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Agro-economic assessment of cluster frontline demonstration on toria in Assam

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Abstract

Demonstration on toria under Cluster Frontline Demonstration on oilseed was conducted in all the six agro climatic zones of Assam covering 26 districts during the last five consecutive years *i.e.* 2018-19 to 2022-23. A total 6923 Cluster Frontline Demonstrations covering 2877.70 ha was conducted in Assam during the study period. Maximum number of demonstrations were conducted in Lower Brahmaputra Valley Zone followed by Upper Brahmaputra Valley Zone whereas, Hill Zone has conducted minimum number of demonstrations. Among the six agro climatic zones, toria recorded highest demonstration yield in Central Brahmaputra Valley Zone followed by Upper Brahmaputra Valley Zone while minimum yield was observed in Hill Zone. In terms of gross and net return, maximum were obtained in Central Brahmaputra Valley Zone followed by Barak Valley Zone. In all the zones, yield of toria under demonstration was higher than that of local check throughout the study period. The pooled average yield of toria in Assam over five years period under demonstration was 9.03 q/ha which was 42.13% higher than the local check. Higher yield of toria under demonstration resulted in more income. The average gross and net return of toria in Assam under demonstration were 43224.00 ₹/ha and 22322.00 ₹/ha respectively with average B:C ratio of 2.06.

Keywords: Cluster frontline demonstration, economic analysis, toria, yield

Introduction

India's agricultural landscape prominently features oilseeds as a major crop, playing a vital role in the country's economy next to cereals. The domestic availability of edible oils were 11.65 million tonnes and import were 14.94 million tonnes during 2021-22 to fulfil the total availability consumption of 25.84 million tonnes (Anonymous, 2023) [1]. This clearly indicates the huge gap between demand and supply due to which the edible oil imports which was around 48% of the total domestic consumption two decades ago is around 55% of the total domestic consumption in 2021-22 (Anonymous, 2023) [1]. Rapid population growth, changing dietary preferences, and the expanding food processing industry contribute to the high demand for edible oils. Despite the highest oilseed output in India's history of 37.96 million tonnes and working towards oilseed self-sufficiency in 2021–22 (Chauhan *et al.*, 2021, Jat *et al.*, 2019) [3, 6], the country is liable to rely on imports.

India, a nation endowed with a wide variety of agro-ecological circumstances, is well-suited to produce all nine annual oilseeds, including seven edible oilseeds: groundnut, rapeseed-mustard, sunflower, sesame, niger, safflower, soybean while castor & linseed as non-edible oilseeds (Thapa *et al.*, 2019) [12]. Among all the nine annual oilseed, rapeseed mustard is the second highest oilseed crop grown in the country and it ranks number one in the North East. In North East also, due to diverse agro-climatic scenario of Assam, it supports growing of all the major oilseeds (Kumar *et al.*, 2023) [8], out of that a significant part is contributed by rapeseed mustard. Despite the smaller area coverage in the year 2020-21, rapeseed mustard has contributed 1.56% of total production of oilseed in the country (Chakrabarty *et al.*, 2021) [2]. Within the rapeseed-mustard, toria is the most commonly grown oilseed due to its early maturity and favourable agro climatic conditions that allow farmers to plant summer crops after the harvest of toria.

Technology Mission on Oilseeds in 1986 which has been converted into a National Mission on Oilseeds and Oil Palm (NMOOP) in 2014 have significantly contributed to the edible oil economy (Kumar *et al.*, 2023) [8]. Further, it has been boosted by the Cluster Frontline Demonstration (CFLD) on oilseeds started by Ministry of Agriculture, Govt. of India, conducted under close supervision of farm scientists (Devi *et al.*, 2023) [5]. The CFLD on oilseeds was started with the objective to increase the production and productivity of oilseeds crops under diverse agro-ecological situations by demonstration & popularization of improved agricultural technology on farmers' fields under varied farming situations. It will lead to effective transfer of generated technologies and fill the gap between improved technology and the indigenous technology of the existing farm situation. Krishi Vigyan Kendra (KVK) were the implementation centre for the CFLD on oil seeds. As the study was undertaken in Assam only, the 26 KVKs of the

state under the close supervision of ICAR-ATARI, Zone VI, Guwahati have demonstrated the improved agricultural technologies at the farmer's field. The study was conducted with the objective to visualize the yield pattern and economics of oilseeds, demonstrated through CFLD in the six agro climatic zones of Assam.

Materials and Methods

Cluster Frontline demonstrations for toria were conducted by 26 KVKs of Assam during 2018-19 to 2022-23 under the supervision of ICAR-ATARI, Zone VI, Guwahati on 2877.70 ha area of Assam covering 6923 number of farmers. Full package of recommended practices were adopted on demonstration plots, whereas, in the adjoining farmers' fields, crop was grown as per the practices followed by the farmers which served as control/local check. The study area covered all the six (6) agro-climatic zones of Assam having the KVK (Table 1). Plot cutting methodology followed by personal interviews were used to gather primary data on yield and economic parameters, farmer practices and other crop related information from the farmers.

Cost of cultivation of toria includes cost of inputs like seeds, fertilizers, pesticides purchased by the farmers (in farmers' practice)/supplied by the KVK (in demonstration plots) as well as hired labour, sowing charges of bullocks/ tractor, post-harvest operation charges paid by the farmers etc. The net return was worked out accordingly by taking cost of cultivation and gross return. Similarly, the benefit-cost ratio (B:C) was worked out as a ratio of gross returns corresponding costs of cultivation.

Table 1: Agro-climatic Zone wise toria growing districts of Assam

Agro Climatic Zones	Name of KVKs/districts
Central Brahmaputra Valley Zone	Morigaon, Nagaon
Lower Brahmaputra Valley Zone	Baksa, Bongaigaon, Chirang, Goalpara, Kamrup, Kokrajhar, Dhubri, Nalbari, Barpeta
North Bank Plain Zone	Darrang, Lakhimpur, Sonitpur, Dhemaji, Udalguri
Upper Brahmaputra Valley Zone	Golaghat, Dibrugarh, Sivsagar, Tinsukia, Jorhat
Hills Zone	Karbi Anglong, Dima Hasao
Barak Valley Zone	Karimganj, Hailkandi, Cachar

Results and Discussion

Area and number of demonstrations conducted on toria under CFLD on oilseed

Demonstration on toria under CFLD on oilseed was conducted in different districts of Assam covering all the six agro-climatic zones of the state. During the last five years i.e. 2018-19 to 2022-23, in the six agro-climatic zones of Assam namely Central Brahmaputra valley zone, Lower Brahmaputra valley zone, North bank plain zone, Upper Brahmaputra valley zone, Hill zone and Barak Valley zone a total of 738, 2802, 1357, 1264, 245 and 517 demonstrations were conducted covering 290 ha, 1093.30 ha, 549.40 ha, 605 ha, 110 ha and 230 ha respectively (Figure 1). It was observed that in Lower Brahmaputra Valley Zone and Upper Brahmaputra Valley Zone, maximum number of demonstrations and area were covered. This is mainly due to more numbers of KVKs i.e. nine under LBNZ and five under UBVZ were included under CFLD on oilseed. Lowest number of demonstrations and area were covered in Hill Zone as only two districts are under this zone.

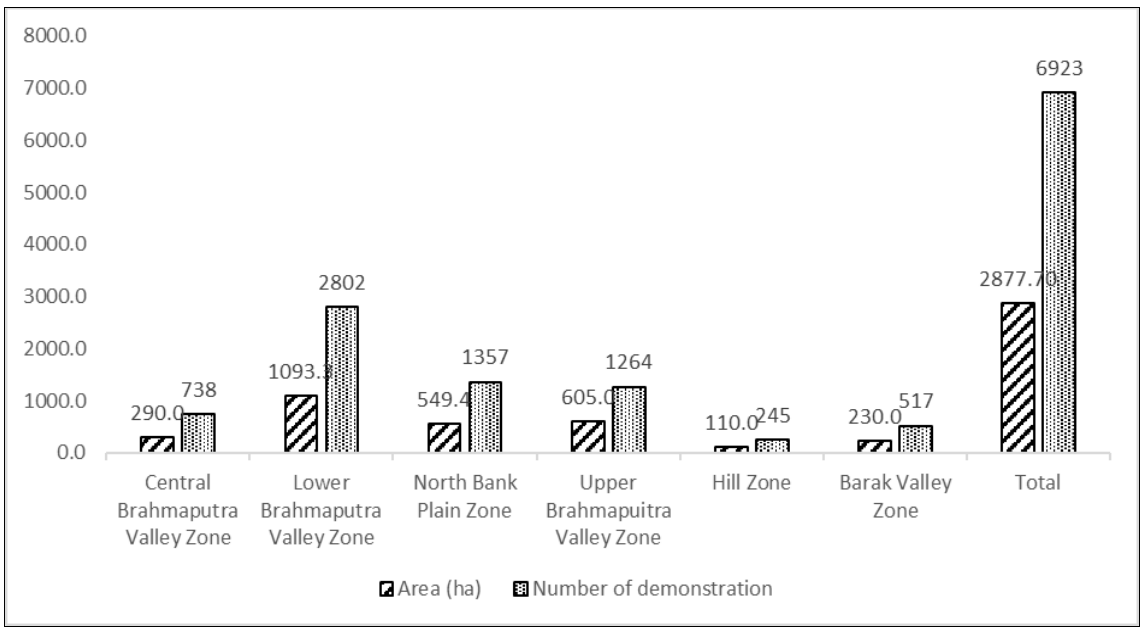

Fig 1: Total Area and number of demonstrations conducted on toria during 2018-19 to 2022-23

Figure 2 depict the year wise number of demonstrations conducted and area covered under demonstration on toria during the last five consecutive years i.e. 2018-19 to 2022-23 in Assam. During 2022-23, maximum number of demonstrations (2446) were conducted covering an area of 1000 ha. In the year, 2018-19 various schemes related with the NFSM and oilseeds providing input subsidy and incentives have been merged with the revamped NFSM. This gave a thrust to Government's efforts for augmenting the production of oilseeds. Number of demonstrations and area coverage was comparatively less during 2019-20 and 2020-21 due to covid pandemic. During 2021-22, the area and demonstrations were reduced due to the budget constraints of government, whereas during 2022-23 sufficient budget has been allocated due to which the number and area of demonstrations has been increased.

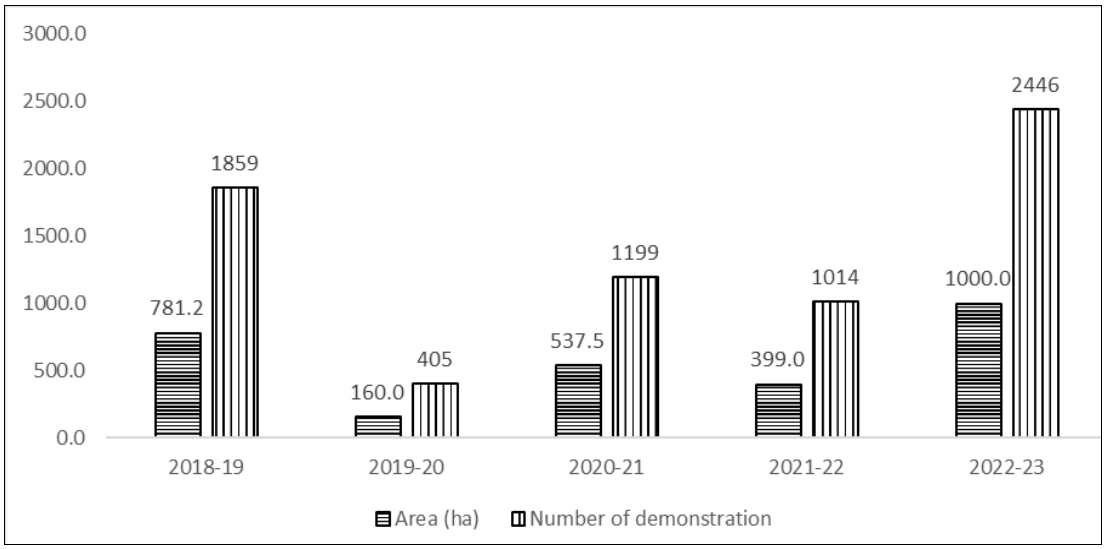

Fig 2: Year wise area and number of demonstrations conducted on toria in Assam

Yield and economics of toria in Central Brahmaputra Valley Zone

In Central Brahmaputra Valley Zone, the pooled average yield of toria over five years under demonstration was 9.82 q/ha which was 55.26% more than local check (Table 2). The yield of toria under demonstration ranged from 7.64 q/ha during 2020-21 to 11.47 q/ha during 2018-19. Average gross return under demonstration was 51090.00 ₹/ha as compared to 33649.00 ₹/ha in local check. Average net return under demonstration was 28464.00 ₹/ha which was 110.68% higher than local check and B:C ratio of 2.22 was recorded under demonstration (Figure 3). This yield enhancement was mainly due to the adoption of high yielding variety along with improved package of practice. Regional Agriculture Research Station (RARS), Shillongani, Nagaon, Assam, specialized in oilseed and one of coordinating centres under All India Coordinated Research Project on Rapeseed-Mustard (AICRP-RM) working under ICAR-DRMR has contributed significantly in providing the quality seeds as well as the capacity building of the progressive farmers and extension personnel which resulted in the yield enhancement of the zone. The yield enhancement under demonstration was also reported by Kumar *et al.* (2023) [8].

Table 2: Yield and economics of toria in Central Brahmaputra Valley Zone

Central Brahmaputra Valley Zone												
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	7.38	11.47	55.42	17450	18916	25805	41928	8355	23012	1.48	2.22
2019-20	5.50	9.00	63.64	18500	19750	21400	27585	2900	7835	1.16	1.40
2020-21	4.71	7.64	62.21	20168	24917	30453	54667	10285	29750	1.51	2.19
2021-22	7.05	10.86	54.04	21593	24640	44989	68263	23396	43623	2.08	2.77
2022-23	7.17	10.11	41.00	22983	24906	45599	63008	22616	38102	1.98	2.53
Average	6.36	9.82	55.26	20139	22626	33649	51090	13510	28464	1.64	2.22

Yield and economics of toria in Lower Brahmaputra Valley Zone

The pooled average yield of toria over five years was found to be 9.25 q/ha which was 29.17% higher than local check (7.16 2/ha) in Lower Brahmaputra Valley Zone of Assam (Table 3). The maximum yield of toria (10.02 q/ha) under demonstration was observed during 2022-23 and minimum yield (8.43 q/ha) was observed during 2019-20. The average gross return, net return and B:C ratio under demonstration were 44630.00 ₹/ha, 22728.00 ₹/ha and 2.04 respectively which were comparatively higher than local check. The average net return under demonstration was 61.66% more than local check (Figure 3). The higher net return under demonstration was due to harvest of more yield. The yield enhancement through adoption of improved farm technology has also been reported in earlier studies of FLDs' (Vedna, 2007, Sharma *et al*., 2012, Choudhary *et. al.*, 2009 and Kumar *et al.*, 2017) [13, 10, 4, 9].

Table 3: Yield and economics of toria in Lower Brahmaputra Valley Zone

Lower Brahmaputra Valley Zone												
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	7.39	9.28	25.58	18000	19438	29396	36795	11396	17357	1.63	1.89
2019-20	7.23	10.02	38.59	18563	20500	30514	46161	11951	25661	1.64	2.25
2020-21	7.49	9.63	28.57	21091	22351	39510	49395	18419	27044	1.87	2.21
2021-22	6.93	8.90	28.43	21292	23006	38254	47749	16962	24743	1.80	2.08
2022-23	6.76	8.43	24.70	21528	24215	33093	43049	11565	18834	1.54	1.78
Average	7.16	9.25	29.17	20095	21902	34153	44630	14059	22728	1.70	2.04

Yield and economics of toria in North Bank Plain Zone

In North Bank Plain Zone, the average yield obtained under check and demonstration were 8.89 q/ha and 6.76 q/ha respectively and per cent increase in yield under demonstration is 31.62 (Table 4). Maximum yield (9.21 q/ha) under demonstration was recorded during 2022-23 and minimum yield (8.70 q/ha) during 2020-21. The average gross return, net return and B:C ratio under demonstration were 35819.00 ₹/ha, 17974.00 ₹/ha and 2.01 respectively. The per cent increase in net income over check was 71.36% (Figure 3). Variations in the gross and net returns during the study period may be attributed to the variable performance of toria in different years. Similar kind of finding was also reported by Kumar *et al.* (2017) [9].

Table 4: Yield and economics of toria in North Bank Plain Zone

North Bank Plain Zone											
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	6.97	8.89	27.55	17250	18342	24858	35524	7608	17182	1.44	1.94
2020-21	6.62	8.70	31.42	17298	19273	27398	38360	10100	19087	1.58	1.99
2021-22	6.43	8.74	35.93	17020	18637	30729	38154	13709	19517	1.81	2.05
2022-23	7.00	9.21	31.57	11273	15128	21811	31237	10538	16109	1.93	2.06
Average	6.76	8.89	31.62	15710	17845	26199	35819	10489	17974	1.69	2.01

Yield and economics of toria in Upper Brahmaputra Valley Zone

The pooled average yield of toria over the study period of five years in Upper Brahmaputra Valley Zone under demonstration was 9.80 q/ha which was 48.11% higher than local check (Table 5). The yield of toria under demonstration ranged from 9.06 q/ha during 2022-23 to 10.51 q/ha during 2021-22. The average gross return, net return and B:C ratio under demonstration were 39258.00 ₹/ha, 18648.00 ₹/ha and 1.91 respectively which were comparatively higher than check. Average net income under demonstration was 100.32% higher than check (Figure 3).

Table 5: Yield and economics of toria in Upper Brahmaputra Valley Zone

Upper Brahmaputra Valley Zone											
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	6.81	9.70	42.44	15800	19538	22578	33973	6778	14435	1.43	1.74
2019-20	7.49	10.48	39.92	18850	23500	28780	42727	9930	19227	1.53	1.82
2020-21	6.30	9.26	46.98	15916	19389	27306	40608	11390	21219	1.72	2.09
2021-22	6.49	10.51	61.94	16081	19038	26849	39929	10768	20891	1.67	2.10
2022-23	6.07	9.06	49.26	17948	21584	25626	39051	7678	17467	1.43	1.81
Average	6.63	9.80	48.11	16919	20610	26228	39258	9309	18648	1.56	1.91

Yield and economics of toria in Hill Zone

In Hill Zone of Assam, the average demonstration yield of toria over the five years study period was 7.71 q/ha as compared to 5.56 q/ha under local check (Table 6). Maximum yield (8.34 q/ha) under demonstration was recorded during 2018-19 and minimum yield (7.12 q/ha) during 2020-21. The average gross return, net return and B:C ratio under demonstration were 35186.00 ₹/ha, 16879.00 ₹/ha and 1.96 respectively which were comparatively higher than those of check (20926.00 ₹/ha, 6670 ₹/ha and 1.51). The average net income was 153.06% more than that of check (Figure 3).

Table 6: Yield and economics of toria in Hill Zone

Hill Zone											
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	5.60	8.34	48.93	16550	19050	20044	34860	3494	15810	1.21	1.83
2020-21	5.50	7.12	29.45	11000	13500	21166	31875	10166	18375	1.92	2.36
2021-22	5.54	7.36	32.85	13894	19212	21470	35425	7576	16213	1.55	1.84
2022-23	5.59	8.00	43.11	15579	21467	21024	38584	5445	17117	1.35	1.80
Average	5.56	7.71	38.59	14256	18307	20926	35186	6670	16879	1.51	1.96

Yield and economics of toria in Barak Valley Zone

In Barak Valley Zone of Assam, average yield of toria under demonstration was 8.22 q/ha as compared to that of check 5.65 q/ha (Table 7). The yield of toria under demonstration ranged from 7.44 q/ha during 2020-21 to 8.95 q/ha during 2022-23. The average gross return, net return and B:C ratio under demonstration were 51357.00 ₹/ha, 28394.00 ₹/ha and 2.22 respectively which was higher than those of local check. The average net income was 50.82% more than that of check (Figure 3).

Table 7: Yield and economics of toria in Barak Valley Zone

Barak Valley Zone												
	Yield (q/ha)		% increase in yield over check	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Check	Demo		Check	Demo	Check	Demo	Check	Demo	Check	Demo
2018-19	5.98	8.42	40.80	15480	20621	28850	43249	13370	22628	1.86	2.10
2019-20	6.09	8.38	37.60	14637	20150	31987	45590	17350	25440	2.19	2.26
2020-21	4.99	7.44	49.10	20183	22853	41475	52147	21292	29294	2.05	2.28
2021-22	5.00	7.93	58.60	19933	23767	35650	45800	15717	22033	1.79	1.93
2022-23	6.20	8.95	44.35	24588	27425	50994	70000	26406	42575	2.07	2.55
Average	5.65	8.22	46.09	18964	22963	37791	51357	18827	28394	1.99	2.22

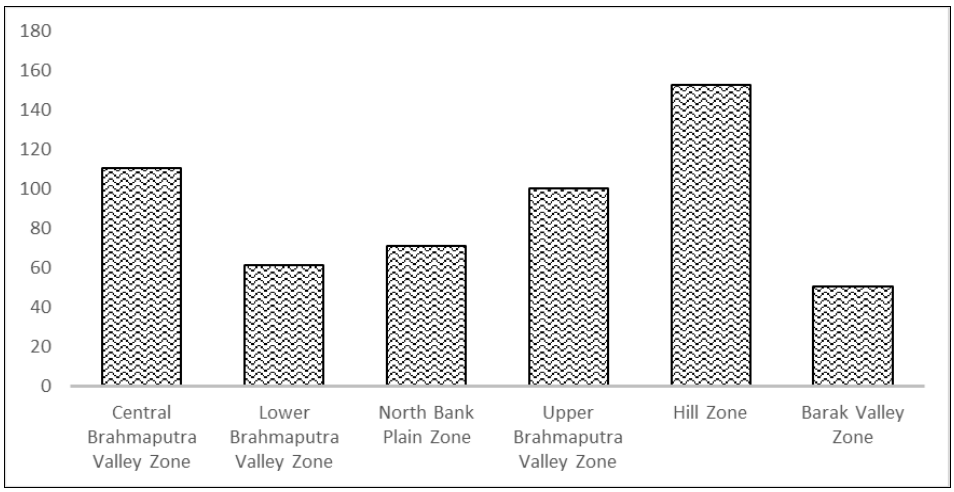

Fig 3: Per cent increase in average net income over check

Comparison of yield and economics of toria in different agro-climatic zones of Assam

From the study, it was cleared that toria gave higher yield in Central Brahmaputra Valley Zone followed by Upper Brahmaputra Valley Zone and minimum yield was recorded in Hill Zone (Figure 4). Maximum gross and net return was obtained in Central Brahmaputra Valley Zone followed by Barak Valley Zone (Figure 5). Overall, economic analysis data inferred that demonstration of improved technology for toria cultivation resulted in the farmer's income enhancement leading to better livelihood status of farmers.

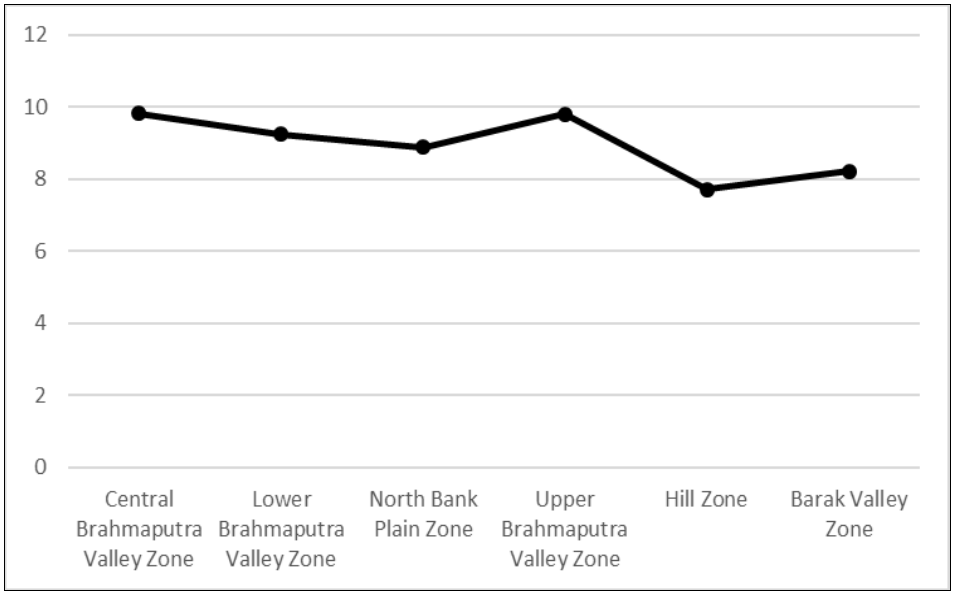

Fig 4: Average yield of toria (q/ha) under demonstration over five years i.e. 2018-19 to 2022-23 in different zones

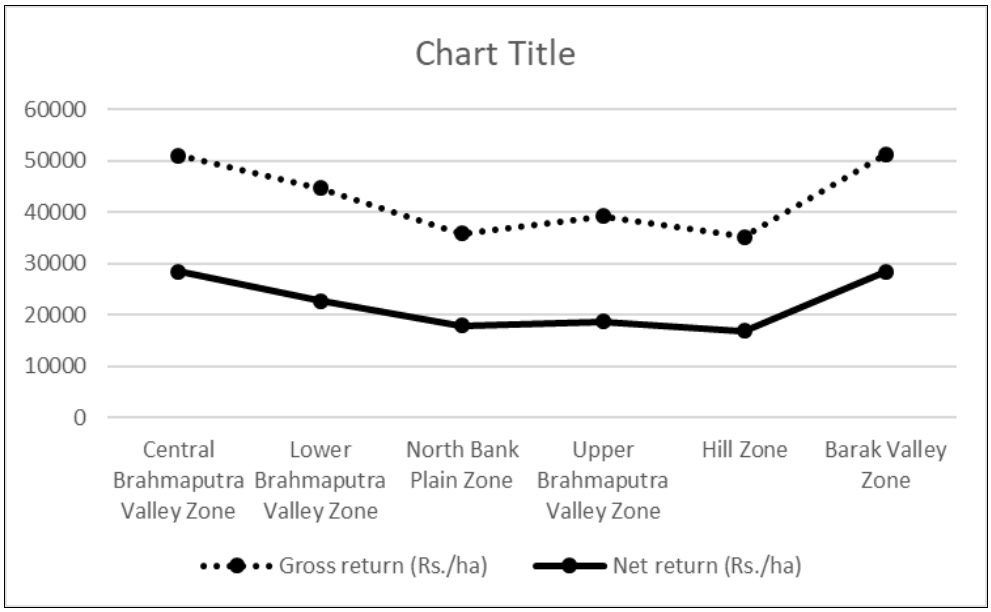

Fig 5: Gross and net return of toria demonstration over five years i.e. 2018-19 to 2022-23 in different zones

Yield and economics of toria in Assam

During the study period of five years i.e. 2018-19 to 2022-23, the average yield of toria under demonstration was 6.38 q/ha which was 42.13% higher than local check (Figure 4). The low yield of toria under local check was due to use of local cultivars, non-availability of quality seeds on time, delay in sowing of toria in rice fallow due to late harvesting of long duration rice varieties, lack of irrigation facility, etc. The average gross and net return under check and demonstration were 30132.00 ₹/ha, 43224.00 ₹/ha and 12274.00 ₹/ha, 22322.00 ₹/ha respectively (Figure 5). The average B:C ratio under check and demonstration were recorded to be 1.68 and 2.06 respectively. The positive effect on yield under demonstration was due to use of improve variety of toria along with adoption of improve crop management practices. Jha *et al*. (2021) [7] and Kumar *et al*. (2023) [8] also reported similar yield enhancement in rapeseed and mustard under cluster frontline demonstration. The higher gross and net return under demonstration due to more yield under demonstration as compared to local check indicates the economic feasibility of the adopted improved technology.

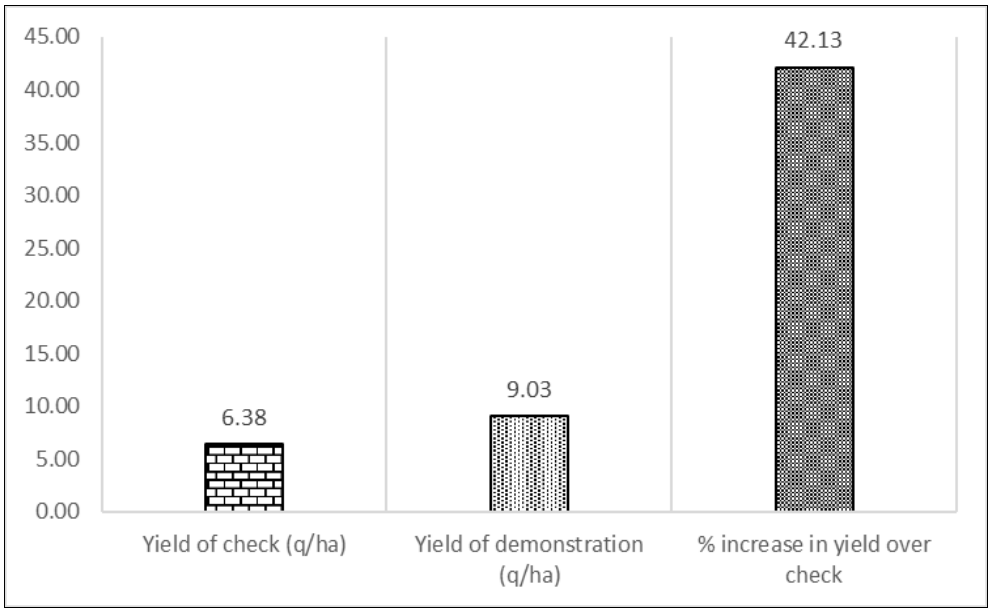

Fig 6: Yield of toria average over five years i.e. 2018-19 to 2022-23 in Assam

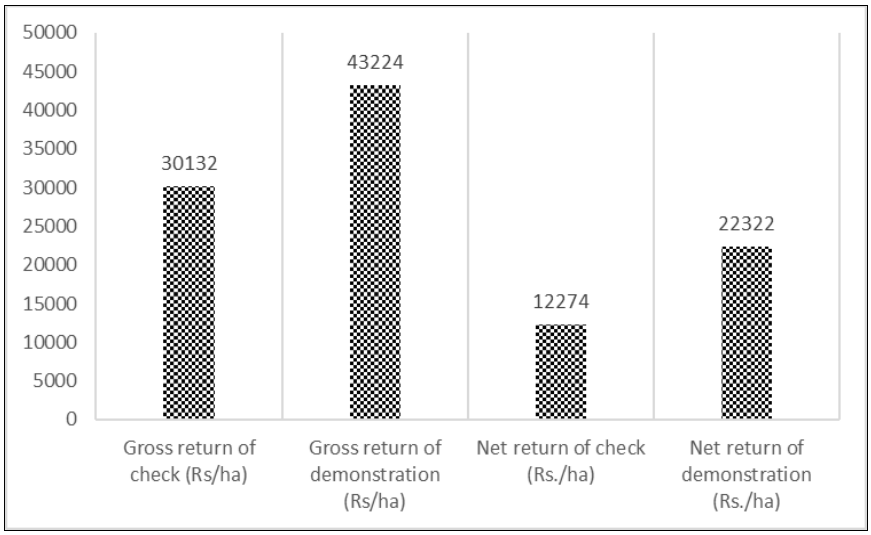

Fig 7: Economics of toria average over five years i.e. 2018-19 to 2022-23 in Assam

The agro-climatic situation of Assam supports to grow the toria across the agro-climatic zone of the state. Toria is one of the oilseed having the potential to fill the rice fallow area. The CFLD on oilseeds has given the ample opportunity to showcase the yield potential of toria to the various stakeholders. The yield gap between the demonstration and local check were low, moderate or high across the agro-climatic zones of Assam during the last five years. Based on the yield gap scenario, the policy makers can use the agro-climatic zone wise strategy for augmenting the oilseed production in the state.

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