DYNAMICS OF PRODUCTION AND TREND OF OILSEEDS IN INDIA

काशी हिन्दू विश्वविद्यालय BANARAS HINDU UNIVERSITY

Thesis submitted in partial fulfilment of
the requirements for degree of

Master of Science (Agriculture)
in
Agricultural Economics

Supervisor
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Submitted by
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To
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Through: The Head, Department of Agricultural Economics,
Institute of Agricultural Sciences. B.H.U, Varanasi.

Dear Sir,

I have great pleasure in forwarding the thesis entitled **Dynamics of Production and Trend of Oilseeds in India** submitted by **Miss Shriti Kumari Sinha, I.D No. 20412AGE013,** in partial fulfillment of the requirements for the degree of **Master of Science (Agriculture)** in **Agricultural Economics**, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi and placing on record that he has completed the requisite residential requirements as contained in the statute of the University.

I certify that the entire scheme of investigation presented herein was planned and carried out solely by the candidate under my guidance and supervision. The data presented in the thesis, to the best of my knowledge and belief, are genuine andoriginal.

Thanking you Yours faithfully

Forwarded
(Head)

Prof. Rakesh Singh
(Supervisor)

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Date: ***(Shriti Sinha)***

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LIST OF ABBREVIATIONS USED

TMO	:	Technology Mission on Oilseeds
MSP	:	Minimum Support Price
NMEO-OP	:	National Mission on Edible Oils- Oil Palm
CPO	:	Crude Palm Oil
GM	:	Genetically Modified
OPDP	:	Oilpalm Development Programme
ISOPOM	:	Integrated Scheme on Oilseed, Pulses and Oilpalm Development
GNP	:	Gross National Product
GDP	:	Gross Domestic Product
CAGR	:	Compounded Annual Growth Rate
WTO	:	World Trade Center
DOC	:	De-Oil Cake
RMSE	:	Root Mean Square Error
ARIMA	:	Autoregressive Integrated Moving Average
FOREX	:	Foreign Exchange
STC	:	State Trading Corporation
OGCP	:	Oilseed Growers Corporation Project
NDDB	:	National Dairy Development Board
OPTP	:	Oilseed Production Thrust Programme
TBO	:	Tree Borne Oilseeds
PM-ASHA	:	Prime Minister Annadata Aya Sanrakshan Abhiyan
PDPS	:	Price Deficit Payment Scheme
HYV	:	High Yielding Variety

Chapter I

INTRODUCTION

Chapter I

INTRODUCTION

India has the world's fourth largest edible oil economy, after the United States, China, and Brazil. India is the world's second largest consumer of edible oil, accounting for more than 7% of production and 12% of consumption. Oilseed production in India has remained nearly stagnant due to low productivity. Nonetheless, consumption is soaring, with the country's annual demand increasing at a rate of 6%, while domestic output has increased at a rate of only about 2%. To bridge the huge demand-supply gap in edible oil production in the country, the government has resorted to imports, which have met 60% of the country's demand; only 40% of the demand could be met through domestic sources. In 2018-19, the import bill for vegetable oil was close to 70000 crores, accounting for 50% of India's total agricultural import bill.

The global agricultural market is a complex mechanism whose state is determined by numerous factors, the majority of which cannot be quantified. However, the solution to not only the problem of food security, but also the problem of maintaining global economic and political stability. According to the International Association of Vegetable Oils, oilseeds and fats in global commerce operations include more than 25 different types of oilseeds, with more than 95 percent of production and the world market accounting for 7 basic types: soybean, rapeseed, cotton, sunflower, peanut, oil palm, and copra.

The oilseed market has its own characteristics, which are reflected in a high degree of product interchangeability, reliance on other agricultural and food markets (grain, meat, animal fats, etc.), and a complex composition.

Oilseeds account for a significant portion of cropland in the world, accounting for more than 180 million hectares (soybean, cotton, sunflower, rapeseed, and peanuts). The diversity of natural conditions does not universally provide a sufficiently high efficiency of oil seed production, thus playing an important role in the placement of these crops in accordance with their biological requirements as well as zonal features. The European Union countries produce the majority of oilseeds, accounting for more than half of the gross yield.

Table 1.1: Major countries-producers of oilseeds in the world

Oilseeds	Countries
Sunflower	Ukraine, Russia, Argentina, EU countries
Rapeseed	Canada, China, India, France, Austria, Great Britain, Germany, Poland, Denmark, Czech Republic, Slovakia, USA, Russia
Soybean	USA, Brazil, Argentina, China, India, Paraguay, Bolivia, Russia
Cotton	USA, Brazil, China, Pakistan, Uzbekistan
Safflower	China, USA, Spain, Portugal

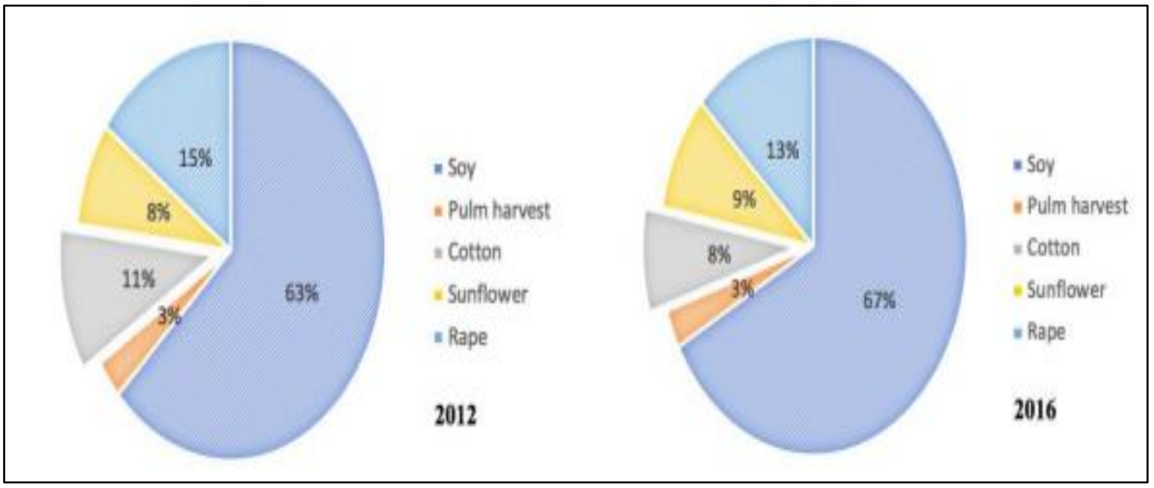

Figure 1.1: comparative production of oilseed in 2012 and 2016

During the study period, the global oil seed production structure changed slightly: soybean maintained its leading position, with a 4-percentage point increase in 2016 as compared to 2012. Three countries dominated the global soybean production: the United States, Brazil, and Argentina. Despite reduced acreage, gross yield of rapeseed remains among the top three in world oilseed production. Canada (23 percent) and China (21 percent) had the highest rapeseed production. Sunflower is the second-largest produced oilseed, accounting for 9% of global output. Ukraine, the Russian Federation, and EU countries produce the majority of sunflower oilseeds, accounting for more than 70% of total production.

Demand on the global market is influenced by various factors such as living standards, climatic conditions, and seasonality of production. Social and economic policies, as well as environmental protection, are among the constantly acting factors that have the greatest influence on demand.

The main factors influencing the market of Oilseeds:

a) **Growth factor:**

Natural conditions in the United States and Latin America have a negative impact on yield. Oil prices could rise as a result of OPEC's (Organization of the Petroleum Exporting Countries) likely announcement of a reduction in oil production. Reduced harvest of palm trees, ultimately leads to rise in the price of soybean oil.

b) **Fall factor**:

Oil prices are continuing to fall due to various factors across the world. Possible decrease in demand from EU biodiesel and bioethanol processors and producers (from rapeseed) (from soy). Argentina's soybean tariffs have been reduced, and crop yields have increased. The depreciation of the rial and peso, which contributes to cheaper products from Brazil and Argentina. China's potential reduction in soybean purchases, given that China is the world's largest importer of soybeans and soybean products.

The use of oilseeds in livestock allows for the connection of two markets: oilseeds and grains. Furthermore, the increased interest in the production of biodiesel fuel determines the oil market's influence on the energy market. The oil products market has a significant impact on the prices of vegetable oils, including sunflower oil, which is not used in the production of biofuels.

The decline in population income is one of the primary drivers of the increase in demand for sunflower oil. As a result, it is used as a cheap food product in low-income countries, and processed products are used as a valuable protein supplement for animals. It should also be noted that in economically developed countries, the structure of nutrition is shifting away from animal fats and toward vegetable fats. Oilseeds are important not only in human diet but also in industry due to their high oil, protein, vitamin, and fiber content. Oilseeds are also used as fertilizers for land rejuvenation, the fiber is used in the textile and plastic industries, and the cakes that remain after seed processing are important in animal feeding. Oil seeds are an efficient source of renewable energy in the form of biodiesel.

c) Government interventions:

The key policy changes included privatized imports and tariff reductions. Prior to 1994, the government determined edible oil import levels, which were made by the monopoly STC, based on factors such as domestic market conditions, producer versus consumer interests, international prices, and foreign exchange availability. Although the government allowed relatively high imports at times—averaging as much as 1.3 million tons per year between 1976/77 and 1987/88—imports were sharply reduced in 1988/89-1993/94, when the government promoted domestic oilseeds production through its Technology Mission on Oilseeds (TMO) program. Oil imports averaged only 325,000 tons per year during the TMO program, resulting in higher domestic oilseed prices and a temporary surge in domestic production.

However, beginning in 1998, the Indian government began making frequent tariff adjustments in order to protect domestic oilseed producers and processors from imports and to smooth the impact of fluctuating global prices on domestic consumers (figs. 6a and 6b). Although applied tariffs fell in 1999 following an initial increase in June 1998, the trend after April 2000 was incremental increases to applied rates for all oils, with adjustments to the relative rates on different types of oil—for example, palm versus soybean oil and crude versus refined oil—creating a more complicated tariff structure.

Domestic policies aimed at other crops have an impact on oilseed production. One factor contributing to a lack of domestic supply of oilseeds is India's domestic price support program, which has frequently favored the production of crops that compete for land with oilseeds. Under the Minimum Support Price (MSP) program, the Indian government annually sets minimum prices for crops such as rice, wheat, coarse grains, pulses, and various oilseeds, based primarily on estimated production costs, and are obligated to defend these prices by making purchases after harvest.

On the back of good monsoon rains, the government has set a record food grain production target of 328 million tons for the 2022-23 crop year. The target is 3.8 percent higher than last year's output. The target for the 2022-23 crop year (July-June) was established at the National Conference for Kharif Campaign 2022, which was held on Tuesday to review the Rabi season's progress and plan for the kharif crops. The Centre has cracked down on oil seed and edible oil hoarding in Maharashtra and Madhya Pradesh, and inspections are underway in five other states.

The central and state governments must reconsider the current MSP procurement policy. More incentives for growing pulses, oilseeds, and other high – value crops are needed to promote diversification and encourage farmers to shift away from water – intensive crops such as paddy and wheat and toward other sustainable and profitable crops in which MP has a stake.

The stock limit for edible oilseeds would be 100 quintals for retailers and 2000 quintals for wholesalers. Processors of edible oilseeds would be able to stock 90 days of edible oil production based on daily input production capacity. Imports supply more than 60 percent of India's domestic demand for edible oils. The retail price of edible oils has risen due to a rise in the global market. According to the Agriculture Ministry's budget allocation for 2022-23, the edible oil – oil palm program received Rs 900 crore, while the edible oilseed program received Rs 600 crore. Given the enormous potential for oil palm cultivation and CPO production, the government launched the National Mission on Edible Oils – Oil Palm (NMEO-OP) to increase the availability of edible oil in the country through area expansion and price incentives. Only 3.70 lakh hectares are currently under cultivation for oil palm. The scheme aims to cover an additional 6.5 lakh hectares for oil palm by 2025-26, bringing the total to 10 lakh hectares. The scheme also aims to increase CPO production to 11.20 lakh tons by 2025-26 and up to 28 lakh tons by 2029-30.

According to government data, edible oil prices in domestic retail markets have risen by up to 46.15 percent in the last year due to global factors and a local supply shortage. Oilseed crops are mostly rainfed (more than 70%) and are more susceptible to biotic and abiotic stresses. Due to the high risk and limited resource base of farmers in rain-fed areas, these crops are grown with minimal inputs. High seed rate and seed cost, as well as the lack of hybrids in major oilseeds such as groundnut and soybean, are other constraints to increasing crop productivity. External price shock due to the scarcity of imported oil is a major challenge in this sector.

The market connection index was used to evaluate the degree of market integration within domestic markets as well as between international and domestic markets. Price variability of both international and domestic price transmission, if any, is tested. Using demand supply and price linkage equations, the effects of trade liberalization on producers, consumers, and net social welfare were estimated.

Compound growth rate analysis revealed that after liberalizing edible oil imports, the production performance of oilseeds was dismal. The poor performance of oilseeds production was due to poor responses of area and yield of oilseeds. Oilseed plants have been used to produce edible oils since ancient times, but they are now also considered promising substitutes for regular diesel fuel because they are renewable and environmentally friendly. Oil crops are grown in large quantities all over the world. Rapeseed, soybean, mustard, peanut, sunflower, safflower, and cotton are among the most popular.

Oilseed crops are grown all over the world and are important crops because of their economic value. Heavy metal stress is one of the major abiotic stresses that limit the growth and development of oilseed crops. Heavy metals cause toxicity in oilseed crops through a variety of mechanisms, with symptoms that vary depending on the crop, metal, and dose. Oilseed crops have the potential to reduce metal-included toxicity by adjusting hemostasis to the optimal level. Heavy metals promote the production of free radicals, compete with the metal cofactor of plant enzymes, affect through the binding of sulfhydryl and nitrogen – containing groups, and cause cellular leakage through interactions with phospholipid head groups in oilseed crops.

The problem is primarily viewed as one that must be addressed through supply-side improvements. And it is in this context that the crop developers of Genetically Modified (GM) mustard hybrid were able to secure hundreds of millions of dollars in taxpayer funds for research, development, and testing of transgenic mustard. Oilseed seeds are high-value crops, but they are grown in low-energy environments. More than 85% of the area under oilseeds is rainfed, and it is frequently cultivated with low input and poor management practices. The majority of oilseed crops are grown on marginal and sub marginal lands with low fertility. Without crop rotation, most soil seed crops in India are grown as monocropping in traditional areas, resulting in the perpetuation and development of pest and disease inoculums. Yield losses due to diseases and pests account for 40% of total yield losses. One of the main causes of low yield of oil seed crops, particularly rapeseed and mustard, is insect pest attack, particularly aphid attack.

Supply of desired inputs and technology transfer from farm institutions to farmers is very poor. India was self-sufficient in edible oilseeds and oils prior to the start of the Green Revolution. India exported edible oilseeds as well. Following the implementation of the green revolution in India, the country became an importer of edible oils in the 1980s. This is the major challenge that the Indian government faces in achieving self-sufficiency in the production of oilseeds through the use of a better package and practices in the cultivation of oilseed crops. To overcome the country's stagnation in oilseeds production, the government of India launched the "Technology Mission on Oilseeds (TMO)" in May 1986 to increase oilseed production, reduce imports, and achieve self-sufficiency in edible oil. In due course, a number of programs, including the Oil Palm Development Programme (OPDP), the Integrated Scheme on Oilseed, Pulses, and Oil palm Development (ISOPOM), were launched across the country to boost edible oil production.

Oilseeds account for 13% of gross cropped area, 3% of gross national product (GNP), and 10% of total agricultural commodity value. Almost 72 percent of total oilseeds area is confined to rainfed farming cultivation under input-limited conditions, with biotic and abiotic stresses being some of the major causes of poor oilseed productivity. Domestic consumption of vegetable oils has increased at a CAGR of 4.3 percent over the last two decades and is expected to continue increasing due to a growing population, changing demographic patterns, and rising per capita consumption due to increased GDP growth. India is an example of a price elastic market in which lower prices encourage higher per capita consumption.

Vegetable oil consumption per capita is steadily increasing, surpassing 14 kg per year in 2010-11. This is nearly 40% more than the ICMR's recommended fat intake to meet the nutritional needs of India's population. Various agencies/researchers have recently projected demand for vegetable oils in India by the end of the XII plan (2017), which is expected to be at least 16kg/year per capita. The total vegetable oil requirements for a projected population of 1276 million will be 204 lakh tons. It is nearly equivalent to 680 lakh tons in terms of oilseeds, assuming that the proportion of different oilseeds remains constant in the coming years. If at least 20% of vegetable oils are derived from sources other than annual oilseeds such as rice bran, cotton seed, coconut, tree borne oilseeds, oil palm, and so on, the country will need to produce approximately 544 lakh tons by the end of the XII plan to achieve near self-reliance in vegetable oils. Almost all oilseed crops are grown in India. Soybean, Groundnut, Rapeseed–Mustard, Sesame, Sunflower, Castor, Safflower, Castor, Sunflower, Linseed, and Niger are the most important.

The area, production, and yield scenarios have shown a mixed trend from the first (1951-56) to the eleventh Five Year Plan (2007-2012), but the highest average yield was recorded as 267.48 lakh hac, 286.27 lakh tons, and 1082 kg/hac respectively in the eleventh five-year plan. Among the nine oilseed crops grown in India, soybean (39%) has the highest average contribution to total oil seed production, followed by groundnut (26%) and (24%). Similarly, soybean has the highest average area contribution to total oilseed area (36%), followed by Rapeseed–Mustard (23%), and Groundnut (22%). On average, total kharif oilseed crops contribute approximately 67 percent of total production, with Rabi/summer oilseed crops accounting for the remaining 33 percent.

d) Trade Pattern and Tariff Policies in Edible Oils:

The previous chapter's analysis revealed that the country's consumption of edible oils is increasing. Because domestic production of edible oils has not been able to keep up with rising demand, significant quantities of various edible oils have had to be imported on occasion to meet domestic demand. Imports of edible oils have serious consequences for domestic prices because they expose the domestic market to the influences of international price volatility. Thus, before examining price volatility, it is necessary to examine the pattern of edible oil imports and the variability in imports.

Imports of edible oils:

Imports of total edible oils fluctuated significantly between 1980-1981 and 2019-2020. Significant changes in the quantity of edible oil imports can be seen between the implementation of the Technology Mission on Oilseeds (TMO) and the emergence of the new trade regime following the establishment of the World Trade Organization (WTO). Imports of edible oils decreased significantly two years after TMO implementation and remained low until 1994-95. Imports began to rise again following the establishment of the WTO and the implementation of trade-related reform measures. From approximately 347 thousand tonnes in 1995-1996 to 4196 thousand tonnes in 1999-2000, and finally to 34.19 million tonnes in 2019-2020.

Export of oil meals from India:

India is a major exporter of oil meals, particularly soybean meal. Between April 1, 2020 and March 31, 2021, India's oilseed meal exports increased by 51%. Soya meal cake accounted for the lion's share of exports, with India exporting 15.64 lakh tonnes in the previous fiscal year. Similarly, rapeseed meal exports surpassed a million tonnes due to increased purchases by South Korea, Thailand, and Bangladesh. Rice bran exports more than doubled due to strong demand from Vietnam and new demand from Bangladesh as a result of their rice crop failure. Due to higher international realisation, overall earnings more than doubled to Rs 8,838 crore from Rs 4,437 crore in the previous year (2019-20). This also assisted farmers in obtaining a higher price for their produce (oilseeds) in the domestic market. Soybean meal exports have recovered and doubled, while rice bran extraction has increased two and a half times over the previous year.

Brief description of the major oilseed crops-

I. Soybean:

Soybean *(Glycine max Linn.)* is the world's most important seed legume, accounting for 25% of global edible oil, approximately two-thirds of global protein concentrate for livestock feeding, and a valuable ingredient in formulated feeds for poultry and fish. Commercial soybean cultivation in India began in the late 1960s. Soybean production has increased from 0.32 lakh hac in 1970 to 120 lakh hac today. Similarly, production increased from 0.14 lakh tons to 105 lakh tons in 2020. Because of the export of soybean de-oil cake (DOC); soybean has remained a significant foreign exchange earner. In 1986-87, soybean DOC exports totaled Rs. 132 crore, rising to Rs. 1845 billion by 2019-2020. Because of higher prices fetched by Indian DOC in international markets, the market price of soybean has always been much higher than the government's declared minimum support price.

Madhya Pradesh and Maharashtra are the two major soybean growing states, accounting for approximately 86% of total soybean area and production. Soybean cultivation has grown in popularity in Andhra Pradesh in recent years.

II. Groundnut:

Groundnut *(Arachis hypogea L.)* is an important and supplementary food crop worldwide. Groundnut, a native of South America, is grown in tropical, subtropical, and warm temperate climates around the world. Commercial groundnut cultivation, on the other hand, is limited to latitudes between 40o N and 40o S. Groundnut is the world's 13th most important food crop and 3rd most important oilseed crop. In India, groundnut production is primarily concentrated in Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, and Rajasthan. These six states account for roughly 90% of total groundnut area. Anantapuram district in Andhra Pradesh has the highest ground nut production and area, with 3.44 lakh tons produced and 3.44 lakh acres under cultivation respectively followed by Chittoor and Kurnool. The productivity of Ground nut is highest is the Nellore district with 4072kg/hac.

III. Rapeseed And Mustard:

Rapeseed-Mustard crops in India comprise traditionally grown indigenous species, namely toria *(Brassica campestris L. var. toria),* brown sarson *(Brassica campestris L. var. brown sarson),* yellow sarson *(Brassica campestris L. var. yellow sarson),* Indian mustard *(Brassica juncea L.),* black mustard *(Brassica nigra)* and taramira *(Eruca sativa/vesicaria Mill.),* which have been grown since about 3,500 BC along with non-traditional species like gobhi sarson *(Brassica napus L.)* and Ethiopian mustard or karan rai *(Brassica carinata A. Braun)* (*Directorate of rapeseed-mustard research)*. Grown in diverse agro-climatic conditions ranging from north-eastern / north-western hills to down south under irrigated / rainfed, timely / late sown, saline soils and mixed cropping. Two different ecotypes of brown sarson: lotni (self-incompatible) cultivated in colder regions of the country and toria (self-compatible) cultivated in limited areas of eastern U.P. The estimated area production and yield of rapeseed – mustard in the world was 36.59 million hectares (mha), 72.37 million tons and 1980 Kg/ hac, respectively, during 2018-19. Globally, India account for 19.8% and 9.8% of the total acreage and production.

IV. Sunflower:

Helianthus annus. The cultivated sunflower is native to the southern United States and Mexico, but it was introduced to India in the late twentieth century. The oil content of the seed ranges from 35 to 43 percent. Unsaturated fatty acids, such as oleic and linoleic, account for approximately 90% of the total. High oleic sunflower seeds are used in confectionery, and the oil has a long shelf life. Sunflower was grown on an area of 4.006 lakh hac, yielding 2.840 lakh tons and a productivity of 709kg/hac (average of 2014 -15 to 2018-19). Keeping in mind the importance and problems discussed above, this study is titled Dynamics of Oilseed Production and Trade in India. All oilseed production and growth rates are covered in this topic, as the findings have direct implications for agricultural price policy. As a result, the primary objectives for the current study are as follows: to investigate the dynamics of oilseed production, export, and import in India in terms of co-integration, seasonality index, and price volatility in the key oilseed producing states of India.

Objectives

1. To review the policies and reforms for boosting oilseeds production in India.
2. To examine the dynamics of production, export and import of oilseeds in India.
3. To identify the factors for low production of oilseeds in India.

Study outline

The thesis is divided into five sections. The first section is an introduction in which general facts about the study and objectives are mentioned. The second chapter, which was devoted to a review of literature, contained valuable research conducted by various scientists. The third chapter discusses the research methodology and analytical tool used in the current investigation. The current study's results and discussion were discussed and presented in the fourth chapter. The final chapter includes a brief summary and conclusion drawn from the research, followed by references.

Chapter II

REVIEW OF LITERATURE

Chapter II

REVIEW OF LITERATURE

One of the most important aspects of the research process is the review of literature. It assists the researcher in keeping his work moving in the right direction. As a result, an attempt has been made to review the research studies conducted on the Dynamics of Oilseed Production and Trade in India. They have been arranged chronologically and are presented in the following sequences.

1. To review the policies and reforms for boosting oilseeds production in India.
2. To examine the dynamics of production, export and import of oilseeds in India.
3. To identify the factors for low production of oilseeds in India.

Larson (1953) defined the market as "the entire area within which the forces of demand and supply of a given commodity or service interact in effective exchange in determining prices." Thus, a market exists and wherever buyers and sellers are brought together, regardless of the means of communication used.

Krueger (1986) reaffirmed the above general definition and argued that even devaluation in the presence of quantitative restrictions constituted a liberalization episode. He defined liberalization as any policy action that reducing the restrictiveness of controls - reduced the scarcity premium attached to those controls. Thus, a regime with no quantitative restrictions but very high tariff could still be considered fully liberalized but biased.

Bhagwati (1988) emphasized the importance of neutrality in liberalization. In an import-substituting system, incentives are stacked against exports, favoring domestic sales. The introduction of exporter incentives into such a regime would be seen as a step toward liberalization since it would diminish anti-export bias. This would be true even if import restrictions remained unchanged.

Edwards (1989) proposed a definition that will allow for a continuum recognizing different degrees of liberalization. He referred to the earlier definition by Kruerger as mild liberalization and he opined that a move to neutrality would be more intensive liberalization finally a reduction in levels of intervention would constitute a more drastic from of liberalization.

Papageorgiou *et al* (1991) acknowledged that liberalization encompasses not only a reduction in the anti-export bias of the trade regime and an increase in reliance on the price mechanism, but also a reduction in the level off intervention. Inclusion of these concepts in the definition of trade liberalization means that a large number of policy changes like lowering average nominal tariffs, narrowing the range of nominal and effective tariffs, a shift from QRs to tariffs, a real devaluation, a unification of multiple exchange rates, removal of export taxes, removal of export quantitative restrictions, implementation of export subsidies, rebates or compensation schemes form part of liberalization.

Borthakur *et al* (1997) for the period 1951-1993, a linear, quadratic, and exponential function were fitted to the area, production, and productivity of potatoes in Assam. To forecast potato production for the next 10 years, a quadratic regression model was chosen based on its R2 value and significant coefficient. They also discovered that the coefficients of all linear regressions were negative, whereas the coefficients of quadratic regression were positive and significant for area, production, and productivity.

Kerr *et al* (1997) defined market as a social institution that would facilitate the free exchange of commodities between buyers and sellers, usually for money, but sometimes for barter too. Markets in this sense do not refer to a specific location where goods and services would be exchanged, but rather the process by which the exchange would be done.

Ramakumar (1998) referred market as the entire sphere of social and institutional arrangements within which the forces of demand for and supply of a commodity and its products would operate.

Barman (2002) The area, production, and price projection of coconut in Bangladesh were analysed using a third-degree polynomial model, which found that R2 accounted for the most variation (98%) in wholesale price for dry coconut and the lowest variation (56.5%) in wholesale price for coconut oil.

Deka *et al* (2005) Fitting linear, quadratic, and exponential regression models to the growth trends in pineapple area, production, and productivity in Assam. They found 93.1, 93.6, and 66.2 percent R2 in the cases of area, production, and productivity, respectively. In quadratic terms, area and production were negative, but productivity was positive.

Lakshmanan (2005) concluded that area and production of Arhar and other pulses is increasing marginally, while that of gram is shrinking. The production of gram was found constant because of slight increase in productivity during the last two decades. A stagnation in yield of pulses was observed because of low input use and growing this crop under un-irrigated conditions. Hence concerted efforts should be made to enhance the production and productivity of pulses through proper package of practices, which will in turn ensure more availability of pulses to the burgeoning population.

Jha *et al* (2006) conducted a study on the growth rate of area, production and productivity of chickpea in Madhya Pradesh, and to work out the level of instability in the growth along with the percentage contribution of area, productivity and their interaction towards the production of chickpea in the state. Though the state registered a positive compound growth rate in case of area, production and productivity of chickpea but significant growth rate was observed only for area under the crop. An inter period analysis indicated that the state witnessed insignificant growth rate of chickpea production during 1990-91 to 2000-01 instead of significant positive growth rate during 1980-81 to 1989-90. The study of instability index indicated that productivity variability has more influence on production fluctuation of the state. The study revealed that the half of the area under chickpea in the state suffered from low growth rate in production. Hence, there is a need to for developing district and/or sambhag specific strategy rather than old blanket strategy of state as a whole.

Borbora *et al* (2007) estimated the growth trends in area, production and productivity of Horticulture crops in Assam. It was found that although there is increase in area, production and productivity of almost all the crops (except negative area, production and productivity growth of papaya; negative production and productivity growth of brinjal & negative area and production growth of sweet potato), Assam is in better position for 8 numbers of crops (banana, litchi, chilli, turmeric, sweet potato, tapioca, cabbage, coconut- regarding growth of area expansion and banana, orange, lemon, litchi, turmeric, tapioca, lady's finger and coconut – regarding production growth). The study presents that although there is increase in area, production and productivity of almost all the crops (except negative area, production and productivity growth of papaya; negative production and productivity growth of brinjal & negative area and production growth of sweet potato), Assam is in better position for 8 numbers of crops (banana, litchi, chilli, turmeric, sweet potato, tapioca, cabbage, coconut- regarding growth of area expansion and banana, orange, lemon, litchi, turmeric, tapioca, lady's finger and coconut – regarding production growth).

Dhaker (2007) analyzed the temporal trend in area, production and yield, structural changes in economic parameters and acreage response of major oilseed crops in Rajasthan state. The secondary time series data covering the period from 1991-92 to 2004-05 were used. Author concluded that the best trend model for area and production were the same indicating that the production of major oilseed crops was governed by area in the state.

Raju (2008) estimated instability in three major crops before (1981-93) and after (1993-04) the initiation of economic reforms at the state and district levels in Andhra Pradesh, India. The paper used time series data on area. production, yield and farm harvest prices (FHP) at the state and district levels for rice, groundnut and cotton covering the period 1979-80 to 2003-04, which was divided into two sub periods, viz. 1979-80 to 1992-93 and 1993-94 to 2003-04. The study showed that in a large state like Andhra Pradesh, the instability status perceived through the state level data might be vastly different from that experienced at the disaggregated level. The net effect of fluctuations in production and prices on farm income had shown that instabilities in area, production, yield and prices did not negate each other. The instability was higher in farm income than the area, production and prices in all cases, and had not changed over time. It was concluded that the state level analysis does not reflect the complete picture of shocks in agriculture production and furthermore, shocks in production underestimate shocks in farm income. The need for addressing risks in farm income by devising area-specific crop insurance or other suitable mechanisms was suggested.

Adak (2011) In order to quantify and comprehend the spatiotemporal variations in field microenvironment regimes, it was determined that the evaluation of thermal energy use efficiency in oilseed Brassica was required. Our research assessed the time variable energy indices that influence the crop's energy utilization behaviour merely by their major impact on leaf area and dry biomass output, as well as their heat utilization capacities. Furthermore, the time trend of these energy indices fitted in second order polynomial regression equations revealed the energy utilization capacities considerably. Due to differential heat accumulation in crop growth cycles, there was an 80 percent difference in leaf area index and a 94 percent variation in dry biomass production. These time variable changes in leaf area and dry matter production strongly indicated a large variation in their heat use efficiency of 79–95 percent. According to a linear statistical analysis, there is a high and positive link between thermal energy usage efficiency and seed yield production in Brassica of the order of 87 percent.

Sonnad *et al* (2011) concluded that area under rapeseed and mustard, soybean, sunflower and castor increased with an overall annual compound growth rate of 2.13, 17.61, 9.15 and 1.85 per cent respectively. The increase in productivity of all nine selected oilseed crops put together from pre-WTO period to post-WTO period, was 140 kg per ha. The overall growth of productivity was positive in all the oilseed crops except sunflower. The mean production of the nine oilseeds put together had increased from 9.99 million tons during Pre-Technology Mission on Oilseeds (TMO) period to 17.68 million tons in pre-WTO period and to 22.33 million tons in post-WTO period. To attain self-sufficiency in edible oils and to achieve nutritional security, State and Central government should map out programs on the line of TMO to increase and maintain sustainable growth in productivity of all oilseed crops in rainfed areas.

Burman *et al* (2012) the study conducted micro level survey was conducted in the district of Junagadh (Gujarat) and Bharatpur (Rajasthan), for groundnut and rapeseed – mustard respectively, during 2010-11 with the aim to analyze the major constraint in cultivation, processing and marketing of oilseed production. The study identified irrigation, nutrient supply, availability of quality seed, and the crop specific –production growth and input use efficiency. In oilseed processing sector, it was found that better integration between the expelling and solvent extraction sections of the industry can improve the overall efficiency of the oilseed sector. The edible oil industry should take initiatives to increase oilseed production by promoting contract farming sector. The outcome from the study also provided a strong indication that the pricing and market mechanism prevailing for oilseed crop produce are far from satisfactory as far as the primary producers are concerned. This dissatisfaction with the market mechanism needs to be addressed to enthuse farmers towards higher production and productivity in oilseed crops to bridge the demand supply gap of vegetable oils of the country.

Bharti *et al.* (2012) analyzed the growth rates and the impact of Technological Mission on Oilseeds in Uttar Pradesh based on time series data pertaining from 1970-71 to 2005-06. The results indicated an overall positive growth rate in production due to the increase in area. It was observed that before the launch of TMO, increase in oilseeds production were mainly due to the area expansion rather than yield. Low adoption of yield increasing technologies led to the stagnation in productivity. The favorable price situation created by TMO had resulted to the increase in marginal areas, which further led to reduction in average yield.

Jha (2012) Using monthly wholesale price data of oilseed crops such as soybean, peanut, rapeseed, and mustard traded in India's Indore, Rajkot, and Delhi marketplaces, the ARIMA and TDNN models were compared in terms of modeling and predicting. The study's goal is to look at short-term price forecasting up to a year with a variety of projection horizons, including 1, 3, 6, and 12 months. When compared to the ARIMA model for nonlinear relationships, TDNN models have greater forecast accuracy in terms of traditional RMSE. We discovered that nonlinearity of series plays a significant role in giving a solid guide to ARIMA and TDNN models' post-sample forecast accuracy in terms of RMSE for these price series. Our findings clearly show that before using any nonlinear model, one must first determine whether the series is nonlinear. For nonlinear rapeseed and mustard series, TDNN outperformed ARIMA for all forecast horizons except one month ahead. It could be because we identify the best neural network model for a 12-month forecast horizon; as a result, the literature suggests that the best network should be chosen for each prediction horizon. However, TDNNs outperform linear models in predicting the direction of change for these series, and hence may be chosen over linear models in terms of anticipating turning points, which is more important in price forecasting.

Thomas (2012) studied the role of price policy in influencing production and investment decision in crop production is well established. A comparison of the profitability before and after the period of liberalization of edible oil trade and implementation of WTO agreement is also undertaken. Despite increase in the growth rate of implicit prices slowed down significantly after 1995-96 leading to a decline in profitability of oilseed cultivation. The results established that the rise in MSP during the recent past merely compensated oilseed farmers for rise in input cost and will not be sufficient to generate surplus and induce farmers to take up productive investments. The revenue terms of trade for oilseed crops with respect to its major competing crops is shown to decline over the years, further marginalizing oilseed cultivation.

Ahmad *et al* (2014) conducted a study on economic analysis of changes in cropping pattern in Karnataka. The results showed that soybean and sunflower were first in terms of growth in area of more than 8 per cent over a period from 1979-80 to 2008- 09, followed by maize (7.65%) accounting 357.73 per cent of change over the two periods, whereas sunflower (8.31%) and paddy (0.85 %) accounted 473.77 and 25.34 per cent change over the two periods, respectively. Cotton and groundnut showed the negative trend with a growth rate of -2.21and -0.12 per cent, respectively.

Meena *et al* (2014) analyzed the growth and variability in area, production and productivity of soybean in major soybean growing districts of Madhya Pradesh based on time series secondary data from 1980 to 2010. Results revealed that with the exception of the few cases, the growth of area and production were found to be positive and significant in all the districts. The variability in output appeared more initially but gradually reduced in all the districts. It was further concluded that the increment in yield helps in increasing production and makes it more competitive and cost effective at global level.

Pahariya (2014) researched on “Impact Assessment of Trade Liberalization in Oilseeds sector: Rajasthan “than he originated and came up with that India followed different types of oilseed policies until 1994 which gave different types of oilseed sector. It means all the policies followed for oilseed they all are followed before establishing the World Trade Organization agreement on oilseed in 1995. These all policies were not only able to double the oilseed output and stabilize the oilseed production but these also use to production of new crops like soybean, sunflower etc. even for those areas where poor farmers typically face more limited growth opportunities. In 1990’s India was more self-sufficient in edible oils and a large exporter in oilseeds. This represent that India is always a large exporter in oilseeds which represent India always has good creation of oilseeds this make India unique and put India among those countries that have large market share of oilseed in world market. In the mid of 1990’s cheaper imports and faster economic growth accelerates the demand of edible oils which was imported sufficiently according to the demand. The trade liberalization in oilseed sector initiated in 1994.

Debnath *et al* (2015) analyzed the growth and instability of sesame over five sesame growing states of North-Eastern Hill Region of the India. Study was based on analysis of the time series data of 20 years. It was revealed in the study that Nagaland State had shown highest growth rate of area and production but in terms of productivity, Manipur showed the highest growth among all the states under study. The highest instability was seen for Manipur in case of area and productivity whereas, it was lowest in Nagaland.

Rani (2015) examined the association between the WTO agreement and patterns of economic growth in context of India and mentioned International trade as a mechanism to create trade relationships among the nations around the world. The study depicted the imperative role of agriculture sector in the generation of employment opportunities; the study also found the WTO export rate as well as production rate of agriculture segment as imperative parts in the economy. The agricultural sector was also found significant in terms of catalyzing agent of raising level of capital formation in agricultural infrastructure in terms of warehouse and cold storage facilities as well as provision of irrigation facilities.

Syed *et al* (2015) studied Agricultural Export and Economic Growth: A Case Study of Pakistan. The study estimated the relationship between Gross domestic product (GDP) and agricultural and non-agricultural exports as dependent and independent variables respectively by employing Johansen co integration technique. The agricultural exports have an inverse relationship with economic growth of Pakistan while non-agricultural exports have positive relation with economic growth.

Jagadambe (2016) analyzed the export competitiveness of Indian agro-based products along with the ASEAN nations. Increase in the graph of export intensity of the economy in the agricultural trade with respect to ASEAN nations rather the rest of the globe was reported. The study acknowledged the gradual decline in the comparative advantage in the export of agricultural products. Therefore, it was suggested that the government should promote direct policy for the promotion of products with comparative advantage in the exports and the Indian exporters should export more of rice, fruits, tea and meat to these nations.

Roy *et al* (2016) studied problems and prospects of oilseeds production in West Bengal. It was concluded that as spread of irrigation facilities reduced, sesame appeared as a major crop to take advantage of the situation. It was observed that cultivation of sesame required much less irrigation and operational cost while growth of area, production and productivity of mustard had slowed down, that of sesame had picked up momentum and became a major oilseeds sector in state agriculture.

Anjum *et al* (2017) investigated the changing patterns of agricultural exports in India under WTO agreement and found the accomplishment of specialization in the export of agricultural products in the pre-WTO era. WTO had negative influence on the exports of cashews, tea, coffee, oil meals and marine products and positive impact on share of spices, fruits, vegetables and rice.

Mishra (2017) Using the orthogonal polynomial technique on fifty-year time series data, researchers looked at the trend of area under cultivation, production, and productivity of groundnut in India. It also considers the area and productivity effect as primary production drivers. Three primary phenomena emerge through trend research and evaluation of concerns and difficulties. To begin with, there have been recent advances in productivity, however it remains low when compared to other countries. Second, farmers are unable to move groundnut agriculture from marginal to improved fields due to low prices and low profitability. Third, low technical investment, vulnerability to pests and diseases, and a lack of excellent quality seed and storage are all important roadblocks. To break the productivity plateau, investments in groundnut technology upgrades and mechanisation, as well as better market access and processing efficiency, will go a long way toward increasing overall production and productivity. Better cropping systems such as rice, groundnut, rice-mustard, and others, may also be recommended. Improving extension operations by applying scientific methodologies into postharvest management, pest and disease control, and crop production and yield can all help to increase crop production and yield. Promoting agriculture in certain zones with favourable ago-climatic-soil characteristics, as well as more investment and improved farming practices, would undoubtedly yield long-term advantages.

Samal *et al* (2017) Estimated growth rate and volatility in Odisha oilseed production from 1995 to 2015, based on district-level analysis with a focus on groundnut. The research was split into two time periods: 1995-1996 to 2001-05 and 2005-06 to 2014-15. The study found that the overall negative growth of groundnut and total oilseed production was recorded from 1995-96 to 2004-05, whereas the overall positive growth of groundnut and total oilseed production was found from 2005-06 to 2014-15.

Singh *et al* (2017) found huge gap between production and demand of edible oilseeds, which gradually increased the dependency on import. It was concluded that the low productivity of Indian oilseed sector needs to be augmented. Oilseeds producing farmers need support through remunerative price coupled with incentives. Large investments in research and extension, long term planning and execution were suggested as necessary.

Mulik (2018) studied performance of oilseeds in Marathwada region of Maharashtra. It was found that in soybean and safflower, major source of production was yield effect followed by area and interaction effect. Soybean was expanded in the region but the productivity level was continuously reducing. At the same time, safflower lost substantial area from the cropping system. Hence, it was suggested to give proper attention to enhance the productivity level of soybean and proper incentives were to be provided to safflower farmers so as to cultivate this low productive crop in the region.

Bhardi *et al* (2018) discovered that the growth rate performance of oilseed crops in Karnataka state from 2001-01 to 2014-15 and discovered that out of the nine oilseed crops grown in the state, soybean was the only crop that showed positive growth rate in area and productivity to the extent of 10.50 and 12.36 percent, respectively, whereas linseed had the highest negative growth rate in productivity at -7.00 percent per annum.

Arora *et al* (2019) studied the relative contribution of each of the components of Constant Market Share model on the expansion of export of Groundnut for India for the selected periods. He found that the world trade effect and market distribution effects have positively contributed to the change in the total export of India during the period I (2000-06) to period II (2007-17) with the contribution of 40.4% and 2.2%. The results for World trade effects in the table indicates the increases in the Groundnut export of India with expansion in the size of world market during the period I to period II. Similarly, the results of market distribution effects exhibit that Indian export of Groundnut is concerted in the markets where demand is rising faster than world demand. The negative value -113.229 of commodity composition effects suggests that India concentrates on slowly grew markets for Groundnut. During the same period, India gains market share of her export of Groundnut in the various markets due to its competitiveness in the export of the same product.

Renjni *et al* (2019) concluded that the hike in duty will benefit the oilseeds growers through increase in the price of edible oils. Because of the bigger loss in consumer surplus, which may offset the rise in production surplus and government income, the total impact on the economy will be negative. Although the duty increase may provide a short-term advantage, improvements in production, proper procurement, and the strengthening of edible ion of price growth rate of peanuts, Niger, safflower, and sunflower were greater than imports. The study discovered that mustard (0.97 percent) has high export elasticity, whereas peanut, soybean, safflower, sunflower, and Niger have consistent export import pricing. According to the study, establishing a multilateral trade connection with nations that have a high export-import share will aid in the smooth flow of oilseeds. These findings have important implications for policy research and R & D strategies in response and re-orientation of the R&D system to the changing trade scenario to benefit from WTO.

Laxmi *et al* (2019) analyzed Agro Climatic region wise trend and growth of groundnut crop in Madhya Pradesh, based on time series data from 1991-92 to 2007-08. Results denoted net decrease of 30 thousand ha in area at the state between two periods. In relative terms, the highest and lowest increase in area was found in Central Narmada Valley (249.998%), and Satpura Plateau (1.733%) respectively. During the study period, no significant increase was seen in trend of area, production and productivity of groundnut at the state level. The compound growth rates showed the remarkable results for Central Narmada valley among all groundnut producing agro climatic regions. The growth rate in area, production and productivity in Central Narmada valley was 63.186 percent, 101.938 percent and 23.748 percent per annum respectively. Overall yield of the state had been increasing at the rate of 0.688 percent per annum. Study concluded that groundnut was an important crop in Gird region and it was the fourth most important oilseed crop of Madhya Pradesh.

Bansal *et al* (2020) analysed growth and variability in groundnut area, production, and yield in Punjab from 1975-1976 to 2014-15, which was divided into two periods: pre-WTO (1975-1995) and post-WTO (1996-2015). The compound growth rates in area (-4.75) and yield (-5.23) had decreased, but production (3.25) had increased throughout the study period.

Dash *et al* (2020) conducted an analytical study of the growth and volatility of rabi oilseed production in Odisha from 1993-1994 to 2016-17. The CAGR estimated to measure growth revealed that the growth rate of rabi oilseed production was positive and significantly positive despite the fact that area declined atciences, the rate 0.49 percent under rabi oilseeds.

Joseph (2020) Estimated growth and instability in area, production, and productivity of oilseeds in India from 1989-2020 to 2008-09, divided into three sub-periods: Decade I (1989-90 – 1998-99), Decade II (199-2000 to 2008-09), and Decade III (2009-10 to 2018-19). The study found that the CAGR of oilseeds in area, production, and yield was 0.15, 1.89, and 1.74, respectively, for the entire study period as a whole and in the three sub periods, with the exception of a negative growth in its area in decade III.

Kaur *et al* (2020) conducted a district-wise analysis of trends in area, production and productivity of major oilseeds in Punjab where it was observed that the growth rates of area and production in all the major oilseeds, like rapeseed-mustard, groundnut, sunflower and sesamum were negative and significant, whereas, growth rates of productivity were found to be positive and significant in all the oilseeds except sesame across various districts of the state. The policy measures like developing high-yielding variety seeds, ensuring remunerative procurement prices, building requisite market infrastructure and strengthening extension services were suggested to boost the oilseeds‟ production in Punjab.

Sankari *et al* (2020) concluded that India is one of the largest producers of oilseeds in the world, it is the biggest vegetable oil importer to meet the supply-demand imbalance thus causing a huge loss to the exchequer of the nation. The present per capita consumption is 18.2 kg/annum. The growth analysis suggested that during the TMO period, highest rate of growth of area, production was evidenced and highest imports were recorded in WTO and post WTO periods. Population growth rate, per capita consumption, domestic oil availability and out of home consumption, are

observed to be the main factors for higher imports of edible oils. Appropriate policy on import duty of edible oils and increase in MSP for oilseeds and its implementation may encourage domestic production of edible oils thereby reducing the import bill.

Chapter III

METHODOLOGY

Chapter III

METHODOLOGY

India is the world's fourth largest edible economy in the world after US, China and Brazil. India accounts for 7% share of production and 12% share of consumption making it the 2nd largest consumer of the world edible oil. To abridge the huge gap in the demand–supply of edible oil production in the country, government has resorted to imports which is 60% of the country demand; only 40% of the demand could be fulfilled through domestic source.

Present status:

India is a global player in edible oil arena, being the 2nd largest importer, and as well as the 4th largest oilseed producer. Rapeseed and Mustard, Soybean and Groundnut and Groundnut contribute 82% of total inland oilseeds production. Per capita consumption has been increasing and is projected at around 24kg by 2025. There is a gap in production and demand of edible oilseeds, leading to growing dependency on import day by day.

Sources of Data and Conceptual Framework

The research study is based on secondary data extracted from Agmarket portal of Ministry of Agriculture and Farmers Welfare, Government of India. For analysis of dynamics of production and trade of oilseeds in India.

Analytical tools and techniques:

Objective 1: To review the policies and reforms for boosting oilseed production in India.

All the policies and scheme mentioned in table 3.1 were thoroughly reviewed and discussed.

Table 3.1: Different projects and schemes related to Oilseeds

Schemes	Year
Oilseed growers cooperative project	1979-80
Technology mission on oilseeds (TMO)	1986
National oilseed development project	1985-86
Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM)	2004
National Mission on Oilseeds and Oil Palm (NMOOP)	2014
National Food Security Mission (NFSM): Oilseed	2018-19
Kharif Strategy for Self Sufficiency in Oilseeds	2021
Price Support Scheme (PSS)	
Price Deficiency Payment Scheme (PDPS)	

Objective 2: To examine the dynamics of production, export and import of oilseed in India.

In order to study the trend of oilseed, secondary data pertaining to the area, production, yield and MSP of oilseed crop for the period of 20 years (from 2000-01 to 2019-20) was obtained from Directorate of Economics and Statistics. The obtained data was compiled and analysed for area, production and yield and MSP in India. To understand the trend in area, production, yield, and MSP of oilseed, and polynomial models were fitted by using the method of ordinary least squares. Linear, Quadratic, Cubic, Logarithmic models have been used in the present study (Singh and Suraya 2017).

Linear function:

The linear equation is given by,

$$\mathbf{Y_t = a + bt + e_t}$$

Where,

Y_t is the dependent variable i.e., area, production and productivity

t is the independent variable, time in years

e_t is error term

a, b and c are the constants.

Quadratic function:

The quadratic equation is given by,

$$\mathbf{Y_t = a + bt + ct^2 + e_t}$$

Where,

Y_t is the dependent variable i.e., area, production and productivity

t is the independent variable, time in years

e_t is error term

a, b and c are the constants.

Cubic function:

The cubic model is given by the equation,

$$\mathbf{Y_t = a + bt + ct^2 + dt^3 + e_t}$$

Where,

Y_t is the dependent variable i.e., area, production and productivity

t is the independent variable, time in years

e_t is error term

a, b and c are the constants.

Logarithmic function:

The logarithmic model is given by the equation,

$$\mathbf{Y = a + b \log X}$$

Where,

Y is the response variable

X is the predictor variable

a, b are the regression coefficients that describe the relationship between X and Y

Model adequacy checking:

Adequacy of a model indicates the suitability of the model to explain the inherent nature of the collected information. The assumptions made in a linear regression model are, linear dependence of "Y" on regressors, independence and identical distribution (normal) of errors with zero mean. Gross violations of the assumptions may yield an unstable model in the sense that a different sample could lead to a totally different model with opposite conclusion. We cannot detect departures from the underlying assumptions by examination of the summary statistics such as "t" or "F" statistics or R2. These are "Global" model properties and as such they do not ensure model adequacy. Hence, diagnostic methods, primarily based on study of the model residuals. The diagnostics checks of randomness and normality of residuals ascertains the independence and distribution assumption of data.

The coefficient of determination (R2) is a test statistic that will give information about the appropriateness of a model. R2 value is the proportion of variability in a data set that is accounted for by the statistical model. It provides a measure of how well the assumed model explains the variability in dependent variable.

$$\mathbf{R^2 = \frac{RSS}{TSS} = 1 - \frac{ESS}{TSS}}$$

Where,

ESS is error sum of squares

RSS is regression sum of squares

TSS is total sum of squares.

Computed R^2 value lies between zero and one. If R^2 value is closer to 1 indicates that the model fits the data. Adjusted R^2 and Root Mean Square Error (RMSE) were also used for checking the fit of model.

Testing for significance of regression coefficient

Significance of regression coefficient is tested using F-test statistic.

Root Mean Square Error (RMSE)

The Root Mean Square Error (RMSE) (also called the root mean square deviation, RMSD) was used to assess the amount of variation that the model was unable to capture in the data. The RMSE was obtained as the square root of the mean squared error hence considered as the model prediction capability and obtained as,

$$\mathbf{RMSE} = \sqrt{\frac{\sum_{i=1}^{n}(Yt - \hat{Y}t)^2}{n}}$$

Where,

Y_t = observed value

$\hat{Y}t$ = predicted value

n= number of observation.

Objective 3: To identify the factors for low production of oilseed in India

To identify the factors for low production of oilseed in India Multiple Linear Regression Model was employed. Production factor was considered as dependent Factor and Price, Export, Import, MSP etc. were considered as Independent Variables.

Multiple linear regression function:

A multiple linear regression function was fitted to analyze the influencing the factor for low production of oilseed in India.

$$\mathbf{Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6}$$

Where,

Y= Dependent variable (production)

X_1= Area

X_2= Production

X_3= Yield

X_4=MSP

X_5= Export

X_6= Import

Chapter IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The purpose of this study is to investigate the Dynamics of Production and Trends of Oilseeds in India. To achieve the objectives, data and information were collected, tabulated, analyzed, and then the final results were obtained. This chapter describes the findings of the current study and contains the thesis outcome that was obtained after a thorough investigation of the data. Based on the study's objectives, the empirical findings were divided into three categories. A thorough examination of the Policies and Reforms for Increasing Oilseed Production in India, followed by the dynamics of oil seed production, export and import, and finally the factors causing low oil seed production in India was analyzed.

Objective 1: To review the policies and reforms for boosting oilseeds production in India:

Until the 1960s, India was a net exporter of oilseeds, meals, extractions, and edible oils. However, due to stagnant production and rising demand for edible oils, India became a net importer of edible oils by the late 1970s. Despite having the world's second largest area under oilseeds, edible oils were the largest import item by the mid-1980s, accounting for approximately 30% of total imports, trailing only petroleum products. By the 1990s, the government resolved to achieve self-sufficiency in edible oilseeds through various policy and technological interventions. To overcome stagnant oilseed production, the initial strategy was to promote new technologies in oilseed production and processing through centrally sponsored schemes.

Policies of Oilseeds:

Following independence, the Indian government had two choices: an open economy or a largely state-planned mixed economy. The then India opted for a closed economy. This policy aided the administration in the process of nation-building. In reviving the war-torn and famine-stricken country, India faced numerous challenges.

It was a time when the country's agricultural picture was rapidly changing, resulting in outstanding food performance in the 1960s and 1970s. However, there was a stark contrast in the domestic oilseed landscape. The demand-supply gap was enormous. To meet the demands, the government began to loosen the state's grip on the economy. In the early 1980s, India spent approximately Rs. 1000 crores on imported vegetable oils. Recognizing that the country cannot afford such a large outflow, FOREX, the Government of India, established the oilseeds technology mission, a variety of programmes and policies to improve the oilseed sector.

1. Pre- WTO Period

Several safeguards were put in place to protect the Indian oilseed complex until 1994. Quantitative and other restrictions were imposed on the import and export of oilseeds, oils, and oil cakes. Imports of oilseeds and edible oils were routed through the State Trading Corporation (STC), while imports of oil cake were restricted. Oilseed and oil exports were similarly restricted (illegal), but not oil cake exports. Through the Public Distribution System, imported oils were distributed to state governments for sale at predetermined prices (PDS). STC's custom duty and service charges have been included in these costs since 1989. A portion of the imported oil was also provided to the vanaspati sector at reduced prices. Certain development programmes were put in place to assist the oilseeds sector in adapting to rapid technological change.

Oilseed grower’s cooperative project:

In 1979-80, the Oilseed Growers Cooperative Project (OGCP) was formed to restructure oilseed production, processing, and marketing of vegetable oils and byproducts in the covered area. Encouraged by the success of Operation Flood in increasing milk production, the government charged the National Dairy Development Board with increasing oilseed production (NDDB). Gujarat initiated the project. It was later expanded to include other states. The project served as a market outlet for farmers' output as well as a supply channel for farm inputs and support services. Maintenance of demonstration farms, demonstrations through agro-economic centers, and distribution of improved seed, fertiliser, and pesticides were among the activities.

The project established 5513 oilseed grower's co-operative societies, with a total membership of approximately one million people. In 1986-87, the project was deemed successful in terms of influencing market prices, farmers' investment in technology, and the establishment of modern processing capacities. However, it did not contribute to market stability and did not keep farmers loyal to co-operatives.

National oilseed development project

Reorienting various centrally sponsored schemes for oilseed development began in 1984-85 and was launched in 1985-86. The National Oilseed Development Project was implemented in all four provinces and was intended to significantly increase oilseed production in order to reduce edible oil meal imports. The increased output of oilseeds that was achieved through crop intensification and diversification resulted in higher and more stable farm income. The goal was achieved by expanding the area under oilseeds and raising oilseed yields to international levels by establishing an appropriate policy framework and support infrastructure. The project specifically strengthens provincial agriculture departments through the provision of:

- Extension personnel, training, farm equipment, and vehicles to plan, implement, and monitor the oilseed development program;
- Seed processing and multiplication equipment;
- Research personnel and equipment for applied research to adapt varieties; and
- Project coordination and monitoring units at the provincial level.

The project also provided funds to participating credit institutions (PCIs) for loans to farmers for oilseed production.

Technology mission on oilseeds

The Technology Mission on Oilseeds (TMO) was founded in 1986 to improve various sectors of the oilseed and edible oil economies. The strategy was to combine programmes aimed at promoting rapid technological change in oilseed production and processing, reducing domestic price volatility through producer price support operations, and achieving edible oil self-sufficiency by 1990. TMO has been implemented as an integrated policy on oilseeds with four pronged strategies to improve oilseeds crop technology, improve post-harvest technology, strengthen services to the farmers, and ensure remunerative prices to the farmers.

The four missions successfully completed were:

1. **Development of crop production technology:**

Its primary goal was to coordinate and accelerate oilseed crop varietal and agro-economic research. The objectives were to develop improved varieties with high yields increased oil content, shorter duration, and improved resistance to moisture stress, pests, and diseases, as well as the creation and proliferation of breeder seeds

2. **Post-harvest technology development:**

Its emphasis was on promoting the use of modern integrated technologies in the cooperative and private sectors, improving the efficiency of ghanis and expeller units, and developing technology for minor and unconventional oil bearing materials.

3. **Better delivery of input and support services:**

Its goal was to improve credit delivery by strengthening extension services, streamlining quality seed production and distribution, and streamlining the supply and distribution of other inputs. The Oilseed Production Thrust Programme (OPTP) was launched in 1986-87 as part of this mission in 246 districts across 17 states, including 151 NODP districts. In 1990-91, NODP and OPTP were merged into the Oilseed Production Program (OPP), which covered 342 districts in 21 states in 1992-93.

4. **Market development and price support:**

The National Agricultural Cooperative Marketing Federation (NAFED) was tasked with carrying out the price support scheme, which guaranteed farmers a minimum price for their produce. The objectives of the mini mission were to establish and expand integrated processing facilities in the cooperative sector, improve the efficiency of procurement operations, improve price dissemination and ensure fair prices to consumers, and modernize marketing.

II. Post-Liberalisation Era

India is committed to agricultural commodity trade liberalisation as a founding member of the World Trade Organization. Import quantitative restrictions are being phased out, and exports are also being liberalised. With the exception of a few commodities, agricultural exports and imports are now permitted through private trade. In March 1994, the import of refined palm oil was placed under Open General License (OGL), with a tariff rate of 65 percent. Imports of STC and NDDB were permitted with a 20% tariff concession. Imports of STC and NDDB were permitted at a 20% tariff concession. Except for coconut oil, RBD palm oil, and palm steasin, vegetable oils were classified as hazardous in March 1995. OGL stands at 30%. In 1996, the tariff rate was reduced to 20% to bring it up to parity.STC and NDDB tariff rates are allowed. A 2% Special, on the other hand SAD (Supplemental Duty) was imposed. Despite high global prices, imports were resumed. SAD was raised to 5% in September 1997. Tariffs were raised once more in June 1998 reduced to 10% plus 5% SAD for oil imports for trade purposes, plus an additional 4% SAD for oil for further processing.

In February 1999, the tariff was reduced to 15% with a 10% surcharge. In February, soybean was temporarily permitted, subject to meal re-export by private processors. Sunflower and rapeseed-mustard seed exports were permitted in May 1995. In April 1999, RBD palm oil was placed under OGL under EXIM policy, and future trading in oilseeds was permitted. Imports increased as a result, benefiting consumers. Overall, as trade opened up, edible oil imports began to rise. Imports increased their share of total available oil from approximately 4% in the early 1990s to approximately 30% in the late 1990s. Similarly, domestic production of edible oilseeds and oil decreased. The government took steps to restrict large quantities of edible oil imports. Tariffs were increased by up to 85% in the 2001-2002 budgets. With the exception of soybean and rapeseed-mustard oil, which were both 45 percent, India's maximum tariff ceiling bindings for the oilseed sectors were 100 percent for oilseeds and 300 percent for edible oils. On April 30, 2003, the Finance Ministry reduced the customs duty on imported refined palm oil and refined palmolein from 92.4 to 70 percent, while the duty on crude palm oil and crude olein remained at 65 percent.

Integrated Scheme of Oilseeds, Pulses, Oil palm, and Maize (ISOPOM):

The first programme on oilseeds, known as the Technology Mission on Oilseeds (TMO), was launched in 1986. The central idea was to increase oilseed production and productivity in order to make the country self-sufficient in this critical sector. Later, in the 1990s, pulses, oil palm, and maize were added to this category. In 2004, the scheme was restructured as an integrated scheme of oilseeds, pulses, oil palm, and maize. ISOPOM features include:

- The ability for states to use funds for the scheme or crop of their choice.
- The state government will develop an annual action plan for consideration and approval by the Government of India.
- Flexibility for states to introduce innovative measures or any special component up to 10% of financial allocation.
- Involvement of the private sector in programme implementation by the state government, with a financial cap of 15%.
- With the prior approval of the Department of Agriculture and Cooperation, funds may be diverted from seed components to non-seed components.

Oilseeds and Pulses:

For oilseeds and pulses, the ISOPOM was implemented in 14 potential states: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. Maize development programs were being implemented in 15 states under ISOPOM, including Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, J&K, Tamil Nadu, U.P., and West Bengal.

Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Orissa, Tamil Nadu, Goa, Kerala, Assam, Tripura, West Bengal, and Mizoram participated in the Oil Palm Development Program. Small and marginal farmers, as well as SC/ST and women farmers, involved in the cultivation of oilseeds, pulses, maize, and oil palm, were given priority in providing benefits and support under ISOPOM. Also 22.5 percent of state expenditures for input supply and support services provided to farmers, as well as Frontline demonstrations, were set aside for SC and ST farmers.

State governments continued to implement the ISOPOM through their Agriculture/Horticulture Departments. The nodal agency for breeding seed production and front-line demonstrations is the Indian Council of Agricultural Research (ICAR). The private sector, including non-governmental organizations (NGOs), farmer's organizations, cooperative bodies, and public sector agencies, also involved in the program's implementation through state governments.

NFSM-Oilseed and Oil Palm

National Mission on Oilseeds and Oil Palm (NMOOP) for Oilseeds & Oil Palm Development Program in this country was started in 2014-15 and continued up to 2017-18. Objectives of NFSM-Oilseeds & Oil Palm were,

- Increased output and productivity of vegetable oils derived from oilseeds and palm oil. It aims to increase the availability of vegetable oils and reduce edible oil imports by increasing oilseed production and productivity from an average of 29.79 million tonnes and 1122kg/ha during the 12th plan period to 36.10 million tonnes and 1290kg/ha by the end of 2019-20.
- Efforts will be made to increase the area under oil palm cultivation by 1.05 lakh hectares from 2017-18 to 2019-20. With an additional 1.05 lakh ha under Oil Palm over the next three years, up to March 2020, a total area of approximately 4.20 lakh ha will be achieved.
- During the next three years, up to March 2020, an area of 7480 ha will be planted with nine TBOs: Olive, Mahua, Kokum, Wild Apricot, Neem, Jojoba, Karanja, Simaroba, and Tung.

Interventions of NFSM – Oilseed comprises of three major components;

1. The seed component includes the purchase of breeder seeds, the production of foundation seeds, the production of certified seeds, the distribution of certified seeds, the supply of minikits, and the establishment of a seed hub.

2. Production inputs include PP equipment, PP chemicals, NPV / Bio agent, Gypsum / Pyrites / lime, and so on. Bio- fertilisers, improved farm implements, sprinkler sets, water carrying pipes, seed storage bins, and seed treating drums are also included.
3. Transfer of technology component includes cluster/block demonstration, FLD and training through NARS and KVKs, IPM on FFS mode, officer/extension worker training, and need-based R&D project including seminar/kisan mela. Aside from that, the oil extraction unit will be covered by flexi funds.

Interventions NFSM – Oil Palm comprises of three major components;

1. Geographic Expansion Inputs component covering assistance for planning maintenance/cultivation costs, inputs to intercropping in oil palm fields during the gestation period of four years.
2. The production input component, which includes drip irrigation, bore-well/water harvesting structures, and so on. Set of diesel pumps, Vermicompost unit creation of a new seed garden, Machines and tools, Special component for NE/hilly states/LW areas for road construction and the establishment of a new oil palm processing unit.
3. The Transfer of Technologies component, which includes assistance for farmer/officer training. Oil palm field demonstrations, need-based R&D projects on oil palm, including the import of germplasm and training infrastructure support to ICAR/SAUs Local initiatives/publicity/contingency, including monitoring and evaluation and operational costs such as consultant services, etc., exposure visits of farmers/officers to oil palm fields/seminars/conferences, etc.

Interventions of NFSM –TBO comprises three major components: area expansion, maintenance/intercropping during the gestation period of the TBOs, and transfer of technologies, which includes assistance for training of farmers/officers, need-based R & D projects through institutes of ICAR/ICFRE/IITs/SAUs, and installation of pre-processing and oil expeller units, and collection of TBOs.

Kharif Strategy for Self Sufficiency in Oilseeds -2021:

To achieve self-sufficiency in edible oils, the Union Government has developed the Kharif Strategy 2021. Farmers will receive high-yielding seed varieties from the Union government. The plan calls for the distribution of over 8 lakh Soybean mini-kits. The Kharif Strategy 2021 will bring an additional 6.37 million hectares under oil seed cultivation. The Ministry of Agriculture and Farmers Welfare has implemented a multi-pronged strategy to achieve self-sufficiency in the production of oilseeds. The Government of India has approved an ambitious plan for the free distribution of HYVs of seeds to farmers in the form of mini – kits for the kharif season 2021 under the strategy.

The special kharif programme will plant an additional 6.37 lakh hectares of oilseeds, yielding 120.26 lakh quintals of oilseeds and 24.36 lakh quintals of edible oil. To become Aatmanirbhar in oilseeds, focus on increasing oilseed productivity by increasing the availability of high yielding varieties of seeds for farmers to use on their fields. Area and productivity enhancements for soybean and groundnut have been developed, with a focus on high yielding varieties of seeds to be provided free of charge under the National Food Security Mission (Oil Seeds and Oil Palm).

Distribution of soybean seeds for intercropping in 41 districts across six states: MP, Maharashtra, Rajasthan, Gujarat, Karnataka, Telangana, and Chhattisgarh, with a total area of 147500 ha. Distribution of soybean seeds for high potential districts in six states at a cost of Rs 104 crore, and 390000 ha for mini kits in nine states at a cost of Rs 40 crore. The distributed soybean seeds will have a yield of at least 20 q/ha. Seeds for intercropping and high potential districts will be distributed by state seed agencies, while seeds for mini-kits will be distributed by central seed producing agencies (Ministry of Agriculture and Farmer welfare).

Price Deficit Payment Scheme (PDPS) for Oilseeds

PDPS for Oilseeds is under the umbrella scheme of Pradhan Mantri – Annadata Aya Sanrakshan Abhiyan (PM-AASHA). The purpose of PDPS is to ensure a remunerative price for producers of oilseeds whose MSP is notified by the GOI and when sold during the harvest season without actual procurement by government agencies. The scheme provides for direct payment of the difference between the MSP and the market price to farmers who sell their produce in the notified APMC yard via a transparent auction process. After considering the CACP recommendations, the government announces MSP for 22 major agricultural commodities of Fair Average Quality (FAQ) each year during the kharif and rabi crop seasons. Furthermore, the DAC and FW set the MSP for Toria and dehusked coconut based on the MSPs for Rapeseed/ Mustard seed and Copra.

The oil seeds for which the government has declared MSP will be covered by the PDPS. Ground nut in shell, Soybean, Sunflower, Sesamum, Niger seed, Rapeseed / Mustard seed, Safflower, and Toria are among the oilseeds. Oilseeds, particularly groundnuts, require a lot of storage space, and the majority of them go rancid due to enzyme and moisture buildup over time. To benefit from this scheme, states/UTs must agree to bear the financial burden for procurement/support for quantities greater than 25% of production and price deficits greater than 25% of MSP in PDPS.

Coverage of PDPS

- The PDPS scheme applies to oilseeds produced in the implementing state for which MSP is announced by the Government of India.
- The implementing state/UT must select one or more oilseeds produced in their state for which PDPS is proposed to be implemented for the specific marketing season.
- The registration period must be during the predefined period, preferably prior to market arrival. The scheme will be in effect for a period of 90 days.

Table 4.1: Different Reforms and policies launched in different year

S No.	Reforms	Year
1	Oilseed growers cooperative project	1979-80
2	Technology mission on oilseeds(TMO)	1986
3	National oilseed development project	1985-86
4	Integrated Scheme of Oilseeds , Pulses , Oil Palm and Maize (ISOPOM)	2004
5	National Mission on Oilseeds and Oil Palm (NMOOP)	2014

6	NFSM-Oilseed and Oil Palm(NMOOP)	2014-15
7	National Food Security Mission (NFSM):Oilseed	2018-19
8	Kharif Strategy for Self Suffiency in Oilseeds	2021
9	Price Support Scheme(PSS)	
10	Price Deficiency Payment Scheme (PDPS)	

Objective 2: To examine the dynamics of production, export and import of oilseeds in India:

Different polynomial models were fitted for the time series data on area, production, productivity and MSP of oilseed crops in selected from whole India. A model was selected as a best fit for the data when the coefficient of the higher order polynomial was non-significant. In the present study, four growth models viz., linear, quadratic, cubic and logarithmic have been fitted to the time series data on area, production and productivity of the oilseed crops in selected from India.

4.2.1 Groundnut

Polynomial models for area, production, yield and MSP of Groundnut in India

The perusal of Table 4.2 depicts the regression coefficient estimates, RMSE, and p-value of the model for groundnut area, production, yield, and MSP in India. It was observed that among different polynomial models fitted for area, production, yield, and MSP of groundnut crop, the cubic model was found to be the best fit for area (figure 4.1) with R^2 and RMSE values of 0.759 and 0.334, respectively. For production (figure 4.2), no model was significant, with lower values of R^2 and RMSE for linear, logarithmic, quadratic, and cubic models. Similarly, the yield cubic model (figure 4.3) was the best fit, with an R^2 of 0.573 and an RMSE of 221.4. Similarly, the cubic model (figure 4.4) performed best for MSP, with an R^2 of 0.974 and an RMSE of 221.4. Thus, for the overall study period of 2000-01 to 2019-20, it was discovered that for area, yield, and MSP, a cubic model with an increasing trend was identified as the best model, whereas for production, all models were equally increasing and the value of R^2 and RMSE was decreasing, implying that no model was best for groundnut production.

Table 4.2: Parameter estimates of fitted models for Area, Production, Yield and MSP

	Model	a	B	c	d	R^2	RMSE	P Value
Area	Linear	6.759	-.100			0.714	0.364	<0.001
	Logarithmic	7.474	-.821			0.615	0.442	<0.001
	Quadratic	6.697	.085	-.001		0.715	0.363	<0.001
	Cubic	5.890	.240	-.034	0.001	0.759	0.334	<0.001
Production	Linear	5.998	0.106			0.146	1.479	0.096
	Logarithmic	5.291	0.850			0.119	1.509	0.136
	Quadratic	6.643	-0.044	.007		0.161	1.466	0.225
	Cubic	5.0840	0.586	-.058	0.002	0.191	1.440	0.322
Yield	Linear	811.4	43.04			0.537	230.6	<0.001
	Logarithmic	531.8	341.4			0.430	262.7	0.002
	Quadratic	1015.6	-4.4	2.1		0.569	222.4	0.001
	Cubic	897.02	43.5	-2.84	0.142	0.573	221.4	0.003
MSP	Linear	179.26	223.48			0.924	230.6	<0.001
	Logarithmic	-1260.8	1767.35			0.721	255.9	<0.001
	Quadratic	1006.6	31.27	8.357		0.958	222.4	<0.001
	Cubic	1947.89	-348.79	47.25	-1.13	0.974	221.4	<0.001

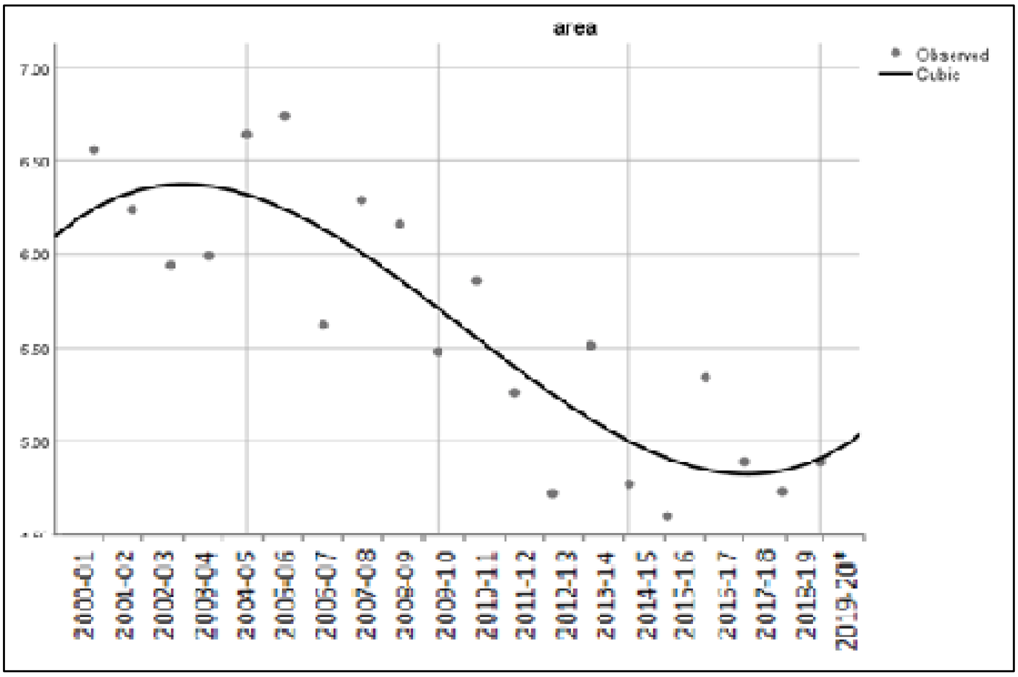

Figure 4.1: Best fitted Cubic model for *Area* under Groundnut in India

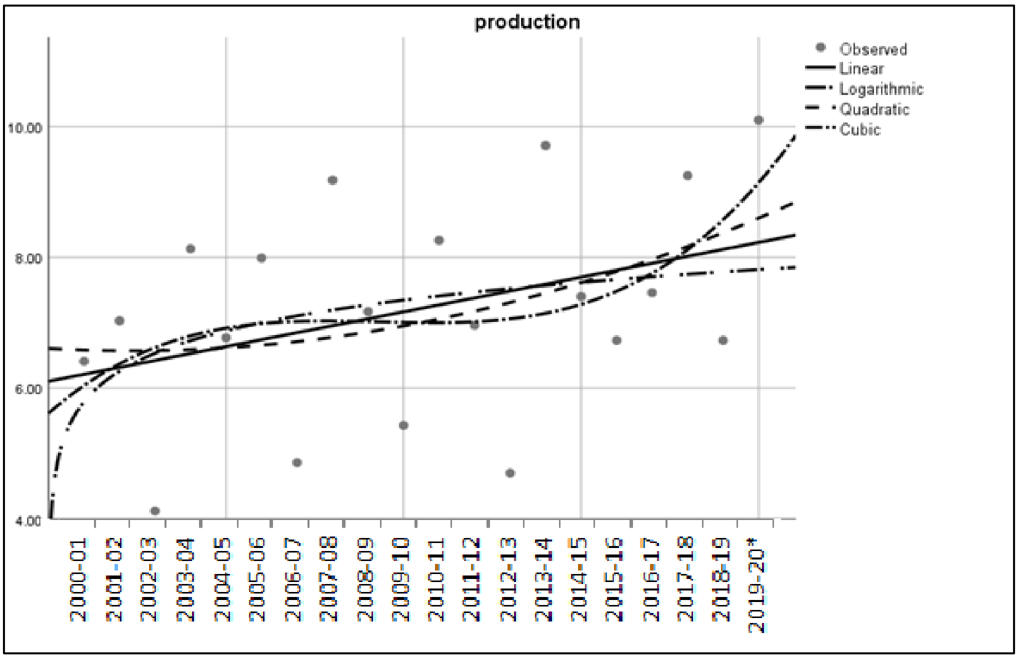

Figure 4.2: All four models fitted for *production* under Groundnut in India

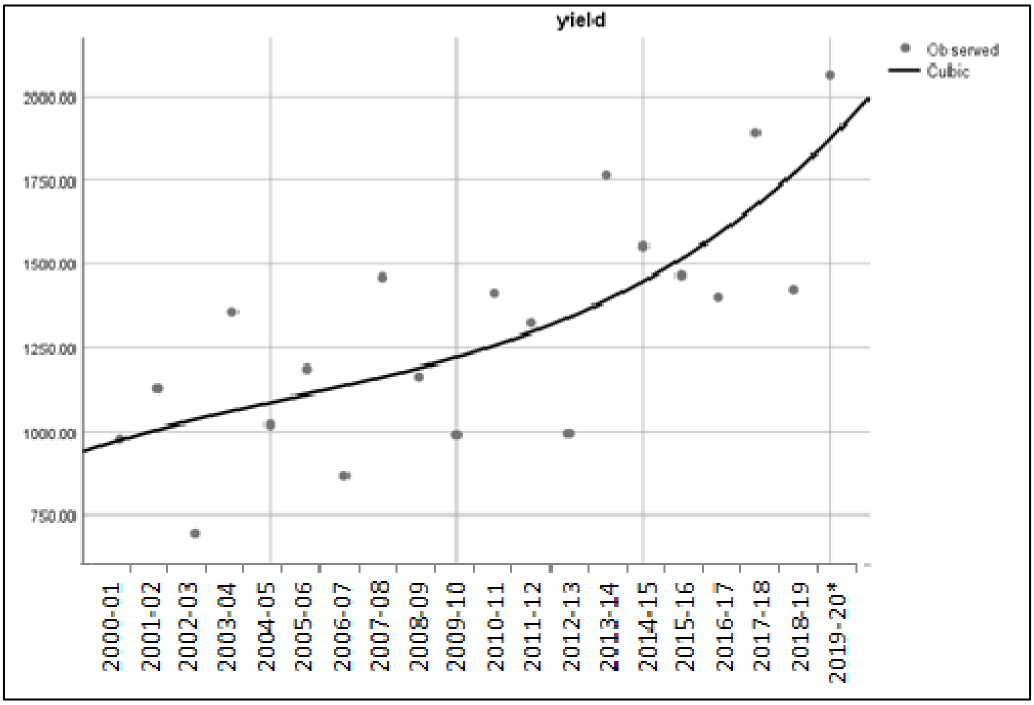

Figure 4.3: Best fitted Cubic model for *Yield* under Groundnut in India

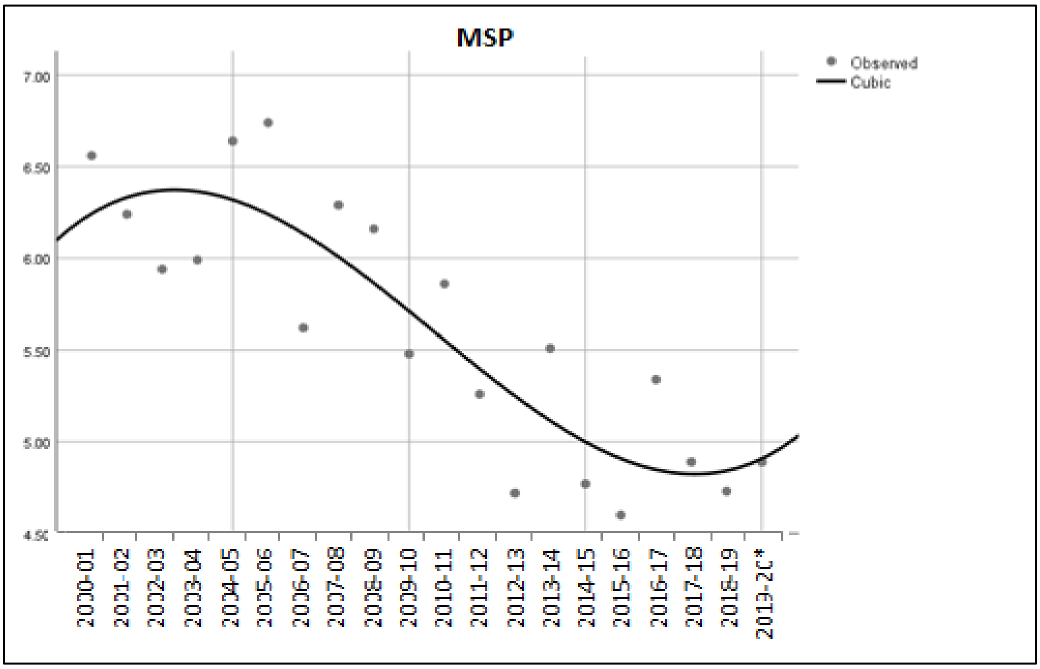

Figure 4.4: Best fitted Cubic model for *MSP* under Groundnut in India

4.2.2 Rapeseed and Mustard

Polynomial models for area, production, yield and MSP of Rapeseed and Mustard in India

The perusal of Table 4.3 shows the regression coefficient estimates, RMSE, and p-value of the model for area, production, yield, and MSP of Rapeseed and Mustard in India. It was observed that among different polynomial models fitted for area, production, yield, and MSP of Rapeseed and Mustard crop, The cubic model was found to be the best fit for area (figure 4.5) , with R^2 and RMSE values of 0.534 and 0.33, respectively. For production (figure 4.6), no model was significant, with lower values of R^2 and RMSE for linear, logarithmic, quadratic, and cubic models. Similarly, the yield cubic model (figure 4.7) had the best match, with an R^2 of 0.742 and an RMSE of 221.4. Similarly, with an R^2 of 0.974 and an RMSE of 217.8, the cubic model (figure 4.8) was the best for MSP. Thus, for the entire study period from 2000-01 to 2019-20, the best model was identified as the area, yield, and MSP cubic model with an increasing trend. However, we discovered that for production, all models were equally increasing and the value of R^2 and RMSE value was decreasing, so no model was best for Rapeseed- Mustard production.

Table 4.3. Parameter estimates of fitted models for Area, Production, Yield and MSP

	Model	a	b	c	d	R^2	RMSE	P Value
Area	Linear	5.55	0.047			0.123	0.36	0.129
	Logarithmic	4.96	0.512			0.275	0.44	0.018
	Quadratic	4.732	0.271	-0.011		0.289	0.36	0.055
	Cubic	3.36	0.969	-0.092	0.003	0.534	0.33	0.006
Production	Linear	5.12	0.182			0.532	1.48	<0.001
	Logarithmic	4.06	1.408			0.598	1.51	<0.001
	Quadratic	4.62	0.318	-0.006		0.550	1.47	0.001
	Cubic	2.61	1.347	-0.126	0.004	0.702	1.44	<0.001
Yield	Linear	920.52	22.413			0.702	230.65	<0.001
	Logarithmic	839.10	149.637			0.591	262.79	<0.001
	Quadratic	963.02	10.821	0.552		0.713	222.41	<0.001
	Cubic	869.74	58.417	-4.978	0.176	0.742	221.40	<0.001
MSP	Linear	677.26	169.523			0.918	369.88	<0.001
	Logarithmic	216.90	1058.38			0.675	761.88	<0.001
	Quadratic	1304.39	-1.512	8.145		0.974	274.79	<0.001
	Cubic	1305.54	-2.099	8.213	-0.002	0.974	217.86	<0.001

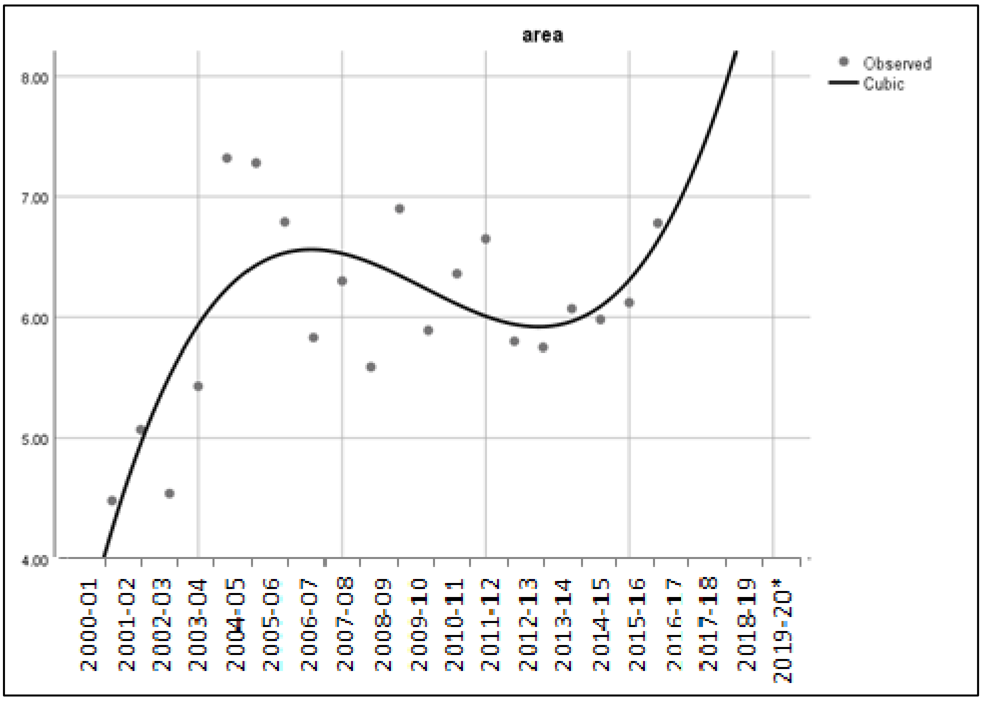

Figure 4.5: Best fitted Cubic model for *Area* under Rapeseed and Mustard in India

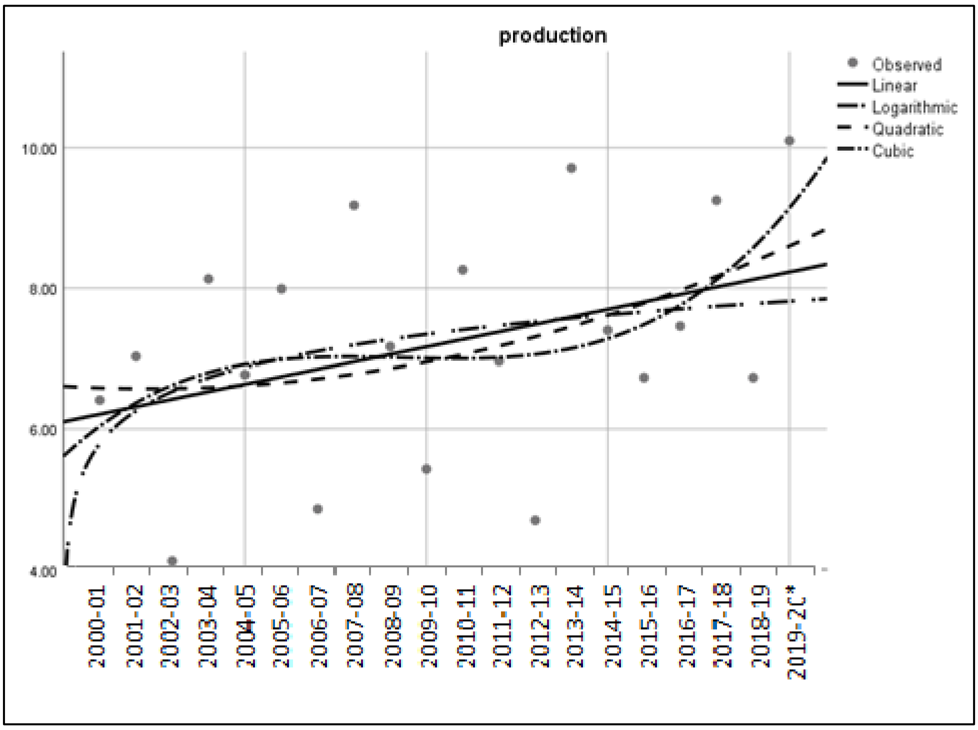

Figure 4.6: All four model fitted for *Production* under Rapeseed-Mustard in India

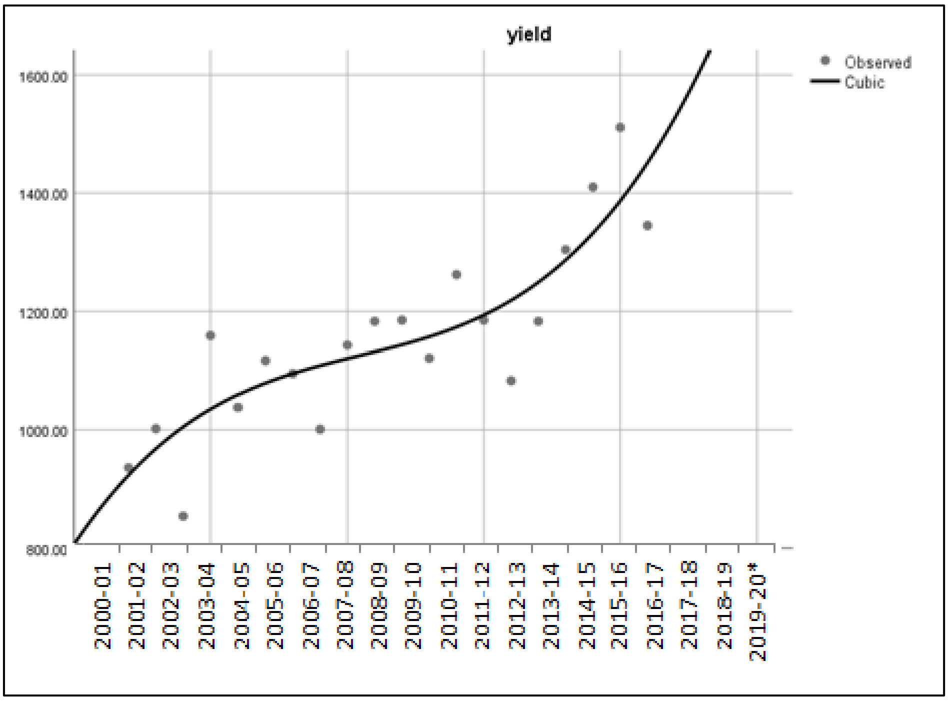

Figure 4.7: Best fitted Cubic model for *Yield* under Rapeseed and Mustard in India

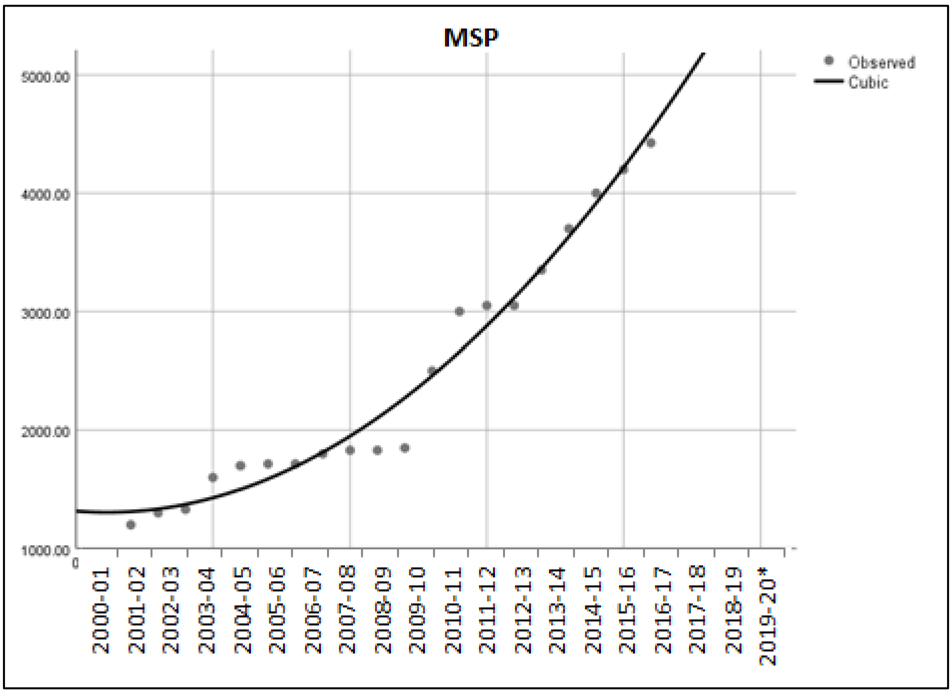

Figure 4.8: Best fitted Cubic model for *MSP* under Rapeseed and Mustard in India

4.2.3 Soybean

Polynomial models for area, production, yield and MSP of Soybean in India

The perusal of Table 4.4 shows regression coefficients, RMSE, and p-value estimations for area, production, yield, and MSP of Soybean in India. It was observed that among multiple polynomial models fitted for area, production, yield, and MSP of Soybean crop, the cubic model was found to be the best match for area (figure 4.9) with R^2 and RMSE values of 0.946 and 0.33, respectively. The linear, logarithmic, quadratic, and cubic models were not significant for production (figure 4.10), and the R^2 and RMSE values were lower. Similarly, with an R^2 of 0.275 and an RMSE of 0.151, the yield cubic model (figure 4.11) was the best fit. Similarly, with an R^2 of 0.981 and an RMSE of 125.19, the cubic model (figure 4.12) was the best for MSP. Thus, for the entire study period from 2000-01 to 2019-20, the best model was identified as the area, yield, and MSP cubic model with an increasing trend. However, we discovered that for production, all models were equally increasing and the value of R^2 and RMSE was decreasing, so no model was best for Soybean production.

Table 4.4. Parameter estimates of fitted models for Area, Production, Yield and MSP

	Model	a	b	c	d	R^2	RMSE	P Value
Area	Linear	6.01	0.317			0.898	0.36	<0.001
	Logarithmic	4.59	2.243			0.851	0.44	<0.001
	Quadratic	5.02	0.586	-0.013		0.936	0.36	<0.001
	Cubic	5.69	0.241	0.027	-0.001	0.946	0.33	<0.001
Production	Linear	6.03	0.367			0.597	1.48	<0.001
	Logarithmic	3.84	2.85			0.681	1.51	<0.001
	Quadratic	3.34	1.1	-0.35		0.741	1.47	<0.001
	Cubic	3.55	0.992	-0.022	0.00	0.741	1.44	<0.001
Yield	Linear	982.56	6.451			0.048	230.65	0.353
	Logarithmic	886.34	77.459			0.131	262.79	0.117
	Quadratic	781.43	61.305	-2.612		0.256	222.41	0.081
	Cubic	696.88	104.447	-7.625	0.159	0.275	221.40	0.151
M SP	Linear	223.90	152.243			0.911	274.04	<0.001
	Logarithmic	-143.93	928.95			0.640	551.61	<0.001
	Quadratic	845.001	-17.148	8.066		0.976	134.10	<0.001
	cubic	1016.92	-104.87	18.259	-0.324	0.981	125.19	<0.001

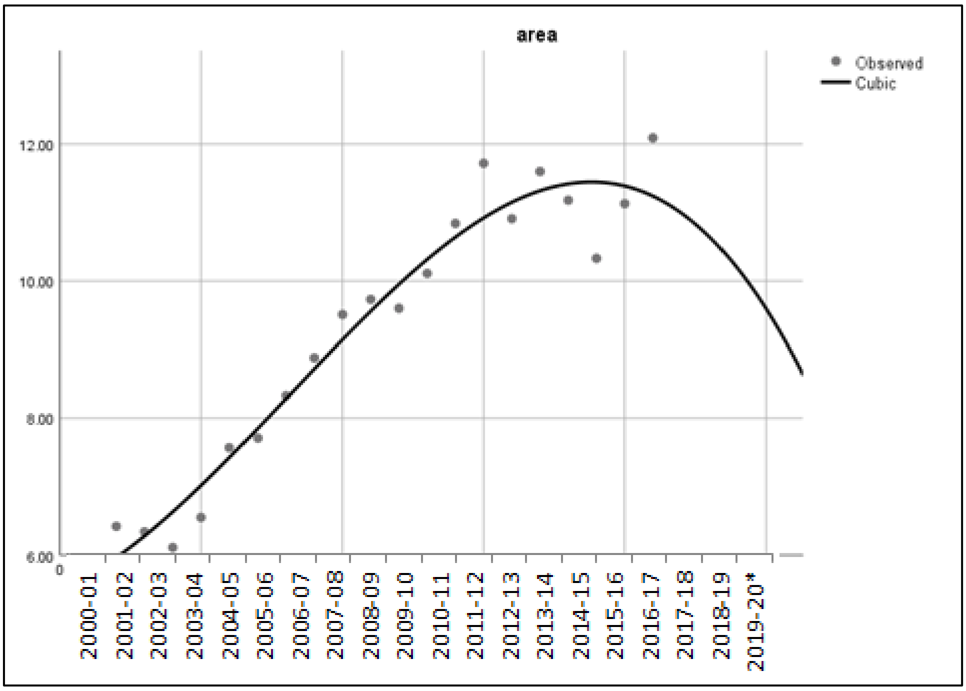

Figure 4.9: Best fitted Cubic model for *Area* under Soybean in India

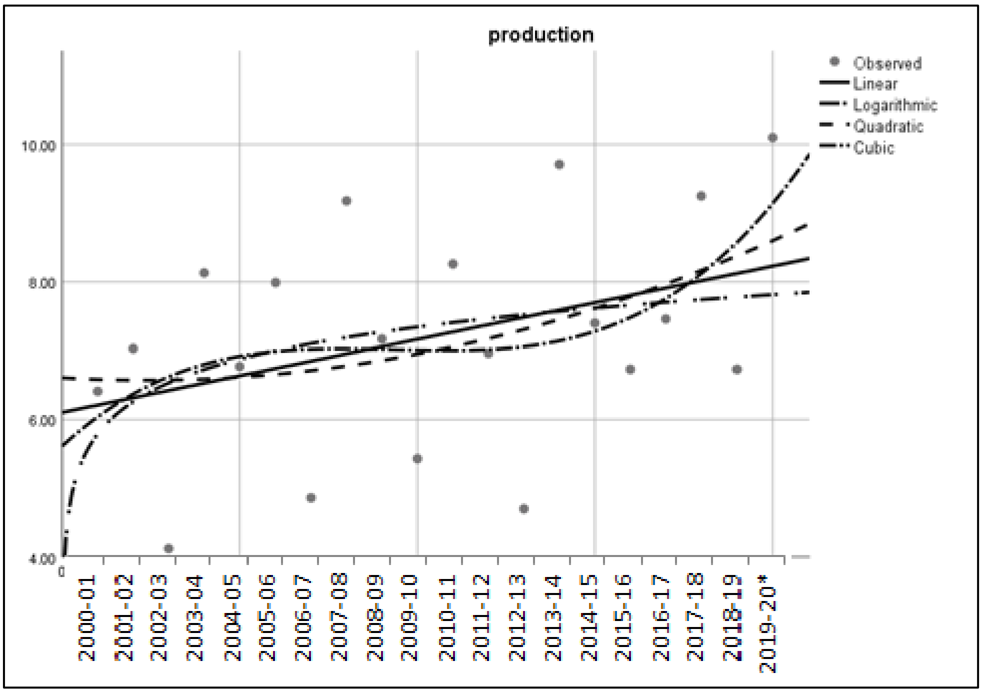

Figure 4.10: All four model fitted for *production* under Soybean in India

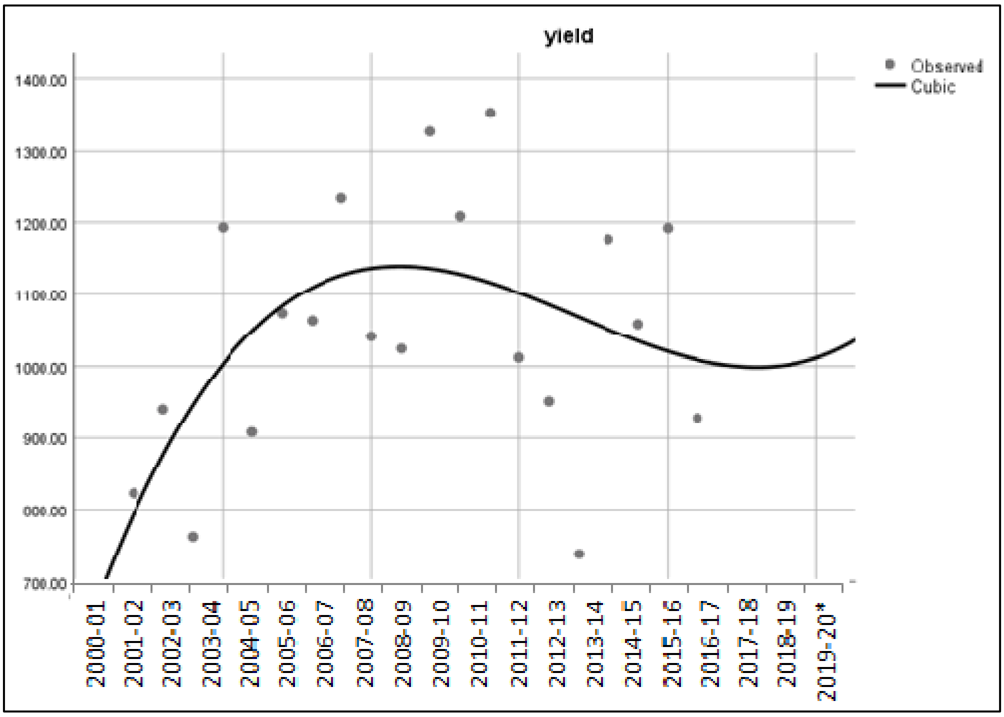

Figure 4.11: Best fitted Cubic model for *Yield* under Soybean in India

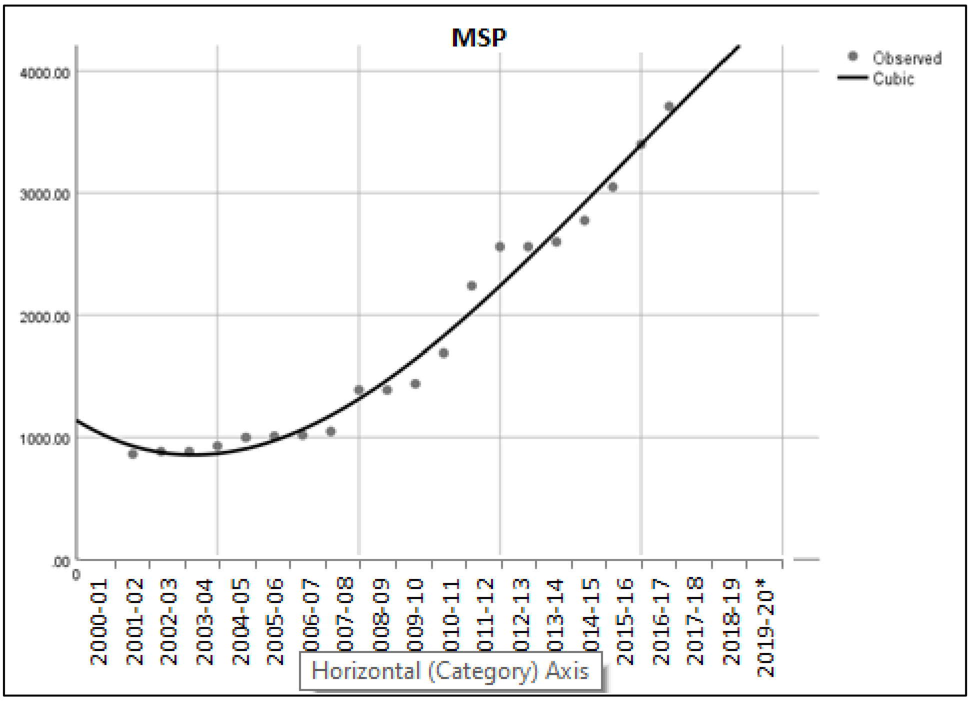

Figure 4.12: Best fitted Cubic model for *MSP* under Soybean in India

4.2.4 Sunflower

Polynomial models for area, production, yield and MSP of Sunflower in India

The perusal of Table 4.5 shows regression coefficients, RMSE, and p-value estimations for area, production, yield, and MSP of Sunflower in India. The cubic model was found to be the best match for area (figure 4.13) among multiple polynomial models fitted for area, production, yield, and MSP of Sunflower crop, with R^2 and RMSE values of 0.946 and 0.17. The linear, logarithmic, quadratic, and cubic models are not significant for production (figure 4.14), and the R^2 and RMSE values are lower. Similarly, with an R^2 of 0.275 and an RMSE of 64.74, the yield cubic model (figure 4.15) was the best fit. Similarly, with an R^2 of 0.981 and an RMSE of 267.53, the MSP cubic model (figure 4.16) was the best. Thus, for the entire study period from 2000-01 to 2019-20, the best model identified for area, yield, and MSP was cubic model with an increasing trend. However, we discovered that for production, all models were equally increasing and the value of R^2 and RMSE was decreasing, so no model was best for Sunflower production.

Table 4.5 Parameter estimates of fitted models for Area, Production, Yield and MSP

	Model	a	b	c	d	R^2	RMSE	P Value
Area	Linear	6.01	0.317			0.898	0.44	<0.001
	Logarithmic	4.59	2.243			0.851	0.59	<0.001
	Quadratic	5.02	0.586	-0.013		0.936	0.36	<0.001
	Cubic	5.70	0.241	0.027	-0.001	0.946	0.17	<0.001
Production	Linear	6.03	0.367			0.597	0.28	<0.001
	Logarithmic	3.84	2.85			0.681	0.35	<0.001
	Quadratic	3.34	1.10	-0.035		0.741	0.22	<0.001
	Cubic	3.55	0.992	-0.022	0.00	0.741	0.13	<0.001
Yield	Linear	982.56	6.421			0.048	67.12	0.353
	Logarithmic	886.34	77.459			0.131	79.79	0.117
	Quadratic	781.43	61.305	-2.612		0.256	65.26	0.081
	Cubic	696.88	104.447	-7.625	0.159	0.275	64.74	0.151
MSP	Linear	223.90	152.243			0.911	399.87	<0.001
	Logarithmic	-143.93	928.950			0.640	806.73	<0.001
	Quadratic	845.00	-17.148	8.066		0.979	271.38	<0.001
	Cubic	1016.92	-104.87	18.259	-0.324	0.981	267.53	<0.001

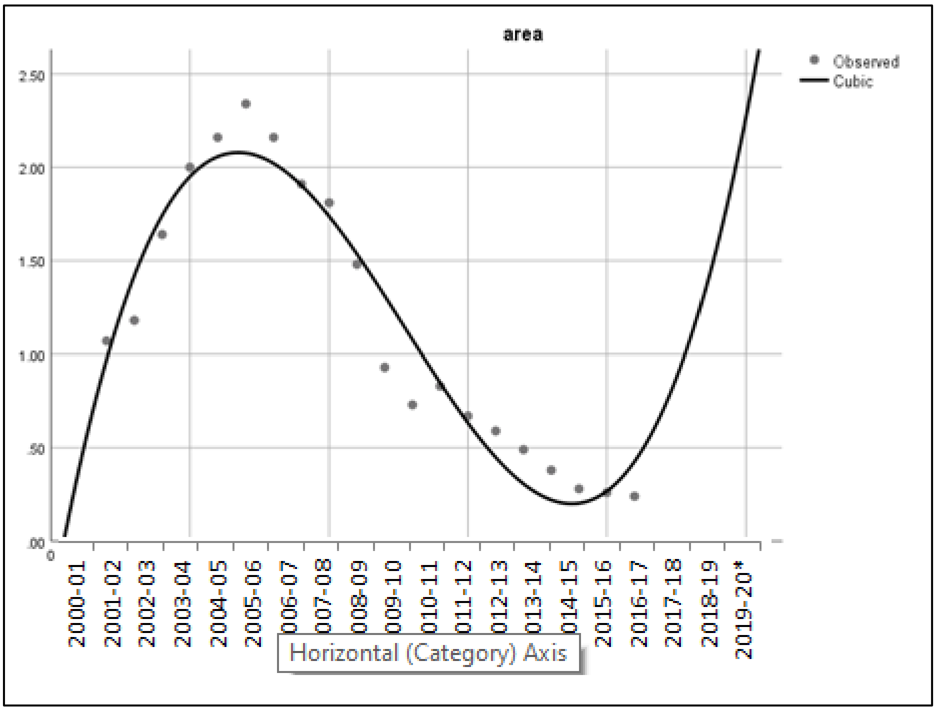

Figure 4.13 Best fitted Cubic model for *Area* under Sunflower in India

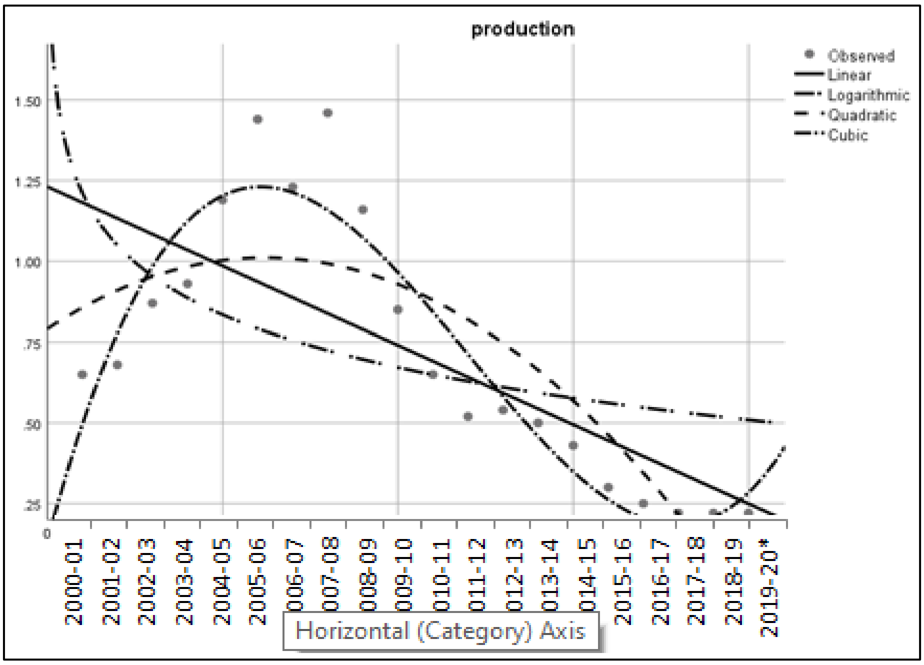

Figure 4.14: All four model fitted for *Production* under sunflower in India

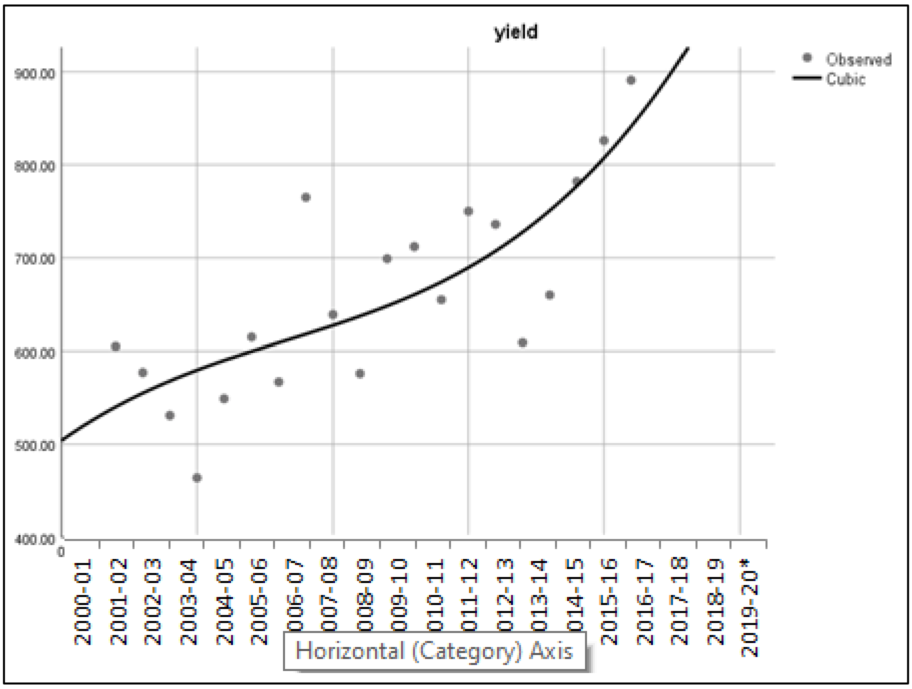

Figure 4.15: Best fitted Cubic model for *Yield* under Sunflower in India

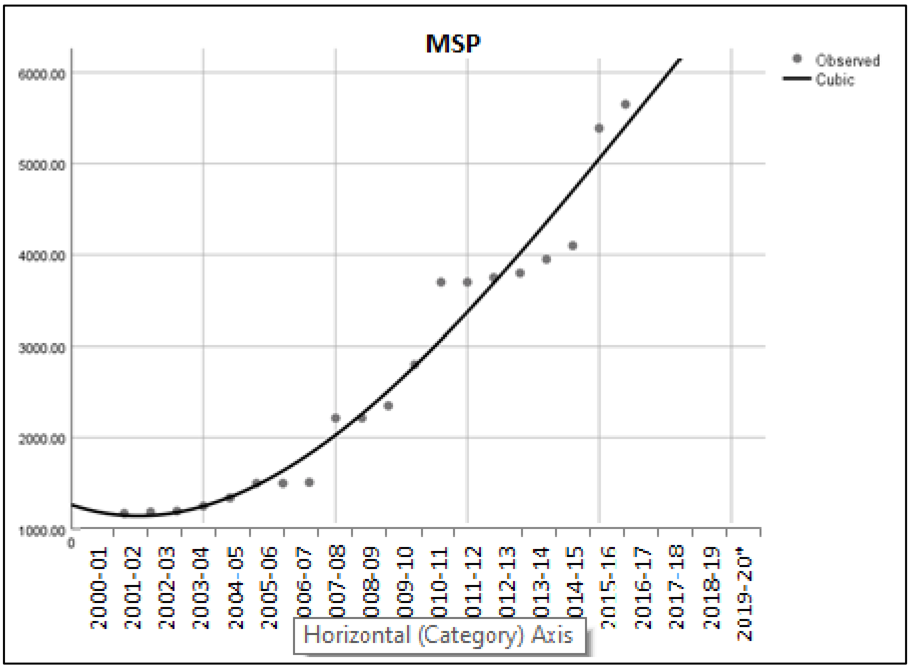

Figure 4.16: Best fitted Cubic model for *MSP* under Sunflower in India

Objective 3: To identify the factors for low production of oilseeds in India

Several factors have been claimed to the factors for low production of oilseeds. In this case, multiple regression analysis was utilized to estimate the impact of several factors on low production. In this regression model Production is dependent variable and Area, Yield, MSP, export and import are independent variable.

4.3.1 Groundnut

Groundnut is a major oilseed crop in India, where it ranks first in terms of acreage and second in terms of production after soyabean. Groundnut production in China is 17.57 million tonnes, followed by India 6.73 million tonnes, Nigeria 4.45 lakh tonnes, Sudan 2.83 million tonnes, and the United States of America 2.49 million tonnes, accounting for 36.01, 13.79, 9.12, 5.80, and 5.11 percent of total global production of 48.80 million tonnes in 2019-20, respectively. Groundnut production estimate (kharif) for 2021-22 was 82.54 lakh tonnes, down from 85.56 million tonnes in 2020-21, according to the first advance estimates (kharif)(www.agricoop.gov.in)

Among all the factors, Area (X_1), Yield (X_2), and Export (X_3) were found statistically significant at 5% level whereas another factors import (X_4) and MSP (X_5) were found to be insignificant. The negative values of import (X_4) and MSP (X_5) indicates decrease in the factors, while all other factors have a positive value meaning that an increase in area, yields and export has increased the production. The coefficient of multiple determination (R^2) of production was 0.993 indicating the explanatory power of the model.

Table 4.6: Regression analysis of factors affecting low production of groundnut

	Coefficients	Significance
Intercept	-7.579*	0.000
Area (X_1)	1.329*	0.000
Yield (X_2)	.005*	0.000
Export (X_3)	.001*	0.020
Import (X_4)	-2.617E-5	0.820
MSP (X_5)	-4.109E-5	0.587
R^2	0.993	
Adjusted R^2	0.991	

*Significance at 5 percent level

Table 4.7 represents the significant variables that is area, yield and import after dropping the non-significant variables. The perusal of table reveals that after removing non-significant variables, R^2 reduced infinitesimally from 0.993 to 0.992, which means the production is effected majorly by the significant variables only as compared to the non-significant variables.

Table 4.7 Regression analysis of significant factors

	Coefficients	**Significance**
Intercept	-7.579*	0.000
Area	1.329*	0.000
Yield	.005*	0.000
Export	.001*	0.020
R^2	0.992	
Adjusted R^2	0.991	

4.3.2 Rapeseed And Mustard

The edible oil industry's Central Organisation for Oil Industry and Trade (COOIT) forecast mustard seed production at an all-time high of 109.50 lakh tonnes for the 2021-22 crop year, up 29 percent from the previous year. In 2021-22, the yield of mustard seeds cultivated in the rabi (winter-sown) season was 85 lakh tonnes.

Among all the factors, Area (X_1) and Yield (X_2) were found statistically significant at 5% whereas other factors Export (X_3), import (X_4) and MSP (X_5) were found to be insignificant. The coefficient of multiple determination (R^2) of production was 0.997 indicating the explanatory power of the model.

Table 4.8: Regression analysis of factors affecting low production of Rapeseed and mustard

	Coefficients	Significance
Intercept	-6.172	.000
Area (X_1)	1.076*	.000
Yield (X_2)	0.006*	.000
Export (X_3)	4.920E-5	.151
Import (X_4)	0.000	.333
MSP (X_5)	5.956E-5	.130
R^2	0.997	
Adjusted R^2	0.996	

*Significance at 5 percent level

Table 4.9 represents significant variables that is area and yield after dropping the non-significant variables. The perusal of table reveals that after removing non-significant variables, R^2 reduced infinitesimally from 0.997 to 0.996, which means the production is effected majorly by the significant variables only as compared to the non-significant variables.

Table 4.9: Regression analysis of significant factors

	Coefficients	**Significance**
Intercept	-6.085	.000
Area	0.006	.000
Yield	1.041	.000
R^2	0.996	
Adjusted R^2	0.996	

4.3.3 Soybean

Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, and Telangana are the major soyabean-growing states. Soybean production is expected to be 127.20 lakh tonnes in 2021-22, down from 128.97 lakh tonnes in 2020-21, according to the Ministry of Agriculture's first advance projections.

Among all factors, Area (X_1) and Yield (X_2) were found statistically significant at 5% level of significance whereas other factors Export (X_3), import (X_4) and MSP (X_5) were found to be insignificant. The coefficient of multiple determination (R^2) of production was 0.988 indicating the explanatory power of the model.

Table 4.10: Regression analysis of factors affecting low production of Soybean

	Coefficients	Significance
Intercept	-8.902*	.000
Area (X_1)	.871*	.000
Yield (X_2)	.010*	.000
Export (X_3)	.000	.688
Import (X_4)	-7.764 E-7	.505
MSP (X_5)	.000	.321
R^2	0.988	
Adjusted R^2	0.984	

*Significance at 5 percent level

Table 4.11 represents significant variables that is area and yield after dropping the non-significant variables. The perusal of table reveals that after removing non-significant variables, R^2 reduced infinitesimally from 0.988 to 0.987, which means the production is effected majorly by the significant variables only as compared to the non-significant variables.

Table 4.11: Regression analysis of significant factors

	Coefficients	Significance
Intercept	-9.071	.000
Area	0.961	.000
Yield	0.010	.000
R^2	0.987	
Adjusted R^2	0.986	

4.3.4 Sunflower

Sunflower production in 2021-22 is at 0.95 lakh tonnes compared to the 0.77 lakh tonnes previous year.

Among all the factors, Area (X_1), Yield (X_2) and MSP (X_5) were found statistically significant at 5% level whereas other factors, Export (X_3) and import (X_4) were found to be insignificant. MSP Showing negative growth. The coefficient of multiple determination (R^2) of production was 0.985 indicating the explanatory power of the model.

Table 4.12: Regression analysis of factors affecting low production of Sunflower

	Coefficients	Significance
Intercept	-.516*	.030
Area (X_1)	.543*	.000
Yield (X_2)	.001*	.001
Export (X_3)	1.309E-5	.068
Import (X_4)	5.503E-5	.268
MSP (X_5)	-7.638E-5*	.019
R^2	0.985	
Adjusted R^2	0.979	

*Significance at 5 percent level

Table 4.13 represents significant variables that is area, yield and MSP after dropping the non-significant variables. The perusal of table reveals that after removing non-significant variables, R^2 reduced infinitesimally from 0.985 to 0.979, which means the production is effected majorly by the significant variables only as compared to the non-significant variables.

Table 4.13: Regression analysis of significant factors

	Coefficients	Significance
Intercept	-0.694	0.000
Area	0.591	0.000
Yield	0.001	0.000
MSP	-5.432E-5	0.030
R^2	.979	
Adjusted R^2	.975	

Chapter V

SUMMARY AND CONCLUSION

Chapter V

SUMMARY AND CONCLUSION

The conclusion chapter is an essential component of every research project since it provides a summary of the entire study and highlights the most important findings. This is followed by a description of the study's findings and policy implications. The first section of the paper focuses on the study's framework. This is followed by a description of the study's findings and policy implications.

Summary

The following research shows that India's oilseeds economy has struggled in the past, with poor levels of area, production, and productivity growth. The sector responded positively to interventions such as the Technology Mission on Oilseeds and ISOPOM, which is encouraging and indicates a potential that is currently latent. This potential may be realised through the implementation of appropriate policies that provide an impetus to the sector. The low levels of production of oilseeds imply low production of edible oils which necessitate imports of edible oils. The disparity between demand and domestic availability is expected to persist in the medium term, as the study's findings suggest, just as earlier projections have showed, and so reliance on imports will continue. In general, the country's imports are reliant on a few sources. As a result of increased competition, expanding the import base may assist lower import prices.

Along with the production, export, and import of oilseeds, we discovered that India imports more than 40% of its domestic edible oil requirements. The largest edible oil imports are palm oil, soybean oil, and mustard oil, with palm oil and soybean oil accounting for more than 80% of total edible oil imports. Mustard oil is only imported in small quantities. India's edible oil imports have expanded dramatically since the WTO was established. India is significantly reliant on imports to meet its edible oil needs, and is the world's largest importer of vegetable oils (15 percent), followed by China and the United States. In India, the current situation with edible oil is as follows: During 2016-17, 14.01 million tonnes of edible oil were imported, with a total value of Rs. 73,048 crores.

According to a recent study on global oilseed output, soybean production is predicted to grow by 1.3 percent per year, compared to 4.0 percent per year in the previous decade. Other oilseeds (rapeseed, sunflower seed, and groundnuts) will grow at a slower 1.2 percent per year, compared to 2.8 percent per year over the previous ten years (2010-2019). When compared to soybean yield enhancement, which accounts for 66 percent of overall production growth, other oil seed growth is linked to increasing yield, which accounts for 78 percent of total production growth. The research thus focused on dynamics of production and trend of oilseeds in India.

The study's specific objectives were:

1. To review the policies and reforms for boosting oilseeds in India.
2. To study the dynamics of production, export and import of oilseeds in India.
3. To identify the factors for low production of oilseeds in India.

The data were collected from the Directorate of Economics and Statistics, Ministry of Agriculture and Farmer Welfare, statistics at a glance, ITC Trade Map (Trade statistics for international business development monthly, quarterly, and yearly trade data), import and export values, volumes, growth rate, market share, and other secondary sources for the dynamics of production and trend of oilseed in India. We used a polynomial regression model to determine the policy and reforms policies for the production of oilseed.In second objective dynamics of production export import oilseed we used polynomial regression model to analysed the trend analysis of oilseed crop. For the 3rd objective factor for low production we applied multiple regression model, for calculating why production of oilseed decreasing.

The major findings of the present research investigation are given as follows:

5.1 Review of the policies and reforms for boosting oilseeds in India

- For decades, trade policy has influenced the general structure and performance of India's edible oil business. Edible oils were prohibited from entering the country, and all imports were routed through the State Trading Corporation (STC) and the Hindustan Vegetable Oils Corporation (HVOC) for distribution through the Public Distribution System (PDS). However, in April 1994, the industry was partially liberalised, with permission to import palmolein under the OGL at a duty rate of 65 percent.
- The country's edible oil import bill increased by 75% to Rs 104354 crore in the first nine months of this fiscal year (April to December 2021) from Rs 59543 crore the previous year.
- Several safeguards were placed in place before to the WTO to protect the Indian oilseed complex till 1994. Import and export of oilseeds, oils, and oil cakes were subjected to quantitative and other restrictions. Oilcake imports were prohibited, while oilseed and edible oil imports were handled through the State Trading Corporation (STC).
- Oilcake exports were allowed, but oilseed and oil exports were restricted (illegal). Under the Public Distribution System, imported oils were distributed to state governments for sale at predetermined prices.
- In 1979-80, the Oilseed Growers Cooperative Project (OGCP) was established to restructure oilseed production, processing, and sale of vegetable oil and byproducts in the covered area. The project acted as both a market outlet for farmers' output and a supply channel for agriculture inputs and support services. The project was rated effective in 1986-87 in terms of influencing market prices, farmer technology investment, and the creation of modern processing capacity.
- Following the OGCP, the National Oilseed Development Project was initiated in 1985-86 and would be executed in all four provinces with the goal of greatly increasing oilseed output and reducing edible oil meal imports. Higher

and more consistent farm revenue will result from increased oilseed output achieved through crop intensification and diversification.

- ❖ The Technology Mission on Oilseeds (TMO) was established in 1986 with the goal of improving different aspects of the oilseed and edible oil industries. The plan called for a combination of programmes aimed at fostering rapid technological progress in oilseed production and processing, lowering domestic price volatility through producer price support operations, and reaching edible oil sufficiency by 1900.
- ❖ The term "post-liberalization" refers to a period following the liberalisation of a market as a founding member of the World Trade Organization, India is dedicated to agricultural commodities trade liberalisation. Quantitative restrictions on imports are being phased out, and exports are being liberalised as well. Imports of refined palm oil were placed under the Open General License (OGL) in March 1994, with a tariff rate of 65 percent. Imports of STC and NDDB were allowed with a tariff reduction of 20%.
- ❖ Integrated Scheme of oilseeds, Pulses, Oil Palm and Maize (ISOPOM) in 2004. The central idea was to boost oilseed production and productivity in order for the country to become self-sufficient in this vital area. Oilseeds and pulses are included in ISOPOM in 14 different potential states. Small and marginal farmers, as well as SC/ST and women farmers, who cultivate oilseeds, pulses, maize, and oil palm, would receive priority in ISOPOM benefits and support.
- ❖ The National Mission on Oilseeds and Oil Palm (NMOOP) for the development of oilseeds and oil palm in this country began in 2014-15 and lasted through 2017-18. By raising oilseed output and productivity from an average of 29.79 million tonnes and 1122 kg/hac during the 12th plan period to 36.10 million tonnes and 1290 kg/hac by the end of 2019-20, it intends to enhance the availability of vegetable oils and minimise edible oil imports. During the four-year gestation period, the NFSM of oilseeds and Oil Palm Geographic Expansion Inputs component covers help for planning maintenance / cultivation costs, as well as inputs to intercropping in oil palm fields.

- Kharif Strategy for Edible Oil Self-Sufficiency, The Union Government has created the Kharif Strategy 2021 to achieve edible oil self-sufficiency. The Union government would provide farmers with high-yielding seed kinds. Over 8 lakh Soybean mini-kits would be distributed as part of the strategy. The Kharif Strategy 2021 will increase oil seed cultivation by 6.37 million hectares.
- PDPS for Oilseeds is part of the Pradhan Mantri – Annadata Aya Sanrakshan Abhiyan umbrella project (PM-AASHA) The goal of the PDPS is to ensure that producers of oilseeds whose MSP has been announced by the GOI receive a fair price when they sell during the harvest season without being purchased by government agencies. Farmers who sell their produce in the notified APMC yard via a transparent auction process will get immediate reimbursement of the difference between the MSP and the market price.

5.2 The dynamics of production, export and import of oilseeds in India

- The model's regression coefficient estimates, R^2, RMSE, and p-value for groundnut area, production, yield, and MSP in India were depicted. With R^2 and RMSE values of 0.759 and 0.334, respectively, and a significant p-value, the cubic model was found to be the best match for area.
- Different polynomial models were used for Groundnut production, including linear, logarithmic, quadratic, and cubic models, but the data were not significant, and the R^2 value was very low.
- For the groundnut Yield cubic model was the best fit, with an R^2 of 0.573 and an RMSE of 221.4.
- Similarly, for Groundnut MSP, the cubic model performed best for MSP, with an R^2 of 0.974 and an RMSE of 221.4.
- It was discovered that multiple polynomial model models fit for Rapeseed and Mustard crop area, productivity, yield, and MSP. The cubic model is the best fit for area, yield, and MSP, with significant values, however none of the four models were significant for output.
- For the area, production, yield, and MSP of the soybean oilseed crop, the regression coefficient, RMSE, R^2, and p-value estimation for the area,

production, yield, and MSP are best fitted, and production all four models indicate equal output.

- ❖ The best model was chosen as the area, yield, and MSP cubic model with an increasing trend for the full study period from 2000-01 to 2019-20. However, we noticed that for production, all models are increasing similarly, but the R2 and RMSE values are falling, implying that no model is optimal for Sunflower production.

5.3 The factors for low production of oilseeds in India

- ❖ Out of several factors, area, yield, and export were found statistically significant at 5%, however other factors import and MSP were determined to be negligible. The negative numbers of import and MSP indicate that groundnut import and MSP are decreasing.
- ❖ Low rapeseed and mustard production area, and yield were found statistically significant at 5% level whereas other factors such as export, import, and MSP were shown to be insignificant.
- ❖ For soybean area and yield were found statistically significant at 5% whereas other factors, export, import and MSP were found to be insignificant. The coefficient of multiple determination of production was 0.993 indicating the explanatory power of the model.
- ❖ In the case of Sunflower, it was discovered that area, yield, and MSP were statistically significant at 5% level. Other factors, such as export and import, were determined to be insignificant. MSP is growing at a negative rate. The model's explanatory strength was indicated by the coefficient of multiple determination of production, which was 0.993.

Conclusions

Agriculture is the most important sector of the Indian economy, producing 9.2% of the country's real GDP in 2021-22 and providing livelihood to around one-third of the population. Indian agriculture has achieved significant success, particularly in irrigated areas for food crops such as wheat and rice, but performance has been less impressive for other crops such as oilseeds, pulses, and coarse cereals. As a result, after achieving food grain self-sufficiency, the government is concentrating its efforts on other agricultural commodities**.**

In the post-reform period, when India became one of the world's leading importers of edible oils, importing roughly half of its domestic requirement in the 1990s, the oilseed industry was a major source of concern and intervention for Indian policymakers. India is the world's fourth largest edible oil economy, contributing roughly 7% of total oilseed production, 6-7 percent of global oil production, and around 7% of protein production. To improve the situation of oilseeds in India, the government of India launched various programmes and missions for oilseeds, including the Technology Mission on Oilseed (1986), National Oilseed Development Project (1985-1986), ISOPOM (2004), NFSM – Oilseed and Oil Palm (2014), National Food Security Mission: Oilseed (2018-19), Kharif Strategy for Self-Sufficiency in Oilseeds (2021). Oilseed import and export.

In order to achieve the second objective, the current study made a careful effort to investigate the trends in area, production, yield, and MSP of four different oilseed crops. For the years 2000-01 to 2019-20, data was acquired from India's Directorate of Economics and Statistics. For the aim of future prediction, the trend equations were fitted to the area, production, yield, and MSP of the oilseed crop, and the best fitted model was chosen. The analysis shows that the area, yield, and MSP of groundnut, rapeseed & mustard, soybean, and sunflower are all increasing, although the production of all four crops is non-significant. For area, yield, and MSP, the cubic model is the best fit for all crops.

In order to investigate the factors that contribute to poor oilseed production, we employed a multiple regression model in which production is the dependent variable and area, yield, MSP, import, and export are the independent variables. We calculate multiple determination R2 and adjusted R2 in this model at a 5% level of significance. There is a minor variation in Adjusted R2 after removing the non-significant components.

Policy Implications

- Because of the rain-fed nature of oilseeds and the laborious cultivation procedures involved in their production as compared to cereals, it has been discovered that oilseeds producers are not making a profit, prompting farmers to reconsider their decision to cultivate oilseeds. Oilseed cultivation practices based on rainwater Farmers need to be educated about safe oilseed production procedures, the use of superior quality seeds, and weather-based crop insurance systems.
- India is the largest importer of edible oil in the world. Imports meet up to 70% of India's domestic need for oil. As a result, in light of this vision, India must become self-sufficient in oilseed production, which can be achieved through the provision of high yielding oilseed cultivars, extension services, and subsidized inputs, as well as the offering of MSP, price fixing, and promotion of oilseed cultivation.
- Strategies with special attention on quantity as well as quality enhancement and value addition technologies with a scope of employment generation through skilled entrepreneurship development.
- Technologies with a high impact that demand a reasonable investment with a high return on investment (ROI), with an emphasis on environmental friendliness, high input utilisation efficiency, and so on.
- New opportunities to investigate non-traditional seasons and crop areas might be developed to demonstrate the success of area expansion and cropping system integration.

REFERENCES

REFERENCES

Adak, T., Chakravarty, N. V. K., Muthukumar, M., Deshmukh, P. S., Joshi, H. C., & Katiyar, R. K. (2011). Evaluation of biomass and thermal energy utilization efficiency of oilseed Brassica (*Brassica juncea*) under altered microenvironments. *Biomass and Bioenergy*, ***35***(5):2254–2267.

Ahmad, F.R., Basavaraja, H., Kunnal, L.B., Mahajanashetti, S.B. & Megeri, S.N. (2014), An economic analysis of changes in cropping pattern in Karnataka, *Karnataka Journal of Agricultural Sciences*, **27**(3):312-315

Arora, A., & Batra, D. (2019). Export competitiveness of Indian oilseeds: The method of constant market share (CMS) with special reference to groundnut. *International Journal of Innovative Technology and Exploring Engineering*, *8*(9 Special Issue):1098

Anjum, S. & Khan, A. (2017). Changing Pattern in India's Agricultural Exports under WTO. *Economic Affairs*. ***62***(2):253-262.

Bansal, S, & Singh, L, (2020). An analysis of growth and variability in area, production and yield of groundnut in Punjab. *International journal of Farm Science*, ***10***(1):61-65.

Barman, S. C. (2002). Production and price of Coconut (*Cocus nucifera* L.) and its oil in Bangladesh. *Economic Affairs*, ***47***(4):221-227

Burman, R., Dubey, S.K., Jha, G.K., Singh, G. & Sharma, M.K. (2012). Analysis of Production Gap, Marketing and Processing Status and Associated Constraints for Major Oilseeds in the States of Rajasthan and Gujarat, Journal of Community Mobilization and Sustainable Development,***7***(2):198-209.

Bhardi, H.H., & Kurubetta, S., (2018). An analysis of growth rate performance of oilseed crops in Karnataka state, *International journal of Farm Sciences*, ***8***(1):110-113.

Bharti, A.K., Sharma, M.K., Sharma, H.L., Sisodia, B.V.S. & Dube, L.K. (2012), Pattern of growth and technological impact on oilseeds production in Uttar Pradesh, *Journal of crop and weed*, ***8***(2):1-6

Bhagwati, J. (1988), Export Promoting Trade Strategy: Issues and evidences, *World Bank Research Observer*, ***3***:27-58.

Borbora, S., Das, I. & Dutta, M. (2007). Status and Growth Trends in Area, Production and Productivity of Horticulture Crops in Assam. *The IUP Journal of Agricultural Economics*, ***4***:7-24.

Borthakur, S. and Bhattacharyya, B. K. (1998). Trend Analysis of area, production and productivity of potato in Assam: 1951-1993. *Economic Affairs*.

Chandel, B. & Rao, D. (2003). Investment in Oilseeds Research in India. *Economic and Political Weekly*. ***38***:4618-4622.

Choudhary, D. (2018). Causes of low production of oilseed in India & further strategy for enhancing the production and productivity.

Dash, A, & Hansdah, R. (2020). Analytical study of growth and instability of Rabi oilseed production in Odisha. *Journal of Pharmacognosy and Phytochemistry*, ***9***(2):2145-2149.

Dastagiri, M. B., & Jainuddin, S. (2017). International Trading Prices of India's Oilseed Crops: Growth Rates, Elasticities and Foreign Trade Policy. *European Scientific Journal, ESJ*, ***13***(31):185.

Debnath, P., Singh, R., & Sarkar, A. (2015), Study on Growth and Instability of Sesame in North-Eastern Hill Region of India, *Economic Affairs*, ***60***(2)

Deka, N. & Sarmah, A. K. (2005). An analysis of growth trends in area, production and productivity of pineapple in Assam. *Economic Affairs*, ***50***, (2):110- 113

Directorate of Oilseed Development, Government of India (2021). *Status paper on oilseed crops Directorate of Oilseeds Development, Status Paper on Oilseeds*.

Edwards, S. (1989) Openness, Outward Orientation, Trade Liberalization and Economic Performance in Developing Countries. *World Bank PPR:*191.

Embaye, W. T., Bergtold, J. S., Archer, D., Flora, C., Andrango, G. C., Odening, M., & Buysse, J. (2018). Examining farmers' willingness to grow and allocate land for oilseed crops for biofuel production. *Energy Economics*, ***71***:311–320.

Evans, N., Butterworth, M. H., Baierl, A., Semenov, M. A., West, J. S., Barnes, A., Moran, D., & Fitt, B. D. L. (2009). *The impact of climate change on disease constraints on production of oilseed rape*.

Farooq, M. A., Ali, B., Gill, R. A., Islam, F., Cui, P., & Zhou, W. (2016). Breeding Oil Crops for Sustainable Production: Heavy Metal Tolerance. *Breeding Oilseed Crops for Sustainable Production: Opportunities and Constraints*:19–31.

Jagdambe, S. (2016). Analysis of Export Competitiveness of Indian Agricultural Products with ASEAN Countries. *Working Paper*, ***356***:1-24.

Jha, G.K.& Khare, A.P. (2006). Analysis of growth and instability of chickpea (gram) production in Madhya Pradesh, *Agriculture Situation in India*, ***63*** (4):251-259

Kruegar, A., (1986). General Issues in Economic Liberalizations in Developing Countries, 15.

Kerr, J.M., Marothia, D. K., Ramaswamy, C. & Bentley, W. (1997), Natural Resource Economics – Theory and application in India:631-632.

Kaur A & Grover D K (2020). Trends in area, yield and production of major oilseeds in Punjab: District-wise analysis. *Agricultural Situation in India*. LXXVI (10):26-36

Larson, L. A., (1953) Agricultural Marketing:33-34.

Laxmi, S., Sahu, R.M., & Kumar, T. (2019), Groundnut benefits: trend and growth situation in Madhya Pradesh, India, *Plant Archives*, ***19*** (2):2753-2758

Meena, M., Mishra, A. P., & Narayanan, G. (2014). *Dynamics of oilseeds and edible oils sector in India-An impact analysis of trade liberalization*.

Mishra, C.M. (2017), Trends in Area Production and Productivity of Groundnut in Uttar Pradesh: Future Business Implications, *International Journal of Business and Management Invention,* ***6***(2):65-70

Mulik, S.S., More, S.S. & Shelke, R.D. (2018), Performance of Oilseed Crops in Marathwada Region of Maharashtra State, *International Journal of Current Microbiology and Applied Sciences*, ***7***(8):3663-3669

Pahariya, N.C. (2015), Impact Assessment of Trade Liberalisation in Oilseeds Sector: Rajasthan.

Papageorgiou, D., Michael, M. & Choski, A. (1999). Liberalising Foreign Trade:Lessons of Experience in the Developing World, 7

Persaud, S., & Landes, M. R. (2007). The Role of Policy and Industry Structure in India's Oilseed Markets, *Economic Research Service.*

Pullens, J. W. M., Kersebaum, K. C., Bottcher, U., Kage, H., & Olesen, J. E. (2021). Model sensitivity of simulated yield of winter oilseed rape to climate change scenarios in Europe. *European Journal of Agronomy*:129-126.

Ramakumar, R. (1998), An Economic Investigation of Marketing and Price Behaviour – The case of Coconut and its Products in Kerela State, M.Sc. (Ag.), thesis submitted to the Department of Agricultural Economics, TNAU, Coimbatore:19-32.

Rani, P. (2015). A Study of WTO and Agriculture Sector in India. *International Journal of Multidisciplinary Research and Development.* ***2***(9):456-459.

Raju, S.S. & Chand, R. (2008), Instability in Andhra Pradesh Agriculture — A Disaggregate Analysis, *Agricultural Economics Research Review*, ***21***:283-288

Samal, S. B., Patra, R., Das, M. K. & Nanda, B. (2017) Growth and instability in oilseeds production production in Odisha: A district level analysis. *International journal of Humanities and Social Science Invention*, ***6***(11):39-45.

Sankari, D.V., Rao, S.V.R., & Reddy, A.V. (2020). Trends in consumption of vegetable edible oils in India: A temporal analysis. *Journal of Oilseeds Research* :254

Secondo, A. S. P., & Reddy, Y. A. N. (2018). Plant Growth Retardants Improve Sink Strength and Yield of Sunflower. *International Journal of Current Microbiology and Applied Sciences*, ***7***(10):111–119

Sharma, A. (2018). Current Trends in Oilseed Crops Production: An overview. *International Journal of Agriculture Sciences (IJAS)*, ***10***(3):5104.

Sharma, V. P. (2014). *Problems and Prospects of Oilseeds Production in India*.

Shenoi, R. V. (2003). *Occasional Paper-26 Oilseeds production, processing and trade : a policy framework*.

Singh, O. P., & Kumari, S. (2012). *Growth and Instability of Major Oilseed Production in India Master of Agri-business Management*.

Sinha, S., Kumar, A., Sohane, R. K., & Kumar, R. (2020). *National Webinar on Breeding of Oilseeds: A Challenge for Self-Sufficiency*.

Sonnad, J.S., Raveedaran, N., Ajjan, N. & Selvaraj, K.N. (2011), Growth analysis of oilseed crops in India during pre and post - WTO periods, *Karnataka Journal of Agricultural Sciences*, ***24***(2):184-187

Syed, W. A., Muhammed, A. U. & Rana, M. A. (2015). Agricultural Export and Economic Growth: a case study of Pakistan. *International Journal of African and Asian Studies*,***13***:1-9.

Vinnichek, L., Pogorelova, E., & Dergunov, A. (2019). *IOP Conference Series: Earth and Environmental Science Oilseed market: global trends Oilseed market: global trends*.

VR, R., & Jha, G. (2019). Oilseeds sector in India: A trade policy perspective. *Indian Journal of Agricultural Sciences*, ***89***:73-78.