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Tracing the changes in the composition of oilseeds in Indian Punjab: 1990-91 to 2020-21

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Abstract

India ranks fourth in oilseeds production in the world. Currently, the Indian Punjab produces 93.5 metric tons of oilseeds and holds 16th position in oilseeds production in India. Correspondingly, the oilseed sector occupies an important position in the agricultural economy of the country. Oilseeds, especially edible oilseeds have been an integral part of the cropping system in Indian Punjab till the beginning of monoculture triggered by the implementation of new agriculture strategies since 1960s.Oilseeds composition has also played a vital role in agricultural and allied activities. This paper examines the cropping pattern of oilseed diversity in the Indian Punjab according to six agro-climatic zones. The study reveals the changes in cropping pattern that have taken place in Indian Punjab over the period from 1990-91 to 2020-21.Various statistical techniques such as the Herfindahl Index, Simpson Index and Panel regression model are used to examine the diversification and specialization in oilseeds.

Keywords*: *Agriculture, agro-climatic zone, cropping pattern, crop diversification, Punjab, rainfall

Introduction

India is the fourth-largest oilseeds producer in the world, followed by USA, China, and Brazil (Reddy and Immanuelraj, 2017). The country harvests approximately 32.10 million tons of oilseeds annually constituting 2.7 percent of the global oilseed production. These oilseeds have been cultivated across an extensive area of nearly 26 million hectares, accounting for 19 percent of the world's oilseed cultivation with an average annual yield of 1224 kg per hectare (Jha, 2017). India benefits its diverse agro-ecological conditions that are highly conducive to the cultivation of various oilseed crops, including groundnut, rapeseed, mustard, sunflower, soybean, sesame, safflower, castor seed, linseed, niger seed, and two perennial oilseeds, namely coconut and palm oil (Kaur and Kaur, 2019).

India's agricultural landscape has undergone a profound transformation, shifting from pre-modern farming to market agriculture. This transition towards agricultural diversification has emerged as a pivotal element in achieving various objectives, including increased agricultural output, higher income for farmers, the creation of employment opportunities, sustainable management of natural resources, and poverty reduction (Kumar and Gupta, 2015; Mukherjee, 2021). The agricultural sector in India has witnessed an erratic journey in terms of income generation and diversification, showcasing substantial disparities among distinct geographic regions at the disaggregated level (Radhakrishna and Panda, 2012).The era of the Green Revolution of the 1960s aimed to achieve self-sufficiency in food grain production and triumphed through the technology-driven transformation in Punjab which was based on a monoculture cropping pattern. However, a pivotal moment came when the cropping pattern gave way to a predominant focus on mono-cropping, leading to significant ecological challenges. These challenges encompassed the excessive depletion of groundwater, soil degradation and other natural resources resulting from excess use of fertilizer, pesticides, herbicides, weedicides and residue burning (Singh and Sidhu, 2004). The growing demand for edible oils has led to substantial imports, which now make up to 60 percent of the country's total requirement (Jha, 2017). In recent years, there has been a notable increase in the consumption of vegetable oils, both for culinary and industrial purposes (Bansil,1997).

The diversification of crops holds significant potential as an economic driver within the agricultural sector, making it a crucial factor in addressing the challenges that have arisen in the post-green revolution era. Given the diminishing availability of agricultural land and smaller operational holdings due to urban expansion, the rapid growth of the population, and evolving consumer food preferences, farmers are grappling with the need to incorporate new high-value crops into their cropping systems, either alongside or as substitutes (Bhatt *et al.*, 2016; Shergill, 2005). Many scholars have put forth the notion that agricultural diversification serves as a tool to elevate farm income, create job prospects, combat poverty, and contribute to the preservation of natural resources (Braun, 1995; Birthal *et al.*, 2005, Johl *et al.*, 1986; Johl, 1996; Pingali and Rosegrant, 1995; Ryan and Spencer, 2001; Vyas, 1996). Ecological changes across time effects the agriculture production according to various economists (Arora, 2019; Cline, 1996; Chauhan *et al*., 2014). In the face of increased climate deterioration, alterations in temperature and precipitation patterns, and other global environmental shifts, it is anticipated that a spectrum of responses from crops and ecosystems will come into play, ultimately influencing all critical agricultural processes. These effects encompass alterations in nutrient circulation, soil moisture, as well as shifts in the prevalence of pests and plant diseases, all of which will have significant ramifications on food production and food security (Fuhrer, 2003; Jones and Thornton, 2003).

The country's capacity to vary its crop patterns to achieve various objectives relies on the existingnecessity for diversification, possibilities for diversification, and how farmers will respond to these requisites and prospects. Large and wealthier farms are comparatively less diversified as wealthier farms are less risk averse. Farms that are located closer to the market and have greater irrigation intensity are supposed to be more diversified (Gupta and Tewari, 1985).Opportunities for diversifying crops stem from various reasons, for example, technological advancements, shifts in consumer preferences, the expansion of irrigation facilities, the presence of marketing infrastructure, and evolving trade agreements. The need for crop diversification arises from several factors, including the imperative to (i) mitigate risks related to yield, market fluctuations, and prices; (ii) combat the deterioration of natural resources and the environment; and (iii) achieve national objectives such as generating employment, achieving self-sufficiency in essential crop commodities, and earning foreign exchange. (Reddy and Suresh, 2009). In other words, diversification entails capitalizing on emerging prospects generated by technology, evolving markets, policy shifts, and other factors to address specific objectives, confront challenges, and mitigate risks (Chand and Chauhan, 2002). In the case of oilseed production, crop diversification can also be influenced by government policies and focused efforts on certain crops for a specific duration, as exemplified by the establishment of initiatives like the Technology Mission on Oilseeds (TMO) to prioritize oilseed production in response to the national imperative of reducing imports to meet the country's requirements.

This paper explores the spatial-temporal changes in the cropping pattern of oilseeds in Punjab at the agro-climatic zones during the four points of time 1990-91, 2000-01, 2010-11 and 2020-21. This paper tries to find out the districts encountering crop "diversification" as well as "specialization" and focuses on the role of agricultural policy of the government (both center and state) in increasing area and production in Indian Punjab. To provide deeper insight, this paper has been categorized into five sections. The first section deals with the arguments of how and why a region has changes in cropping patterns and crop diversification. The second section deals with the study area and methodology. Section third deals with empirical considerations of oilseed cropping pattern and composition of oilseed crops from 1990-91 to 2020-21. The penultimate section lights on the econometric analysis and public policy of oilseed development. The last (fifth) section deals with the broad conclusions.

Study area and Methodology

Geographically, Punjab is situated in the North-West of India, which extends between 29^0 302 N to 32^0 322 N latitudes and between 73^0 552 Eto 76^0 502 E longitudes. The state covers an area of 50,362 square kilometers, which is 1.53 percent of India's total geographical area.The state is bordered by Himachal Pradesh to the north and north-east, Haryana to the south and southeast, and Rajasthan to the south-west; by the Indian union territories of Chandigarh to the east and Jammu and Kashmir to the north. It shares an international border with Pakistan to the west. Punjab is divided into six agro-climatic zones namely; Sub Mountain Undulating Region (Pathankot, Ropar, Mohali, Gurdaspur, and Hoshiarpur), Undulating Plain Region (Pathankot, Ropar, Mohali, Gurdaspur, and Hoshiarpur), Central Plain Region (Amritsar, Tarn Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Patiala, and Sangrur), Western Plain Region (Firozpur, Moga, Barnala, and Faridkot), Western Region (ShriMuktsar Sahib, Fazilka, Bathinda and Mansa), and Flood Plain Region (parts of various districts along with Beas, Sutlej, Ravi, Ghaggar rivers are included).

This research work is based on both primary and secondary data. The primary data were collected from sixty farmers using the interview method. The respondents were selected using a purposive sampling technique. Farmers were selected from various categories like marginal, small, medium, and large. The data was collected in the period of March-May 2024 across marginal to large farmers' categories from six agro-climatic regions of Punjab.The data from the Ministry of Agriculture from the websites of the Government of India has been used to collect relevant information regarding areas under crops. Various issues of the Statistical Abstracts of Punjab have been pressed into service. To look into the policy change and its effects, the data was

Table 1: Land holding and educational profile of the farmers

Farmers categories	Number of Farmers	Mean year of schooling	Average land holding (acre)
Marginal	18	4.10	2.05
Small	18	4.91	4.80
Medium	12	8.33	7.12
Large	12	5.01	15.14
Average	15	5.58	7.27

Source: Depth Interviews conducted

divided into four periods of time i.e. 1990-91, 2000-01, 2010-11, and 2020-21. A simple percentage share method is used to examine the area under crops across the agro-climatic zone of Indian Punjab. To analyze the diversification of crops, statistical techniques like the Herfindahl Index (HI), Simpson Index (SI), and a panel regression modelare used.

The authors conducted the depth interviews and had insightful discussions with the farmers who were divided into four main categories namely marginal, small, medium and large. Table 1 provides the information about number of farmers selected for the interviews, their years of schooling and their average land holdings. More farmers have been selected from marginal and small categories for the interview, because the number of farmers cultivating small proportions of land is quite large when compared to medium and large farmers. The purpose of asking about the schooling years of farmers was to understand how much knowledge they have about their surroundings. In the table, it is evident that on an average, a farmer went to school for 5 and a half years. This is the main reason that farmers are not aware about crop diversification, reducing levels of ground water, soil degradation, effect of fertilizers on food crops etc. They are dependent on wheat and rice mostly as these crops are incentivized by the governments of the state and the country.

Empirical Consideration

Table 2 illustrates the percentage share and area under various oilseed crops in Indian Punjab across different agro-climatic regions for different time periods namely 1990-91, 2000-01, 2010-11, and 2020-21.

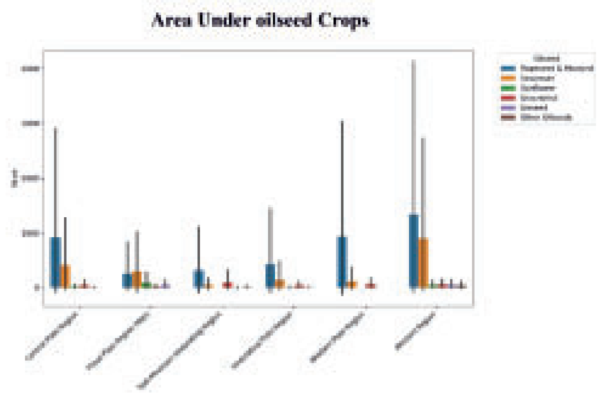
In 1990-91, Rapeseed - Mustard dominated oilseed crops, with significant contributions across most regions, holding substantial shares such as 90.55 percent in the Western Region and 66.78 percent in the Central Plain Region. This dominance indicates its strong adaptation and preference by farmers of Punjab. Sesameand Groundnut also played notable roles, with sesame comprising up to 60.20 percent of the area in the Flood Plain Region and Groundnut showing a substantial 25 percent share in the Sub-Mountain Undulating Region. However, a shift can be seen from 2000-01. The area under Rapeseed & Mustard increased to 53.62 percent overall, showing its continued importance, but Sesame's share declined significantly in several regions, particularly in the Central Plain Region, where it fell to 27.61 percent. Groundnut also saw a reduction in its share, reflecting changing agricultural practices and potentially shifting market demands. This decline in sesame and Groundnut underscores a broader trend of decreasing reliance on these crops. In 2010-11, Rapeseed & Mustard continued to gain prominence, reaching a peak of 72.58 percent in overall cultivation, while sesame and Groundnut shares further decreased to 11.29 percent and 16.13 percent respectively. The data indicates a consolidation of Rapeseed & Mustard as the primary oilseed crop, potentially due to its superior yield and adaptability in Punjab's agro-climatic conditions. By 2020-21, the trend continued with Rapeseed & Mustard maintaining a dominant position with 67.95 percent of the oilseed area.

Groundnut's presence remained relatively small at 19.23 percent, while other oilseeds gained some traction, comprising 7.69 percent of the area. The sesame's share reduced further to 5.13 percent, reflecting a continued shift away from this crop. Overall, the data reveals a clear trend of Rapeseed & Mustard increasingly dominating oilseed cultivation in Punjab, while the shares of sesames and Groundnuthave diminished over time. This shift can be attributed to various factors such as changes in market demand, advancements in agricultural technology, and evolving environmental conditions (Goyal *et al*., 2022). For instance, the substantial reduction in sesame cultivation aligns with the observed increases in other crops' shares, suggesting adjustments in crop selection based on economic or environmental factors. To revitalize these crops, initiatives are needed to boost the cultivation of oilseed crops in Punjab, particularly in areas where they constitute nearly 99 percent of the total oilseed production (Goyal *et al*., 2022; Patel, 2016). Additionally,

Table 2: The analysis of the area under oilseed crops and its changing composition has been presented by Agro-Climatic Zones into four points of time 1990-91 to 2020-21 in Indian Punjab

Agro-Climatic Region of Indian Punjab	Year	Rapeseed - Mustard	Sesame	Sunflower	Groundnut	Linseed	Other Oilseeds
Sub-Mountain Undulating Region	1990-91	(50.00)60 0	(25.00)300	(0.00)0	(25.00)300	(0.00)0	(0.00)0
	2000-01	(53.62)370	(15.94)110	(0.00)0	(27.53)190	(2.90)20	(0.00)0
	2010-11	(72.58)900	(11.29)140	(0.00)0	(16.13)200	(0.00)0	(0.00)0
	2020-21	(67.95)530	(5.13)40	(0.00)0	(19.23)150	(0.00)0	(7.69)60
Undulating Plain Region	1990-91	(90.91)100	(9.09)10	(0.00)0	(0.00)0	(0.00)0	(0.00)0
	2000-01	(54.54)60	(18.18)20	(0.00)0	(0.00)0	(27.27)30	(0.00)0
	2010-11	(100.00)200	(0.00)0	(0.00)0	(0.00)0	(0.00)0	(0.00)0
	2020-21	(85.00)170	(0.00)0	(15.00)30	(0.00)0	(0.00)0	(0.00)0
Central Plain Region	1990-91	(66.78)2000	(26.54)795	(0.00)0	(6.68)200	(0.00)0	(0.00)0
	2000-01	(27.61)450	(65.03)1060	(0.00)0	(6.13)100	(1.23)20	(0.00)0
	2010-11	(64.52)600	(35.48)330	(0.00)0	(0.00)0	(0.00)0	(0.00)0
	2020-21	(79.17)760	(13.54)130	(7.29)70	(0.00)0	(0.00)0	(0.00)0
Western Plain Region	1990-91	(88.24)2100	(7.56)180	(0.00)0	(4.20)100	(0.00)0	(0.00)0
	2000-01	(64.28)180	(35.72)100	(0.00)0	(0.00)0	(0.00)0	(0.00)0
	2010-11	(78.95)2100	(17.29)460	(0.00)0	(3.76)100	(0.00)0	(0.00)0
	2020-21	(96.36)530	(3.64)20	(0.00)0	(0.00)0	(0.00)0	(0.00)0
Western Region	1990-91	(90.55)2300	(1.57)40	(0.00)0	(7.87)200	(0.00)0	(0.00)0
	2000-01	(90.55)2300	(1.57)40	(0.00)0	(7.87)200	(0.00)0	(0.00)0
	2010-11	(95.89)700	(2.74)20	(0.00)0	(1.37)10	(0.00)0	(0.00)0
	2020-21	(76.81)530	(0.00)0	(0.00)0	(0.00)0	(0.00)0	(23.19)160
Flood Plain Region (Wet)	1990-91	(33.44)2000	(60.20)3600	(3.01)180	(0.00)0	(3.34)200	(0.00)0
	2000-01	(72.46)1000	(0.00)0	(20.29)280	(0.00)0	(7.25)100	(0.00)0
	2010-11	(8.47)100	(76.27)900	(6.78)80	(0.00)0	(8.47)100	(0.00)0
	2020-21	(0.00)0	(83.64)460	(3.64)20	(12.73)70	(0.00)0	(0.00)0

Source: Statistical Abstract of Punjab, 1990-91 to 2020-21



the rise in Other Oilseeds reflects a diversification trend in response to new agricultural practices or market opportunities. These fluctuations in crop shares highlight the dynamic nature of agriculture in Punjab, influenced by both internal and external factors. To enhance the cultivation of declining oilseeds such as sesame and Groundnut, targeted initiatives and supportive policies may be necessary to revitalize their production, ensuring a balanced and resilient agricultural sector. This might be because many farmers are choosing to grow other crops like Rice and wheat cropping patterns (Gondalia *et al*., 2020). The compound growth rates for the area under oilseed crops and their production were negative and not statistically significant, indicating a consistent decline. This trend could be explained by the increasing wheat and rice cultivation in Punjab, as farmers are assured of markets for these crops (Kumar and Gupta, 2015). The rise in oilseed production following the introduction of TMO can be attributed to increased inputs, expanded cropping areas, and price incentives (Chand, 2002; Gulati *et al*., 1996).

Econometric Analysis

Herfindahl Index (HI): HI is calculated by taking the sum of the squares of the ratio of the area of each crop to find the total area using the formula:

$$H.I. = \sum_{i=1}^{N} P_i^2$$

Where N is the total number of crops and Pi is the ratio of the area of the i^{th} crop to the total area visited. Its index values are varied from 0 and 1. As diversification increases, HI decreases. The index value is 1 in the presence of full specialization and it is close to 0 when crops are fully diversified. It has proved to be the limitation that it cannot assume the theoretical minimum, i.e. 0 for smaller values of N (number of crops). HI is a concentration measurement that uses a corrected value (1-HI) instead of HI. To avoid confusion with other indices, (1-HI) is sometimes used as a measure of dispersion instead of HI (Kaur and Singh, 2023; Khatun and Roy, 2014).

Table 3: Oilseeds specialization and diversification index value across the Agro-Climatic Region in Indian Punjab: 1990-91 to 2020-21

Year	Herfindahl Index	Simson Index
Sub-Mountain Undulating Region		
1990-91 to 2000-01	0.47	0.53
2000-01 to 2010-11	0.41	0.59
2010-11 to 2020-21	0.57	0.43
2020-21	0.51	0.49
Undulating Plain Region		
1990-91 to 2000-01	0.62	0.38
2000-01 to 2010-11	0.42	0.58
2010-11 to 2020-21	1.00	0.00
2020-21	0.55	0.45
Central Plain Region		
1990-91 to 2000-01	0.52	0.48
2000-01 to 2010-11	0.25	0.75
2010-11 to 2020-21	0.57	0.43
2020-21	0.53	0.47
Western Plain Region		
1990-91 to 2000-01	0.79	0.21
2000-01 to 2010-11	0.60	0.40
2010-11 to 2020-21	0.76	0.24
2020-21	0.93	0.07
Western Region		
1990-91 to 2000-01	0.83	0.17
2000-01 to 2010-11	0.73	0.27
2010-11 to 2020-21	0.83	0.17
2020-21	0.64	0.36
Flood plain Region		
1990-91 to 2000-01	0.80	0.20
2000-01 to 2010-11	0.61	0.39
2010-11 to 2020-21	0.86	0.14
2020-21	0.70	0.30

Source: Author's calculations

*Note:H.I.: (0) Represents Crop Diversification and (1) Represents Complete Specialization

S.I.: (0) Represents Crop Specializations and (1) Represents Crop Diversification

Simpson's Index (SI):SI is given by the following formula:

$$S.I. = 1 - \sum_{i=1}^{N} P_i^2$$

Where N is the total number of crops in a region and Pi represents the acreage proportion of the i^{th}crop. This SI index value also lies between 0 and 1. SI is a measure of diversification and is measured as SI = 1 HI (Valdivia *et al.*, 1996).

Panel Data Regression Model

The following Panel regression model has been used to identify the contribution of different factors that affect Oilseed Diversification. The following results are based on the given equation:

$SI = \hat{a}_0 + \hat{a}_1\ (YI) + \hat{a}_2\ (RL) + \hat{a}_3\ (P) + \text{å}$

Where represents signs are given in:SI = Simpson Diversity Index; YI = Yield; RL = Rainfall; P = Production; å = Error Term

Table 3 elaborates the index values of the Agro-climatic zones in Punjabfrom 1990-91 to 2020-21. These calculations help us to understand the level of diversification in a particular area ofa specific crop. These values are calculated with the use of Herfindahl and Simpson Indexes. These indexes were required for understanding the diversificationlevel, as the reader cannot estimate this level by a mere glance at the percentage share of a specific crop in an area. After making thecalculations using the Herfindahl Index and Simpson Index, we get a score that lies at the center of (0) and (1). This shows a moderatediversification of oilseed crops inthe Sub Mountain undulating region and undulating plain region 0.58, 0.59 in 2000-01. All othercalculations are made similarly by using the two listed indices. The interpretation of the results is based onthese index values. Simpson index is a method that is used here to describethe oilseed diversification of the Agro-climatic zone in Punjab from 1990-91 to 2020-21. Western region, western plain region, and flood plain region under falls have ahigh specialization. The state government initiated a new Programme (Technology Mission on Oilseeds) to increase the area under production.

Panel Data Regression Model

Why panel data?

Panel data regression models are used to analyze datasets with both cross-sectional and time-series dimensions. They allow for controlling individual-specific effects, addressing endogeneity, and capturing dynamic relationships. These models efficiently use available data, improving precision and providing insights into policy impacts. Overall, they offer a versatile framework for robust empirical analyses. In summary, panel data regression models are a versatile and powerful tool for empirical research, especially when dealing with datasets that exhibit both cross-sectional and time-series dimensions. They provide a flexible framework for addressing various econometric challenges and offer researchers the ability to explore complex relationships.

Table 4: Diagnostic tests

Diagnostic Tests	Results	Threshold	
Variance inflation factor method	Multicollinearity	1.77	< 5
Breusch-Pagan	Heteroscedasticity	0.3880	> 0.05
Wooldridge for Auto co-correlation	Auto-Correlation	0.1155	> 0.05

Source: Authors calculations

A total of threepost-estimation tests have been applied:

i. The first one is the test of multicollinearity using the Variance inflation factor (VIF) method (one of the methods to check multicollinearity). The value of VIF should be less than 5. So, we have 1.7 so there is no problem of multicollinearity.

ii. The second test was the Test of Heteroscedasticity by Breusch-Pagan; the value needs to be more than 0.05 so we have no problem.

iii. Third was the Test of auto-correlation given by Wooldridge again the value is more than 0.05 so there is no problem of autocorrelation.

Post estimation tests

Post-estimation tests refer to statistical tests that are conducted after the initial regression analysis has been performed in order to assess the validity and reliability of the estimated regression model. These tests are important because they allow researchers to determine whether the assumptions underlying the regression model hold, and whether the model provides a good fit for the data. In our study we have conducted the test of multicollinearity, Heteroscedasticity and autocorrelation test.

The coefficient for rainfall is 0.002. This means that, for each unit increase in rainfall, the dependent variable SI is

Table 5: Panel Data Regression Results based on the Random Effects model

SI	Coefficient	Std. Error	z- Statistic	P>|Z|
rainfall	.0020157	.0005608	3.59	0.000
production	0.00000562	0.00000338	-1.66	0.096
yield	-.0111766	.0073491	-1.52	0.128
_cons	-.0035347	.1526947	-0.02	0.982

Source: Authors calculations

expected to increase by approximately 0.002 units, all else being equal. The p-value associated with rainfall is very low ($p < 0.001$), indicating that rainfall is statistically significant at conventional significance levels (e.g., 0.05). Therefore, there is strong evidence to suggest that rainfall has a significant relationship with SI. For each unit increase in production, the dependent variable SI is expected to decrease by approximately 5.62e-06 units, all else being equal. The p-value associated with production is 0.096, which is greater than the conventional significance level of 0.05. Therefore, production is not statistically significant in predicting SI based on this model. The relationship between production and SI is not strong enough to conclude statistical significance.

The coefficient for yield is -0.011. This means that, for each unit increase in yield, the dependent variable SI is expected to decrease by approximately 0.011 units, all else being equal. The p-value associated with yield is 0.128, which is greater than the conventional significance level of 0.05. Therefore, similar to production, yield is not statistically significant in predicting SI based on this model. The relationship between yield and SI is not strong enough to conclude statistical significance.The estimated value of rho is approximately 0.758. This suggests that a substantial portion (approximately 75.89 percent) of the total variance in the dependent variable SI is attributed to differences between the groups or regions. In other words, there is a meaningful variation in SI that can be explained by the grouping variable region.

Qualitative Analysis (Primary Survey)

1. After the change in the social formation of Punjab with the green revolution, production shifts from use-value to exchange-value. In other words, most of the farmers have to start production to earn maximum profits to retain in the market competition.

2. The farmers of Punjab said that there is high price volatility on oilseed crops. This means that the magnitude of price fluctuation is very high on these crops. The oilseed markets are not properly developed in Punjab. Due to this, the farmers who sow these crops have to go to different markets in Haryana and Rajasthan to sell them, which is a very loss-making venture. Because of this, there is less growth in oilseed cultivation.

3. The farmers do not even have High Yielding Variety (HYV) seeds for oilseed production and they are not able to get good yield from the traditional seeds. These seeds are also prone to pest attacks due to which the oilseed produce is not able to survive in Punjab. That's why farmers do not like to cultivate oilseed crops either for selling in the market or for self-sustenance.

4. The less educated and illiterate farmers do not have knowledge about the oils available in the market like refined oil, Vanaspati ghee, olive oil, etc. They do not even know about how the edible oils are made that are available at home. Talking to the farmers also revealed that they do not understand that these oils are made from cottonseed which is actually not very good for health and can have negative effects on body if put to continuous use with these foods.

5. In the present scenario, the farmers of Punjab use Vanaspati Ghee and refined oil in their homes instead of desi ghee and mustard oil because the former are available at lower prices, due to which farmers have increased their use. The farmers of Punjab have also started using chemically prepared oils like gooseberry, almond, coconut oil, etc., which are not good for their health. Due to the market imperative and profit maximization instead of crop diversification which results in the reduction of oilseed diversity and increased crop specialization.

6. Talking to a farmer of Talwandi Sabo, the authors came to know that before 1980–81, all the farmers used to sow mustard. However there was a shift from traditional farming practices to mechanization (tube wells and other harnessing equipment), and farmers also shifted from low-value crops such as taramira, mustard, sunflower, groundnut, etc. to commercial crops such as rice and wheat. This change led to crop specialization in Punjab and the production of oilseed crops stagnated.

7. During the conversation with the farmers, it was also learned that earlier people used to pour the oil on their animals, which increased the power of the animals to give milk. Now people are leaving the ancient crops and moving towards wheat and paddy, which is proving to be very harmful for Punjab.

8. A few years ago, people used to cook vegetables in mustard oil. Various varieties of desserts, like gulgule and podes, were prepared only in mustard oil and with all kinds of pickles too. But now, it can be seen that natural and healthy products made from enriched oils are not available on the market, and the only reason is a huge reduction in the growth of oilseeds.

Policy implications for oilseed development

A technology mission on oilseeds, known as the National Oilseeds and Vegetable Oils Development (NOVOD) Program, was launched in1986. Its main objectives were to increase domestic oilseeds production to reduce edible oil imports, promote oilseed cultivation through improved technology and research, and enhance the income of oilseed farmers and to develop a self-reliant oilseed industry. The program aimed to achieve self-sufficiency in edible oil production in India.The NMOOP oilseed policy in India is a comprehensive initiative aimed at increasing domestic oilseed production, reducing edible oil imports, and improving the livelihoods of oilseed farmers. It is a multi-phased program that has evolved over the years to address the specific challenges and opportunities in the oilseed sector. NMOOP was implemented in various phases started since 1986.

During 2009-10, for (ISOPOM) Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM) (1986) administrative approval of 63.05 was received from Govt. An expenditure of Rs. 38.56 lac was incurred to implement various components of the scheme. To popularize different seed varieties during the year 2009-10, 18499 seed minikits of rayasarson are distributed free of cost. 89 plots (5 ha each) were covered under block demonstration plots of groundnut, soybean, toria and sunflower. Reconstruct the ISOPOM in (2004) Bulk of the oilseeds and vegetable oils production in the country is derived from the nine annual oilseed crops, i.e. groundnut, soybean, rapeseed and mustard, sunflower, sesame, safflower, niger, castor and linseed. The Mission's integrated strategy from development of production technologies to crop production, post harvest processing, price support and marketing, implemented through four Mini–Missions had brought about near self-sufficiency in the edible oils. The production of nine oilseeds was more than doubled to 247.5 lakh tones by 1998- 99 from the level of 109.3 lakh tones in 1985-86.

The per capita availability of the edible oil has increased from 3.2 kg per person per year in 1960-61 to about 19.2 kg per person per year in 2019-20 whereas the per capita availability of Vanaspati is stagnated at 0.6 kg per person per year. This reflects the shift towards an increasing demand for edible oils in India over a period. But the production targets set for the oilseeds are hardly achieved in the past years. The country were able to achieve above 90% of set production targets in only three years out of the past 17 years which gets us to a total of five times. Whereas, for wheat and paddy, the targets were achieved in at least 11 times since 2003 (Bhatt & Jit, 2022).Even after the introduction of various policies and schemes for the development of oilseeds and expansion in the cropping area to increase diversification, the area under oilseeds has decreased. This takes the reader to the conclusion that there are some discrepancies either in the formulation or in the execution of the policies devised by the government.

Conclusion

Talking about the cropping pattern of Punjab, the authors found that the agriculture system of Punjab is not future-oriented for oilseeds.The cropping pattern of Punjab depends only on fixed-value crops like a wheat-rice system. The Punjabi farmers aremostly dependent on the market products rather than the self-grown produce. In this paper, the authors have tried to investigate the oilseeds composition of Punjab. It is also becoming clear in this paper that the mustard and rapeseed crops are dominant and that too is slowly decreasing with time. The authors examined that there is no oilseed diversification within the state because two crops are mostly produced in Punjab that are wheat and paddy. During the conversation with the farmers, it was found that the farmers were not very enthusiastic about implementing crop diversification. The authors also learned this by looking at the cropping pattern data of Punjab. Punjab is walking on the path of specialization. Even the government of Punjab has not been able to establish any market for oilseeds so far, where the oilseed produce can be sold. Thirdly, Even if there are policies devised by the Punjab government, no changes have been made since the introduction of these policies. The farmers should be provided with MSP (Minimum Support Price) on each crop and there should be awareness programmes regarding the oilseed crops so that the farmers can shift to diversification which will help to make the cropping cycle more sustainable, ensuring the great agricultural future of the state.

Conflict of interest

The authors declare that there is no financial or commercialrelationship that could be elucidated in this research as a conflict of interest.

Author's contributions

Jasvir Singh: Conceptualization, writing review, editing, and writing the original draft. Jaskiran Kaur and Shivjeet Kaur: Formal analysis, interpretation, methodology, and writing the original draft.

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