, extension gap and technology index were a work out as suggested by Samui et al. [6].

Technology gap = Potential yield- Demonstration yield

Extension gap = Demonstration yield- Farmers practice yield

Technology index (%) = Technology gap ÷ Potential yield x 100

Benefit cost ratio = Gross return ÷ Gross cost

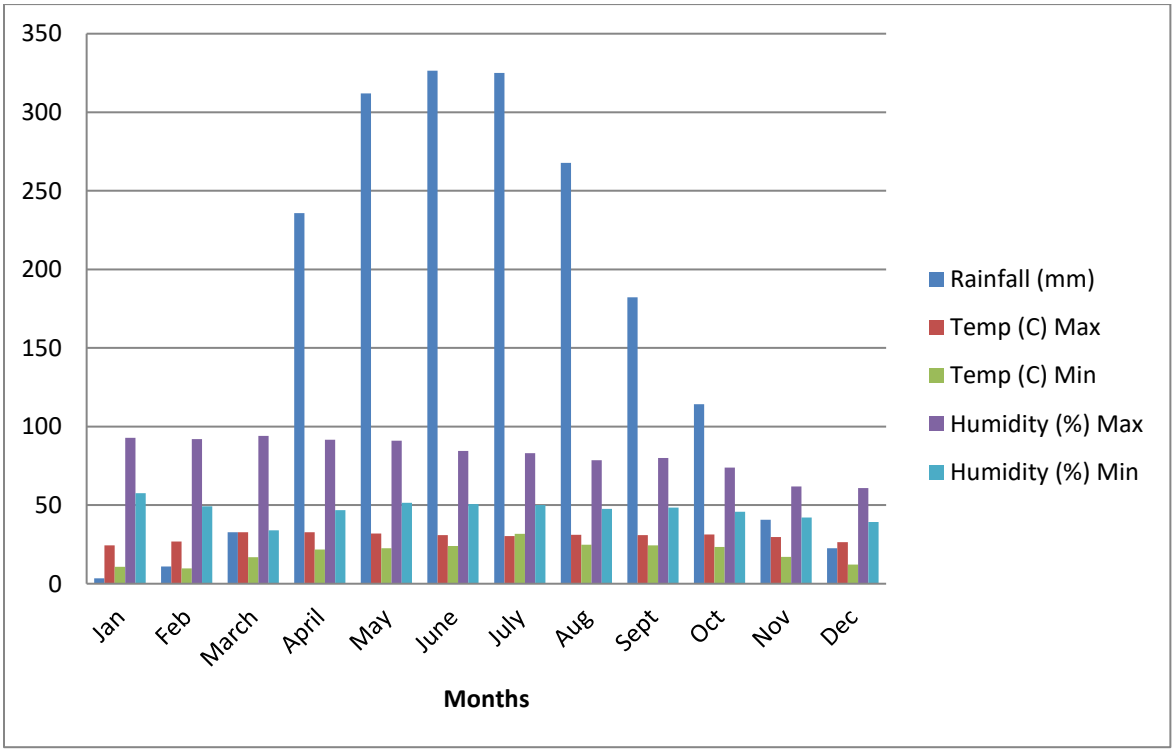


Fig. 1. Metrological observation

Table 1. Details of recommended practices and existing practices under Rapeseed- Mustard CFLD

Crop operations	Recommended practices	Farmers practices
Variety	YSH- 40 (Yellow Sarson); TRC T-1-1-5-1; NRCHB-101	Local or old variety
Seed rate	5 kg/ ha	8 kg/ ha
Seed treatment	Bavistin @ 2.5g/ kg of seed	No seed treatment
Sowing method and spacing	Line sowing at 30cm row spacing	Broadcasting
Time of sowing	October- November	October- November
Thinning & weeding	Thinning and weeding was done 25- 30 DAS	No thinning and weeding practice
Nutrient management	Application of 60 kg N, 40 kg P, 20 kg K, and15 kg S/ ha	Use of under dose of fertilizers
Irrigation	One light irrigation at flowering stage and after poding if winter rain not noticed	Uncontrolled irrigation
Plant protection	Need based application of Imidachloprid 7.8 SL + Sulfex to protect the crop from sucking pests and disease.	No measurement adopted
Harvesting and threshing	Harvested as soon as the pods turn yellowish and moisture content of the seed is about 40%. Moisture content of the seed necessities less than 9% at the time of storage.	Harvested over- matured crops causes shattering of grains. Not considered of seed moisture content at harvesting and storage.

3. RESULTS AND DISCUSSION

Yield: The data given in Table 3 revealed that the maximum yield was recorded 10.50 q/ ha during 2021- 22 and minimum yield was recorded 8.00 q/ ha in year 2016- 17 under CFLDs demonstrated plots and the mean seed yield was recorded 9.24 q/ ha in eight consecutive years under demonstrated plots which was higher than the farmers traditional practice 5.88 q/ha. On an average 36.21% increase in yield was recorded under CFLDs over FPs. The results are in conformity with the finding of earlier investigators Singh, [1]; Tiwari and Saxena, [7]; Sachan, [8].

Economics: The input and output prices of commodities prevailed during each year of demonstration were taken for calculating cost of cultivation, gross return, net return, and benefit cost ratio (Table 4). The year wise net return ranged from CFLDs practices was Rs 9100 to Rs 26,850/- with mean net return of Rs 18,644/- while the net return ranged from farmers practice of Rs 4400 to Rs 11,450/- with average net return Rs 7046. The additional cost of Rs 4480 to Rs 7800 gave additional net return; it ranged Rs. 4350 to Rs. 17,750/- per hectare, respectively. The estimated benefit cost ratio, it ranged from 1.33 to 1.87 in recommended practices and 1.22 to 1.30 in farmers practice. Thus, and it was clearly showed that the demonstration of mustard with scientific technology was better than the farmers practices. Similar results have been reported by earlier by Patil et al., [9]; Sachan [8]; Datta, [10]; Tiwari and Saxena, [7]; Kumar, [11].

Extension and Technology Gap: An extension gap of 2.50 to 4.00 q/ ha was found between demonstrated technology and farmers practice during different eight years and on average basis the extension gap was 3.36 q/ ha (Table 3). Such gap might be attributed to adoption of improved technology in demonstrations which resulted in higher grain yield than the traditional farmer's practices.

Wide technology gap were observed during different years and this was lowest (1.00 q/ ha) during the period of 2016- 17; 2017- 18 and 2018- 19 due to might be the variety was match with similar agro climatic conditions, tested and released by the ICAR Research Complex for NEH Region, Tripura Centre and was highest 5.13 q/ ha during rabi 2015- 16 followed by 4.86 q/ ha in the year 2019- 20. On eight years average basis the technology gap of total 430 demonstrations was found 3.23 q/ ha (Table 3). The observed technology gap may be attributed dissimilarity in soil fertility status, rainfall

distribution, disease and pest attacks as well as the change in the locations of demonstration plots every year. The difference in technology gap during different years could be due to more feasibility of recommended technologies during different years. Technological yield gap of crops due to variation in the soil fertility and weather conditions is reported by Jatav et al., [12]; Mitra and Samajdar, [13]; Sachan [14]; Das et al., [15]; Singh et al., [3]; Sachan et al., [5]; Meena et al., [16].

Technology Index: The technology index for all the demonstrations during different years were in accordance with technology gap. The highest technology index percent of 35.06 was recorded in the year 2015- 16 and the lowest was observed in the year three consecutive years 2016- 17; 2017- 18 and 2018-19 respectively in rabi season which were 11.11%. The technology index shows the feasibility of the evolved technology at the farmer's fields and the lower the value of technology index more is feasibility of the technology (Table 3).

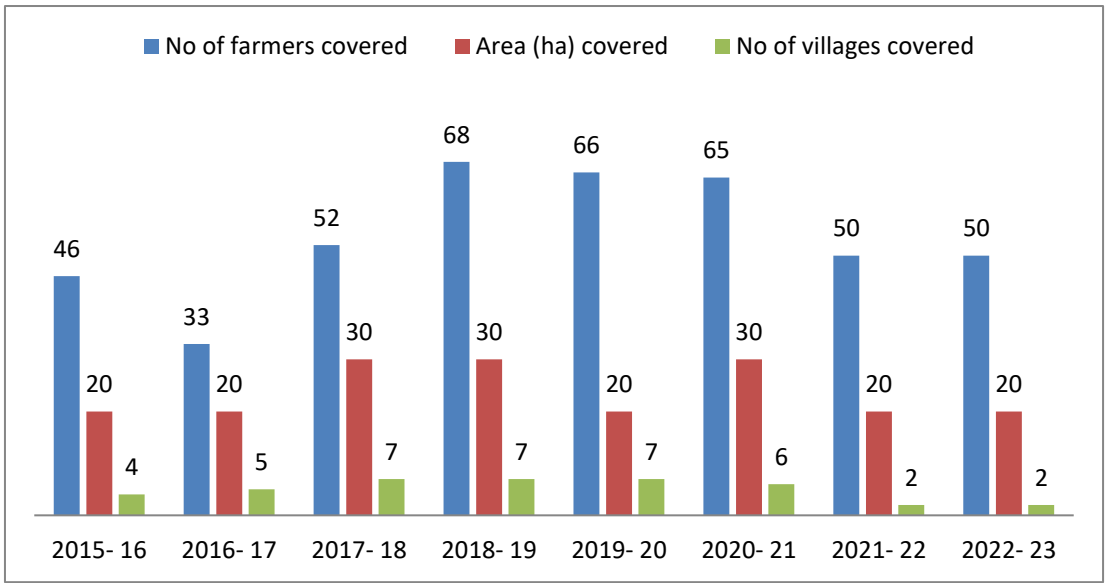


Fig. 2. Year wise farmers, area & villages covered

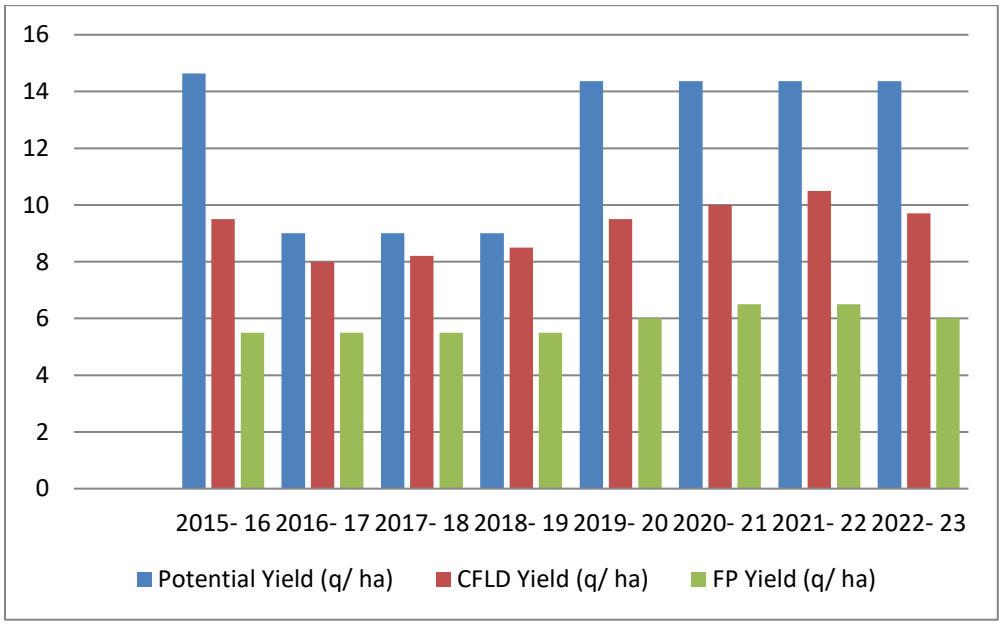


Fig. 3. Year wise yield performance

Table 2. Year wise details of variety, area, demonstrations and villages covered under CFLD on rapeseed- mustard

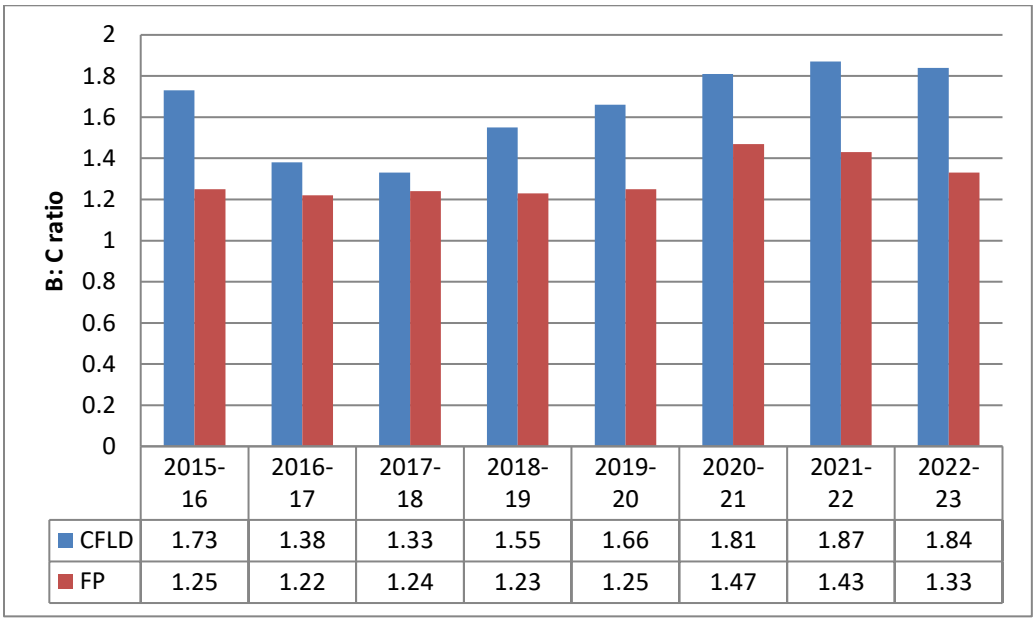
Year	Variety	Source & year of release	No of demo	No of farmers covered	Area (ha) covered	No of villages covered	Name of demo. village
2015- 16	YSH- 401	CCS- HAU, Hisar; 2009	46	46	20	4	RC Ghat, Batapora, Nama para, Chebri
2016- 17	TRC T-1-1-5-1	ICAR (RC) for NEH Region, Tripura Centre; 2014	33	33	20	5	RC Ghat, Batapora, Nama Para, Chebri, Ratia
2017- 18	TRC T-1-1-5-1	ICAR (RC) for NEH Region, Tripura Centre; 2014	52	52	30	7	RC Ghat, Batapora, Nama para, Chebri, Ratia, Ghilatali, Krishna Pur
2018- 19	TRC T-1-1-5-1	ICAR (RC) for NEH Region, Tripura Centre; 2014	68	68	30	7	RC Ghat, Batapora, Nama para, Chebri, Ratia, Nayan Pur, Krishna Pur
2019- 20	NRCHB-101	ICAR- DRMR, Bharatpur, Rajsthan; 2009	66	66	20	7	RC Ghat, Batapora, Nama para, Chebri, Ratia, Nayan Pur, Krishna Pur
2020- 21	NRCHB-101	ICAR- DRMR, Bharatpur, Rajsthan; 2009	65	65	30	6	SinghicherraBatapora, Nama para, Chebri, Ratia, Nayan pur
2021- 22	NRCHB-101	ICAR- DRMR, Bharatpur, Rajsthan; 2009	50	50	20	2	Batapora, Nama para,
2022- 23	NRCHB-101	ICAR- DRMR, Bharatpur, Rajsthan; 2009	50	50	20	2	Batapora, Nama para,
Total	**3**	**-**	**430**	**430**	**190**	**-**	**9**

Table 3. Yield performance and gap analysis of frontline demonstrations of rapeseed- mustard at farmers field from 2015- 16 to 2022- 23

Year	Potential Yield (q/ ha)	CFLD Yield (q/ ha)	FP Yield (q/ ha)	(%) increase over FP	Extension gap (q/ ha)	Technology gap (q/ ha)	Technology index (%)
2015- 16	14.63	9.50	5.50	42.10	4.00	5.13	35.06
2016- 17	9.00	8.00	5.50	31.25	2.50	1.00	11.11
2017- 18	9.00	8.20	5.50	32.93	2.70	1.00	11.11
2018- 19	9.00	8.50	5.50	35.29	3.00	1.00	11.11
2019- 20	14.36	9.50	6.00	36.84	3.50	4.86	33.84
2020- 21	14.36	10.00	6.50	35.00	3.50	4.36	30.36
2021- 22	14.36	10.50	6.50	38.09	4.00	3.86	33.84
2022- 23	14.36	9.70	6.00	38.14	3.70	4.66	32.45
Average	**12.38**	**9.24**	**5.875**	**36.205**	**3.3625**	**3.23375**	**24.86**

Table 4. Economic indicators of cluster frontline demonstrations of rapeseed- mustard at farmers field from 2015- 16 to 2022-23

Year	Cost of cultivation (Rs/ ha)		Gross return (Rs/ ha)		Net return (Rs/ ha)		B: C ratio		Additional Cost (Rs)	Additional net return (Rs)
	CFLD	FP	CFLD	FP	CFLD	FP	CFLD	FP		
2015- 16	24,700	19,800	42,750	24,750	18,050	5050	1.73	1.25	4900	13,000
2016- 17	26,100	20,350	36,000	24,750	9900	4400	1.38	1.22	5750	5500
2017- 18	27,800	20,000	36,900	24,750	9100	4750	1.33	1.24	7800	4350
2018- 19	27,400	22,430	42,500	27,500	15,100	5070	1.55	1.23	4970	10,030
2019- 20	28,670	24,000	47,500	30,000	18,850	6000	1.66	1.25	4670	12,150
2020- 21	30,350	24,300	55,000	35,750	24,650	11,450	1.81	1.47	6050	13,200
2021- 22	30,900	25,000	57,750	35,750	26,850	10,750	1.87	1.43	5900	16,100
2022- 23	31,580	27,100	58,200	36,000	26,650	8900	1.84	1.33	4480	17,750
Average	**28,438**	**22,873**	**47,075**	**29,906**	**18,644**	**7,046**	**1.65**	**1.30**	**5,565**	**11,510**



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
CFLD	1.73	1.38	1.33	1.55	1.66	1.81	1.87	1.84
FP	1.25	1.22	1.24	1.23	1.25	1.47	1.43	1.33

Fig. 4. Benefit cost ratio

4. CONCLUSION

It is concluded that the cultivation of mustard-rapeseed with improved technologies has been found more productive and yield might be average increased up to 36.20 percent. Technology and extension gap extended which can be bridges by popularity package of practices with emphasis of improved variety. The replacement of a variety with a newly released variety will boost production and net profits. The recommended technique was judged to be appropriate because it fits well with the present farming environment and has been positively received by the farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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