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Cluster frontline demonstrations envisage high productivity and horizontal spread of oilseeds in aspirational District Moga, Punjab

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Abstract

Cluster frontline demonstrations, which involve showcase the performance of improved production technologies of field crops in comparison to farmers' practices, is one of the ventures taken up by Government of India. In this regard, Krishi Vigyan Kendra, Budh Singh Wala, Moga, Punjab conducted demonstrations of oilseeds during 2019-20, 2020-21, 2021-22 and 2022-23. Out of all the farmers where demonstrations were laid down, 15 farmer locations were randomly selected to collect data for statistical analysis which was performed in the randomized complete block design with 15 replications. As there were only two treatments (FLD and FPP), so the number of replication was increased to maintain the high error degree of freedom i.e., >10. Furthermore, a survey was also conducted in the year 2022-23 for the impact assessment in terms of adoption and horizontal spread of improved production technologies that were demonstrated during the preceding years. The results revealed that demonstration plots registered 22.70, 26.50, 26.28% higher grain yield during 2019-20, 2020-21 and 2021-22, respectively. Increase in grain yield by adopting resource efficient technologies resulted in better B: C in demonstration plots than FPP during all the years. For example, demonstrations plots recorded B: C of 2.54 and 2.49 during 2020-21 and 2021-22, respectively, in comparison to 1.86 and 1.90 FPP. Indices like extension gap ranged from 3.83 to 4.4 among the years which clearly depict the superiority of improved production technologies relative to farmers' cultivation practices. The value of technology gap was lesser than 2 during all the years except during 2021-22 (2.55). It shows that during 2021-22, either farmers showed lesser cooperation in following improved production technology or there may be prevalence of unfavourable weather conditions. Weather data recorded during the February and March shows hike in ambient temperature during this period which affected the grain filling process in oilseed which in turn decreased the grain yield relative to potential yield. During the year 2020-21, demonstrations recorded 4.55 technology index but during 2021-22, the value of technology index was 11.46. Lower value of technology index indicates more viability of adoption of oilseeds in the district. Increase in technology index during 2021-22 can be attributed to increase in ambient temperature at grain filling period which decreased the grain yield. Results of the survey for impact assessment showed an overall adoption of improved production technologies to the extent of 31.08%. An overall horizontal spread of 29.64% of improved technologies was recorded in the survey. Relative to the area under oilseeds in 2018-19, an increase of 133.33% has been reported in the district during 2022-23. Out of 100farmers, 87 farmers cultivate oilseeds due to better market price followed by 73 farmers who started cultivation due to availability of high yielding varieties. Out of 100 farmers, cultivate oilseeds to sell the produce directly in the open market followed by 82 who also keep some quantity for domestic use. Less number of farmers who prefer processing of oilseeds (6) clearly shows the requirement and scope of awareness and training activities of farmers in this context so that they can earn more profit.

Keywords: Oilseed crops, cluster frontline demonstrations, B: C, survey, impact assessment

1. Introduction

Oilseeds can be described as packs of nutrition due to their richness in oil content, saturated and unsaturated fatty acids, vitamins, and minerals. Oilseeds are not only an important part of human diet, but also essentially act in the industry related to a variety of items like paints, textiles, soap, hair oils, etc. While processing of the oilseeds such extraction of oil, the byproduct i.e., oilcakes, is used as nutrient rich animal feed and manure. India has 19% of total area and 2.7% of total global production of oilseeds, due to which these crops are always kept at position two after the cereals in terms of determining the economy of Indian agriculture. India is at number 4 after USA, China and Brazil in terms of area (20% of the world), productivity, total production (10% of the world) of oilseeds (Reddy and Immanuelraj, 2017) [4]. In India, total oilseed are cultivated on an area of 271.39 lakh ha with productivity of 12.24 q/ha and total production of 332.19 lakh tonne. In Punjab, total oilseed are cultivated on an area of 0.4 lakh ha with productivity of 14.72 q/ha and total production of 0.58 lakh tonne (Anonymous, 2020) [1]. Out of total oilseeds, rapeseed mustard is cultivated on an area of 0.31 lakh ha with productivity of 15.95 q/ha and total production of 0.50 lakh tone (Anonymous, 2022a) [2]. In district Moga, rapeseed mustard is grown on an area of 600 ha with productivity of 17.66 q/ha and total production of 1100 MT (Anonymous, 2022b) [3]. An array of agro-ecological conditions in India provides avenues for successful cultivation of edible oilseeds namely groundnut, mustard, sunflower, sesame, Niger, safflower and soybean. In India, oilseeds are mainly cultivated in rainfed conditions (70%). With passage of time, mustard crop has faced deceleration in area by 0.3% in India. It mainly occurred due to availability of assured irrigation facility and fertilizer supply which lures farmers to go for cultivation of alternate crops like paddy, wheat, potato etc. Therefore, meeting the oilseed demands growing local population has become is a challenge for agriculture research and extension system. Simultaneously, formulation of farmer friendly policies for promotion of oilseed production and processing is also need of the hour. At the same time, there lies a difference between the potential yield and the productivity level achieved by the farmers due to non-adoption or partial adoption of recommended package of practices. Poor knowledge about recently released crop production technologies and their application at the farmers' fields is one of the constraints in realizing better oilseed production. Therefore, improving the technical competency of farmers plays critical role in improving acreage and productivity of rapeseed mustard. One of the initiatives carried out by GOI is conducting cluster frontline demonstrations of oilseed crops at the farmers' fields with an objective to promote the improved crop production technologies under different farming situations. Frontline demonstrations work on the basis of principle of 'learning by doing' concept. Improved technology can be a latest variety having high yield potential, nutrient management, plant protection technique etc. that helps improvise monetary benefits of the farmers without harming the ecology of the locality. The demonstration plots of improved technology and farmer's practice are maintained parallel to each other and the results of both the plots are compared. The performance of the frontline demonstrations need to be assessed through various techniques like extension gap, technology gap etc. that helps in identification of growth factors or areas which need more emphasis for further improvisations. The Krishi Vigyan Kendra, Budh Singh Wala, Moga, Punjab also undertakes the cluster frontline demonstrations of oilseeds and other crops. The present analytical study was undertaken to evaluate the performance of frontline demonstrations of rapeseed mustard conducted from 2019-20 to 2022-23 relative to farmers' practices in the district.

Methodology's

The present analytical study was undertaken to evaluate the effectiveness of front-line demonstrations of oilseeds in terms of crop productivity and net returns of the farmers relative to the farmers' practices. The demonstrations were conducted carried out in operational area of Krishi Vigyan Kendra (KVK), Budh Singh Wala, Moga, Punjab during the year 2019-20, 2020-21 and 2022-23. The year wise details of the frontline demonstrations such as crop, variety and potential yield of crops are given in Table 1.

Table 1: Number of frontline demonstrations of oilseeds laid out in the District and potential yield of crops

S No	Year	Crop	Variety	Number of Demonstrations	Potential yield (q/ha)
1	2019-20	Gobhi Sarson	GSC 7	70	22.25
2	2020-21	Gobhi Sarson	PGSH 1707	43	22.0
3	2021-22	Gobhi Sarson	GSC 7	75	22.25
4	2022-23	Gobhi Sarson	GSC 7	75	22.25
		Raya Sarson	RLC 3	225	18.25

While conducting demonstrations, farmers were guided for improved production technologies (Table 2) through training camps, farm literature and personal contact.

Table 2: Details of farmers' practices (FPP) and intervention in demonstration plot

Particulars	FPP	FLD
Variety	Local	Improved variety
Time of sowing	November	As per recommendation
Method of sowing	Broadcasting	Line sowing
Seed rate (kg/ha)	2.5	3.75
Thinning and gap filling	No	At 25-30 DAS
Nutrient management (kg/ha)	Nitrogen-115 kg/ha Phosphorus- 57.5 kg/ha Source- Urea and DAP	Nitrogen-100 kg/ha Phosphorus- 30 kg/ha Source- Urea and SSP
Weed management	Use of non-recommended herbicides	Hand weeding at 3-4 weeks after sowing
Pest and disease management	Use of insecticides	Adoption of Integrated pest management (IPM) approach

At each farmer field, a check plot containing farmers' practices was maintained parallel to the demonstration plot. All the demonstrations were regularly visited by KVK scientists especially to supervise the critical farm operations and crop health. Extension activities like group meetings and field days were organized at the demonstration site with an objective to spread the outcomes of the technology among other farmers of the area. The data regarding crop yield, cost of cultivation, gross returns etc. were collected from both demonstration and check plots which were further used to calculate various indices and ratios (Samui *et al*., 2000) [5] as given below:

Extension gap = Demonstration Yield - Farmers yield

Technology gap = Potential yield - Demonstration yield

Technology index= Technology gap/Potential yield × 100

The adoption and horizontal spread of improved technologies was assessed by conducting a survey of 100 farmers during year 2023-24 with help of a well-constructed questionnaire. The data related to reasons and purpose behind cultivation of oilseeds was also collected in the survey. The impact of demonstrations in terms of adoption level and horizontal spread was calculated by using following formulae:

$$\text{Impact in terms of adoption} = \frac{\text{No. of adopters after demon.} - \text{No. of adopters before demon.}}{\text{No. of adopters before demon.}} \times 100$$

$$\text{Impact in terms of hortizontal spread} = \frac{\text{Area after demo. (ha)} - \text{Area before deom. (ha)}}{\text{Area before deom. (ha)}} \times 100$$

Out of all the farmers where demonstrations were laid down, 15 farmer locations were randomly selected to collect data for statistical analysis. The statistical analysis was performed in the randomized complete block design with 15 replications. As there were only two treatments (FLD and FPP), so the number of replication was increased to maintain the high error degree of freedom i.e., >10.

Economic analysis of both demonstration as well as check plots was performed to check the economic viability and profitability of the technologies demonstrated. Benefit: cost ratio was derived by calculating the cost of cultivation, gross returns, net returns.
B: C= Net returns/Cost of cultivation

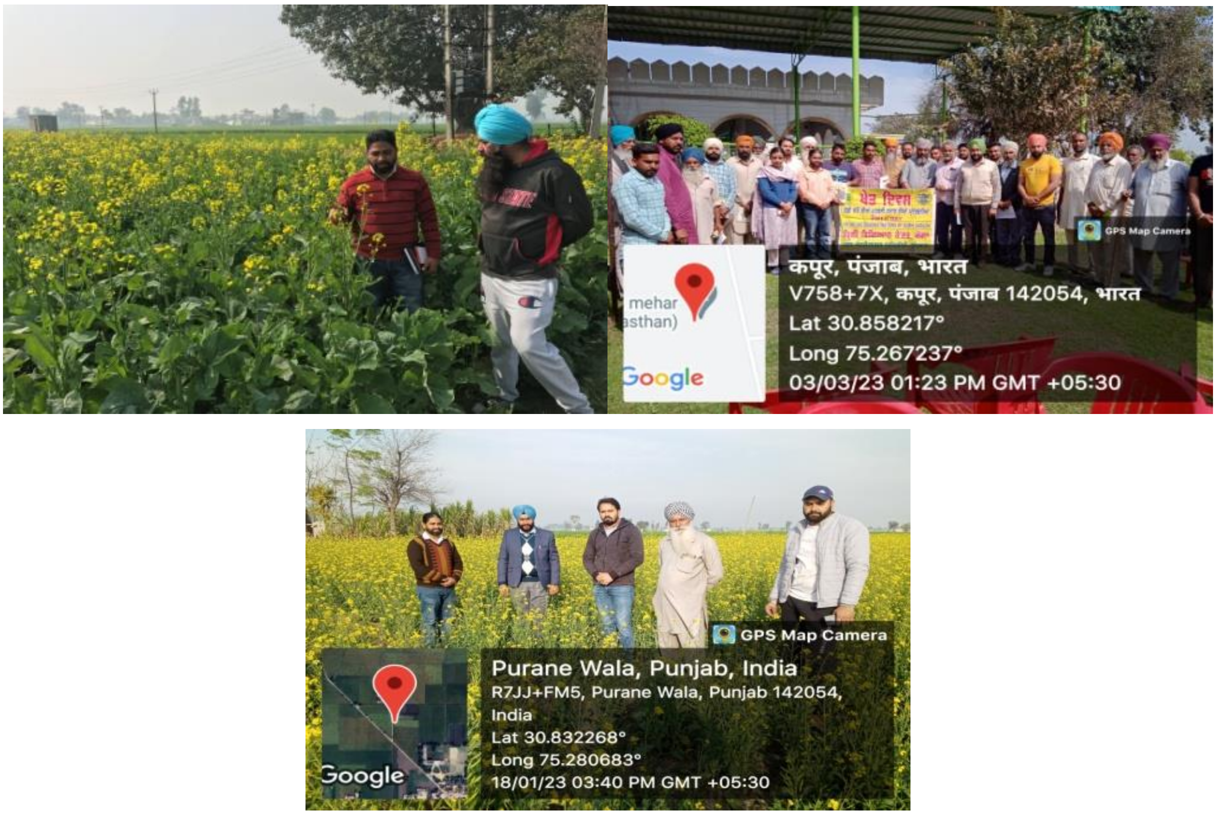


Fig 1: Glimpses of extension activities carried by the KVK Moga

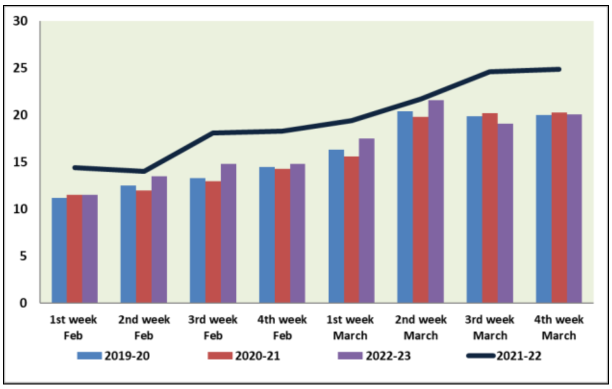


Fig 2: Average Temperature and rainfall during the month of February and March

Results and Discussions

Grain yield

Compilation of data on performance of demonstration plots and local practices (Table 3) revealed that improved technologies recorded an enhancement in grain yield of oilseeds in comparison to farmers' practice. For instance, during the year 2019-20, demonstration plot recorded 22.70% higher and significantly different grain yield than farmers' practice. Similar results were recorded in the consecutive years where improved production technology in the demonstration plot out-yielded the farmers' practice. The increase in grain yield in demonstration plots can be attributed to use of improved variety, suitable seed rate and method of sowing, integrated nutrient and pest management practices, which in turn, helped in overall growth and development of crop. In contrast, use of local cultivar, non-judicious use of fertilizers, pesticides, and irrigation water resulted in poor performance of FPP. Results show the significance of conducting demonstrations at farmers' field by which the actual benefits and prospects of any technology can be assessed under real and existing weather conditions. High grain yield of oilseed crops in demonstration plots is in line with Poonia and Pithia (2011) [10], Patel *et al*. (2013) [8] and Raj *et al*. (2013) [11].

Table 3: Productivity of oilseed crops in demonstrations (FLD) and farmers' practices (FPP)

Treatment	2019-20	2020-21	2021-22	2022-23	
				Gobhi Sarson	Raya Sarson
FLD	20.7	21.00	19.70	21.09	17.52
FPP	16.87	16.60	15.6	16.79	15.60
CD	1.73	1.7	1.69	1.92	1.51
CV	11.67	11.43	12.1	12.82	11.54
Change over FPP (%)	22.70	26.50	26.28	25.61	12.31

Benefit-Cost Ratio (B: C)

Economic analysis of any factor or enterprise elaborates the financial liabilities as well as assets emerging as an output of the system. As it is directly describes the avenues of monitory gains or losses, so the economics of the any crop production programme is the major driving force for wide spread adoption. Compilation of data (Table 4) revealed that demonstration of improved variety along with better production technology recorded significantly higher B: C in comparison to farmers' practice. For example, during 2021-22 demonstration plot registered 1.05% higher B: C relative to farmers' practice. From the data it can be concluded that cultivation of improved variety of oilseed crop with refined production technologies such as thinning and gap filling, use of suitable fertilizers, integrated pest management etc. helps enhance the seed yield, reduce the cost of cultivation, better net returns, in turn, high B:C. Farmers in the district can go for adoption of the improved variety in combination with site specific production practices to have enhanced monetary returns as compared to conventional practices.

Table 4: Benefit-cost ratio of frontline demonstrations and farmers' practices

Treatment	2019-20	2020-21	2021-22	2022-23	
				Gobhi Sarson	Raya Sarson
FLD	2.49	2.54	2.49	2.67	3.00
FPP	1.97	1.86	1.90	1.79	1.87
CD	0.17	0.16	0.21	0.19	0.23
CV	9.74	9.32	11.04	10.49	11.77
Change over FPP (%)	26.40	36.56	31.05	49.16	60.43

Performance Indices

Extension gap indicates the extent of farmers' education and need for dissemination of information regarding the given technology. More value of extension gap depicts high level of difference between performance of farmers' practice and technology practised in the demonstration and vice-versa. The compilation of data (Table 5) revealed that extension gap ranged from 3.83 to 4.4 among the years which clearly depict the superiority of improved production technologies relative to farmers' cultivation practices. High value of extension gap demonstrates that farmers of the block have lower level of awareness, less technical know-how, less exposure to improved technologies due to which their local practices could not perform better in contrast to the technologies followed in the demonstrations. It further shows requirement to concentrate the extension activities or awareness programmes to educate the farmers so as to enhance their competence to follow improved package of practices (Singh and Singh, 2020) [13]. The intensification of activities is required to uplift the farmers' skills in the context of improved production technology of all the crops. Technology gap indicates the level of cooperation showed by the farmers in adoption and use of new technology practised in the demonstration. More value of technology gap depicts lesser interest showed by farmers in practising the improved technology, poor performance of improved technology that can be due to weather variability, region specific problem, which widens the difference between potential yield and yield obtained in demonstration plot. In case of oilseed demonstrations (Table 5), the value of technology gap was lesser than 2 during all the years except during 2021-22 (2.55). It shows that during 2021-22, either farmers showed lesser cooperation in following improved production technology or there may be prevalence of unfavourable weather conditions. Weather data recorded during the February and March shows hike in ambient temperature (Figure 2**)** during this period which affected the grain filling process in oilseed which in turn decreased the grain yield relative to potential yield. At the same time, there is need to convince the farmers regarding the production technology of oilseeds like thinning, gap filling, fertilizer management, irrigation requirement etc. There is need to have crop specific, variety specific, region specific packages of practices to enhance the performance of improved technologies of the oilseeds, and planning and execution of extension activities to bridge the gap between potential and demonstration yield (Dash *et al*., 2021) [7]. These findings are similar to the findings of Patel *et al*., (2013) [8].

Table 5: Performance indices of frontline demonstrations of oilseeds in district Moga

Extension Gap				
Crop	**2019-20**	**2020-21**	**2021-22**	**2022-23**
Gobhi Sarson	3.83	4.4	4.1	4.3
Raya Sarson	-	-	-	1.92
Technology Gap				
Gobhi Sarson	1.55	1.00	2.55*	1.16
Raya Sarson	-	-	-	0.73
Technology Index				
Gobhi Sarson	6.97	4.55	11.46*	5.21
Raya Sarson	-	-	-	4.00

*Heat stress

Technology index indicates the feasibility of any technology for cultivation or adoption in a given locality. More value of technology index shows lower possibility of adoption at farmers' fields and vice-versa. Less value in a given location indirectly shows importance of promotional activities in those areas to improve performance and adaptability to existing conditions so that the given technology becomes ecologically and economically viable. For example, during the year 2020-21, demonstrations recorded 4.55 technology index but during 2021-22, the value of technology index was 11.46. Lower value of technology index indicates more viability of adoption of oilseeds in the district. Increase in technology index during 2021-22 can be attributed to increase in ambient temperature at grain filling period (Figure 2) which decreased the grain yield. At the same time, higher value also indicates the need of farmer education and training programmes on regular basis to create awareness among the farmers regarding improved production technology and climate smart technologies to cope up the harmful effect of climate vagaries like increase in temperature. The high value of technology index can be attributed to the unfavorable weather conditions (Pawar *et al*, 2018) [9]. The results of the present study are in accordance with the findings of Bar and Das (2015) [6].

Impact assessment of frontline demonstrations (survey)

Frontline demonstrations are conducted to exhibit the superiority of any technology in contrast to local practices. The good results of the improved technology are presented in the form of increased yield, enhanced efficiency, improved B: C etc. Afterwards, it is worthwhile to assess the impact of demonstrations in terms of adoption of that technology by the farmers of the region. The impact can be evaluated in terms of relative change in number of farmers and change in area under that given technology. Compilation of survey data (Table 6) revealed that out of all the production technologies, highest percentage (52.22%) of farmers adopted improved variety of the oilseeds followed by date of sowing (30.83%) and method of sowing (27.89%). Adoption of improved variety by more number of farmers indicates the importance of promising genotypes in realization of better grain yield and their adoption at farmers' field. An overall impact of improved production technologies to the extent of 31.08% was recorded in the survey. Singh and Sharma (2018) [12] also observed an increase in adoption level and horizontal spread of cumin cultivation through frontline demonstrations. Data pertaining to% adoption of technologies in terms of area (Table 6) showed that more acreage was recorded in adoption of improved variety (43.61%) followed by date of sowing (31.59%) and integrated pest management practices (25.39%). An overall adoption of 29.64% was recorded in the survey. Furthermore, the data regarding year wise acreage under oilseed crops in the district show an increase in area under cultivation. A sudden hike in area under cultivation was there during the year 2022-23. The year wise increase in area under oilseed crops in the district can be attributed to better awareness among farmers, high yielding ability of improved varieties, better market price etc.

Table 6: Impact of frontline demonstrations (in terms of number of farmers) on adoption of improved technologies

S No	Technology	% adoption w.r.t count	% adoption w.r.t area
1.	Cultivation of improved variety	52.22	43.61
2.	Recommended date of sowing	30.83	31.59
3.	Method of sowing	27.89	25.16
4.	Optimum seed rate	18.06	22.43
5.	Integrated nutrient/pest/weed management	26.39	25.39
6.	Overall impact	31.08	29.64

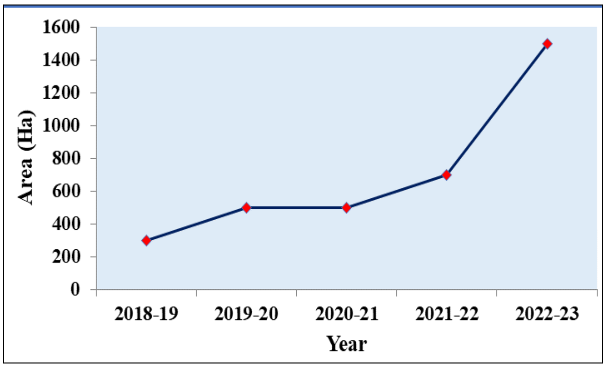


Fig 3: Year wise area under oilseeds in district Moga, Punjab

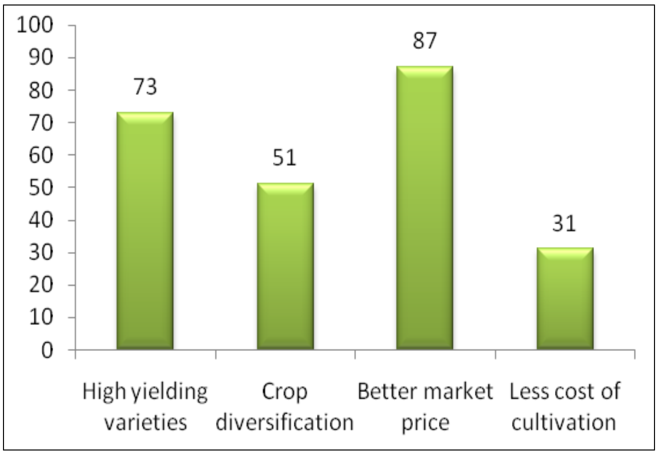
Table 8: Year wise horizontal spread (%) of rapeseed mustard (relative to area in 2018-19 i.e., 300 ha) in district Moga, Punjab

S No	Technology	Year			
		2019-20	2020-21	2021-22	2022-23
1.	Rapeseed mustard	66.67	66.67	133.33	400

(***Source***: Department of Agriculture and Farmers' Welfare, Moga, Punjab)

Farmers' prospect behind of cultivation of oilseeds

The data of survey showed that out of 100 respondents, 87 farmers cultivate oilseeds due to better market price (Figure 4) of their produce followed by 73 farmers who started cultivation due to availability of high yielding varieties. Cultivation of high yielding varieties give better grain yield and at the same time prevalence of better market price improves economic viability of oilseeds at farmers' field. Therefore, more number of farmers in these both categories shows that farmers feel secure in adoption of oilseeds in terms of monetary returns. Furthermore, survey results showed that 93 farmers out of 100 cultivate oilseeds to directly sell in the open market (Figure 5) followed by 82 who also keep some quantity for domestic use. Only 6 farmers reported that they also go for processing of oilseed to sell the oil and mustard cake in the market. Less number of farmers who prefer processing of oilseeds clearly shows the requirement and scope of awareness and training activities of farmers in this context so that they can earn more profit.



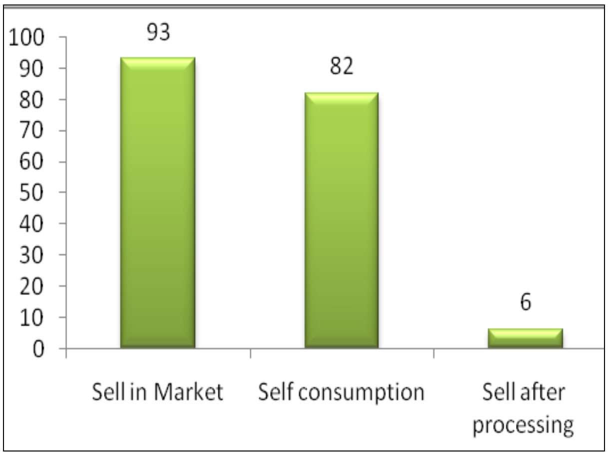


Fig 4, 5: Results of survey showing reason and purpose of cultivation of oilseeds by the farmers

Conclusion

The results of the study indicate that the frontline demonstrations showed an increase in grain yield, enhanced B:C in all the blocks of the district. Yield gap analysis revealed that there is need to develop crop specific, variety specific, region specific package of practices for pulse crops. As frontline demonstrations work on the grounds of "learning by doing", the impact assessment of showed that these are worthwhile in adoption as well as horizontal spread of improved technologies. Demonstrations satiate the need to improve the knowledge base, technicality and confidence level of farmers which, in turn, can certainly prove propitious in increasing area, production and productivity of pulse crops. At the same time, market price and availability of good quality planting material prove helpful in adoption and spread of any technology at farmer field.

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